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A WORLD IN CONSTANT MOTION

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A World in Constant Motion

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PREFACE

Manfred SCHRENK,

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WELCOME to REAL CORP 2017, the 22nd International Conference on Urban & Regional Development and Spatial Planning in the Information Society!

The proceedings of this year's conference contain 66 scientific papers which were selected after a double-blind, double-stage (for both abstracts and full papers) peer-review process for publication and presentation at the 22nd International Conference on Urban Planning and Regional Development in the Information Society, REAL CORP 2017. Also some non-reviewed papers were accepted by the programme committee after a double-blind abstract review. The conference is held from 12 to 14 September 2017 in Vienna, Austria, in co-operation with Vienna University of Technology, Department of Geodesy and Geoinformation, Research Group Geoinformation. REAL CORP 2017 "PANTA RHEI – A World in Constant Motion" has a special focus on everything that moves in time and space.

Mobility is a multifaceted topic with a complex past development. Ideological quarrels, almost religious wars have been fought during the past decades when talking about mobility issues: boundless mobility for free citizens or priority to humane, liveable settlements? Can mobility cost transparency start an overdue restructuring or would it bring down or complete economic system? Expansion of transport infrastructure to shrink distances or shrinking of transport infrastructure for a compact city of short distances?

How can we use today's knowledge and techniques to shape the forward-looking mobility of tomorrow? Mobility is necessary; each human spends a certain percentage of their lifetime on mobility. When mankind became permanent residents, transport routes were built to cover our daily needs and start early trade. Today, our cities are completely dependent on mobility processes. But how far must, may, or should mobility form – or dominate – our lives? These questions and many other topics are dealt with during the conference days.

Vienna, the host city of REAL CORP 2017, is the most liveable city in the world according to the well-known Mercer study on quality of living. The results of this study show, for the 8th time now, that Vienna's approach to quality of living is acknowledged internationally. In the year 2017, once again Mercer has ranked Vienna first in its international quality of living survey as the city with the highest quality of living worldwide. The study compares 230 cities worldwide based on 39 criteria such as political, social, economic, and environmental factors. Two more European cities are among the top

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five: Zurich on the second and Munich on the fourth position. Auckland (3) and Vancouver (5) complete the top five cities.

Vienna is a very international city not only because of its location as a bridgehead between Western, Central, and Eastern Europe, but also as homebase of many international organisations like United Nations, IAEO, or OPEC. What a perfect locatioon for REAL CORP which has always been a conference with a strong focus on international presenters and audience – this year we brought together some 250 participants from more than 40 countries worldwide.

The main goal of the REAL CORP conference series is to bring together leading experts in the field of spatial planning, geoinformation and related disciplines to exchange their knowledge, share their ideas, discuss current developments and get together for face to face networking leading to the development of new thoughts, partnerships and projects.

The success of the REAL CORP conferences is – clearly without doubt – the result of the efforts of participants, reviewers, and the conference organising team consisting of CORP association, Karlsruhe Institute of Technology and Vienna University of Technology, supported by the Austrian Federal Ministry of Transport, Innovation and Technology, Austrian Mobile Power, AustriaTech, and ISOCARP. We would like to acknowledge the Reviewer Team and Programme Committee members for their valueable voluntary help with the review process. Our thanks go to all participants and authors of the submitted papers as well.

Welcome to Vienna! Have a great conference!

Manfred SCHRENK, Clemens BEYER & the REAL CORP Team

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A Mode Choice Model for the Elderly: Case of Mashhad City, Iran

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1 ABSTRACT

Although much research has been conducted on mode choice, very little has focused on the topic for the elderly. Considering the very particular behavior of this population group, different factors are expected to influence their decisions. Travel behavior of the elderly are mostly studied in developed countries. However, developing countries will have a great share of the elderly in a few decades. This paper aims to analyze Mashhad's elderly travel behavior statistically through the application of multinomial logit model. A questionnaire is then designed based on the literature and the particular sample in Iran and administered to a sample of 499 elderly people through a field survey. The questionnaire contains socio-economic and trip characteristics questions. That includes travel origin and destinations, mode of travel, purpose and frequency of travel, number of the people along with respondents, household size, educational attainment, monthly household expenses, number of cars in the household, elderly car-ownership and having a driving license. To determine the statistically significant variables and Multi Nomial Logit model is used and the results indicate that the elderly in Masshad tend to use public transport more. Also, car users are mostly women and they prefer to be car passengers. Elderly with higher educational attainment and income tend to use car more. Elderly prefer to walk more as they get older and elderly men walk more than women. The walking mode has a negative correlation with the travel distance.

Keywords: mixed model, multinomial logit model, mode choice, elderly, transport

2 INTRODUCTION

Developing countries have a great share of the elderly population increase. By 2050, 8 out of every 10 elderly will be living in a developing country. Over the past three decades, the Islamic Republic of Iran has been experiencing rapid socio-demographic and economic changes that have placed Iran amongst the countries that will have an old age structure by the mid-21st century. These changes have occurred so rapidly that social institutions were unable to acquire necessary capacities and capabilities to cope with and keep pace with them. Only during recent years, these emerging issues attracted the attention of official institutions and bodies [Khosravi et al., 2014].

The elderly population itself is ageing too. The share of 80+ (oldest old) which is now 14 percent will reach 19 percent in 2050, and there is not much time left to adapt facilities in order to improve future life quality of this group [Khosravi et al., 2014]. The number of people aged 60 years or over is expected to double between 2015 and 2030 in Iran [United Nations, 2013]. Quality of life in old age is related to mobility [Metz, 2000]. As Ipingbemi mentioned, in most cities in developing countries, gross inadequacies of public transport, overcrowded buses, environmental pollution, and poor road infrastructure are the major mobility challenges of urban population [Ipingbemi, 2010].

Despite the problems mentioned, it is an important consideration for policy makers to realize the elderly travel characteristics and behavior. To better understand how the elderly travel in Iran, this paper focuses on Mashhad's elderly and suggests a Multinomial Logit Model for travel mode choice of this group, considering socio-economic and trip characteristics. This paper considers some attitudinal factors and checks whether these factors affect mode of travel.

The next section reviews the existing literature on travel behavior and mode choice of the elderly. The third section explains data and methods. It contains a statistical analysis of the data that gathered as the material of this study. In section four, model results are presented. Finally, there are conclusions and discussions in the last section.

3 LITERATURE REVIEW

This section reviews the existing literature on the effects of an ageing population on travel behavior. It focuses on travel mode choice of the elderly in both developed and developing countries.

Rosenbloom used data from the US, Australia, Germany, New Zealand, Norway, and the United Kingdom to study environmental problems caused by an aging population and increased automobility. The results show that in spite of cultural and policy differences, older people around the world are more likely to have a license, to take more trips, and to do so more often as the driver of a car than older people just a decade ago; they are also less likely to use public transit and all these lead to increased environmental pollution [Rosenbloom, 2001].

Collia et al. highlighted travel patterns of older adults living in the United States and compared basic travel characteristics of older adults (age 65+) with younger adults (ages 19–64). The results indicate that although older Americans travel extensively, they are less mobile than their younger counterparts. This pattern is more pronounced among older women and among those with mobility problems. Older women consistently take the least number of trips per day, have the lowest driving rates and travel the shortest distances. Older Americans travel extensively and rely on personal vehicles as heavily as their younger counterparts. 89% of the elderly travel in personal vehicles, and excluding personal vehicle and walking, all other means of transportation account for about 2% of daily travel [Collia, Sharp and Giesbrecht, 2003].

Stern used a correlated multinomial logit model and a Poisson model to measure the factors affecting demand for different types of transportation by elderly and disabled people in rural Virginia. The results indicate that the number of trips were smaller for females, older seniors and people with walking difficulties. High education and being married resulted in more trips. In order to examine the travel distances of senior citizens, (log-)linear regression models are usually used. The results indicate that a paratransit system providing door-to-door service is highly valued by transportation-handicapped people; Taxis are probably a potential but inferior alternative even when subsidized; Buses are a poor alternative, especially in rural areas where distances to bus stops may be long; Making buses handicap-accessible would have a statistically significant but small effect on mode choice; Demand is price inelastic; and total number of trips taken is insensitive to mode availability and characteristics [Stern, 1993].

Van den Berg et al. studies trip-making for social purposes, with a special focus on the demographic ageing factors. Using social activity diary data, models are estimated to predict the number of social trips, the travel distance and mode of transport for social trips. With regard to transport mode choice the results indicate that older seniors (75+) are less likely to choose the bicycle, relative to driving. No other significant age effects were found. Significant effects were found for gender, household structure, education level, car ownership, having a disability, urban density, distance and the purpose of the social activity [Van den Berg, Arentze and Timmermans, 2011].

Schmöker et al. analyzed the choice of mode made by both older and disabled people (including the younger disabled) for shopping trips to determine what policies can best meet their mobility and activity. The model specification was quite sensitive to the assumed costs associated with each mode, in particular for the choice of driving. Assumptions were made regarding the costs of unchosen alternatives (which is a requirement in all choice modelling with revealed preference data), they found the best model fit when marginal costs associated with car use are included, namely petrol and parking costs, rather than a full average cost associated with driving (which includes capital depreciation and maintenance costs) [Schmöcker et al., 2008].

Li et al. explored the factors that might affect the elderly people’s mode choice behavior in Taiwan. Under the structure of disaggregated demand analysis, a conceptual framework on elderly people’s mode usage was formulated. Empirical results showed that age, gender, employment status, and living environment are the significant factors that influence mode usage of the elderly in Taiwan [Chang and Wu, 2005].

Newbold et al. used the 1986, 1992, and 1998 General Social Surveys and pseudo-cohort methods to address changing driving behavior among older Canadians, and to compare it among different age cohorts. Results indicate that while older Canadians undertake fewer trips, and travel for different reasons than those in the labor force, their reliance upon the private automobile for transportation is no less significant and the number of trips by car with older drivers increase over the study period as the population ages [Newbold et al, 2005].

Mercado and Paez investigated the determinants of mean trip distance traveled by different mode types. They used data from the Hamilton metropolitan area in Canada, and multilevel models to investigate the variables that impact distance traveled, with a specific focus on demographic aging factors. The results suggests that while this effect of age is present for all modes analyzed (car driving, car passenger, and bus) it is considerably more marked for car driving; also there are significant effects compounded by the interrelated factors of gender, employment constraints, household contextual factors; and neighborhoods with high commercial and residential mix showed a negative relation with distance traveled only in the case of car driver [Mercado and Páez, 2009].

Kim and Ulfarsson analyzed the mode choice of the elderly and how it relates to activity purpose, using a Multinomial Logit model. The results showed that the elderly prefer car between private car, carpool, public transport and walking. This mode is negatively influenced by age and is positively influenced by vehicle ownership, high income and living alone. The elderly prefer walking when going on recreational or personal trips [Kim and Ulfarsson, 2004].

Hu et al. presented a survey and analysis of elderly people travel behavior in Changchun, China, including the different gentle elderly people s trip frequency per day, trip purpose, and mode choice. Then compared the difference between developing countries and developed countries on elderly people travel behavior, as well as analyzed the reason of these phenomena [Hu, Wang and Wang, 2013].

Ipingbemi assessed the travel characteristic and mobility crisis of the elderly in Ibadan Metropolis. The use of bus and walking accounted for 30% and 29.6% of the modal split. Chi-square analysis indicated significant variations in terms of travel time and transport cost in the three density zones. Vehicle design, long access and waiting time as well as poor facilities at the terminals were identified as constraints to the effective mobility of the elderly [Ipingbemi, 2010].

4 DATA AND METHOD

In this section there is a brief introduction to the available modes of travel in Mashhad followed by Data Collection part, in which the properties of the questionnaire and the data is discussed. Then in the third part, the used method in this study is explained.

4.1 Modes of travel in Mashhad

There are three primary travel modes in Mashhad. Public Transport including bus, LRT and taxi; driving a car or being a car passenger; and walking. Bikes can’t be ridden by women in Mashhad due to cultural issues. Also, there are a few bicycle lines with limited access to different parts of the city. So, not many people use bicycles. The elderly in Mashhad don’t have subsidies for transportation in specific hours of the day. Also, there isn’t any special service or any fare discount for them. Taking these into account, this paper aims to introduce a model that estimates travel mode choice of the elderly in Mashhad.

4.2 Collecting Data

For the purpose of this paper, a questionnaire mainly based on LATS (London Area Travel Survey) questionnaire was developed and then localized, in December 2015. To consider the distribution of the elderly in the city, an estimation of the rate of the elderly over the total population in each zone then calculated, using Statistical Center of Iran’s data of 2011. A face to face survey with 524 respondent were conducted in February 2016. The final number of records used for mode choice modeling is 499 records and it excludes bikes and motorcycles due to their little share in the sample.

The questionnaire has three sections. The first section asks about trip information (i.e. mode of travel, purpose and frequency of travel, number and relation of the people along with respondents during their travel), while the second part asks about personal information (i.e. age, gender, work status, personal and household characteristics, car-ownership and educational attainment) and the third part is about individual perceptions on environment, safety, comfort, convenience and flexibility of mode of travel. The third section was not found statistically significant and therefore we don’t mention it in the following sections. Also by asking residential area of the respondents, travel distance was measured afterward.

Sample characteristics are shown in Table 1. Men and women have almost equal shares in this sample. Age is categorized in three groups. The youngest person in the sample is 60 and the oldest is 105 years old.

Educational attainment grouping starts from the option "less than middle school" because most elderly, especially older women, has primary education or no education at all due to economic and cultural issues of their time. In order to have an income index, household average monthly expenses is asked. In traditional families in Mashhad, men has all the responsibilities to financially support the family and for this reason a few elderly women in the sample (3%) are not aware of the average household monthly expenses. Most elderly in the sample don't live alone and 41% of them has a bigger household size than 2.

Variables used in the Model	All related categories	N	%
Gender **(gender: female =1 , male=0)**	Woman	252	51
	Man	247	49
Age	60-64	307	61
	65-70	114	23
	70<	78	16
Household size **(HH 1 : If Household size is 1 = 1; otherwise = 0)**	1	86	17
	2	208	42
	3	138	28
	4	47	9
	5	17	3
	+6	3	1
Educational attainment **Education 1 (Less than Middle school =1; otherwise = 0)**	Less than Middle school	236	47
	Middle school	83	17
	High school diploma	93	19
	Associate degree	26	5
	Bachelor's degree	40	8
	Masters and higher degree	21	4
Household average monthly expenses (million tomans) **(1 USD = 32,457.90 IRR)**	Less than 1	236	47
	1-2	163	33
	2-3	70	14
	3-4	8	2
	4-5	6	1
	5<	0	0
	I don't know	16	3
Elderly car-ownership	none	296	59
	1	166	33
	2	37	7
	+3	3	1
# Cars in household	none	232	46
	1	216	44
	2	48	10
	+3	0	0
Driving license **(License: having license =1, otherwise= 0)**	Men	196	78
	women	44	19
Trip Frequency **(Trip frequency 2: If trip frequency is 2-4 days a week =1; otherwise = 0)**	5 or more days a week	106	21
	2-4 days a week	72	15
	Once a week	86	17
	1-3 times a month	66	13
	Less than once a month	130	26
	Made journey once only	39	8
Trip Purpose **(purpose 3 : If trip purpose is visiting friends / relatives =1; otherwise = 0)**	Returning home	113	23
	Workplace	28	6
	Visiting friends/relatives at their home	88	17
	Personal business (e.g. doctor, hospital, bank)	99	20
	Shopping	107	21
	Sport or entertainment	44	9
	pilgrimage	20	4
# along with respondent	none	320	64
	1	138	28
	2	35	7
	+3	6	1
Gender 1 (Gender of the person along with respondent: female =1, male =0)	Woman		
	Man		

Table 1: Sample characteristics

Having a driving license among men and women is calculated separately. 78% of men and 19% percent of women have a driving license in this sample. There is a major holy shrine in Mashhad and thus trip purposes contain pilgrimage. Also work status is not used in the model, because of the small share of this question response.

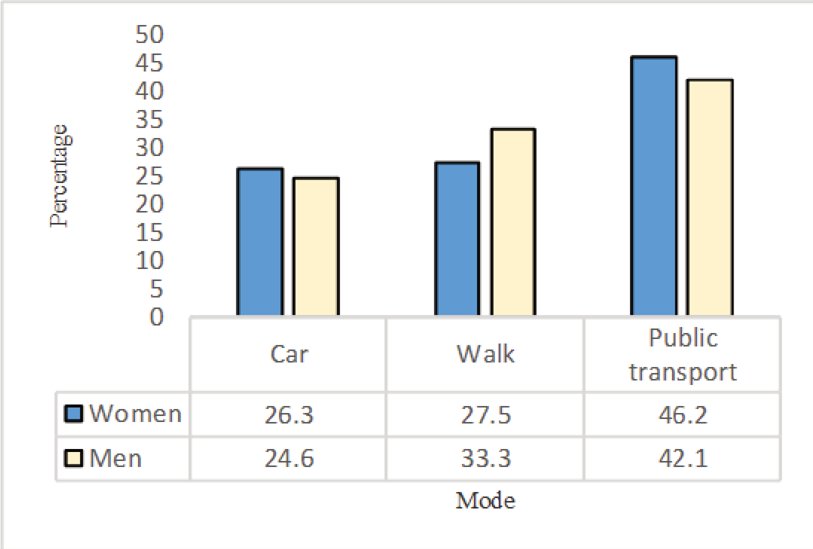

Figure 1: Elderly users of each mode by gender

According to Figure 1, elderly men tend to walk more than women while a greater percentage of women use public transport and car as their mode of travel.

By only 19% percent of driving license, it is concluded that women prefer to be car passengers while men prefer to drive.

	Car	Walk	Public Transport
Women	11.7	13.7	19.0
Men	7.1	7.9	12.3

Table 2: Percentage of the elderly with someone along during travel

Table 2 shows that older women who use car have a greater share of traveling with at least one person along with them. Elderly men tend to walk more than women while women use public transport more.

According to Table 3, average travel distance for the elderly that use car is higher than other modes. Those who walk have a smaller average walking time to the nearest bust stops, although the difference for this measure among three groups are not very considerable.

	Car	Walk	Public Transport
Average Travel Distance (km)	5.3	3.4	4.4
Average Travel Time (min)	16.0	41.3	29.0
Average Walking time to the nearest bus station (min)	9.5	8.51	9.3

Table 3: Average travel time and distance by each group of users

		Car		Walk		Public Transport	
Age	60-64	78	25%	98	32%	134	43%
	65-69	30	26%	31	27%	54	47%
	+70	20	27%	25	34%	29	39%

Table 4: Percentage of elderly by mode and age

As indicates, how share of each travel mode changes by increasing age of the elderly. By increasing age, elderly prefere to walk more and this result is similar with Hu et al. [Hu, Wang and L. Wang, 2013] findings. In this part, sample characteristics were presented. In the following part, the modelling method is explained briefly.

4.3 Method

To determine the relation between personal and trip characteristics and mode of travel of the elderly, a multinomial logit model (MNL) is applied to distinguish the differences among different options provided by the questionnaire. MNL is the simplest practical discrete choice model. Discrete choice models are derived from the assumption of utility maximization of decision makers' behavior. The net utility (U_{ni}) for option n and individual i is formulated as follows:

(1) $$U_{ni} = V_{ni} + \varepsilon_{ni}$$

Where V_{ni} is the observed part and ε_{ni} is the random part. V_{ni} is a function of the observed attributes and is a linear combination of these attributes. The logit choice probability is:

(2) $$P_{ni} = \frac{e^{V_{ni}}}{\sum_j e^{V_{ni}}}$$

The logit model is obtained by assuming that each εni is independently, identically distributed extreme value. The distribution is also called Gumbel and type I extreme value [Train, 2009].

Variables used in modeling are listed in Table 1. Also, statistically significant dummy variables are specified in the Table 5.

5 RESULTS

In this section, statistically significant variables are represented in Table 5. The choice of travel is between car, walking and public transport as mentioned earlier. By adding another constant to the model, the constants would indicate that, if all explanatory variables are evaluated at zero, people are less likely to walk or use a car and more likely to use public transport. By increasing travel distance, it is less likely that elderly walk as expected.

Mode of travel	Variable	Parameter	P-Value
Car	Constant	-0.79301	0.0029
	Gender	0.92433	0.0016
	No License * gender 1	0.45739	0.0147
	Education1	-0.29789	0.0055
	License	-0.33688	0.0174
	Monthly expense	0.08477	0.0190
Walk	Travel distance	-0.02726	0.0012
	License	0.88280	0.0826
Public transport	Trip frequency 2	-0.28142	0.0109
	Education 1	0.17570	0.0187
	#along * Purpose 3	-0.65208	0.0143
	Gender 1 * gender * purpose 3* HH 1	0.77451	0.0539
	Walking time to the nearest bus station	-0.51328	0.0246
Number of observations	499		
Log-likelihood (no coefficient)	-534.6508		
Log-likelihood	-489.2842		
R-squared	0.0849		
R-squared adjusted	0.1075		

Table 5: MNL model for Mashhad elderly mode of travel

Older people in Mashhad make the majority of their trips by public transport according to Table 4, which is similar to results of Hu et al. [Hu, Wang and L. Wang, 2013].Women, who are accompanied by another woman and travel with the purpose of visiting friends or relatives and live alone, tend to use public transport rather than car, and this group is statistically significant in the model. Statistical analysis have shown that men prefer to drive more than women while women prefer to be car passengers and it confirms the results of the Netherlands [Van den Berg, Arentze and Timmermans, 2011], London [Schmöcker et al., 2008] and Taiwan [Chang and Wu, 2005]. Elderly with higher than primary education tend to use car more. High trip frequency (2-4 times a week) has a negative influence on using public transport.

With regard to Table 1, car users are mostly women and the majority of this group don't have a driving license (81%) and the model shows these results as well. As monthly household expenses increase, elderly are more likely to choose car. Monthly expenses is considered as an income index and it can be concluded that as income level increases elderly prefer to use car more and this result is similar to findings of Schmöcker et al. [Schmöcker et al., 2008]. For walking mode, travel distance has a negative sign which shows that as the distance increases, it is less likely for the elderly to choose this mode. Driving license is positively significant in this mode. According to Figure 1, in this sample men use walking mode more than women, and they mostly have a driving license. According to the model, as the walking distance to the nearest bus station increases, it is more likely for public transport users to choose this mode. Average travel time to the nearest bus station is shown in Table 3 for all three modes. The difference among these distances are not significant. Also the distance is asked from the elderly and is not calculated exactly.

6 CONCLUSION

The elderly is a significant part of the society and their travel characteristics is necessary due to their specific travel pattern and its involvement in transport planning. This study was conducted to find out the travel characteristics of the elderly in Mashhad, the second populated city of Iran. The research in this exclusive sample indicates that 47 percent of the elderly has a less than middle school level of education and their monthly expenses are less than 1 million tomans (1 USD = 32,457.90 IRR) on average. Elderly with higher educational attainment and higher income tend to use car more. In addition, 46 percent of the elderly do not own a car in the household and 59 percent of the elderly don’t have a car of their own. 78 percent of the elderly men and 19 precent of the elderly women in the sample have a driving license.

All variables were tested to find out the statistically significant variables through an Multi Nomial Logit model then.The results indicate that the elderly in Mashhad tend to use public transport more than other modes. Car users are mostly women and with a 19 percent rate of having a license, they are mostly car passengers. By increasing travel distance elderly are less likely to walk. Walking has a greater share among elderly men.

It is recommended that similar studies with focus on one specific purpose, or one city zone or a greater number of respondents being conducted to obtain more detailed results.

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8 REFERENCES

KHOSRAVI, A., M. ALIZADEH, M. TORKASHVAND AND N. AGHAEI, Population Ageing in IR Iran, (2014).
UNITED NATIONS. (2013). World Population Aging.
METZ, D. H. (2000). Mobility of older people and their quality of life. Transport policy 7(2).
IPINGBEMI, O. (2010). Travel characteristics and mobility constraints of the elderly in Ibadan, Nigeria. Journal of Transport Geography 18(2).
ROSENBLOOM, S. (2001). Sustainability and automobility among the elderly: An international assessment. Transportation 28(4).
COLLIA, D. V., J. SHARP AND L. GIESBRECHT (2003). The 2001 national household travel survey: A look into the travel patterns of older Americans. Journal of safety research 34(4).
STERN, S. (1993). A disaggregate discrete choice model of transportation demand by elderly and disabled people in rural Virginia. Transportation Research Part A: Policy and Practice 27(4).
VAN DEN BERG, P., T. ARENTZE AND H. TIMMERMANS (2011). Estimating social travel demand of senior citizens in the Netherlands. Journal of Transport Geography 19(2).
SCHMÖCKER, J.-D., M. A. QUDDUS, R. B. NOLAND AND M. G. BELL (2008). Mode choice of older and disabled people: a case study of shopping trips in London. Journal of Transport Geography 16(4).
CHANG, H.-L. AND S.-C. WU (2005). Exploring the mode choice in daily travel behavior of the elderly in Taiwan. Journal of the Eastern Asia Society for Transportation Studies 6.
Newbold, K. B., D. M. Scott, J. E. Spinney, P. Kanaroglou and A. Páez (2005). Travel behavior within Canada’s older population: a cohort analysis. Journal of Transport Geography 13(4).
MERCADO, R., & PÁEZ, A. (2009). Determinants of distance traveled with a focus on the elderly: a multilevel analysis in the Hamilton CMA, Canada. Journal of Transport Geography, 17(1), 65-76.
KIM, S., & ULFARSSON, G. (2004). Travel mode choice of the elderly: effects of personal, household, neighborhood, and trip characteristics. Transportation Research Record: Journal of the Transportation Research Board, (1894), 117-126.
HU, X., J. WANG AND L. WANG (2013). Understanding the travel behavior of elderly people in the developing country: a case study of Changchun, China. Procedia-Social and Behavioral Sciences 96.
TRAIN, K. E. (2009). Discrete choice methods with simulation, Cambridge University Press.

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Active Mobility – the New Health Trend in Smart Cities, or even More?

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1 ABSTRACT

Active mobility (AM), including walking and cycling as single trips or in combination with public transport, has recently been promoted by health professionals – with WHO leading the way – to tackle health problems caused by physical inactivity. In fact only 1/3 of the European population is estimated to meet the minimum recommended levels of physical activity by the WHO of 30 minutes of moderate-intensity activity 5 times per week. Being aware that we spend between 70 to 80 min per day travelling and that 50% of all car trips (in Europe) are shorter than 5 km, active mobility has an enormous potential to get people more active.

However, how is this knowledge of proven positive health effects of AM been taken into account – either by urban and transport planning authorities or by health administration? Is this „new health trend“ visible in strategies, cooperation or – what's even more important – in implemented measures in smart cities?

"Physical activity through sustainable transport approaches" (PASTA[1])" is a European project addressing and analyzing the promising link between transport and health. It pursues an interdisciplinary approach involving scientists and leading experts from a range of disciplines, including (among others) transport and urban planning, public health, environmental sciences, climate change and energy, and transport economics. The overall aim of the project is to generate knowledge about the effects of AM in consideration of health effects.

This paper reveals backgrounds and relationships between transport and health work in seven European case study cities (Antwerp, Barcelona, London, Örebro, Rome, Vienna and Zurich) based on workshops and stakeholder interviews conducted in PASTA. Considering cities' framework conditions (strategies and policies, infrastructure and other measures promoting AM etc.) and comparing stakeholders' perspectives bring out that cities have to struggle with similar barriers and challenges. Otherwise they take promising approaches and efforts towards sustainable and healthy urban development; increasing synergies between the health and transport sector seems to be one of the missing links between transport and health. Good practices and new ideas for transport planners and health experts are provided aiding to create livable conditions through well-planned infrastructure, a safe environment and attractive public space, awareness-raising activities and various broader policies – including the health policy. After all AM should not just be an ephemeral health trend, but common (health) practice.

Keywords: Transport planning, strategies & Policy, health effects, health promotion, active mobility

[1] PASTA – Physical Activity through sustainable transport approaches. (2013 – 2017)
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2 INTRODUCTION

Planners and policy makers all over the world are putting their efforts to transform cities and urban areas into more livable places. The challenges they have to deal with are wide spread and they are often faced with diverging demands. A balanced and integrated development of all transport modes is a main characteristic of Sustainable Urban Mobility Plans (SUMP) (Wefering et al. (2014)) and a key goal in the strategic EU policy documents (EC (2007a), EC (2011), EC (2013)). Increasing sustainable and active mobility (AM), like walking, cycling and the use of public transport, reduces the consumption of space for motorized transport infrastructure, energy use, air pollution and noise, and improves overall quality of urban life (Jones (2009), Wee et al. (2013), Woodcock et al. (2009), Brand et al. (2013)).

At the same time overweight related diseases caused by sedentary behavior, physical inactivity and high-calorie diets are on the rise. Only one-third of the European population is estimated to meet the minimum recommended levels of physical activity (PA), which for adults correspond to at least 150 min of moderate-intensity aerobic PA throughout the week (Hallal et al. (2012), WHO (2007), WHO (2010a)). Globally, physical inactivity is a major cause of non-communicable diseases and a relevant risk factor for mortality (Forouzanfar et al. (2015), WHO (2009), WHO (2010b)). Reducing sedentary behavior and increasing the level of PA in the population is a key goal of WHO (WHO (2007)) and EU Strategies (EC (2007b)), but in contrast to these policy goals, levels of PA are decreasing (EC et al. (2014), Hallal et al. (2012)).

Increasing AM not only serves transport planning goals but supports public health objectives equally. Nevertheless this coherence is rarely explicitly considered in transport strategies and SUMPs. Practitioners in both public health and transport planning departments search for ways to raise AM; however, they usually do not collaborate and thus they do not benefit from possible synergies of integrated approach.

Walking and cycling for transport solely or in combination with public transport (all three modes comprised as AM), are well suited to bring more PA into everyday life considering that a mobile person in Europe spends between 70 to 80 min per day travelling and that 50% of all car trips are shorter than 5 km (Herry et al. (2011), Follmer et al. (2010), Transport (2015)). In contrast to sports or exercise, AM requires less time and motivation; it is convenient as a mode of transport and as a form of exercise, and it is economically affordable. Hence, AM has the potential to reach parts of the population who may be less receptive to appeal to participate in sports and exercise, or cannot afford doing these in terms of finance or time (Sahlqvist et al. (2012)). Especially for physically inactive people, such as sedentary working, obese and elderly people, it is easier to start with AM as a moderate form of regular PA than with sports or other types of vigorous PA (Warburton et al. (2006)).

PASTA "Physical activity trough sustainable transport approaches" is a project funded by the EC under FP7-HEALTH-2013-INNOVATION-1 carried out from 2013-2017, which is addressing and analyzing the promising link between transport and health. It pursues an interdisciplinary approach involving scientists and leading experts from a range of disciplines, including (among others) transport and urban planning, public health, environmental sciences, climate change and energy, and transport economics.

3 OBJECTIVES

In PASTA a mixed-method and multilevel design is applied in seven case study cities (CSCs) Antwerp, Barcelona, London, Örebro, Rome, Vienna and Zurich aiming for a better understanding of the interrelation between travel behavior and health. The main objectives are to examine key determinants of AM behavior, how AM relates to PA and the effectiveness of measures to promote AM. A detailed protocol of the study can be found in Gerike et al. (2016).

The focus of this paper is on one part of the project: the analysis of the framework conditions affecting the successful implementation of measures and strategies to increase AM (thereafter referred to as AM measures) and the link of transport and health on a strategic level. The cities' framework as well as policies and AM measures were gathered by means of workshops and interviews with local stakeholders and experts from public health, transport and urban planning in the CSCs, and completed by a review and analysis of city indicators. Enabling factors for active mobility (comprising strategies, visions and policies driven by politics), barriers and challenges perceived by stakeholders as well as their impressions of the cooperation of the health and transport planning area were collected. Out of this compilation the question raised how active and healthy the cities are.

4 ACTIVE AND HEALTHY CITIES?

4.1 City profiles of PASTA case study cities

Various indicators have been collected in each of the seven PASTA CSCs, which are quite different in their characteristics (size, area, transport supply etc.) and therefore difficult to compare and to generalize.

Nevertheless, some hypothesis can be derived from the compiled indicators: Correlations between a high inhabitants' density and compact city structures, which are a precondition for short trip distances that easily can be covered by bike or on foot (Pucher et al. (2010)), are evident; this argument has been proven by a correlation of density and walking share in the CSCs (e.g. high density and high walking share in Barcelona). Motorization or car ownership rates (cars/1,000 inhabitants) are to a large extent linked to the amount of motorized traffic. Rome's high car ownership rate with 696 cars per 1,000 inhabitants together with the large street network are a possible explanation for the high car rate of 54%, however culture also plays a role (emphasized by Rome's interviewed stakeholders) (Table 1, Table 2 and Figure 1). The low car ownership rate in London Newham can be explained by the relatively young and low income population (PASTA-Consortium, 2016). London is the only (in PASTA examined) city with road pricing (London congestion charge) in the inner city with the explicit and successful goal to reduce motorized traffic for the benefit of AM (London, 2003). A green environment, here indicated by the percentage of green space in a city, can favor walking and cycling (Brownson et al., 2009), however this relationship could not be proved in the CSCs. The indicated length of the cycling network in the CSCs is quite inhomogeneous (Table 2), as the official figures of the cities are varying (partly including not only cycle lanes and cycle paths but cycling routes and traffic calmed areas), and doesn't allow conclusions on the cycling share.

City profile factors together with enabling factors build up the framework for transport and mobility supply and demand and the role of AM in a city.

Indicator (n.s. = not specified)	Antwerp* (2012)	Barcelona (2012)	London Newham (2011)	Örebro (2012)	Rome* (2012)	Vienna (2012)	Zurich (2012)
Inhabitants [number]	506,000	1,620,943	308,000	138,952	2,683,842	1,741,246	398,575
Density [Inhabitants/km²]	2,458	15,891	8,556	101	2,088	4,196	4,332
Area [km²]	205	102	36	1,373	1,285	415	92
Green space [%]	19%	29%	50%	n.s.	33%	46%	35%
Cars/ 1,000 inhabitants	383	361	198	450	696	390	343

Table 1: Selected Indicators in the CSCs: City profile factors; References: (Barcelona, 2013a, Barcelona, 2014, Carreno et al., 2013, MA23, 2015, Zürich, 2013b, UK-Census, 2011) *Figures from our city partners without reference

Indicator (n.s. = not specified)	Antwerp * (2012)	Barcelona (2012)	London Newham (2011)	Örebro (2012)	Rome* (2012)	Vienna (2012)	Zurich (2012)
Road network [km]	1,649	1,362	n.s.	3,604	8,770	2,763	n.s.
Parking regulations [y/n/p][2]	y	y	y	y	y	y	y
Road pricing [y/n/p]	n	n	y	n	p	p	n
PT network [km]	n.s.	1,747	n.s.	n.s.	2,323	794	280
PT annual ticket [price in €]	249	n.s.	1,820	n.s.	250	365	665
Cycling network [km]	n.s.	187	n.s.	215	254	1,223	340

Table 2: Selected Indicators in the CSCs: Transport system and services; References: (Barcelona, 2013b, London, 2012, Carreno et al., 2013, MA23, 2015, Zürich, 2013b) *Figures from our city partners without reference

[2] [y=yes; n=no; p=partly]

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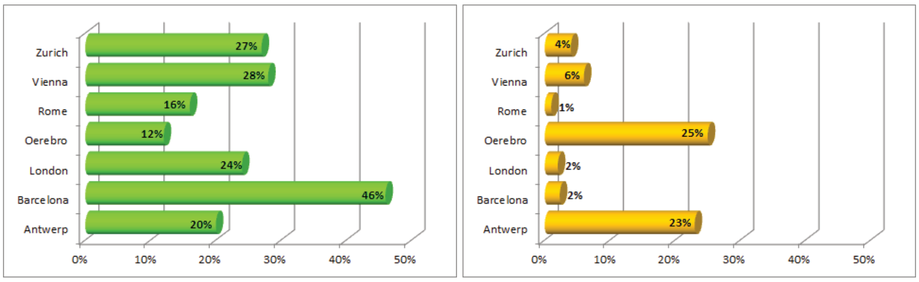
4.2 Active Mobility in the case study cities

Irrespective of the size and area of each city the modal split is the most interesting mobility indicator and provides a concise view of the mobility demand. With regard to cyclists, pedestrians and public transport (PT) users it gives a glimpse on "how active" a city is (Figure 1).

Antwerp (23%) and Örebro (25%) have the highest share of cyclists, but on the other hand they have a large amount of car traffic (Antwerp: 41%, Örebro: 54%), together with Rome (54%), which also corresponds with the high car ownership rate especially in Rome and Örebro (Table 1). In London (42%), Zurich (39%) and Vienna (39%) the proportion of public transport is very high. Looking at their relatively low share of cycling trips, it can be asssumed that PT and cycling are competing – addressing similar targets and user groups, but with higher investment and supply for PT; this theory has been confirmed by stakeholders during the PASTA workshops.

Barcelona (46%) has an outstanding high amount of pedestrians, which might be due to the southern warm climate, density (compare chapter 4.1) and walking infrastructure. In Vienna, Zurich, London and Antwerp walking trips are between 20% and 30% of all trips, and much less in Rome (16%) and Örebro (12%).

The modal split is after all a result of framework conditions, various measures and policies. The sum of measures and interventions contributes to and influences residents' mobility behavior (= transport demand).



Walking share in PASTA CSCs, Cycling share in PASTA CSCs

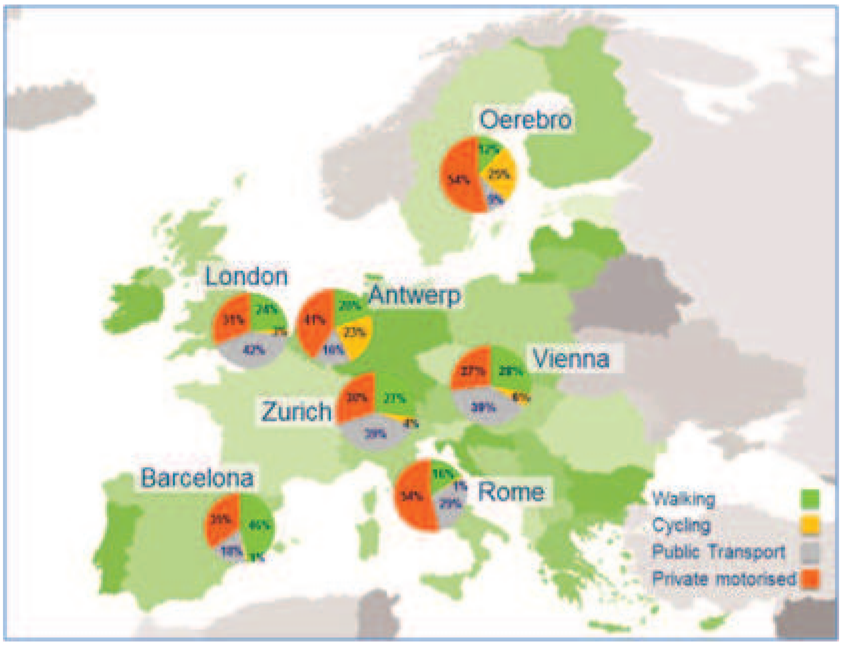


Figure 1: Modal Split in the PASTA CSCs (figure by PASTA consortium) [Antwerp (2010) figures from city partner; Oerebro (2011) Mobility data from city survey, Zurich (2010) (Zürich, 2013a), Vienna (2012) (Wien, 2014), Barcelona (2012) (Barcelona, 2013b), London (2012) (London, 2013), Rome (2012) Mobility data from city survey]

A vast collection of measures and interventions promoting AM in the seven case study cities has been undertaken (Figure 2). It is an outcome of interviews with stakeholders and experts in the CSCs and reviews of urban development and mobility plans. There are a lot of efforts undertaken and measures implemented in the cities towards an increase of AM.

In PASTA AM measures are defined as follows: "An AM measure is an action undertaken in order to increase the level of active mobility (in a specified population). This ranges from changing urban infrastructure or introducing new policies to campaigns to change people's transport behavior".

These active mobility measures have been classified according to four categories: Strategic Policy, Social Environment, Physical Environment (Infrastructure) and Regulation & Legislation. The majority of the gathered AM measures come under physical as well as social environment (behavioral measures to change mobility culture and to raise awareness for the benefits of active mobility) as the most visible efforts undertaken to promote AM.

All PASTA CSCs have a more or less strong vision or plan to become a more sustainable and livable city. The implemented strategic policies aim to reduce motorised traffic and to increase the share of AM. However, having a strategic policy is still no guarantee for reaching the targets, when implementation fails e.g. due to changes in politics or lacking budget (noted by stakeholders in the PASTA workshops).

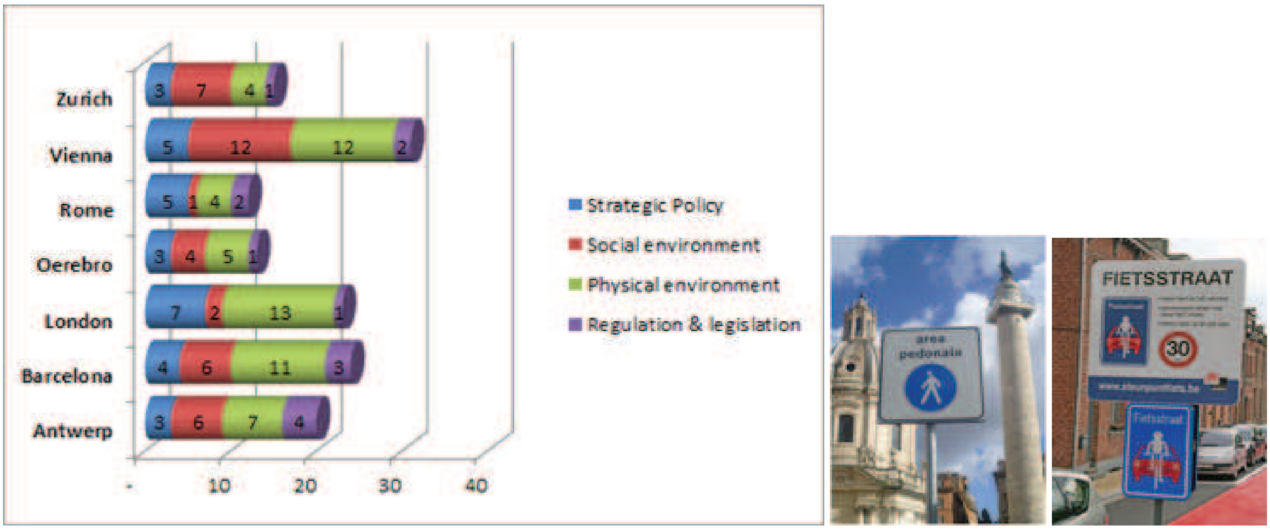


Figure 2: AM measures according to categories collected in PASTA Case Study Cities (not exhaustive); Pictures: Pedestrian zone in Rome and Bicycle Boulevard in Antwerp (both pictures © PASTA consortium)

Behavioral measures comprised under 'social environment' include projects and measures to change mobility culture and to raise awareness for the benefits of active mobility. Various activities (e.g. cycle training courses, educational programmes for kids), campaigns (e.g. Bike2work, 10,000 steps project) and initiatives are undertaken in the seven case study cities.

Physical environment and infrastructure – in combination with legislation and regulation (e.g. 30 km/h zones, contra-flow cycling) – is a precondition for travelling. However, it seems that in the last decades cycling and walking infrastructure has been a side product of road construction (noted by stakeholders in the PASTA workshops). The importance of cycling infrastructure (cycle path, routes, parking etc.) and attractive walking routes is well known among transport planners and researchers (Pucher et al., 2010) and forced and specified under cities' strategies and policies. Cycling highways, Quietways programme, pedestrian areas and traffic calming are some examples of the variety of efforts undertaken in the CSCs. One great challenge in this concern is the re-appropriation of space dedicated to car traffic (parking spaces and roads) for a fair allocation of public space among all road users (raised by various stakeholders in the CSCs).

4.3 Enabling factors, barriers and challenges

Enabling factors for active mobility comprise above all strategies, visions and policies driven by politics (Table 3). A clear political will and visions of a sustainable city often tied with a powerful politician, are the most important driving forces towards reduced car traffic and increased cycling and walking in those selected European cities (outcome of stakeholder interviews). Environmental targets improved road safety as well as awareness and knowledge of the benefits of active mobility for health are also strong arguments for promoting sustainable transport. Urban mobility plans, cycling concepts and all kinds of AM measures and interventions on the implementation level complete the active mobility puzzle.

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On the other hand promoting AM is in most cases a challenge with numerous barriers hindering the efforts towards sustainable cities (Table 4). Beside missing political will often resulting from a fear of losing car drivers votes, lack of budget, limited space dedicated to car traffic, missing collaborations between the different administrative departments (national or local government), different planning sectors (transport, health) and various stakeholders involved, were identified as key barriers to support and reform AM. Inadequate and lacking cycling infrastructure as well as cultural development lead to a "non-cycling" culture and a lack of public acceptance.

Antwerp	Barcelona	London Newham	Örebro	Rome	Vienna	Zurich
Active cycling policy	Urban Mobility Plan	Political leadership:Mayor's cycling vision	Transport Master Plan	New Traffic Masterplan	Urban Development Plan 2025	Urban Transport programme
Diversity and connectivity	Urban density, short distances	Mixture of policies and funding (TfL)	Culture leading to political will	Powerful politician	Clear political will	Masterplan Cycling
Cycling infrastructure	Promotion of PT, reduction of car use	Awareness of health issue	Cycling infrastructure	Need for "cultural evolution"	Representative for walking and cycling	Cycling department

Table 3: Enabling factors for active mobility in PASTA cities (non-exhaustive extract of stakeholder interviews and workshops)

Antwerp	Barcelona	London Newham	Örebro	Rome	Vienna	Zurich
Budget and political willingness	Lack of inter-sectoral collaborations	Reverse planning policies: supporting car infrastructure	Budget and economy issues	Economic issue, lack of budget	Scattered responsibility (decision – implementation)	Political will to act – a specific policy alone is not enough
Scattered responsibility	Obstructive top-down approaches	Lack of safe cycling infrastructure	Political will: Car votes vs. AM	Lack of cycling infrastructure	Political reasons: 'Votes of car drivers'	Allocation of space: cycling vs. car
Lack of public support for AM	Limited space for urban renewal	Cultural barriers and social norms	Deficiencies in cycling infrastructure	Cultural issue: favoring cars	Lack of cycling culture and tolerance	PT as a barrier for cycling promotion

Table 4: Barriers and challenges hindering active mobility in PASTA cities (non-exhaustive extract of stakeholder interviews and workshops)

5 TRANSPORT & HEALTH …

5.1 … the promising link

The relation between the policy fields transport and health is evident (Figure 3): Both aim at creating an environment and setting to influence people's behavior by operating with different measures and interventions (correspond to variable influencing factors). Urban and transport planning influence people's mobility behaviour, while health service focuses among others on promoting physical activity and increasing activity levels – in order to prevent non-communicable diseases. Active mobility is the interface between transport and health. The impacts and effects according to the (changed) mobility behaviour (shift from car traffic to AM) appear in the city or transport environment: less congestion, less air pollution, less noise, more social interaction, more space for walking and cycling, which makes a city more liveable etc. and in a healthier society. The positive health effects through active mobility arise from enhanced physical activity, and exceed the possible risks by air pollution or road accidents by far (Mueller et al. (2015)).

This promising link is also addressed in the WHO approach 'Health in All Policies', which is based on the cognition that health in population can only be achieved by bundled efforts and consideration in all policy fields (WHO (2015)). The main determinants of health cover individual lifestyle factors, social and community networks and general socioeconomic, cultural and environmental conditions. The latter includes urban and transport planning. According to this approach it is crucial to start thinking and acting cross-sectoral.

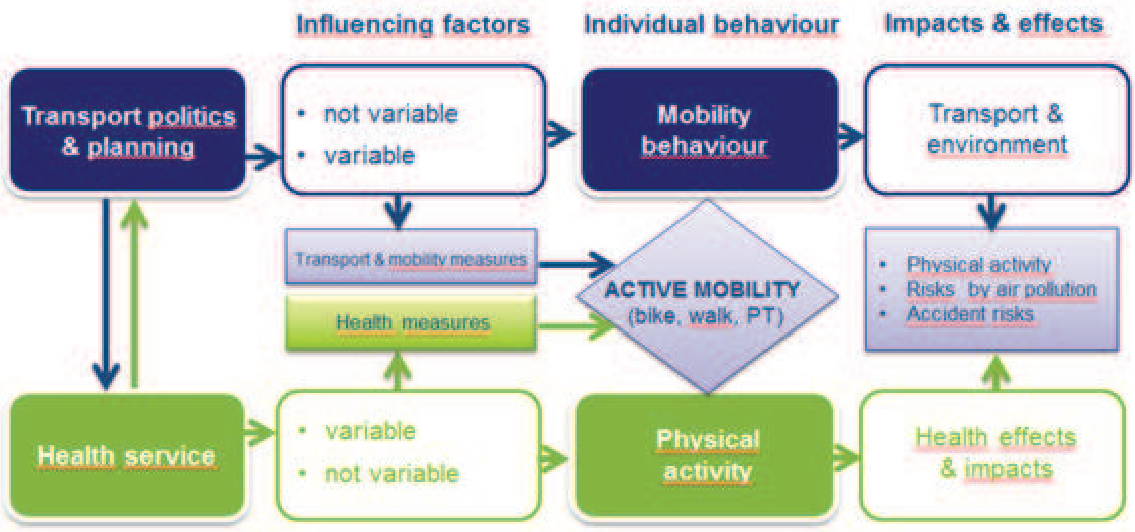

Figure 3: Relation between transport planning and health service (figure by PASTA consortium)

5.2 …the missing link

The importance of the interlinkage between health care with mobility planning issues gains awareness; however, it remains a major challenge. Stakeholders from both fields of action – urban/transport planning and health care – are very well aware of the favourable link and the mutual benefits. In all of the CSCs there is a similar tenor that the health benefit, in terms of boosting citizens' PA level, is not prioritised in the planning process, but a welcome side effect. The primary discussion is about reducing congestion (Antwerp) and emissions (Rome, London), increasing traffic safety (Zurich, Vienna) and providing infrastructure and accessibility.

Fortunately, there are already promising initiatives and approaches like the "Healthy Street Approach" in the UK or the integration of health objectives in transport plans (Wien, 2014) and mobility matters in health strategies (Rendi-Wagner, 2015, Angel, 2013) in Austria.

With HEAT[3] there is a proven economic assessment tool available to support politicians decisions by arguing that investing in walking and cycling projects means an investment in a healthy society.

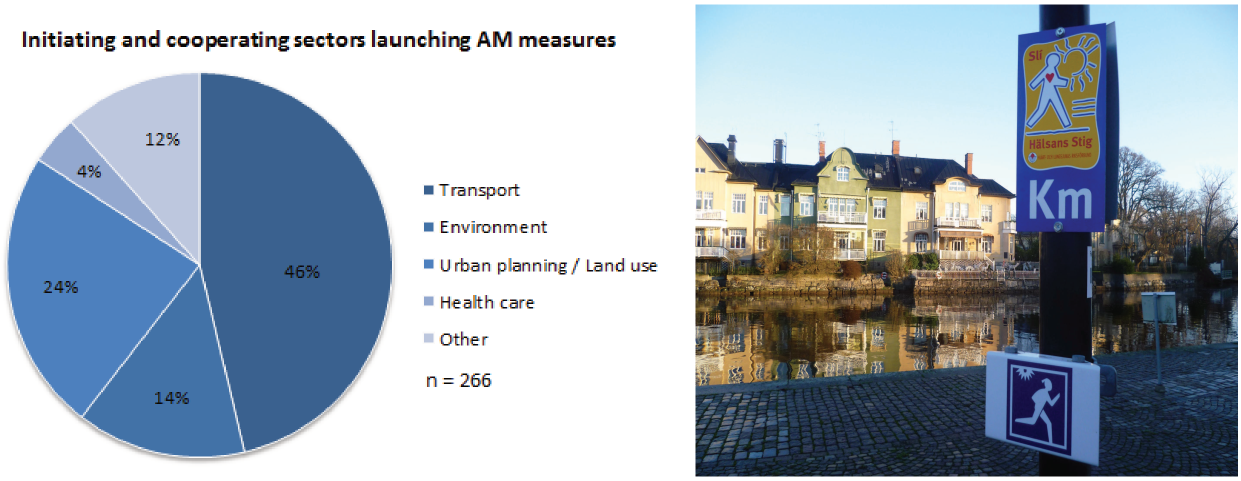

Figure 4: Initiating and cooperating sectors launching AM measures (Analysis of AM measures collection in PASTA CSCs); Picture: Health walk signs in Örebro (© PASTA consortium)

However, transport and health departments operate in most cases separtely and implementation of common projects is slow and tentative. This issue is also underpinned by an analysis of AM measures in the PASTA CSCs showing that the majority of projects was initiated by the transport sector. Health care was involved in 4% of the cases (Figure 4), which is a positive sign towards beginning interdisciplinary thinking and

[3] HEAT – Health economic assessment tool for walking and cycling http://heatwalkingcycling.org/

cooperation. Whether it's about missing collaboration, the integration of health arguments in transport related decisions or about financial responsibilities, the statements of (transport as well as health) stakeholders in the case study cities are indeed very similar (Table 5). Increasing synergies and cooperation between the health and transport sector seems to be one of the missing links for a beneficial convergence.

TRANSPORT & HEALTH: Perspectives of stakeholders in PASTA cities						
Antwerp	**Barcelona**	**London Newham**	**Örebro**	**Rome**	**Vienna**	**Zurich**
Cooperation bet. mobility and health is not structural or a regular interchange.	Health issue is receiving less attention among politicians compared to environment.	Awareness of healthy urban planning is focused on access to greenspace and leisure facilities.	Little cooperation bet. health and transport; health issues neither considered nor communicated.	Traffic Masterplan: Improving life of citizens by impact of reduced car traffic.	Health issue is considered in Urban dev.plan; Mobility is considered in the Austrian's 'Health targets'	Collaboration between the transport and health sectors is quite limited.
Health in mobility often reduced to air pollution. Safety & PA rarely included.	"It would be important that public health & environmental departments find integrated approaches for co-benefits. "	Transport planners are far more aware of the health impacts than health experts are of transport issues.	Traffic is not a prioritized area on the public health agenda;	The Mayor is a doctor, so he is aware of the link health - transport and promotes AM.	Health benefits are a welcome side-effect; on administrative level: single projects; more potential for cooperation.	Health is used as an argument to promote cycling on canton level.
Health gains are long-term (national level) implementation, costs are local and immediate.	Need to raise awareness in civil society on health impacts of urban policies.	Public Health recently been devolved back to local authorities; idea of healthy urban streets.	Public health argument more related to safety perspective rather than AM and PA	"Mobility is not considered to be relevant for health"	"Investment by the transport department – cost savings in the health resort".	HEAT: "good economic situation in Switzerland therefore economic issues less prominent"

Table 5: Transport & health perspectives in PASTA cities (non-exhaustive extract of stakeholder interviews and workshops)

6 CONCLUSION

Ambitious goals to reduce motorized traffic and to increase the share of walking and cycling are defined in the strategic policies (urban development plans, transport concepts etc.) of the seven CSCs, clearly directed towards more sustainable and healthy cities. Political will, often tied with a powerful politician, is the most important driving force and a cornerstone for promoting AM; it needs courage and sensitivity to reduce car traffic ('fear to loose votes of car drivers') and collaborations between the different administrative departments, planning sectors and stakeholders, which is often missing and challenging.

Various measures and interventions to promote AM were implemented in the cities ranging from strategic policies (SUMP), social environment measures like promotion campaigns (e.g. bike2work), improving the physical environment and infrastructure for active transport modes (e.g. new cycling lanes) up to regulations restricting motorized traffic (e.g. 30 km/h zones). A shift towards more AM is a result of all measures and interventions implemented in the cities influencing residents' mobility behavior.

Active mobility as a remedy for a healthier life has recently been promoted by health experts. On the other side the importance of health benefits resulting from walking and cycling has to be raised among decision makers and stakeholders in cities' planning departments as well as among citizens. HEAT is one tool to monetize health benefits of an increased share of pedestrians and cyclists and to justify investments in walking and cycling measures and interventions. A tight cooperation between the health and the transport and city planning sector would be valuable and reasonable for both sectors and after all for the people.

7 REFERENCES

ANGEL, B., CHAHROUR, M., HALBWACHS, CH., PEINHAUPT, CH. 2013. Nationaler Aktionsplan Bewegung. NAP.b. Wien: Bundesministerium für Landesverteidigung und Sport, Bundesministerium für Gesundheit.

BARCELONA, A. D. 2013a. Dades basiques de mobilitat 2012 [Online]. Available: http://prod-mobilitat.s3.amazonaws.com/DB_2012_compr.pdf [Accessed].

BARCELONA, A. D. 2013b. Dades basiques de mobilitat 2012.

BARCELONA, A. D. 2014. Indicadors de Sostenibilitat de Barcelona - Informe 2013.

BRAND, C., GOODMAN, A., RUTTER, H., SONG, Y. & OGILVIE, D. 2013. Associations of individual, household and environmental characteristics with carbon dioxide emissions from motorised passenger travel. Appl Energy, 104, 158-169.

BROWNSON, R. C., HOEHNER, C. M., DAY, K., FORSYTH, A. & SALLIS, J. F. 2009. Measuring the Built Environment for Physical Activity: State of the Science. American journal of preventive medicine, 36, S99-123.e12.

CARRENO, M., VLEUGELS, I., BACKX, K., CLARK, A., NEERGARD, K., EVANTH, K., IVANOVA, E., HUDAK, K. & KIRKELS, M. 2013. Eco Mobility SHIFT: Manual for Auditors and Advisors. Bonn.

EC 2007a. GREEN PAPER Towards a new culture for Urban mobility. European Commission.

EC 2007b. WHITE PAPER ON a strategy for Europe on Nutrition, Overweight and Obesity related health issues. European Commission.

EC 2011. White Paper: Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system. European Commission.

EC 2013. Together towards competitive and resource-efficient urban mobility. European Commission.

EC, DIRECTORATE-GENERAL FOR, E., CULTURE, OPINION, T. N. S. & SOCIAL 2014. Sport and physical activity report. [Brussels]: [European Commission].

FOLLMER, R., GRUSCHWITZ, D., JESSKE, B., QUANDT, S., LENZ, B., NOBIS, C., KÖHLER, K. & MEHLIN, M. 2010. MiD2008 Mobilität in Deutschland 2008 Ergebnisbericht. Bonn und Berlin: Bundesministerium für Verkehr, Bau und Stadtentwicklung.

FOROUZANFAR, M. H., ALEXANDER, L., ANDERSON, H. R., BACHMAN, V. F., BIRYUKOV, S., BRAUER, M., BURNETT, R., CASEY, D., COATES, M. M., COHEN, A., DELWICHE, K., ESTEP, K., FROSTAD, J. J., KC, A., KYU, H. H., MORADI-LAKEH, M., NG, M., SLEPAK, E. L., THOMAS, B. A., WAGNER, J., AASVANG, G. M., ABBAFATI, C., OZGOREN, A. A., ABD-ALLAH, F., ABERA, S. F., ABOYANS, V., ABRAHAM, B., ABRAHAM, J. P., ABUBAKAR, I., ABU-RMEILEH, N. M. E., ABURTO, T. C., ACHOKI, T., ADELEKAN, A., ADOFO, K., ADOU, A. K., ADSUAR, J. C., AFSHIN, A., AGARDH, E. E., AL KHABOURI, M. J., AL LAMI, F. H., ALAM, S. S., ALASFOOR, D., ALBITTAR, M. I., ALEGRETTI, M. A., ALEMAN, A. V., ALEMU, Z. A., ALFONSO-CRISTANCHO, R., ALHABIB, S., ALI, R., ALI, M. K., ALLA, F., ALLEBECK, P., ALLEN, P. J., ALSHARIF, U., ALVAREZ, E., ALVIS-GUZMAN, N., AMANKWAA, A. A., AMARE, A. T., AMEH, E. A., AMELI, O., AMINI, H., AMMAR, W., ANDERSON, B. O., ANTONIO, C. A. T., ANWARI, P., CUNNINGHAM, S. A., ARNLÖV, J., ARSENIJEVIC, V. S. A., ARTAMAN, A., ASGHAR, R. J., ASSADI, R., ATKINS, L. S., ATKINSON, C., AVILA, M. A., AWUAH, B., BADAWI, A., BAHIT, M. C., BAKFALOUNI, T., BALAKRISHNAN, K., BALALLA, S., BALU, R. K., BANERJEE, A., BARBER, R. M., BARKER-COLLO, S. L., BARQUERA, S., BARREGARD, L., BARRERO, L. H., BARRIENTOS-GUTIERREZ, T., BASTO-ABREU, A. C., BASU, A., BASU, S., BASULAIMAN, M. O., RUVALCABA, C. B., BEARDSLEY, J., BEDI, N., BEKELE, T., BELL, M. L., BENJET, C., BENNETT, D. A., BENZIAN, H., et al. 2015. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet, 386, 2287-2323.

GERIKE, R., DE NAZELLE, A., NIEUWENHUIJSEN, M., PANIS, L. I., ANAYA, E., AVILA-PALENCIA, I., BOSCHETTI, F., BRAND, C., COLE-HUNTER, T., DONS, E., ERIKSSON, U., GAUPP-BERGHAUSEN, M., KAHLMEIER, S., LAEREMANS, M., MUELLER, N., ORJUELA, J. P., RACIOPPI, F., RASER, E., ROJAS-RUEDA, D., SCHWEIZER, C., STANDAERT, A., UHLMANN, T., WEGENER, S., GOTSCHI, T. & CONSORTIUM, P. 2016. Physical Activity through Sustainable Transport Approaches (PASTA): a study protocol for a multicentre project. BMJ Open, 6, e009924.

HALLAL, P. C., ANDERSEN, L. B., BULL, F. C., GUTHOLD, R., HASKELL, W. & EKELUND, U. 2012. Global physical activity levels: surveillance progress, pitfalls, and prospects. The Lancet, 380, 247-257.

HERRY, M., SEDLACEK, N. & STEINACHER, I. 2011. Verkehr in Zahlen Österreich. Wien: Bundesministerium für Verkehr, Innovation und Technologie.

JONES, P. 2009. The role of an evolving paradigm in shaping international transport research and policy agendas over the last 50 years. In: PENDYALA, R. M. & BATH, C. R. (eds.) Travel Behaviour Research in an Evolving World.

LONDON, T. F. 2003. Annual Report for 2002/03. Tfl website.

LONDON, T. F. 2012. Travel in London - Report 5. TfL website.

LONDON, T. F. 2013. Report 6.

MA23, V. C. A. 2015. Vienna in Figures 2015. Lukacsy, Michaela Fendt, Christian ed.: Vienna City Administration MA23.

MUELLER, N., ROJAS-RUEDA, D., COLE-HUNTER, T., DE NAZELLE, A., DONS, E., GERIKE, R., GOTSCHI, T., INT PANIS, L., KAHLMEIER, S. & NIEUWENHUIJSEN, M. 2015. Health impact assessment of active transportation: A systematic review. Prev Med, 76, 103-14.

PASTA-CONSORTIUM 2016. D2.1 - Baseline analysis of active mobility in case study cities (in progress).

PUCHER, J., DILL, J. & HANDY, S. 2010. Infrastructure, programs, and policies to increase bicycling: An international review. Preventive Medicine, 50, Supplement, S106-S125.

RENDI-WAGNER, P. 2015. Rahmengesundheitsziele. Richtungsweisende Vorschläge für ein gesundes Österreich. Bundesministerium für Gesundheit, Fonds Gesunds Österreich.

SAHLQVIST, S., SONG, Y. & OGILVIE, D. 2012. Is active travel associated with greater physical activity? The contribution of commuting and non-commuting active travel to total physical activity in adults. Prev Med, 55, 206-11.
TRANSPORT, D. F. 2015. National Travel Survey: England 2014. London.
UK-CENSUS. 2011. Population [Online]. Available: http://www.ons.gov.uk/ons/taxonomy/index.html?nscl=Population [Accessed 15.02.2016 2016].
WARBURTON, D. E., NICOL, C. W. & BREDIN, S. S. 2006. Health benefits of physical activity: the evidence. CMAJ, 174, 801-9.
WEE, B. V., ANNEMA, J. A. & BANISTER, D. 2013. The transport system and transport policy: an introduction. Cheltenham, UK: Edward Elgar.
WEFERING, F., RUPPRECHT, S., BÜHRMANN, S. & BÖHLER-BAEDEKER, S. 2014. Guidelines Developing and Implementing a Sustainable Urban Mobility Plan.
WHO 2007. Steps to health: a European framework to promote physical activity for health.
WHO 2009. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva, Switzerland: World Health Organization.
WHO 2010a. Global recommendations on physical activity for health.
WHO 2010b. Tackling chronic disease in Europe: strategies, interventions and challenges. Observatory studies series. Copenhagen: World Health Organization on behalf of the European Observatory on Health Systems and Policies.
WHO 2015. Health in all policies: training manual. Geneva: WHO.
WIEN, M.-S. U. S. 2014. STEP 2025 Stadtentwicklungsplan Wien.
WOODCOCK, J., EDWARDS, P., TONNE, C., ARMSTRONG, B. G., ASHIRU, O., BANISTER, D., BEEVERS, S., CHALABI, Z., CHOWDHURY, Z., COHEN, A., FRANCO, O. H., HAINES, A., HICKMAN, R., LINDSAY, G., MITTAL, I., MOHAN, D., TIWARI, G., WOODWARD, A. & ROBERTS, I. 2009. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. The Lancet, 374, 1930-1943.
ZÜRICH, S. 2013a. Umweltbericht 2013.
ZÜRICH, S. A. D. K. 2013b. Statistisches Jahrbuch des Kantons Zürich. Statistisches Amt der Kantons Zürich.

reviewed paper

An Investigation of Information Communication and Dissemination Needs: Case of Gautrain Operations

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1 ABSTRACT

Public transport plays an important part in the way people move around their communities. Information dissemination concerns the process of conveying information through Intelligent Transport Systems from transport operators to commuters. Correct and timely dissemination is essential to maximize operational efficiency and reduce the effects of disruptions. Public transport operators often concentrate on the technical aspect of services while commuter needs are neglected. The Gauteng province has been making efforts in the pursuit to improve mobility; a case in point is the Gautrain. The Gautrain is the first mass rapid rail transit system in South Africa and the first in Africa. Although much effort has been made there has not been much effort in understanding the information dissemination needs of commuters. The study aimed to identify information communication and dissemination (ICD) strategies of the Gautrain and evaluate the effectiveness of those strategies. It then described the impact of information dissemination needs also analysing the level of smartness in those aspects. Questionnaires and key informative interviews were conducted in order to obtain the user's perspectives and understand their information needs. The results reveal the various dissemination tools used by the Gautrain Management Agency are the Gautrain App, Social Media and Interactive Public Information Displays among others are utilised as tools to communicate with their commuters. Indicators were selected in order to measure the level of smartness on the Gautrain ICD strategies, which indicated that Gautrain was partly smart. The research highlighted how ICD strategies can enhance the overall improvement in public transport and influence user satisfaction. Lastly, the study also highlights some challenges public transport agencies face in providing adequate information to commuters such as policy disputes and demand.

Keywords: Smart mobility, Public Transport, Intelligent Transport System (ITS), Information Communication Dissemination (ICD), Public Information Displays (PIDs), commuters, Gautrain

2 INTRODUCTION

The South African public transport system over the years has seen immense changes from the Apartheid era up till the present day. Many residents were forced into areas that were far away from job opportunities and essential facilities needed for their livelihood. Transport, in particular rail was seen as integrating these areas with the city and most importantly transporting individuals to their places of work (Walters, 2013). Rail offered a more effective means of moving large numbers of people as compared to other modes of transport and was able to connect the spatially fragmented apartheid city. The South African transport system has since progressed and in times progress is evident in terms of the type and quality of public transport that is available. The introduction of bus rapid transport (BRT) and high-speed rail in the form oft he Gautrain in cities such as Johannesburg and Tshwane has shown that there is progress. The Gautrain in particular was seen as "the key to future transport" as this was Africa's first. Rail transit added a new dynamic to the South African transport system and has since changed the face of public transport in the country. However, challenges continue to cripple the growth of the South African transport sector like the lack of a holistic approach towards public transport, lack of sustainable funding to achieve desired policy objectives and lack of skills to effectively monitor policy initiatives. The immense public pressure to radically advance public transport accessibility, reliability, efficiency and safety was a challenge especially because of the introduction of e-tolls on the freeways (Walters, 2013).

The advancement of urban areas brought numerous issues and challenges, such as trying to find means of reducing pollution and planning for sufficient transportation systems that would meet the consistent population movements, and should focus on improving the performance of public transport services (Bubeck, Tomaschek, & Fahl, 2014; Musakwa & Gumbo, 2017)). As a result there was a need to plan cities in a new way through smart city concepts. Smart cities are a representation of a multidisciplinary field constantly shaped by the developments in technology and urban developments. The smart city buzzword is attracting city leaders around the world often being associated with Information Communication Technology (ICT). The smart city concept drives the user satisfaction narrative. The word smart city is a self-sufficient city that is resilient and uses Information Technology as a force to transform cities to be savvy for the people who live in it (March, 2017). The smart city is from the idea of intelligent city including the connection between urban space and development relating to issues such as e-government, social learning and provision of ICT structures Castells and Hall, 1994; Komninos, 2002, Hollands, 2008). What is definite is that smart city is a diverse field that is shaped by the progression in technology and the influence it has on the urban development. The smart city narrative has various concepts to it such as smart governance, economy, mobility and environment. Smart mobility also stems from the smart city concept with more focus on transportation. It is seen as a way to reduce pollution due to traffic congestion by creating a reliable transport efficient and reliable public transport systems in order to increase safety and overall commuter satisfaction. Smart mobility involves the use of ICT in the form of mobile applications, social media, public information displays (PIDs) in order to support effective transport routes and for commuters to be able to engage effectively with transport operators or agencies more effectively (Longo et al., 2013).

Smartphones allow users to access travel information about their travel, view where others might be in their social network and share information (Dickinson et al., 2015). Application developers have recognised this potential and as result there has been great developments in a range of apps that determine, track users, share travel information and provide real time public transport information as they enable access to data resources that were once perhaps difficult to access (Dickinson et al., 2015). Smartphones are the ideal travel instruments as they can be used on the move and to share, access information on travelling (Dickinson et al., 2014). The trend of applications has been focused more on travel information and route planning. However, more recently transport companies have developed apps to facilitate a more collaborative use where commuters may purchase tickets in advance through these mobile apps and use their smartphones as tickets.

Similarly, in the 21st social media has transformed the way people interact and share information in essence the way individuals communicate (Musakwa, 2014). Social media platforms are web-based services that enable people to disseminate and receive information in real time. Social media may be used for various functions such as promoting businesses, for customer relations and for real time information notices (Cottrill et al., 2017; Rashidi, Abbasi, Maghrebi, Hasan, & Waller, 2017). For this reason the use of social media grows day by day and various sectors have begun to take social media marketing seriously as they are able to reach a wider audience through this medium (Gal-Tzura et al., 2014). The core purpose of social media use across organisations is information sharing and updates, advising the public on travel disruption, handling travel queries, and responding to queries and messages. Giving information and updates and generally informing users on issues and processes of transportation system. Updating the public on delays and disruptions are essential aspect that many organisations particularly those involved with the scheduling, ticket sales and timetables. Real time Public Information Displays (PIDs) are prominent features for traveling. These systems show real-time information by providing features such as next departure of trains and buses at stations and stops. Research has shown that commuters appreciate this kind of information and the installation of PIDs is significantly to improve traveller information and the quality of service.

Understanding Information Dissemination (ID) is a requirement for customer satisfaction. Information Dissemination can be defined as a process of conveying information either through Information Technology Systems (ITS) applications from operator to partner (regulator or agency) to commuters. ID is an important aspect where people make decisions by accessing real-time information, in awareness of upcoming problems because it modifies people's behaviours. ID can essentially be utilised in 3 ways, disseminating for awareness, action and understanding. Correct and timely dissemination is essential to maximize operational efficiency and reduce the effects of disruptions. Public transport operators often concentrate on the technical aspect of services while commuter needs are neglected. It is essential to understand information communication and dissemination needs to help improve user satisfaction not only to increase ridership but also provide a smart public system that is reliable, convenient and accessible that will also encourage people to use public transport. The study aim was to identify ICD strategies of the Gautrain and evaluate the effectiveness or smartness of those strategies.

3 STUDY AREA

The study area is Gauteng Province, South Africa, which is the economic hub of the country and the fastest growing province in terms of the economy, development and population. The Gautrain operates in three metropolitan cities in Gauteng namely the City of Tshwane, the City of Johannesburg, and the City of Ekurhuleni. These and are the only cities in the country which have a rapid transit train (see figure 1 below).

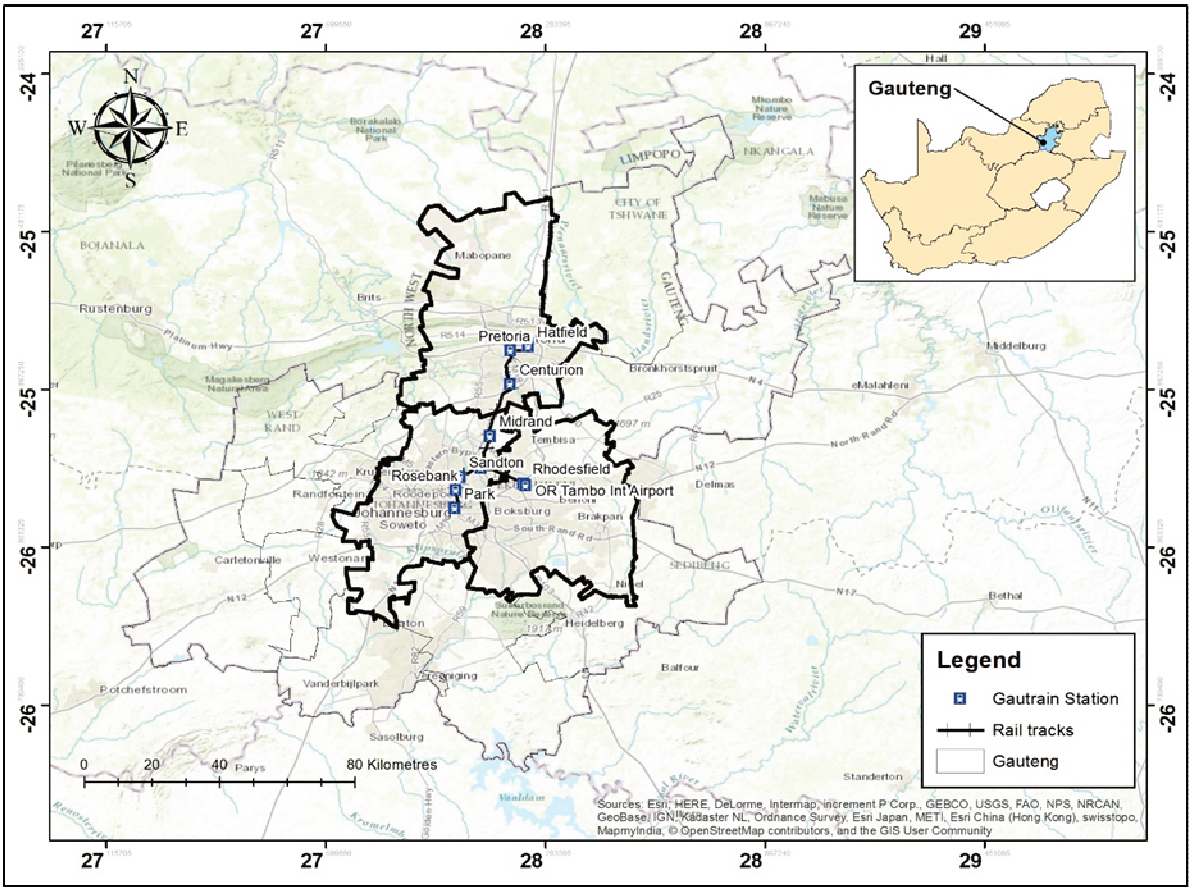

Fig.1: Location of the study area

3.1 The Gautrain Rapid Transit

Gautrain is Africa's first rapid rail system and is located in the Gauteng province of South Africa (GMA, 2014).

Fig. 2: Gautrain transit. Source (GMA 2013)

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The Gautrain project was initiated in 1997/1998, but was formally announced in the year 2000 by the premier of Gauteng. The project was created as a government initiative for strategic economic infrastructure. It officially started operating on the 8th of June 2010. The Gautrain project serves as an integrated network between 3 metropolitan cities in Gauteng namely, City of Tshwane, Johannesburg and Ekurhuleni. The purpose of the Gautrain project was to ease the traffic congestion between Pretoria and Johannesburg but also to offer a more reliable transportation system to the general public (GMA, 2010a).

4 STUDY METHODS

The research study is a survey and utilises both quantitative and qualitative methods. The study seeks to investigate user experiences and understand their information and dissemination needs. A questionnaire consisting of both open and closed questions was developed through Google forms and was administered through Gautrain social media pages (Facebook and twitter). One key informant interview was conducted with key personnel from the GMA to identify various strategies that the GMA utilises to communicate with their users. Secondary data in the form of reports from Jan 2015- Dec 2016 was also gathered. Data collected from questionnaires was analysed using Google forms and converted into statistical representations (graphs and charts). Other various analysis techniques utilised was content, narrative, statistical and time series. Echo-echo was also another essential analysis tool used to analyse Facebook and twitter feeds from the Gautrain. The study also utilised observation and the study period was from 2010-2016.

4.1 Indicators

In this study a number of indicators were chosen in order to make comparisons on smart mobility and determining the level of smartness of the Gautrain namely; Public Mobility Systems (PMS) and Public Transport Support System (PTSS). PMS consisted of SMS service; mobile app, PIDs and social media and PTSS consisted of electronic bus stop sign, electronic ticket payment system. Various studies have used indicators to measure and evaluate the performance of various sectors, including mobility (Garau et al., 2016). The two variables that where identified were utilized to analyse and make comparisons on smart mobility regarding Gautrain. Indicators were selected in order to identify and examine the current state of ICD in Gautrain and also assist in identifying strategies utilised for information dissemination.

5 RESULTS AND DISCUSSION

5.1 Public mobility systems

These are systems in place that are there to assist commuters in their travelling. They consist of a number of the SMS and voice announcement, Public information Displays and mobile apps.

5.1.1 <u>SMS service and voice announcements</u>

The SMS's service has become a widely used tool to disseminate important information to commuters and is utilised by the Gautrain as a means of informing their users should any issue arise regarding any operational issues. The Gautrain utilises voice announcement as a means of communicating with their users. These give information on the arrival and departure times of the train, notice of any delays or any other issues that might hamper the commuter's safety and also caters for people with impaired or blind vision as they can hear the announcements being made. Voice announcement is a reliable means of disseminating information, as it is real-time and common worldwide in various modes of public transport. Nevertheless the voice and sms service is a one-way form of communication, which does not, allows commuter feedback.

5.1.2 <u>Mobile app</u>

The study revealed that 51,6% of commuters was using the app to plan their trips and 48,4% did not utilise the app. This meant that they don't use the app at all. The official Gautrain mobile App was developed by AfriGIS, which provides commuters with what they need to know about Gautrain and with the live bus route information. Some of the features included in the app are the user-friendly interface, finding the nearest Gautrain station and bus stop, bus tracking system, map view displaying all the Gautrain stations, bus stops and routes, trip planner to and from all different Gautrain stations, calculate estimated trip fares including parking and bus fares. The Gautrain is currently running on all major Smartphone and tablet devices including Android, Blackberry, iOS and Windows phone 7. Significant utilization of smart mobile applications can be potentially very beneficial, particularly in car travel mode to reduce travel time, cost, and vehicle emissions. This is due to the fact that car travel is the dominant mode of transportation in most urban cities around the world. However the mobile app struggles with providing real-time information thus it can be regarded as being largely static

5.1.3 Public Information Displays (PIDs)

The survey revealed that 73,3% was aware of PIDs while 26,7% was not. It indicates that most respondents are aware that there are Public information Displays. Public Information Displays (PIDs) provide new possibilities for transportation companies to provide information at different stages of the journey. Public displays with interactive functionality provide the opportunity to support different users in their interaction, through specific support functions by providing information on schedule, calculate fares and train and bus routes. Gautrain has public information kiosk that offer users with the type of information they would need for their trip (see fig. 3). These kiosks are more engaging than the traditional PIDs on the train station. There needs to be more of these PIDS put at various stations to increase usage.

Fig 3: PIDs kiosk

5.2 Public Transport Support System

The concept of public transport support systems is a well-defined and professional field and can be defined as (geo) information technology-based instruments that are dedicated to support public transport systems (Geertman, et al., 2015).

5.2.1 Electronic bus stop system

The Gautrain busses do not possess any electronic bus stops, which can provide commuters with specific information about their journey. In order to avoid confusion about the location and incoming bus services, electronic bus stops signs may be seen as an essential element for public transport. In order for Public transit system in Johannesburg to reach smart city status there is an urgent need to invest in these smart and informative electronic bus stop signs. As a result commuters can wait indefinitely without knowing when the next bus comes.

5.2.2 Electronic Ticket Payment

The Gautrain electronic ticketing system is a cash-free ticketing system that uses reloadable smart cards. The smart cards are obtained at the self-help ticket vending machines or a manned ticket office in each station in order to pay for the train and/ or bus trips (see fig 4). Gautrain offers an average of four automated machines

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per station where commuters can load money on the smart card. This system is smart as it reduces paperwork and ensures that if the smart card is lost the card cannot be reused if the commuter had registered and can even recover the money in the card (Gautrain, 2010b).

Fig 4: Gautrain ticket system

6 CHALLENGES

Public Transport systems, notably bus and rail, are undoubtedly important parts of the transport operation. Continuing challenges of public transport are identified in various sectors such as safety and security, population growth and the inability of cities and transport systems to cater for that demand (Miller, 2013). The role of ITS today has transformed an entire generation in the way public transport companies can share important information with users. However, the reluctance of transport agencies to invest in such concepts can be seen as a setback for public transport and hampers the potential growth of the transport sector. Gautrain has made various efforts in ensuring their information strategies are set in place to encourage commuter engagements, but do not have suitable plans in place that will be able to cater for information communication needs in future. This is a challenge in many public transport systems today, the inability to have proper strategies in place for future developments and in that regard there is a need for re-learning as public transport agencies need to be forward-thinking and constantly investing in measures that will improve their systems so as to have a more flexible, efficient and smart public transport system.

7 CONCLUSION

Public transport is a key feature in sustainable growth thus, it should be properly designed to be flexible and meet the continuously changing demands in cities. Understanding the needs of passengers is an important factor in the level of satisfaction of users. The findings from this research highlight the various information communication and dissemination strategies of the Gautrain that are categorised in terms of Public Mobility Systems and Public Transport Support Systems. These consist of information dissemination strategies that are utilised as tools of communication from operator to user and support systems that aid the user in travelling. Although Gautrain has since implemented these mechanisms they are still faced with challenges in planning for future ICD needs of commuters, and as a result there is a need for re-learning. Proper evaluation and planning of ICD needs can assist transport companies in understanding their customers, expanding their brand and potentially attracting more people into using public transport. Moreover, in order to reach an efficient and smart public transport system, effective collaboration from various organisations should be shared. It is important to note that collaboration involves values such as understanding the motives and roles of each party, mutual respect and engagement. Creating real value in collaboration or co-action is an important theoretical task, which requires action and active learning. Users are an important feature in public transport. Innovative solutions are needed to find forms in which passengers' experience can be used.

8 REFERENCES

Bubeck, S., Tomaschek, J., & Fahl, U. (2014). Potential for mitigating greenhouse gases through expanding public transport services: A case study for Gauteng Province, South Africa. Transportation Research Part D: Transport and Environment, 32, 57-69. doi:http://dx.doi.org/10.1016/j.trd.2014.07.002

Castells, M., & Hall, P. (1994). Technopoles of the world. London: Routledge.

Cottrill, C., Gault, P., Yeboah, G., Nelson, J. D., Anable, J., & Budd, T. (2017). Tweeting Transit: An examination of social media strategies for transport information management during a large event. Transportation Research Part C: Emerging Technologies, 77, 421-432. doi:http://dx.doi.org/10.1016/j.trc.2017.02.008

Dickinson, J.E., Cherrett, T., Hibbert, J.F., Winstanely, C., Shingleton, D., Davies, N., Nargate, S., Speed, C. (2015). Fundamental Challenges in designing a collaborative Travel App.

Gal-Tzur, A., Grant-Muller, S.M., Kuflik, T., Minkov, E., Nocera, S., & Shoor, I. (2014). The potential of social media in delivering transport policy goals. Transport Policy, 32, pp. 115-123.

Garau, C., Masala, F., Pinna, F. (2016). Cagliari and smart urban mobility: Analysis and Comparison. Cities, 56, 35-46. doi: http://doi.org/10.1016/j.cities.2016.02.012

Gautrain Management Agency: Gautrain's Route (2014). Available from: www.gautrain.co.za/about/route/gautrain-route/. Accessed (21 September 2014).

Gautrain Management Agency: Socio-economic development progress. In: http://www.gautrain.co.za/contents/brochures/sed_brochure_final_print.pdf, 2010a

Gautrain Management Agency: Spatial development. In: http://www.gautrain.co.za/about/about-gautrain/studies-documents/spatial-development/, 2010b.

Greertman, S., Ferreira, J., Goodspeed, R., Stillwell, J. (eds). (2015). Planning Support Systems and Smart Cities, Springer, Switzerland.

Hollands, R. (2008). Will the real Smart City Please Stand Up? Intelligent, progressive or entrepreneurial? City, 12(3), pp 303-320.

Komninos, N. (2002). Intelligent Cities: Innovation, Knowledge systems and digital spaces. London: Routledge.

Litescu, S., Viswanathan, V., Lees, M., Knoll, A., & Aydt, H. (2015). Information impact on transportation systems. Journal of Computational Science, 9, pp 88-93.

Longo, M., Hassain, C.M., Roscia, M. (2013). Smart Mobility for Green University Campus. International Symposium on Power Electronics, Electrical driver, Automation and Motion.

March, H. (2017). The Smart City and other ICT-led techno-imaginaries: Any room for dialogue with Degrowth? Journal of Cleaner Production. doi:http://dx.doi.org/10.1016/j.jclepro.2016.09.154

Musakwa, W. (2014). The use of social media in public transit systems: the case of the Gautrain, Gauteng province, South Africa: analysis and lessons learnt. Paper presented at the REAL CORP 2014–PLAN IT SMART! Clever Solutions for Smart Cities. Proceedings of 19th International Conference on Urban Planning, Regional Development and Information Society.

Musakwa, W., & Gumbo, T. (2017). Impact of Urban Policy on Public Transportation in Gauteng, South Africa: Smart or Dumb City Systems Is the Question. In R. Álvarez Fernández, S. Zubelzu, & R. Martínez (Eds.), Carbon Footprint and the Industrial Life Cycle: From Urban Planning to Recycling (pp. 339-356). Cham: Springer International Publishing.

Rashidi, T. H., Abbasi, A., Maghrebi, M., Hasan, S., & Waller, T. S. (2017). Exploring the capacity of social media data for modelling travel behaviour: Opportunities and challenges. Transportation Research Part C: Emerging Technologies, 75, 197-211. doi:http://dx.doi.org/10.1016/j.trc.2016.12.008

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Application of Web 2.0 Technologies for Integration of Land-use and Transportation System

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1 ABSTRACT

Transportation networks are the life line of any city but only when the decision of land-use system and transportation system are integrated in smart and intelligent ways. The present paper examines the complexities of development and planning decision that are embedded in the process for finding an effective solution for integration of land-use and transportation system. The present paper also answers the question that how society democratically and effectively access to Web 2.0 technologies for spatial information and translate the virtually tested, analyzed design in the real world. In overall, the paper tries to frame a concept to use Web 2.0 technologies as a tool for establishing Intelligent Transportation System within the existing land-use system. No doubt Web 2.0 technologies in the cybernetic age is the fastest way to access, collect, analyze and transfer spatial information and providing innovative, sustainable, participatory solutions for effective government and community empowerment. However, the use of Web 2.0 technologies in transportation system is not the part of smart city model in India. Hence, the paper will act as a guiding principle and methodology for Smart City Mission in India. The paper also suggests the possible ways to establish Web 2.0 technologies applications for intelligent transport system through community base local Neighbourhood Digital Technology Center (NDTC). The establishment of NDTC will give local urban community free hand to tailored or customized Web 2.0 software as per their need and requirement and generate or manipulate their own information or spatial data rather than given answer or raised query to the predefined proposed land-use map.

Keywords: integration, web 2.0 technologies, intelligent transportation system, land use system, real time data

2 INTRODUCTION

In India, with the present urban population of 410 million person, it is estimated that 814 million person by 2050 will be living in Indian cities. In order to cater the need of large urban population and growing economy, the transport sector plays an important role. It is also evident, that, as urban area contribute 58% of countries GDP, transport sector alone share is 6.7% (2016) and which is expected to increase 12% in 2026. Ever growing economy of India has witnessed a steep rise in demand for transport sector. About 85% of passenger and traffic and 60% of freight are taken care by road sector. If compared with USA (0.65 Kms) and China (0.16 Kms), density of Indian Highways are 0.66 Kms of roads per square Kilometre of land. Opening up of Indian economy during 1990's and stating of Smart City project in 100 cites, India has witnessed a rise in demand for transport infrastructure and services. However, the growing complex urban economises in India has not been able to keep pace with rising demand of efficient and sustainable transport system. Out of 87 metro's only 20 cities have organized transport system and only 4 metro cities have rapid mass transportation system. Even the share of public transport in these metro's cities are decreasing form 69% in 1994 to 38% in 2007. The transport data of major metro cities reflected that the share of slow moving vehicles are given way to fast moving vehicle and so it also true for public transport to private transport sector. Thus, in combination with demographic change, social changes in lifestyle, impact of social media, had gear-up the pace of mobility on the one hand; and lack of integrated development strategies for efficient transportation system leads to mounting congestion and pollution in India cities on the other; resulting in low economic return, low quality of life and high environmental & social cost.

In the present age of Information and Communication Technologies (ICT) the urban planner and manager looking forward to Web.2.0 and other freely available internet base applications to solve complex urban problems of integrating land-use and transportation system. Transportation networks are the life line of any city but only when the decision of land-use system and transportation system are integrated in smart and intelligent ways. The present paper in the context of Rourkela Smart Transportation System Project (RSTSP) and Comprehensive Development Plan of Rourkela (one of the Indian smart city project in Odisha

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State) examines the complexities of development and planning decision that are embedded in the process for finding an effective solution for integration of land-use and transportation system. It is evident that smart and intelligent transport system will boost the economy of any urban area. In this context the present paper answers the question that how society democratically and effectively access to Web 2.0 technologies for spatial information and translate the virtually tested, analyzed design in the real world.

3 WEB 2.0 TECHNOLOGIES FOR TRNASPORT MANAGEMENT

Online Web 2.0 technologies are interactive, participatory, transparent, interoperable, share, tag, locate and involve citizen for decision making. In fact Web 2.0 Technologies help in people participation through customization of city planning information and data tailored to their need, requirement and priorities. The citizen can create or identify content, edit and give preference or request to government or urban development Authorities/ managers for inclusive, participatory planning process and decision making.

In order to disseminate information over the digital platforms Web 2.0 technologies provide limitless possibilities for social inclusion of the local community for making urban planning and design sustainable cites. Web 2.0 technologies which is participatory web applications one can participate and create their own content and communicate over map, sketch, picture with the local and worldwide governance system, irrespectively language difference. Infact Web 2.0 is a powerful tool to communicate by the planner with the local community and vice-versa. Social networking sites, Google map Mashups, blogs, YouTube, are some of the effective example of Web 2.0 technologies. Moreover, Web 2.0 technologies are also providing transparency to the governance system through interoperability of the urban planning. Transparent government system is the essential need for social inclusion and local community involvement in the planning process.

Basic importance of the Web 2.0 technologies is that, all unconventional data, irrespective of its source, which have geo-located information, can be used for planning purposes. Thus, the use of this unconventional data to translate in to planning solutions will define the Smart E-Solution Model for Rourkela or any other city. For example data available on road side camera for traffic management will provide many important data if fixed with the Urban planning portal, banking transaction system, smart phone video recording and uploading on social networking sites, controlling social behaviour or traffic movement on roads through FM Radio, GPS installed on taxi and many innovative data mining techniques will measure the smartness for defining Smart Urban planning. (S.K. Raut and P.B. Raut, REAL CORP, 2016)

With reference to Transportation system many Web 2.0 application tools can be used, however, one specific application can be used for one Transportation solution in one region/city and similar Web 2.0 application can be use to find out other solutions of problems in transport sector. The most important use of Web 2.0 technologies is to have real time data and accordingly taking decision on ground. For identification of traffic and transportation problems, Web 2.0 application site like ‘SeeClickFix‘ is an good options for tagging the issues or problem on Google Map and also give option for voting i.e. interactive and similarly exposing the government agencies for not taking the community problem more seriously or making the government more responsible, transparent and efficient. SeeClickFix help government agencies to prioritise the problems issues through voting pattern and similarly channelizing the funds for larger satisfaction of urban community. Hence, Web 2.0 applications are customized and entrepreneur specific and not region/city specific or not for exclusive use for single purpose but multiuse technologies. Another example is Cyclopath, a common Web 2.0 application generally used to find out the best possible way for bicycles. However, by using Cyclopath, crowd sourced unique rating system data will help to find the best routes for buses and trucks and will also interact with best possible way to reach particular destination. One of the important things to know that Cyclopath includes interactive map that can share edit and tag information and can be seen worldwide.

A Mashup is a web application that combines data from more than one source into one integrated tool. These Mashups are created by internet users, for internet users. Google Map’s, Map my India and Wiki map are very popular sites that may be quickly incorporated into Mashups. There are over 1500 Google Maps Mashups in existence, allowing users to calculate electoral votes spatially, rate restaurants, map out their running routes, and even plot celebrities’ homes on a map or share stories. The potential utility for Google Maps Mashups in Smart and Intelligent transportation System is enormous. User submitted information can make the job of transport planners much easier. In particular since communities are often competing for new residence based on the quality of life they offer, Mashups are a very useful tool for transport planning and to have quality of life. The government or transport services provider and users looking for better routes to avoid congestion, festival routes etc all can find a Google Map's Mashup to help them do so. For example morning walk communities who are planning to find better place or route in a more advanced Mashup for good health, better environment and sustainable city research, which helps a particular community to plan routes using a variety of criteria such as distance, elevation change, air quality, and amount of vegetation. This type of Mashup, can also calculate calories burned and index of good health for better working performance. This Mashup could contribute to increasing morning walker safety. Planning offices could provide this service using base GIS data and let citizens add useful information, such as green areas needed for better health, the location of yoga centres, or particularly scenic or safe routes. As the internet moves ever more toward user generated content and functionality, planners have a tremendous opportunity to take advantage of community knowledge especially through spatially oriented Mashups. Such Mashups can be used to maintain power and water supply, efficient traffic and transportation system, safer cycling route, safer school cab route, efficient management of other services for the community etc. (S.K.Raut and P.B. Raut, REAL CORP, 2015).

4 BACKGROUND OF ROURKELA CITY

Literary Rourkela according to the 'Sadri' language means "your home". Raulia a tribal community had been living in the village since time immemorial. The erstwhile revenue village is now known as "old Rourkela". Before the industrialization which took place in 1951 the population of Rourkela was very low, only 4000 persons. The establishment of Rourkela Steel Plan (RSP), a unit of Steel Authority of India Ltd (SAIL) followed to the set up of number of small scale ancillary industries had witnessed a sudden influx of population i.e. 35000 persons in 1961. According to the 2001 census the population had increased to 259553. This registers an annual growth rate of 16.04% which is much higher than the growth of urban population in Odisha. Today Rourkela is an important industrial cum commercial hub of Odisha state. Employment opportunities and benefit of economies of scale made Rourkela an economically vibrant town attracting people from its vast hinterland. Rourkela Planning Area with a geographical area of 259.18 sq km comprises of 52 revenue villages, Rourkela steel plant, Steel Township. Reserve forest constitutes 4.39% of the total planning area. Koel River flowing from east to west divide the entire planning are into three parts. Rourkela Development Authority executes the town planning schemes as well as the development control aspects of the Rourkela Planning Area. Basically the development authority and the municipality – these both two government functionaries are held responsible for the overall development of the Rourkela Planning Area.

5 CONCEPT OF INTELLIGENT TRANSPORTATION SYSTEM THROUGH WEB. 2.0 APPLICATIONS FOR ROURKELA SMART CITY

In India ITS application are limited in use and less developed . Delhi, Pune, Bangaluru, Chennai are few ITS application example with area wide signal control, parking information system, advance public transportation, toll collection etc. Integrated Multi-Modal Transit System for Delhi was lunched during 2011 which is similar to London and Paris Bus Services. The 119 public buses are fitted with GPS in order to have real time information for location and speed. These buses are also fitted with electronic ticketing machines which generate real time ticketing information to identify the ridership. The buses are also fitted with in-built speed governors which regulate the speed of the buses. The voice announcement system, inform commuters about the upcoming bus stops and buses also have CCTV cameras on board to improve security. The cluster buses will follow a unified time table developed by Delhi Integrated Multi Modal Transportation System (DIMTS). 'Trako' application is also developed by DIMTS for tracking Delhi Corporation Buses with users Mobile phone. Passenger Information System is developed to give information on user mobile through simple SMS. Kerala Police launches e-challans system to enable motorists to pay fine for traffic violations through bank. The Kerala Traffic police issues a bank e-challan with 10-digit alphanumeric code to the traffic violator. The defaulter will pay the e-challan on the spot or at any SBT Branch (Bank Branch) or Akshaya Centre (e-Centre of Kerala Traffic Police) within 20 days. Unable to pay in the stipulated period, court will come into picture.

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ITS model simulate the local locational behaviour of residential and workplace mobility pattern. Integrated Land-use Transport Model provides out-put in digital data format for a predefined set of indicators. With the real time data and crowd sourcing application for flow of traffic on the Rourkela city roads/ streets the transportation system can be managed through rerouting buses or opening/identify new lanes for real time traffic flow. Through the intigration of parking spaces and user community over Web 2.0 application or SMS mobile network cam solve the parking problem of heavy vehicals

Rourkela is the hub of Industrial and commercial activities. In the core of Rourkela, Iron and Steel Industries unit is located where the raw material are brought in bulk, stored and finished product are flow out. Apart from core area of Rourkela, other areas like Kulunga and Kumarmunda have ancilary Industries of spong iron and expansion of these industries have contributed more quantities of raw material and other commoditie, thereby increasing the pressure over the existing infrastructure. This has resulted in acute traffic and tranportation problems like increasing traffic jam, accidents, environmental pollution. The smart city project of Rourkela is an attempt to establish intelligent transportation system for not only goods traffic but also for passenger traffic movements and managment.

In combination with existing website of Rourkela Development Authorities (RDA) freely available Web 2.0 application can be connected or developed, for dissemination of government information to its citizen or taking public opinion. The existing Smart City website 'Smartnet' of central government can be developed for Rourkela Intelligent Transportation System (RITS) to disseminate customized transport information and data to its citizens for:

(a) View, create and edit.

(b) Obtaining public feedback

(c) Providing voting rights

(d) Inviting transportation solutions from public

(e)Responding to public question/complaints.

With the concept of RSTS, RDA will experience the saving of time and cost for execution of transport related work and repair, and have more satisfaction of citizen and stakeholder. Moreover, the uses of Web 2.0 applications will improve the internal government agencies communication for more effective decision taking and improving public understanding. In order to tackle the problem of receiving lots of unsupported data from public which make it difficult to filter more meaningful and useful data for effective transportation system, Web 2.0 application Guidelines and Web base law abiding rules and regulation can be framed and put in place.

It is learned from the world wide Web 2.0 technological projects that wide varieties of Web 2.0 application are required to use for different purposed and accomplish project aim and objectives. And also the city like Rourkela where only 39 percent of urban population have access to internet facilities, it becomes difficult to even think to use Web.2.0 technologies base solution to establish Intelligent Transportation System (ITS). However, it is possible after identifying the interested citizen keen to support the project for making core citizen group (CCG) may be called 'YATAYAT FIELDER' (YF). The Yatayat Fielder will be chosen from the different areas of the city and of different communities those have smart phones and have basic education and off course to have interest to take active part with the government. These CCG will work with RDA government official in more effective way to analyse content and solve traffic related problems.

Under the National Urban Information System (NUIS) Scheme, the author already suggested to establish community based local Neighborhood Digital Technology Center (NDTC) at neighborhood level and City Digital Technology Center at City level of all smart cities selected (S.K.Raut and P.B. Raut, REAL CORP, 2015). This NDTC will have internet base GIS lab which will:-

(a) Provide access to GIS and Web 2.0 technology;

(b) Provide information for other related information generation agencies;

(c) Store public information and database;

(d) Analyze public information and feed to the main City Digital Technology Center (CDTC); and

(e) Influence decision making and participatory planning processes.

The Yatayat Fielder will feed/communicate the transport related data to NDTC. Hence, NDTC should be managed 'by the people'; provide information to planning authorities 'for the people'; and information generated 'from the people'. NDTC should be accessed by any local community and, thereby, giving the people empowerment and direct access to digital spatial data system. These Yatayat Fielders should be identified for providing training and access in GIS and Web 2.0 technologies especially to poor and slum areas for inclusive public participation. Thus, this is the answer to digital divide and reducing the gap between planning professionals and local public.

Town and Country Planning Organization under the Ministry of Urban Development is ready to give support to RDA and other selected smart cities for identifying smart citizen/government official for GIS and Web 2.0 technological oriented services for use of digital information and its generation, so that its benefit reach to the lower section of the urban community. This would call for sustainability of good quality of Web 2.0 services to citizens for e-governance of the Town Planning organizations and departments which should be fully computerized for delivery of public services and internal functioning of the office. GIS and Web 2.0 technologies education and training and its application for public awareness is another important issue which will act as a foundation for the growth/ success of Web 2.0 technologies. The School of Planning and Architecture (SPA) should take a lead role to facilitate IT and Web 2.0 technologies education to foster budding planner for smart understanding of Web 2.0 technologies. The existing planning professional should be given short training to become technology savvy. The most important areas are software development, Entrepreneur GIS and customized Web 2.0 technologies for Transport Planning application and tools should be developed. These software need to be simple, user friendly and affordable. For Web 2.0 technologies Promotional Group professional organization (like TCPO) and educational institutional (like SPA) should be integrated to maximize the output and professional satisfactions. An awareness programmes to make Web 2.0 technology based planning and public participation software, as a mass movement need to be worked out by encouraging value added network services in the form of 'Telematic Kiosks/ window for 'One window and Non Stop' series for the urban community. These programmes and training should be in local or regional languages in order to have easy understanding and social acceptability.

6 RITS PROJECT ARE DIVIDED UNDER FOUR STAGES:

(a) Establishment of e-Platform: Crowd sourcing Web 2.0 application platform will be established at NDTC and CDTC in local language for wider acceptance. Integration of various Web 2.0 applications over single platform are required to be created in order to suport multi functional Transport sector need like, parcel services; at home care services for the elderly and emergency services; care sharing; driver assistance system; use of standardised message set by the stations/platform; exchange information between each other (user and provider); receiving and analysing data for decision making; improve safty and clean environment; traffic efficiency by harmonising traffic flow and planned driving; increase driver comforts and; efficient, safe inter modal transfer. Thus in order to support more and more function multi level Web 2.0 applications platform will be served by single Web 2.0 application platform.

(b) Collection of Data through Crowed Sourcing: The process of collection of data first compounded through unconventional sources through identification of the Intelligent Crowdsourcing and creating a crowdsourcing information platforms. Mobile and internet alert application software should be put in place for reporting and collection of data. Social networking application like Facebook will be best suited and widely accessed by the public. Moreover, collection of data application will also be used by Yatayat Filder in a easy and friendly manner.

(c) Analysis of Data: Collective resources information generated by the Crowd sourcing information platforms should be connected with the different analysing computer models and translating the results for crowd computing. Local community should be mobilized to analyse the solutions of the problems and concluding the solutions over technical controlled but transparent platform. The Web 2.0 application platform should be such that users can provide, analyse and share data to give solution for specific transportation issues and problems as well as also able to see and analyse other views and data tagged. Mashups, Google Groups, Next Stop Design, Virtual Meetings etc and Web 2.0 applications will support transportation data analysis.

(d) Solution and Decision Making: Crowd sourcing should be encouraged to create designing solutions over online mapping and defining the content of the plan for creation of virtual plan. For implementing virtual

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plan over real space will give pride and social satisfaction to the local community and even come forward with innovative idea for fund raising. Web 2.0 applications like Simulation Games will create simulated real world model for finding solution and appropriate design on virtual world. Mobility, Next Stop Design are some of the example for decision making Web 2.0 applications for ITS.

7 CONCLUSIONS

In overall, the paper tries to frame a concept to use Web 2.0 technologies as a tool for establishing intelligent transportation system within the existing land-use system. No doubt Web 2.0 technologies in the cybernetic age is the fastest way to access, collect, analyze and transfer spatial information and providing innovative, sustainable, participatory solutions for effective governance and community empowerment. However, the use of Web 2.0 technologies in transportation system is not the part of smart city model in India. Hence, the paper will act as a guiding principle and methodology for Smart City Mission in India. The paper also suggests the possible ways to establish Web 2.0 technologies applications for intelligent transport system through community base local Neighborhood Digital Technology Center (NDTC). The establishment of NDTC will give local urban community free hand to tailored or customized Web 2.0 software as per their need and requirement and generate or manipulate their own information or spatial data rather than given answer or raised query to the predefined proposed land-use map.

8 REFERENCES

ANTTIROIKO, A. V.: Urban Planning 2.0. International Journal of E-Planning Reserach, 1(I), pp. 16-30, 2012.

CARAYANNIS, E. G. & CAMPBELL, D.F. J: Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and environment related to each other? A proposed framework for a tran-disciplinary analysis of sustainable development and social ecology. International Journal of Social Ecology and Sustainable Development, (1), pp.41-69, 2010.

CENSUS OF INDIA: General Population Tables, 2001and 2011.

COMPREHENSIVE DEVELOPMENT PLAN OF ROURKELA 2031, 2017 (Unpublished)

KELLY, E. D: Community Planning: An introduction to the comprehensive plans (2nd Ed.) Washington DC Island Press, 2010.

NASH, Andrew: Web 2.0 Application for Improving Public Participation in Transportation Planning, Vienna transport Strategies, 2009.

RAUT, S.K. and RAUT P.B.: Building Inclusive Smart Sustainable Cities through Virtual Environment, REAL CORP 2015.

RAUT, S.K. and RAUT P.B.: Smart Sustainable E-Solutions for Implementation and Enforcement of Smart Cities in India, REAL CORP 2016.

RAUT, S.K. and RAUT P.B.: Implementation Challenges for Establishing Smart Urban Information and Knowledge Management System. In: Sustainable Smart Cities in India: Challenges and Future Perspectives, Ed. Sharma P. and Rajput S., Springer, pp. 59-72, 2017.

🏆 *reviewed paper*

Assessment of Environmental Pollution Load of Transit Corridor in India

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1 ABSTRACT

In India, Transit Corridor development is an integral part of planning. India has an extensive transit network of 3.6 million km - the second largest in the world. The Government of India (GOI) launched a radical program in the late 1990s to upgrade three key national transit corridors: (i) the Golden Quadrilateral; (ii) the East-West Corridor; and (iii) the North-South Corridor, covering about 13,000 kilometers. The National Highways Authority of India (NHAI) was mandated with the responsibility of carrying out this National Highways Development Program (NHDP) in 2000s. In post NHDP Phase III programme a massive programe was involving of upgradation of about 10,417 km of national highways. This programme was an addition to the onging NHDP and includes upgrading linkages to the NHDP corridors. This programme involved four or six laning of existing two lane national highways of most of the selected national highways over 29 states and 7 union territories in India. The criteria for selection of the project roads are corridor with high density traffic which has avaergae daily traffic of more than 30,000 passenger car equivalent units, carridor providing state capitals with links to the NHDP network and corridor providing access to economic and tourist centres.

The number of vehicles on roads has been growing at compounded annual growth rate (CAGR) of approximately 8 percent in the last five years. The growth rate of vehicles is the backbone of economic development and the Indian automotive Industry is the second fastest growing in the world. About 8 million vehicles are produced annually in the country today. In 2009, the country reported 121.63 million registered motor vehicles, a motorization rate of 22 vehicles per 1000 population (Road Transport Yearbook, 2008. Motor vehicle growth rate has been largely concentrated in the major cities. India has experienced tremendous growth rate in motor vehicles & this lead to interest of environmentalist, business leaders, government officials and researchers for a number of reasons. Already, India’s motor vehicles have had a substantial detrimental impact on the environment. Automobiles are the primary sources of air pollution in India’s major cities. In India, transport sector emits an estimated 261 Tg of CO_2, of which 94.5 % was contributed by road transport. The transport sector in India consumes about 17 % of total energy & is responsible for 60% of the Green House gas from various activities (Tedoy, 2008). The pollution from vehicles is due to discharge like CO, unburnt HC, Pb, NO_2 & suspended particulate matter mainly from tail pipes.

The potential massive size of the nation’s motor vehicle fleet has raised concern over the addition of carbon dioxide to the atmosphere & its potential for global change. An examination of the factors that have contributed to rapid growth rate of motor vehicle in India is very important to understand the likely future course that the growth might take. Central Pollution Control Board, India is executing a nation-wide programme of ambient air quality monitoring known as National Air Quality Monitoring Programme (NAMP). The network consists of three hundred and forty two (342) operating stations covering one hundred and twenty seven (127) cities/towns in twenty six (26) states and four (4) Union Territories of the country. All receptors are not being monitored all along national highways. There is huge gap in database preparation, monitoring and analysis.

This paper apraises the alignments of national highways all over Country with traffic density and available databse of pollution load. The overall anlayis gives the national wide framework of pollution load all along the transit corridor as baseline anlsysis for future planning.

Keywords: NAMP, transit corridor, NHDP, environmental pollution load, planning

2 INTRODUCTION

Transport is essentially a derived demand depending upon the size and structure of the economy and the demographic profile of the population. Road transport is vital to the economic development and social integration of the India. Easy accessibility, flexibility of operations, door-to-door service and reliability have earned road transport an increasingly higher share of both passenger and freight traffic vis-à-vis other transport modes. Greater the share of commodity-producing sectors like agriculture and manufacturing,

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higher is the demand for transport. From 1951 at 0.399 million km to 4.110 million km as on 2008 the total road length in India has increased. Concurrently, the surfaced road had increased over the same period from 1.57 lakh km to around 20.36 lakh km. Since 1970s the total road length had expanded significantly. It has increased from 0.915 million km in March 1971 to 4.110 million km in March 2008 – with an increase rate of 34.9 percent over these 37 years as compound annual growth rate (CAGR) of 4.1 percent. During this period category wise classification of road length showed that the length of National transit Corridor i.e. National Highways (NHs) increased from 23,838 km to 70,934 km – an increase of over 180 percent or CAGR of 2.8 percent. It is notable that the 'National Highways' registered an increase of 14,744 km (from 52,010 km in 2000 to 70,934 km in March 2010) over a period of 10 years. Arterial roads of the country for inter-state movements of passengers and goods are National Highways. NHs traverses the length and width of the country connecting the National and State capitals, major ports and rail junctions and link up with border roads and foreign highways.

India has an extensive transit network of 3.6 million km - the second largest in the world. The Government of India (GOI) launched a radical program in the late 1990s to upgrade three key national transit corridors: (i) the Golden Quadrilateral; (ii) the East-West Corridor; and (iii) the North-South Corridor, covering about 13,000 kilometers. The National Highways Authority of India (NHAI) was mandated with the responsibility of carrying out this National Highways Development Program (NHDP) in 2000s. In post NHDP Phase III programme a massive programe was involving of upgradation of about 10,417 km of national highways. This programme was an addition to the onging NHDP and includes upgrading linkages to the NHDP corridors. This programme involved four or six laning of existing two lane national highways of most of the selected national highways over 29 states and 7 union territories in India. The criteria for selection of the project roads are corridor with high density traffic which has avaergae daily traffic of more than 30,000 passenger car equivalent units, carridor providing state capitals with links to the NHDP network and corridor providing access to economic and tourist centres.

3 GROWTH OF TRANSIT CORRIDOR

Growing demand in transport India has been rapidly increase. Road transport has grown inter-state freight and passenger movement compared to railways, inland waterways and air because it does not face rigorous en-route checks/barriers. In policy planning and investment decisions transit corridor has to have comprehensive data for analyse further. It is a systematic numbering scheme based on the orientation and the geographic location of the highway. This was adopted to ensure more flexibility and consistency in the numbering of existing and new national highways.

As per the new numbering system:

All north-south oriented highways will have even numbers increasing from the east to the west

All east-west oriented highways will have odd numbers increasing from the north to the south

All major Highways will be single digit or double digit in number

Three digit numbered highways are secondary routes or branches of a main highway. The secondary route number is prefixed to the number of the main highway. For example, 144, 244, 344 etc. will be the branches of the main NH44.

Suffixes A, B, C, D etc. are added to the three digit sub highways to indicate very small spin-offs or stretches of sub-highways.

The network of National Highway of the country spans about 70,934 km. The National Highway Development Project (NHDP) covers a length of about 54,000 km of highways which is India's largest road development programme in its record. Out of total 6 lane toad has 731 km in length, 4 lane road aligns 14,584 km in length, 2 lane road is about 37,488 km and rest is single or intermediate lane. There are total 212 National Higheways are aligned all over in India's teriitory. Out of 35 states and UTs the maxium length is found in state Andhra Pradesh followed by North east state arunachal Pradesh. The length of transit corridor over india's state is tabulated as under. (Table 1)

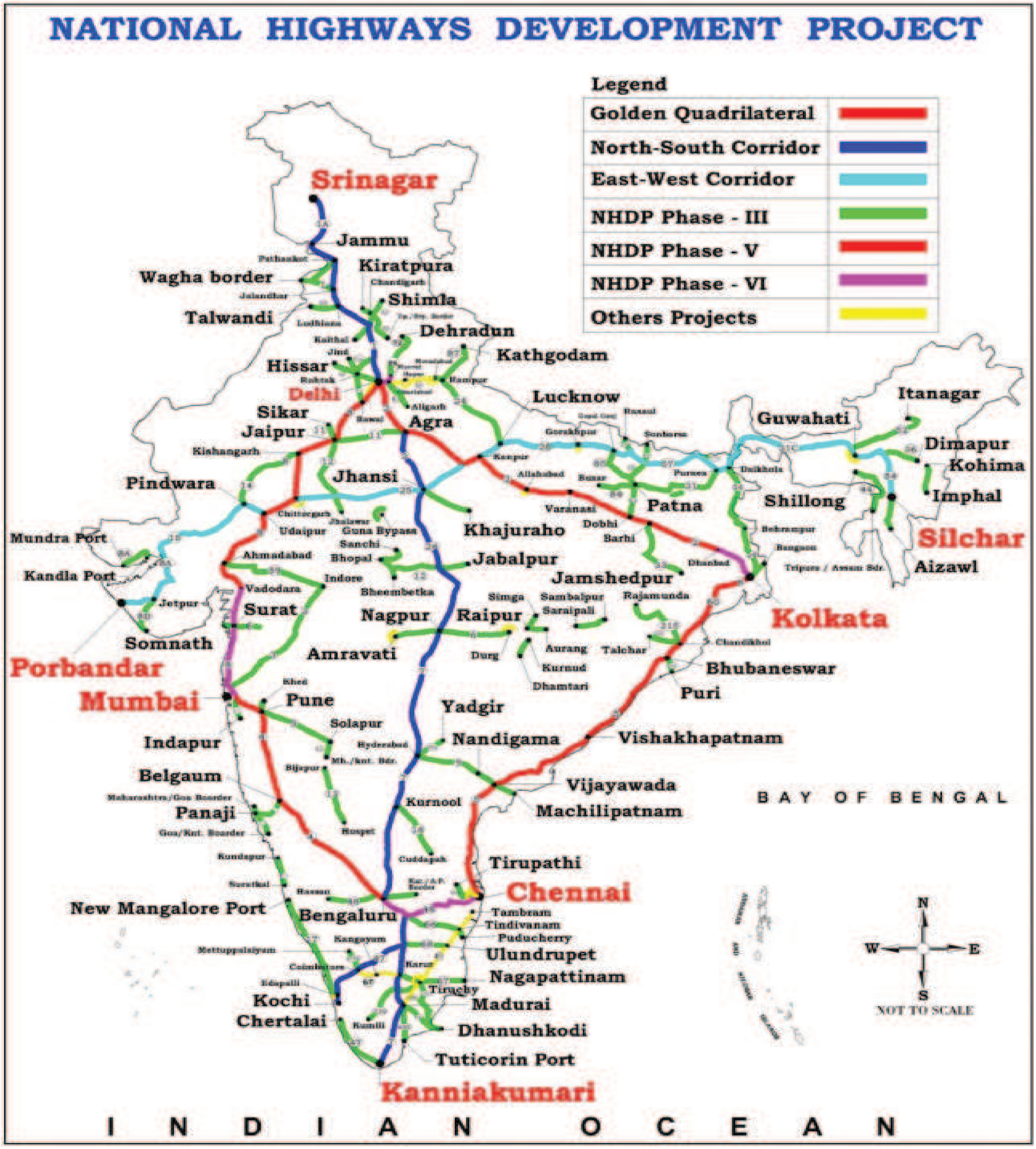

Fig 1: Transit Corridor in India. Source: NHAI, 2012

During the period 2000 to 2008, National Highways extended upto 28 percent. Out of total length (66,754 km) of National Highways 27 percent is of single lane/intermediate lane, 58 percent is 2-lane standard and balance of 15 percent is 4-lane standard or more. Government of India has conceptualized huge investment under construction and upgradation of National Highways under various phases of NHDP. NHDP Phase-I: In December 2000 this phase was approved. It envisaged - (a) Four laning of National Highways comprising Golden Quadrilateral (GQ) linking major metros, viz. Delhi, Mumbai, Chennai and Kolkata having an aggregate length of 5846 km; (b) North-South and East-West corridors covering 981 km; (c) Port connectivity by upgrading 356 km of NHs linking major ports in the country and; (d) upgradation of 315 km of other National Highways. The total aggregate length of NHs for upgradation calculated under Phase I was placed at 7498 km. The total length completed upto 31st March 2010 was 7328 km. NHDP Phase-II: In December 2003 this phase was approved. The main thrust of this phase involved upgradation (4 laning) of (a) North-South (Srinagar to Kanyakumari) and East-West (Silchar to Porbandar) corridors covering a

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distance of 6161 km and; (b) upgradation of 486 km stretch of other National Highways. The total length coverage for upgradation under Phase - II involved 6647 km out of which 4465 km has been completed by 31st March 2010. NHDP Phase-III: NHDP Phase-III involves 4-laning of 12,109 km with high-density stretches of NHs joining State capitals, important tourist places and of economic importance locations through Public Private Partnership (PPP). Out of this, implementation of 4815 km on BOT was approved under NHDP Phase IIIA. NHDP Phase IIIB involving implementation of the balance 7294 km was approved in April 2007. Till 31st March 2010, 1581 km of road length had been completed. NHDP Phase-IV: This phase involved improvement of 20,000 km of NHs to two lanes with paved shoulders. NHDP Phase-V: This phase was approved for six laning of 6,500 km of existing 4 lane highways in October 2006 on Design Build Finance and Operation (DBFO) basis. This included 5,700 km of GQ and 800 km of other selected stretches. NHDP Phase-VI: This phase, approved in November 2006, envisaged development of 1000 km of access controlled four/six lane divided carriageway expressways on DBFO basis.NHDP Phase-VII: This phase was approved in December 2007 for construction of stand alone ring roads, by-passes (including improvements of NH links in city), Grade Separated Intersections, flyovers, elevated highways, Road Over Bridges (ROBs), underpasses and service roads on BOT Toll basis.

Name of the State /Union Territory	Length (Kms)	Name of the State/ Union Territory	Length (Kms)
Andhra Pradesh	5231.74	Manipur	1745.74
Arunachal Pradesh	2513.05	Meghalaya	1204.36
Assam	3811.67	Mizoram	1381
Bihar	4678.79	Nagaland	1150.09
Chandigarh	15.28	Orissa	4644.52
Chhatisgarh	3078.4	Pondicherry	64.03
Delhi	80	Punjab	2769.15
Goa	262	Rajasthan	7906.2
Gujarat	4970.9	Sikkim	309
Haryana	2622.48	Tamil Nadu	5006.14
Himachal Pradesh	2622.48	Tripura	577
Jammu & Kashmir	2593	Telangana	2635.84
Jharkhand	2653.64	Uttar Pradesh	8483
Karnataka	6502.29	Uttarakhand	2841.92
Kerala	1811.52	West Bengal	2909.8
Madhya Pradesh	5193.57	Andaman & Nicobar	330.7
Dadra Nagar Haveli	31	Daman & Diu	22
Maharashtra	7434.79		

Table 1: State wise distribution of National Transit Corridor

4 GROWTH OF MOTOR VEHICLE

The growth rate of vehicles is the backbone of economic development of Indian automotive Industry, which is the second fastest growing in the world. About 8 million vehicles are produced annually in the country today. In 2009, the country reported 121.63 million registered motor vehicles, a motorization rate of 22 vehicles per 1000 population (Road Transport Yearbook, 2008). Over the last three decades, motor vehicles numbers have been doubling every ten or fewer years in India as against a 2 % - 5 % annual growth rate in Canada, the United States, the United Kingdom & Japan (Badami, 2009). The total number of motor vehicles increased from 52.37 million in 2000 to 121.63 million in 2009 i.e. an average growth rate of 9 % per year in the country. Some analysts predicted that India's motorization rate will continue to grow to 40 vehicles per 1000 by 2020. The largest majority of vehicles in India are found in metro cities. Number of vehicles in Indian cities is 40 millions with a share 30 % of total vehicles in India. Chennai, Bangalore, Kolkatta, Delhi and Mumbai with 15.2 million vehicles constitute 38 % of total vehicles of important cites and 13 % of total vehicles in India (Motor Transport Statistics, 2009). The second tier cities like Coimbtore (12 %), Madurai (11 %), Nagpur (14.6 %) and Vishakhapatnam (17.2 %) posted a compound annual growth rate (CAGR) of about 11 % or more. The growth of vehicular traffic on roads has been far greater than the growth of the highways; as a result the main arteries face capacity saturation. Between 1951 and 2002 the vehicle population grew at a compound annual growth rate (CAGR) of close to 11 per cent compared to CAGR of 4.3 per cent in the total road length with National Highway segment increasing by a mere 2.1 per cent. A noteworthy aspect has been a step-up in the growth of national highway network in recent years which has grown at CAGR of more than 5 per cent with total vehicle population growing at close to 10 per cent CAGR during 1991-2004. (Table 2)

Period	Vehicle					Roads				
	Two Wheeler	Cars	HVs	Others	Total	National Highways	State Highways & Public Works Deptt	Rural	Project	Total
1951-2002	15.5	7.9	7.0	15.5	10.9	2.1	0.02	4.5	-	4.3
1951-61	12.5	6.9	6.8	26.5	8.1	1.9	4.0	-0.5	-	2.7
1961-71	20.7	8.2	6.9	15.0	10.9	0.0	2.6	6.0	415.9	5.7
1971-81	16.3	5.5	5.1	18.1	11.2	2.9	-11.9	11.5	4.3	5.0
1981-91	18.4	9.8	8.9	10.9	14.8	0.6	21.0	1.9	2.5	4.6
1991-2001	10.3	9.0	7.2	8.4	9.7	5.1	2.8	4.2	1.7	3.4
1991-2004	10.5	9.4	7.9	7.9	9.9					

Table 2: Compund Annual Growth Rate 9in%) in Vehicles and Road Length. Source: 11th FYP, Planning Commission Report

Composition of vehicle population in India in the year 2004, the latest year for which the data is available, reveals preponderance of two-wheelers with a share of more than 71 per cent in total vehicle population, followed by cars with 13 per cent and other vehicles (a heterogeneous category which includes 3 wheelers, trailers, tractors etc.) with 9.4 per cent. However, the share of buses and trucks in the vehicle population at 1 per cent and 5 per cent respectively is much lower compared to China. With a rising income and inadequate urban public transport system, in particular, the personalized mode of transport is likely to grow in importance in the coming years. Presently the share of cars in the total vehicle population in India is much lower in comparison to Sri Lanka, Malaysia and Chile but equivalent to China.

Motor vehicle fleet in whole country composed of two-wheelers, three wheeler (car, jeep and taxi), passenger vehicle (Bus and other passenger vehicle) and commercial vehicle. India had 121.63 million vehicles at the end of year 2009. Personalized mode (constituting mainly two wheeler and cars) accounted for more than four-fifth of motor vehicles in the country compared to their share of little three-fifth in 1951. Further breakup of motor vehicle population reflects preponderance of two wheeler with share of more than 73 % in total vehicle population followed by three wheeler (Car and Jeep) at 15 % and passenger vehicles at 10 % (See Table 3). Share of commercial vehicle is very low, near about 5 %. With a rising income and greater need for mobility the personalized mode of transport is likely to grow in importance in coming year. India like many other countries in Asia has experienced high annual growth rate in excess of 10 %. This is equivalent to doubling vehicle fleet in about seven years. The two wheeler population in India is 3856 Crores in 2001 which increase upto 91235 crores in 2009 almost tripled in 9 years. With the rapid pace of urbanization and economic development, more is a rising trends of personal vehicles. Car is most comfortable vehicle and luxurious option for transportation in India. So share of car is rising in Indiaand accounts 9 %. The car owner ship in India is 8 per thousand people (Burange & Yamini, 2010). With country's highway infrastructure improving and business growing, growth of small and heavy commercial vehicles segment outperforming in the growth. The commercial vehicle population doubled of in last ten years. The growth rates of commercial vehicle remain same in all the years and steadily rising.

Years	Two wheelers (In Crores)	Three Wheelers (In Crores)	Passenger Vehicle (In Crores)	Commercial Vehicle (In Crores)
2001	38556	7058	6429	2948
2002	41581	7613	6756	2973
2003	47519	8599	7397	3492
2004	51922	9451	7596	3749
2005	58799	10320	8349	4031
2006	64743	11526	8913	4436
2007	73209	11860	9080	4985
2008	81235	12023	10263	5401
2009	91235	12523	10500	5967

Table 3: Composition of Indian Motor Vehicle Population, 2000-2009. Source: Ministry of Surface Transport of India, Society for Automobile Association of India.

Government policy can have a significant impact on the size, composition and growth rate of a nation's motor vehicle fleet. In India, state and national governments directly or indirectly control the supply, demand, the distribution of automobiles, fuel price and fuel supply, the development of road and other component of infrastructure needed to motor vehicles. In India, state also directly involve in the development of public transport system (The Energy Resource Institute, TERI, 2009). Healthy competition benefited the end consumer since cost of service or product come down substantially, added many consumer dreaming of an own vehicle. So number of privately vehicles has grown substantially in last 10 years. Car ownership is growing at a rate of 10-15% per year (Tiwari, 2007). The growth rate of motorcycle is 17.4 % during last 6

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year and overall penetration of two-wheeler in India become 28 % of all household (Indicus, 2010). Secondly, large investments have been made for the development of transport infrastructure and facilities. There has also been impressive qualitative development by state government also. Private participation is made for development of highway, service centre and maintenance of road etc. This promotes better quality services to transport and have a positive impact on the growth rate of private vehicle. Private vehicle accounts for 30 % of total transport in India (Tiwari, 2007).

5 ASSESSMENT OF POLLUTION LOAD ON TRANSIT CORRIDOR

Recently, some scientists and environmentalists have directly challenged government policy to develop a western style automobile centered transportation system. They pointed that automobile will increase traffic congestion and worsen air pollution. So policy maker should concern about problem associated with development of motorized India (Vinish, 2008). The total consumption of petroleum products grew at the rate of 5.7% per annum between 1980-81 and 2003-04. However, growth in consumption has moderated to 2.95% per annum over the four years (2000-01 to 2004-05). Consumption of petrol and diesel grew at 7.3% and 5.8% per annum respectively between 1980-81 and 2004-05. This was the outcome of the growth of personal motorized transport and the rise in share of road haulage. The vehicle population continues to grow at higher than historical rates. However, in the last 5 years growth in consumption of petrol and diesel has been far more moderate at 6.9% and less than 1% respectively. This reflects the improved efficiency of vehicles and better road conditions. In 2004-05, liquid fuel consumption in the transport sector accounted for 28% of our total petroleum products consumption (Source: Integrated Energy Policy, Planning Commission 2006; Page 10).

5.1 Ambient Air Quality Pollution Load Assessment

Emission from the road transport sector depends mainly on the fuel. Apart from type of combustion engine, emission mitigation techniques, maintenance procedures and vehicle age Diesel is used as fuel in public transport and in cargo vehicles, cars and jeeps, used as gasoline. The major pollutants emitted from road transport are CO_2, CO, NOx, N_2O, SO_2, VOC, PM, and HC. Emission from road traffic was estimated based on the number of vehicles and distance travelled in a year per different types of vehicle. This is given in following equation.

$$E_i = \Sigma (V_j * D_j) * E_{ij,km}$$

Where E_i =Emission of compound (i)

V_j = Number of vehicle/type (j)

D_j = Distance traveled in a year per different vehicle type (j)

$E_{ij,km}$ = Emission of compound (i) from vehicle type (j) per driven km.

It is not always feasible and economical to carry out air pollution monitoring to measures the pollutants concentration at all sensitive receptors along the road corridor. To minimize the time and monetary cost, vehicular pollution dispersion modelling is an important aid to predict present as well as future pollutants concentrations along the long stretches of road corridors to facilitate the abatement and management of vehicular/ urban air pollution. They are used to simulate the dispersion of vehicular pollutants near roads where vehicles continuously emit pollutants. CALINE-4 the latest in CALINE series models is most widely used. Gaussian based vehicular pollution dispersion model has predict air pollutants concentrations.

CALINE–4, dispersion model is for prediction of concentrations of critical atmospheric pollutants (CO, NOx, SO_2, SPM and PM10) along the highways. This model employs a mixing zone concept to characterise pollutant dispersion over the highway and can be used to predict the pollutant concentrations for receptors upto 500 m of the corridor. The various input parameters for the prediction of pollutant concentrations are discussed here:

(a) Site Geometry: The input parameters regarding the site conditions as the carriageway width, road height, mixing zone width, surface roughness and topographic conditions have been taken up from the pavement condition and road inventory surveys conducted along the project corridor.

(b) Emission factors: The emission factors for the various vehicle categories vary for different speeds. The emission factors adopted for the various vehicle speeds for the various pollutants are given in the following table.

Pollutant Parameter	Emission factors g/mile		
	Light	Medium	Heavy
	(Irrespective of speed)		60 Kmph
SO2	13.97	7.70	6.95
SPM/ PM^{10}	2.86	0.60	0.22
NOx	14.28	2.48	8.94

Table 4: Speed Corrected Emission factors. Source: Vehicle Emissions and Control Perspective in India, IIP, Dehradun.

Based on the traffic composition, a composite emission factor has been derived for application in the model for the various sensitive receptors and links. The composite emission factor has been derived as a sum of the ratio of light, medium and heavy vehicles to the total volume and their corresponding emission factors.

(c) Meteorological Conditions: The various meteorological input parameters required for modeling as the wind speed, wind direction, mixing height, stability class have been collected from secondary sources as Indian Metrological Department (IMD), for the nearest meteorological stations.

(d) Traffic volume: The through traffic volume and composition along the sensitive receptors have been derived from the traffic volume counts carried out at various locations along the project corridor.

(e) Links: Links are homogenous sections of the project corridor, of length not greater than 10 km, with similar traffic, site geometrics and meteorological characteristics. For calculating the emissions, worst-case scenario is assumed and concentrations are obtained for worst wind direction.

(f) Receptors: Receptors are specific locations within a link, which is likely to be impacted by vehicular emissions. For the purposes of assessing air impacts, sensitive receptors have been identified over an immediate influence area on either side of the project corridor.

(g) The concentrations of the various pollutants due to the project have been estimated applying the various input parameters to the CALINE 4 model.

Predicted Pollution levels:

Various assumptions made for predicting the pollution levels along the corridor through this model are discussed here. No significant change in emission characteristics of the vehicles is anticipated during the different last 5 years and any assumption in decrease of emission factors would only be hypothetical. This assumption would give a conservative estimate of the emissions and any decrease in emissions in future than those used for prediction will be beneficial. There are no major grade differences in the Transit Corridor as it is generally a plain and gentle slopes and the model is applied for “At grade” condition for the whole corridor assumed. The traffic along the national highways state wise is assumed to flow simultaneously in both the lanes and in both directions. This assumption presents a worst-case scenario of the pollution levels. Data have been refereed from different secondary sources and Caline 4 model has been attempted to assess the present level pollution load of Natitional Transit corridor in state wise in cumulative form as under.

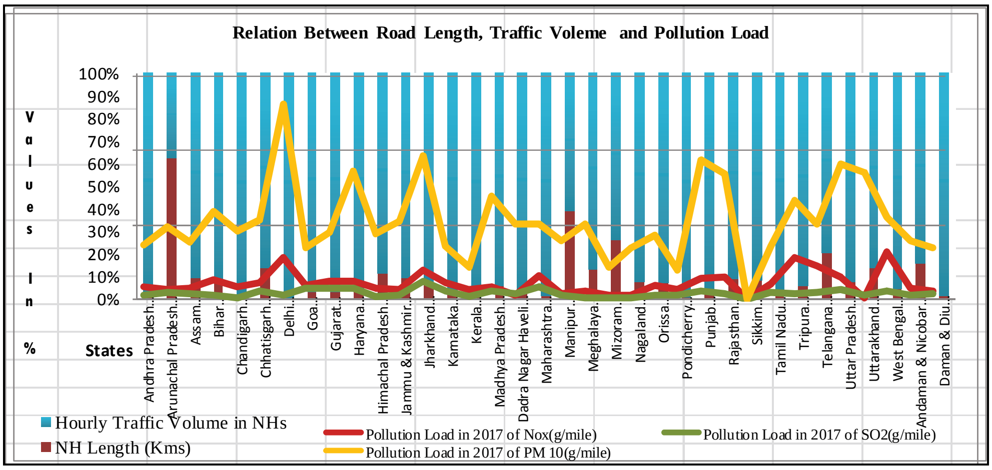

Fig. 2: Relation between road length, traffic volume and pollution load.

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State wise distribution of National Highways in 2011 & Estimated Traffic Volume in 2017							**Composite Emission Factor for year 2017**			**Caline 4 Modeling : Hourly Air Quality Assessment**		
Sr. No.	**Name of the State /Union Territory**	**NH Length (Kms)**	**Light Vehicle**	**Medium Vehicle**	**Heavy Vehicle**	**Hourly Traffic Volume in NHs**	**EF for Nox (g/km)**	**EF for SO2 (g/km)**	**EF for PM 10 (g/km)**	**Pollution Load in 2017 of Nox(g/km)**	**Pollution Load in 2017 of SO2(g/km)**	**Pollution Load in 2017 of PM 10 (g/km)**
1)	Andhra Pradesh	5231.74	211688	62531	110110	274232	1	12	0.05	18	6	74
2)	Arunachal Pradesh	2513.05	1128	375	1670	1503	21	5	4.25	13	9	97
3)	Assam	3811.67	29852	6969	69689	36829	5	18	0.29	16	8	77
4)	Bihar	4678.79	24951	39993	8894	64944	2	8	0.11	27	6	119
5)	Chandigarh	15.28	5521	974	2240	6496	1	13	0.01	17	3	93
6)	Chhatisgarh	3078.4	17080	2770	16569	19851	3	16	0.42	23	12	108
7)	Delhi	80	89811	8563	46005	98379	1	13	0.00	56	6	262
8)	Goa	262	2451	5149	21853	7602	18	16	0.07	19	15	69
9)	Gujarat	4970.9	139337	26353	142344	165706	2	14	0.08	24	16	90
10)	Haryana	2622.48	66194	8989	107818	75195	2	15	0.10	24	15	172
11)	Himachal Pradesh	2622.48	12896	7998	21264	20897	5	16	0.28	16	4	89
12)	Jammu & Kashmir	2593	18019	7511	30035	25533	5	16	0.25	14	6	106
13)	Jharkhand	2653.64	25759	13581	43534	39345	5	15	0.16	40	24	194
14)	Karnataka	6502.29	153616	37062	138188	190694	2	14	0.09	23	11	71
15)	Kerala	1811.52	188390	65864	847006	254351	8	22	0.02	14	5	43
16)	Madhya Pradesh	5193.57	50046	40018	61210	90071	4	12	0.12	18	12	138
17)	Dadra Nagar Haveli	31	1259	68	3436	1327	2	16	0.08	6	8	102
18)	Maharashtra	7434.79	478102	67314	194691	545438	1	13	0.04	32	18	102
19)	Manipur	1745.74	2516	207	5124	2724	10	20	1.99	8	6	79
20)	Meghalaya	1204.36	3374	4638	11306	8013	9	16	0.28	11	3	102
21)	Mizoram	1381	1119	2743	2848	3862	7	15	0.51	7	3	43
22)	Nagaland	1150.09	11744	2752	28132	14499	5	18	0.23	7	3	69
23)	Orissa	4644.52	45212	16734	49735	61952	3	15	0.18	19	6	87
24)	Pondicherry	64.03	4231	2254	7641	6486	4	14	0.02	14	7	39
25)	Punjab	2769.15	56565	5465	49110	62036	1	14	0.13	28	12	188
26)	Rajasthan	7906.2	56398	23473	147048	79888	6	19	0.26	30	8	169
27)	Sikkim	309	269	3329	1254	3598	3	2	0.07	1	1	1
28)	Tamil Nadu	5006.14	223375	74019	223055	297420	2	13	0.04	21	10	71
29)	Tripura	577	8675	724	5553	9399	1	14	0.17	56	8	133
30)	Telangana	2635.84	4656	5436	8945	10093	7	17	0.48	45	9	102
31)	Uttar Pradesh	8483	92963	15644	73320	108615	2	14	0.21	31	13	182
32)	Uttarakhand	2841.92	8933	8838	9923	17772	4	14	0.30	3	6	170
33)	West Bengal	2909.8	22173	37909	153377	60100	15	17	0.10	65	11	111
34)	Andaman & Nicobar	330.7	1690	135	1306	1826	3	15	0.52	16	7	79
35)	Daman & Diu	22	1811	24	1454	1834	0	14	0.04	12	8	70

Source: Planning Commission Report 2012 & NAAQS, CPCB, 2010

Table 5: Assessment of Pollution Load in Transit Coridor in India, 2017

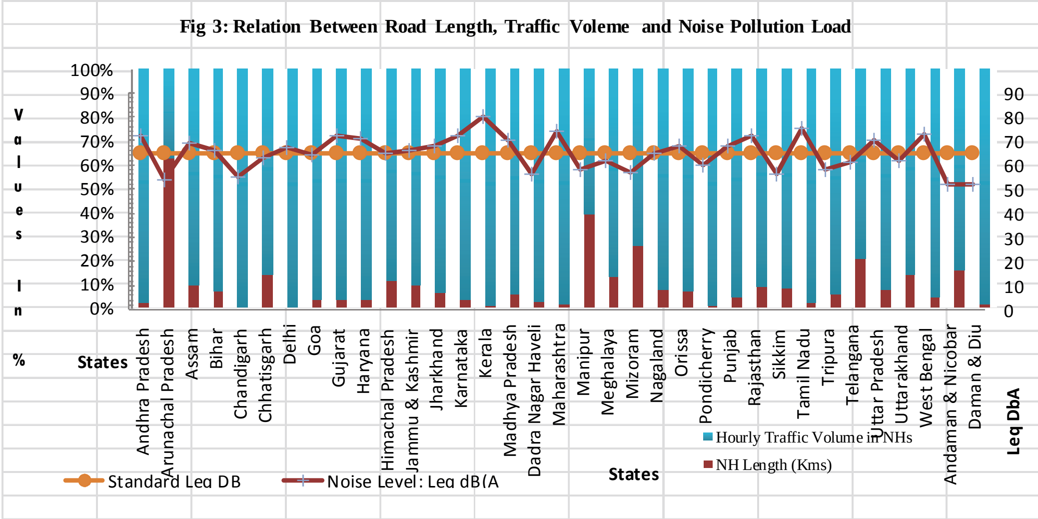

Fig. 3: Relation between road length, traffic volume and noise pollution load.

From above table it depicts the maximum traffic volume emits maximum pollution. Those states have maximum number of vehicle in transit corridor have maxium pollution load in terms of Partculate Matters (PM10 g/km). Even ratio of road length to volume of traffic is also positively coreraled. Major city has more number of vehicular traffic counted in states compared to states located in north east or small states. The maxium vehicular traffic is marked in Mjhrashtra, Delhi, Punjab, Uttar Preadsh, Andhra Pradesh,

Maharashtra, Chandigarh. The maximum road length under National Highway is Rajasthan, Karnataka, Tamil Nadu etc. Most preferable condition compared to road length and traffic volumes are in North Eastern States and Union Territories. The following diagramme shows the concentration of ambient air quality in different states with comparison of Traffic volume and length of National Highways. More favourable condition lies to north eastern states and Union Territories but big states with high density traffic volume genertates more emission.

5.2 Ambient Noise Pollution Assessment

Noise impacts can be predicted at various receptors by application of available simulation models for Highway noise. However, this is applicable only for operation stage of the project. Operational noise for the highway is predicted through the model developed by Federal Highway dministration, Department of Transportation of the U.S. The model used is FHWA Noise Model. The procedure for prediction of noise levels involves the following steps:

Input Parameters: Traffic volume & Speed: Traffic volume for the projected period is obtained from the traffic projections. The total number of vehicles passing per hour by type - light, medium and heavy along with their average speed is used for projections.

Mean Energy level: All the vehicles produce noise, which is taken as the base, and the cumulative noise at the receptor distance due to the whole traffic is estimated. The mean energy level varies depending on the type of vehicle. A mean energy level for the light, medium vehicles is 70 dB and for heavy vehicles it is 80 dB.

Shielding & Absorption factors: This depends on the landuse prevailing along the corridor. The range of shielding provided for the noise and absorption of the noise is 3.5 to 4 and 0.3 to 0.5 respectively.

Application of Model: Equivalent noise levels due to traffic, at the receptor locations is estimated using Federal Highway Noise model,

Leq(h)i = Loe + 10Log (Ni/SiT) + 10Log (15/d)1+b + Ds – 13

Where,

Leq(h)i = Equivalent noise level of ith vehicle (h indicates vehicle type- light, medium, heavy).

Loe = Reference mean energy level.

Ni = Number of class i vehicles passing during time T.

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Si = Average speed for i th vehicle class in km/hr.

T = Duration for which Leq is desired corresponding to Ni.

d = Perpendicular distance in meters from the center line of the traffic lane to the receptor location.

b = Factor related to the absorption characteristics of the ground cover between the roadways and observer.

Ds = Shielding factor to account for the decrease in noise due to obstructions between source and receptor.

The preceding equation is used thrice, for light, medium and heavy vehicles respectively to obtain three values of Leq. The total Leq can be calculated by logarithmic addition of the three Leq values as follows,

Leq(Total) = 10 Leq (10 Leq(L)/10 + 10 Leq(M)/10 + 10 Leq(H)/10)

The total equivalent noise levels at the receptor, at a distance 'd' m from the center of the traffic lane is given by the above equation.

Predicted Noise Levels

Noise standards have been designated for different types of land use, i.e. residential, commercial, industrial and silence zones, as per 'The Noise Pollution (Regulation and Control) Rules, 2009, Notified by the Ministry of Environment and Forests. Different standards have been stipulated during day time (6 am to 10 pm) and night time (10 pm to 6 am). The noise rating method as Leq i.e. equivalent sound pressure level has been adopted for the measurement of noise level. It is the energy means of the noise level over a specified period and is expressed in terms of decibels. State level noise analyses have been used for 2010 year database from secondary source. The predicted model for year 2017 shows that few states have noise level within the permissible range. But those states have high traffic volume have noise level is beyond permissioble limit.

6 CONCLUSIONS

India's motor vehicles have had a substantial detrimental impact on the environment. Automobiles are the primary sources of air pollution in India's major cities. In India, transport sector emits an estimated 261 Tg of pollution, of which 94.5 % was contributed by road transport. Analysis of database depicts the true picture of positive correlation between air pollution with traffic volume as well as Noise pollution with high density traffic in states. Staes level data has shown the basic. From the statistical descriptor values it was concluded that CALINE-4 model is predicting satisfactorily for air pollution under given traffic and meteorological and terrain condition/ national highways of states and Union Territories in India. Further Federal Highway Noise model also provides satisfactory result of noise level prediction of states in average value. The overall anlayis gives the national wide framework of pollution load all along the transit corridor as baseline anlsysis for future planning.

reviewed paper

"Attractive Danube" – Improving Capacities for Enhancing Territorial Attractiveness of the Danube Region

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1 ABSTRACT

Since the launching of the European Observation Network for Territorial Development and Cohesion (ESPON) programme in 2002, as the initiative for territorial monitoring of the EU Cohesion Policy implementation and results evaluation against the European Spatial Development Perspective (ESDP) goals, the number, variation and specialization of the territorial monitoring systems for development policies implementation in Europe have been growing stadily. And, although these territorial monitoring systems are differening among themselves in respect to the specific goals they are aspiring and/or territorial units they are using for analyses, common for all of them is support to the vision of cohesive, smart and sustainable territorial development throughout EU and its cross-border regions up till 2020.

The purpose of this paper is to present the Attractive Danube project, which aim is to build a territorial monitoring system to support the transnational territorial attractiveness policy priorities identification, implementation and evaluation within the Danube Region. Implementing in period 2017-2019 under the Interreg's Danube Transnational Cooperation (DTP) programme, this project has a goal to improve the transnational governance and institutional capacities of 11 countries (Slovenia, Hungary, Czech Republic, Slovakia, Germany, Bulgaria, Romania, Serbia, Croatia, Montenegro and Bosnia and Herzegovina) to enhance their competitive advantages by the better understanding and management of the national social, economic and environmental development potentials within the Danube macroregion.

Thus, in this paper, after the Attractive Danube project's background, aim, goals and methodology description, the territorial attractiveness concept, indicators and monitoring tool would be presented. Afterwards, the approach to improvement of stakeholders' capacities for the territorial attractiveness understanding and management as well as national and transnational policies integration is described. Finally, along with the information on current project status and planned activities in future, conclusions on the expected project's outcomes is made.

Keywords: Attractive Danube project, territorial attractiveness policy, territorial attractiveness monitoring system, cohesive development (EU regional policy), territorial attractiveness

2 BACKGROUND

In 2002, the ESPON programme has been launched as a tool for measuring, monitoring, understanding and comparing the spatial impacts of various EU policies against the ESDP objectives. (URL1) The launching of this programme has motivated since then a number of the other territorial monitoring initatives for the development policies implementation support to emerge. (Faludi, 2006) These initiatives are differing among themselves concerning their specific objectives (KITCAPS (ESPON, 2013a); INTERCO (ESPON, 2013b); etc.), territorial scopes (AIRO (Walsh et al., 2012); ETMS (ESPON, 2014); etc.) and other analytical elements, but common for all these monitoring systems is the support to the cohesive territorial development goal achievement by the sustainable living and working conditions implementation (OECD, 2004; Soria-Lara et al., 2015).

Therefore, the ESPON programme success as the knowledge and information framework, which using the ETMS tool observe, evaluate and geovisualize territorial policies in Europe (ESPON, 2014), has triggered a large proliferation of the different monitoring systems or observatories for the territorial development domain (Soria-Lara et al., 2015). Soria-Lara et al. (2015) research confirmed that spatial planning observatories' maps are excellent tools for territorial development planning, since they can improve the process of learning and understanding of the different focus groups (like decisions makers, planners and the public) on the present and future problems within the spatial planning process. Lindberg and Dubois (2014) agree that visualization is "a key feature supporting spatial visioning and the co-production of a shared transnational understanding of the spatial planning in Europe".

Further, Lindberg and Dubois (2014) and KITCAPS project results (ESPON, 2013a) confirm that selection of the appropriate set of indicators is critical for the capacity of the territorial development monitoring systems to secure the meaningful communication between the focus groups, as well as to support the policy needs for the evidence-based or informed development management. (Fig.1) However, besides importance of the choice of the territorial development indicators for the success and usability of each monitoring system, Lindberg and Dubois (2014) emphasize also the need for geovisual presentation to be interactive and accessible online (ESPON, 2014) (Fig.2), while territorial development monitoring systems should secure their own longevity.

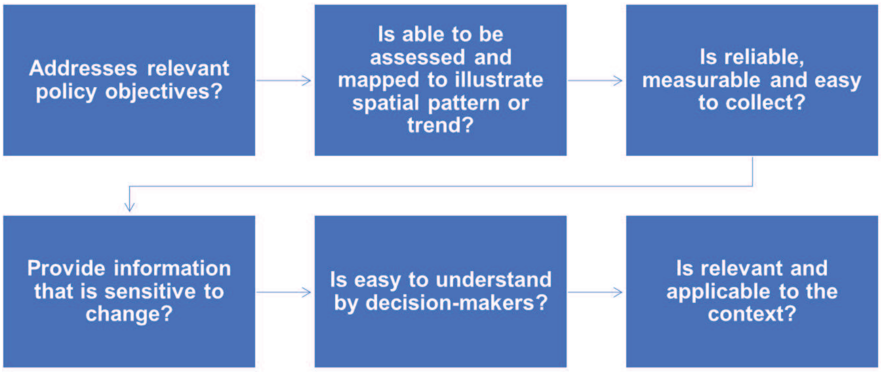

Fig. 1**:** Territorial development indicator: selection flow (source: KITCAPS (ESPON, 2013a))

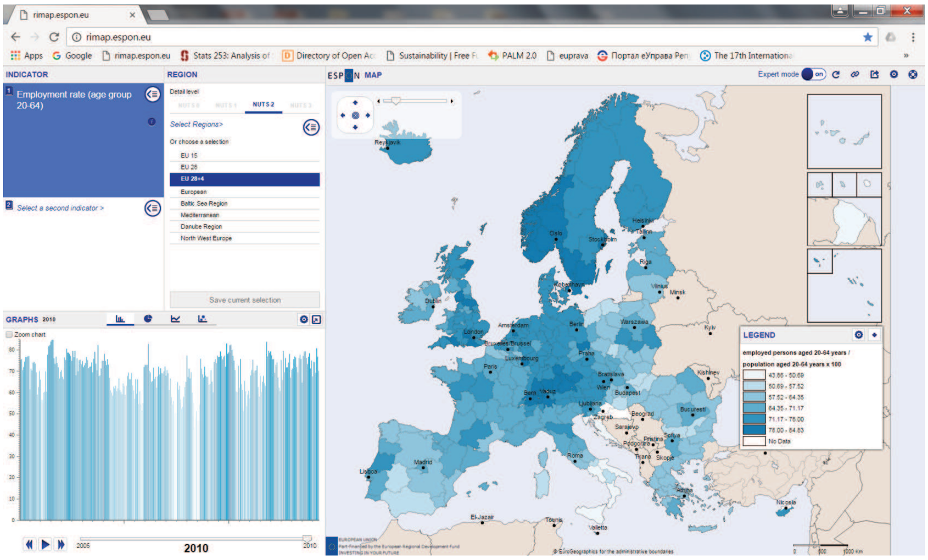

Fig. 2: ESPON Online Mapping Tool: Key ESPON indicators at regional level – Employment rate (age group 20-64) (figure is for illustrative purposes only) (URL1; ESPON, 2014)

In order to secure balanced and sustainable development throughout Europe, by relying on the already developed concepts, tools and best practices of various initiatives, like ESPON, Infrastructure for Spatial Information in Europe (INSPIRE) and others, the European Union (EU) is committing its regulating and funding supports to remove existing structural disparities within its territory. Thus, in order to stimulate better policy integration needed for the cohesive development within the Danube Region, EU has launched the DTP programme (URL7) as a financial instrument of the European Territorial Cooperation (Interreg) programme, which supports the joint actions and policy exchange between national, regional and local actors in the Member states. The aim of the DTP is to promote social, economic and territorial cohesion by the selective policy integration within the Danube Region, and thus tackle the principles of EU Cohesive Policy as well as goals of EU Strategy for Danube Region (EUSDR) on all levels.

After the successful definition of the framework for monitoring system for territorial attractiveness (TA) policy coordination in South-East Europe during the project Attract-SEE (URL5) (4th Call of the SEE Programme), the aim of this article is to provide overview of the follow-up project "Improving Capacities for Enhancing Territorial Attractiveness of the Danube Region" (Attractive Danube) (URL4), which is implementing in period 2017-2019 within the 1st Call of DTP. Thus, relying on the results of the Attract-SEE project, the Attractive Danube project aims 1) to establish GIS-supported territorial monitoring system for TA policy management on national and transnational level, and 2) to build capacities on the side of relevant stakeholders to understand TA concept, and to integrate and implement TA policy through the Danube Region.

3 ATTRACTIVE DANUBE PROJECT

EU development policies and strategies implementation, like EU Cohesion Policy (URL8), Europe2020 Strategy (URL3), Territorial Agenda (TA) 2020 (URL3) and others, rely on the growing number of data, information and knowledge management programmes, like INSPIRE (URL2), ESPON (URL1), etc. However, despite the number of various tools and initatives launched for the improvement in domain of efficient and effective management for competitive, smart and cohesive territorial development in Europe, some European regions still lag in predefined social, economical and environmental targets and goals accomplishment up till 2020.

Thus, in order to improve the territorial development planning and policy management in the SEE region, 9 countries in period 2012-2014 implemented the Attract-SEE project. The main results of this project included:

- Recognised and defined importance of the TA as competitive advantage for cohesive development;
- Identified relevant national and transnational TA indicators and existing TA trends;
- Developed common territorial monitoring framework for TA status monitoring; and
- Established multilevel and cross-sectoral stakeholder networks for informed decision-making and TA policy coordination on both national and transnational –SEE region- level.

The developed project results provided valuable insights into TA feature throughout SEE region and within participating countries themselves. However, since the Attract-SEE project outputs were prevailing just description of the framework or elements needed for the territorial monitoring system establishment in SEE, project partners thought that they could be a good platform for the new project activities, where the main result should include GIS-based tool for supporting TA decision-making and policy management (Živković et al., 2015), i.e. an information platform for more efficient public administration in general.

Thus, relying on the Attract-SEE project results for facing development challenges within the Danube Region, like a brain drain of talents, democratic deficit and lack of sufficient capacities of stakeholders involved in territorial development planning, relevant representatives from 11 Danube countries has launched the Attract-SEE follow-up project –namely, the Attractive Danube project- to support and/or enhance their TA for residents, visitors and companies/investments.

3.1 Aim and objectives

In the 1st Call of DTP, under the priority for 'Well-governed Danube Region' and targeting the specific objective 'Improve institutional capacities to tackle major societal challenges' with the total budget of 1,860,000 euros, 11 Danube countries with 12 financing project partners (Slovenia (Geodetic Institute of Slovenia - Lead partner), Hungary (Lechner Ltd., EMFIE), Czech Republic (CENIA), Slovakia (TUKE), Germany (aifora GmbH), Bulgaria (BIFORUM), Romania (URBASOFIA), Serbia (IAUS), Croatia (KCKZZ), Montenegro (ISSP), and Bosnia and Herzegovina (FMPU)) have lunched the Attractive Danube project to strengthen their policy and democratic capacities for the efficient and effective TA management.

Therefore, the aim of the Attractive Danube project is to strengthen multilevel, cross-sectoral and transnational governance and institutional capacities of the policy planners involved in territorial development of the Danube Region.

Identifying as the common challenges a) general lack of quality data on TA, and b) insufficient or absence of territorial development policy planners cooperation, both within national boundaries and in the Danube Region, partnering countries specified as the project objectives:

1. To make territorial data available to policy planning stakeholders – To make harmonised, quality and updated TA-relevant data and indicators available to all territorial policy planning stakeholders and public in general, by establishment of the TA monitoring platforms on transnational and national levels;

2. To improve and strengthen multilevel and cross-sector territorial development planning – To improve and strengthen the participatory approach to the territorial development planning process within the partner countries, i.e. on national level, and further transnational level, involving policy planners, civil society, companies and academia; and, to integrate TA goals and monitoring results into the territorial development policies on regional, national, cross-border and transnational levels through the policy integration process; and

3. To increase the skills, knowledge and capacities of policy planning stakeholders – To increase the capacities of policy planning stakeholders responsible for the TA capitals and assets, especially in the spatial planning, regional development, business and tourism domains, to understand territorial potentials and get knowledge and skills to utilise them in informed decision-making and policy management, both on national and transnational level, in order to attract and retain residents, visitors and companies/investments.

Innovative approach of the Attractive Danube project relates to the combined capacity building and activities for establishment of the user-friendly GIS-based Web platform for TA monitoring. On the other side, sustainability of the project results is secured by the planned signing of the Memorandums of understanding on behalf of project partners for delivering TA data up to 2021, i.e. 3 years after the project ends.

3.2 Methodology

In order to achieve the competitive and cohesive development in the Danube Region by building common TA monitoring framework to evaluate previous EU and national policies (2007-2013), monitor current (2014-2020) and plan new ones (2020-2027), and thus to achieve the project aim and specified objectives, methodology of the Attractive Danube project includes next steps and outputs:

Step 1 – Building of 11 national TA monitoring platforms (national TAMP)

Output 1.1 Training for project partners on development of national TAMP

Output 1.2 11 national TAMPs built

Output 1.3 Established participatory planning process for national TAMP building

Step 2 – Establishing common –i.e. transnational- TA monitoring platform (CO-TAMP)

Output 2.1 Transnational TAMP established

Output 2.2 TA atlas of the Danube Region prepared

Step 3 – Capacity building for TA policy planners

Output 3.1 Handbook for policy planners on TAMP utilisation prepared

Output 3.2 Capacity building programme for promoting TAMP prepared

Output 3.3 National memorandums for sustaining national TAMPs signed

Step 4 – Policy integration process establishment

Output 4.1 Transnational TA policy coordination workshops held

Output 4.2 TA policy recommendations and capitalisation action plan adopted

Output 4.3 Transnational memorandum for sustaining CO-TAMP signed

From the socio-technical system perspective, the Attractive Danube project implementation could be divided into the 2 main groups of issues: 1) building tool, i.e. Web GIS platforms for TA data/indicators collection, storing, analysis, trend monitoring, geovisualization and dissemination, and 2) building capacity of policy planners and other stakeholders to utilise the Web GIS platforms for informed decision-making and TA policy management. In next chapters (4 and 5) planned project activities, methods and expected results within those 2 groups are described and explained.

4 TERRITORIAL ATTRACTIVENESS MONITORING

4.1 Territorial attractiveness definition and indicators

The definition of TA for the Attractive Danube project relies on the ESPON's ATTREG and SEE Programme's Attract-SEE projects' definitions (URL6), as well as Europe2020 and TA2020 goals, and it describes

"*territorial attractiveness (as) capacity of certain Territorial Capitals and Assets to attract and retain target groups (tourists, residents, migrants and companies/investments) by already existing or developed advantages (environmental, economic and human, anthropic, socio-cultural, and institutional), imposed by relevant policies and their goals*." (Živković et al., 2015)

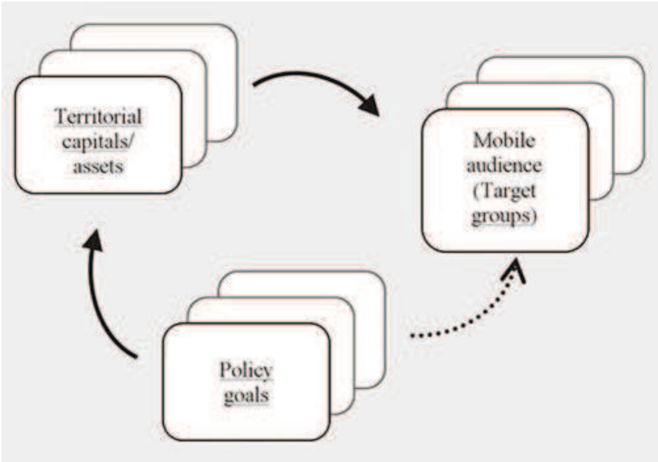

Fig. 3: Territorial attractiveness concept (URL5)

In order for the above identified TA concept (Fig.3) to be measurable and manageable, each territorial capital and asset is described with the several indicators (Table 1.). These TA indicators were found by the Attract-SEE project partners to be relevant as and data available for the regular TA monitoring and policy management, both on national and transnational -SEE region- level. (Živković et al., 2015)

During the Attractive Danube project, here identified 22 TA indicators would be applied for standardized and consistent monitoring and management of the common, transnational territorial development advantages in the Danube Region, through the relevant social, economic, cultural and environmental TA development goals identification and selective policies integration.

Besides listed 22 common TA indicators, project partners would identify, define, collect and process according to the agreed standard also data needed for country-specific set of indicators, which would support preservation and enhancement of the unique local TA assets.

Identification of these specific indicators would be one of the objectives for 3 planned national workshops (NWS). The main goal of these NWSs is to build the national TAMP by strengthening the participatory approach to the TA-relevant territorial development planning process within the each partner country.

Finally, in order for the Attractive Danube project results to be sustained and available to support the next EU programming cycle for period 2020-2027, TA indicators data would be collected by the project partners for period 2008-2018 during project duration, and up till 2021 after its (project) ending.

4.2 Territorial attractiveness monitoring platform

During the Attractive Danube project 11 national TAMPs and transnational CO-TAMP would be established for the TA monitoring, informed decision-making and relevant territorial development policy process management in the Danube Region.

Comparing to the Attract-SEE project results, data collected during the Attractive Danube project for both country-specific and 22 common TA indicators would be stored, analysed, managed, geovisualised and disseminated using the interactive and user-friendly Web GIS application STAGE II.

From the technical point of view, STAtistics&GEography or STAGE II application is integrated platform for dissemination of the geospatial statistics. This application is developed and maintained by the Geodetic

Institute of Slovenia, the Lead partner of the Attractive Danube project, in association with the Statistical Office of the Republic of Slovenia funded by the EUROSTAT. For purpose of the Attractive Danube project, existing registry with 4 types of aggregating spatial units for Slovenia (Cohesion regions, Statistical regions, Municipalities and Settlements) would be extended with the territorial units for project partner countries stored within the Eurogeographics database.

No.	TERRITORIAL ASSET	INDICATOR	TARGET GROUP
		ENVIRONMETAL CAPITAL	
1	Environmental quality	Air pollution: Ozone concentration	tourists, residents, migrants
2		Population connected to urban waste water treatment with at least secondary treatment	
3	Natural resources and energy	Electricity generated from renewable sources	companies/investments, residents
4		Consumption of water per capita	
		ANTHROPIC CAPITAL	
5	Landscape quality	% of terrestrial area protected (total and by ecological region)	tourists, residents
6	Infrastructures	Population (or households) with accessibility to high-speed broadband (1 Mbit/second up and down)	companies/investments, tourists, residents, migrants
		SOCIO-CULTURAL CAPITAL	
7	Culture	European cultural sites on the Unesco World Heritage List, 2010	tourists, residents, migrants
8	Quality of life	Life expectancy at birth by sex (Europe2020 indicator)	companies/investments, tourists, residents, migrants
9		Gross disposable household income	
10		People at risk of poverty or social exclusion (Europe2020 indicator) or % in risk of poverty	
		ECONOMIC/HUMAN CAPITAL	
11	Knowledge & Innovation	Population aged 25-64 with tertiary education	companies/investments, residents, migrants
12		Research & Experimental Development expenditure as % of GDP (Europe 2020 indicator)	
13	Employment	Employment rate 20-64 years by sex [%] (regional) (Europe2020 indicator)	companies/investments, residents, migrants
14		Youth unemployment rate	
15	Specializations / Key sectors	Share of employment by sector	companies/investments
16	Tourism	Number of overnight stays of tourists per capita per year	companies/investments, tourists
17		Share of tourism related employment in total employment	
18	Investment promotion	% of GDP of foreign direct investment	companies/investments, migrants
19	Population	Population growth rate	residents, migrants
20		% of population in age 20-64 years	
21		Ageing index	
		INSTITUTIONAL CAPITAL	
22	International relations	Number of foreign students and/or professors	companies/investments, migrants

Table 1: List of common territorial attractiveness indicators compiled by the Attract-SEE project partner-countries from different sources/databases, like Eurostat, OECD, European Commission, European Environmental Agency, United Nations, UNESCO, World Bank, ESPON projects (URL5)

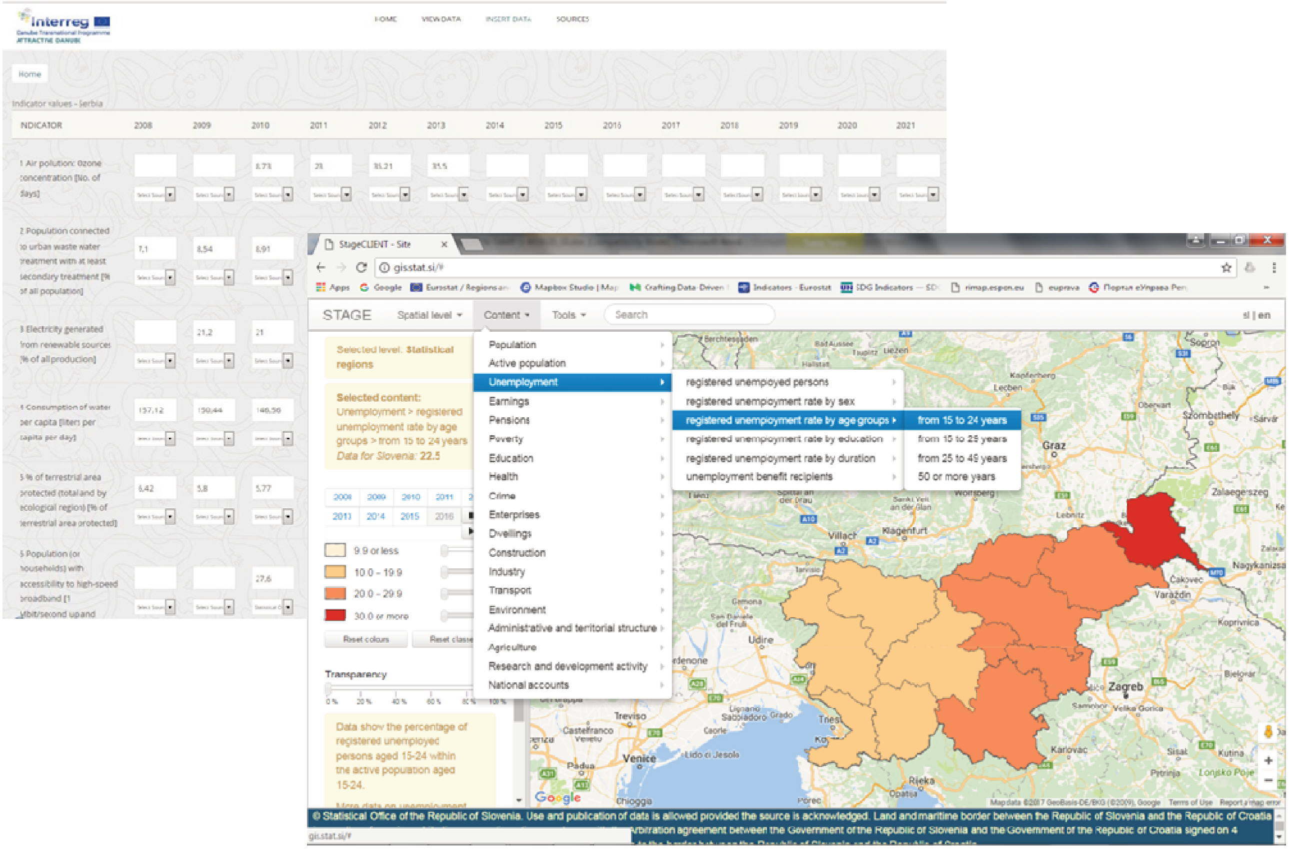

Fig. 4: STAGE II Web-based GIS tool for inserting, monitoring and geovisualization of TA status in the Danube Region

Once the data for national and common TA indicators are collected and processed according to the commonly agreed definition and methods, indicators data input would be performed by the one of two methods: 1) by keying-in indicators data directly to the Web GIS application as attribues of the spatial units (NUTS regions) (Fig.4), and 2) by filling indicators data into the Excel table for their later conversion, i.e. migration to STAGE II.

National TAMPs and transnational CO-TAMP are aimed for the TA monitoring, geovisualization and dissemination of the Attractive Danube project's results, and STAGE II would provide needed user-friendly, online and interactive platform functionalities, like: adjustable legend, different colour palettes, adjustable time slider, adjustable transparency, spatial queries, metadata and methodological data, data export (as image (PNG), SHP file or CSV), and sharing the maps. In other words, it is expected that the TAMP monitoring system would provide the reliable platform for efficient and effective decision-making and territorial development policy planning and integration process, directed to the enhanced TA and cohesive development within the Danube macroregion.

5 STAKEHOLDER INVOLVEMENT AND POLICY MANAGEMENT

Besides the lack of quality data for TA management, one of the main challenges in the Danube countries is the lack of capacity on side of the policy planners and other stakeholders within the territorial development planning domain, to use and base their decisions on the evidence when preparing territorial development policies. Thus, a great importance within the Attractive Danube project is given to the strengthening of institutional capacities and enhancement of multilevel and cross-sectoral governance, which are targeted by the project's Objective 3.

This approach to social capacities improvement of the future Danube TA monitoring framework for reaching national and transnational TA cohesion goals, in parallel or combined with establishment of the previously described Web GIS application, i.e. national TAMPs and transnational CO-TAMP, presents the innovative element of this project.

5.1 Capacity building for TAMP employment

In other words, the project activities for building institutional capacities on the side of each project partner would run combined with the participatory planning approach establishment, planned to be implemented during and for the building of national TAMPs. This approach includes involvement of the stakeholders in the early phase of selection and weighting importance of the each TA indicators for description of the partner-countries specific TA as well as common TA advantages within the Danube Region. (Fig.5)

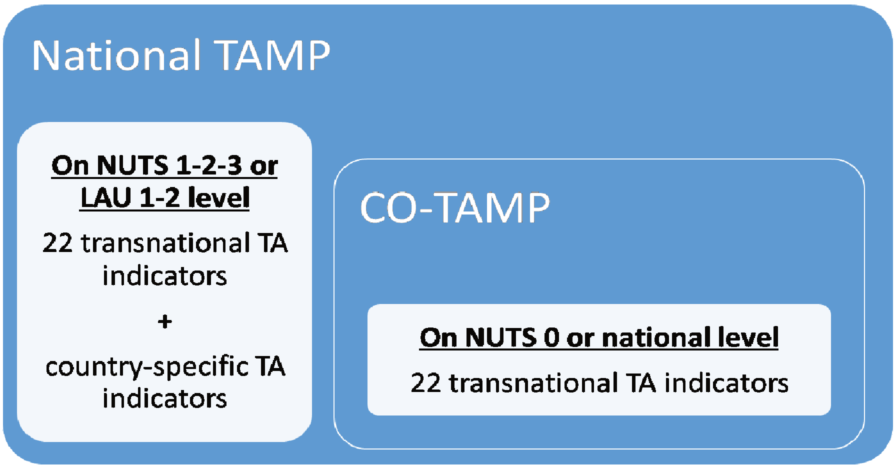

Fig. 5: National TAMP and transnational CO-TAMP

Also, targeting the decision-makers and public authorities in domain of economic, environmental and social affairs, as well as civil society, public agencies, academia and private sector, project partners would prepare a handbook for using the national TAMP, and understanding and interpretation of TA indicator values, their mutual relations and TA trends. Additionally, in order to support utilization of both national and transnational TAMPs results, the 3 national seminars for the empowering territorial development decision-makers and policy planners would be organized. These seminars are expected to provide direct and specific support to the individual institution on the TAMP employment and selective integration of created TA knowledge into the relevant territorial development policies.

Finally, concerning the sustainability of national TAMPs, the National memorandums with action plans for integrating TAMP on national level would be signed on behalf of the each project partner countries, thus keeping project stakeholders committed to the cooperation also after the Attractive Danube project ends.

5.2 Policy priorities management

Finally, combined with the project activities for the national policy planners empowerment to integrate created TA tools, results and knowledge into the national territorial development planning network and policy, transnational TA policy coordination and integration activities would take place. (Fig.6)

Relying on the already established transnational policy stakeholders network for the Attract-SEE project, 3 transnational policy coordination and integration workshops (TWSs) would be organized with the revelant organisations. The goals of TWSs are to promote and discuss the Attractive Danube project results and their sustainability; to establish knowledge sharing forum with the other European macroregions; and to debate integration approach for CO-TAMP results into the national and transnational territorial development policies.

Directed to reach the project Objective 2, the Policy recommendations for integration of TAMP into policies on national and transnational level along the Capitalisation action plan with the potential future capitalization activities of the Attractive Danube project results would be prepared. Also, future cooperation possibilities among the project partners would be identified.

On the end, long-term commitment of the project partners to CO-TAMP sustainability, and thus TAMP monitoring system longevity, would be confirmed by signing of the planned Transnational memorandum of understanding among the all project partners.

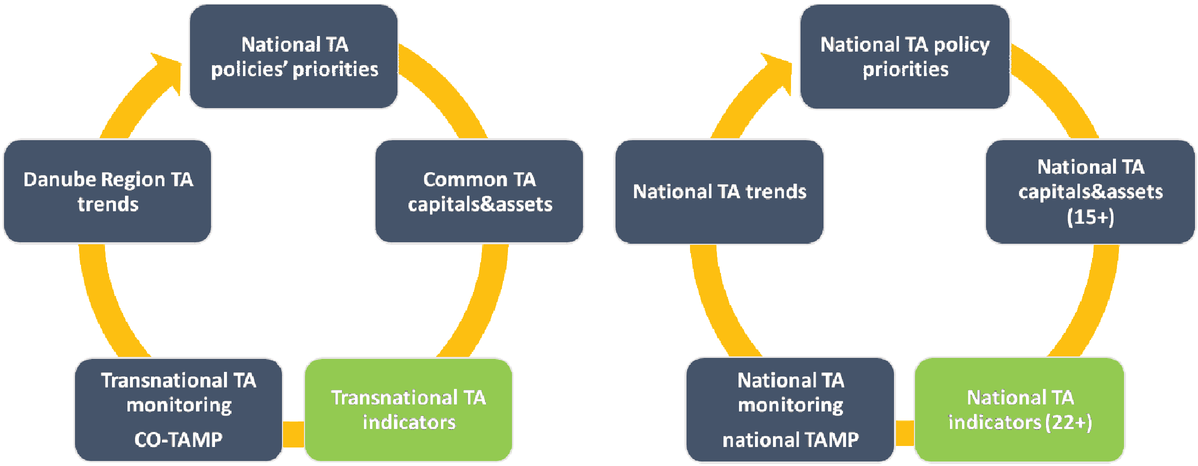

Fig. 6: Transnational TA policy coordination (left) and national TA policies management life-cycle (right)

6 PROJECT STATUS

After the first 6 months of the Attractive Danube project implementation (January-June, 2017), the planned project activities are running in timely and efficient manner.

The project and quality management teams have been established, and the communication activities have been lunched with the Kick-off Conference and 1st Project Partners Meeting in Prague (14th-17th February, 2017). Also, the relevant promo materials are produced and project's pages are created on the leading social networking services, like Facebook, Twitter and LinkedIn.

During the Kick-off Conference and 1st Project Partner Meeting, the knowledge transfer seminar on the Attract-SEE project results and the training for TAMP establishment (Output 1.1) are held for the project partners. Following this first project output, all project partners following the prepared Participatory planning process guidance (Output 1.3) have implemented the same approach to the national TAMP building (Output 1.2). During the 1st NWSs project stakeholders have been introduced to the Attractive Danube project aim, objectives, methodology and expected results, while the country-specific TA indicators are identified and data have been collected for both national and transnational TA indicators, i.e. national and transnational TAMP monitoring systems (Output 2.1).

Until the end of 2017, 2nd Project Partner Meeting would take place in Belgrade in June and 3rd one in Germany in December, while the building activities on the national TAMPs and CO-TAMP should be finalised. Year 2018 and the first half of 2019 are dedicated to the capacity building and policy integration project activities.

7 CONCLUSIONS

In order for the territorial development in the Danube region to be continually and integrally supported and directed towards achievement of the sustainable and cohesive development policy goals, 11 Danube countries has launched the DTP-funded project Attractive Danube. The aim of this project is to strengthen institutional capacities and enhance multilevel governance approach of the partnering-countries' policy planners and other relevant stakeholders to recognise and retain TA on both national and transnational –the Danube Region- level.

The project would be implemented in period 2017-2019 and it would result in:

- Understanding, retaining and improving common and specific TA assets within the Danube Region;
- Establishment of tool, namely, TAMP monitoring systems for informed decision-making and efficient and effective steering of policies life-cycle on both national and transnational level;
- Capacities building of territorial development policy planners and other stakeholders, reaching the more efficient public administration in general;
- Preparation of national action plans and TA policy recommendations, as well as other instruments and measures, for better evidence and knowledge utilization and integration; and

- Contribution to the EU and national sustainable and cohesive development policy goals achievement.

The main advantage of the project concept and approach is adoption and implementation of the European best practices and standards in domain of the monitoring systems for territorial development policy management and integration. This advantage should allow in future national and transnational TAMP monitoring systems to be capable to connect and compare the indicator values and territorial development trends: between them as well as with the other relevant monitoring systems in the Danube Region; with ESPON programme's and projects' monitoring systems; and with the other European monitoring systems in general. Also, assumed interactivity, accessibility and longevity of the TAMP monitoring systems would create conditions for the today needed integrated and participatory territorial development planning approach and process management.

8 LITERATURE

ESPON (2013a) KITCAPS Key Indicators for Territorial Cohesion and Spatial Planning. https://www.espon.eu/export/sites/default/Documents/Projects/TargetedAnalyses/KITCASP/DFR/D._KITCASP_Draft_Final_Report_Appendix_F_Guidelines_for_National_stakeholders_Bound_V3_31.07.13.pdf

ESPON (2013b) INTERCO Indicators of territorial cohesion – Final Report. https://www.espon.eu/export/sites/default/Documents/Projects/ScientificPlatform/Interco/INTERCO_Final-Report_Part-A_Executive-Summary.pdf

ESPON (2014) ETMS European Territorial Monitoring System. http://etms.espon.eu/

EU (2011) Territorial Agenda of the European Union 2020. http://ec.europa.eu/regional_policy/en/information/publications/communications/2011/territorial-agenda-of-the-european-union-2020

FALUDI, Andreas (2006) The European Spatial Development Perspective Shaping the Agenda. European Journal of Spatial Development, No 21. http://www.nordregio.se/Global/EJSD/Refereed%20articles/refereed21.pdf

LINDBERG, Gunnar and DUBOIS, Alexandre (2014) How to Monitor Territorial Dynamics, Nordregio News Publication Issue. http://www.nordregio.se/Publications/Publications-2014/Monitoring-Territorial-Dynamics/

OECD (2004) The spatial monitoring system of the German Federal Office for building and regional planning (BBR) as a tool for political counseling. http://www.oecd.org/site/worldforum/33846622.pdf

SORIA-LARA, Julio A., ZÚÑIGA-ANTÓN, Maria, PÉREZ-CAMPAÑA, Rocio (2015) European spatial planning observatories and maps: merely spatial databases or also effective tools for planning?. Environment and Planning B: Planning and Design, Vol 42, Issue 5, pp 904 – 929. http://journals.sagepub.com/doi/abs/10.1068/b130200p

URL1: ESPON Inspire Policy Making by Territorial Evidence. https://www.espon.eu/main/

URL2: INSPIRE Infrastructure for spatial information in Europe. http://inspire.ec.europa.eu/

URL3: EUROPE 2020 A strategy for smart, sustainable and inclusive growth. http://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf

URL4: ATTRACTIVE DANUBE. http://www.interreg-danube.eu/approved-projects/attractive-danube

URL5: ATTRACT-SEE. http://www.attract-see.eu/

URL6: ATTREG http://www.espon.eu/main/Menu_Projects/Menu_ESPON2013Projects/Menu_AppliedResearch/attreg.html

URL7: Danube Transnational Programme (DTP). http://www.interreg-danube.eu/

URL8: EU Regional or Cohesion Policy. http://ec.europa.eu/regional_policy/en/

WALSH, Cormac, BLAIR, Neale, HETHERINGTON, Jim, GLEESON, Justin (2012) Towards a Spatial Monitoring Framework for the Island of Ireland: a Scoping Study. http://iclrd.org/wp-content/uploads/2012/04/Spatial-Monitoring-Framework-for-the-island-of-Ireland.pdf

ŽIVKOVIĆ, Ljiljana (2017): A Proposal for the Spatial Planning Monitoring System in Serbia, ICCSA 2017

ŽIVKOVIĆ, Ljiljana, MARANI, Stefano, BERK, Sandi, DEŽMAN KETE, Vesna, TRAPANI, Francesco, ESPOSITO, Gianandrea, ŠPEH, Natalija, MILIĆ, Đorđe, ŽIVANOVIĆ, Tijana, BARBORIČ, Blaž (2015) Towards a Monitoring Information System for Territorial Attractiveness Policy Management in South East Europe. Geodetski vestnik, Vol 59, No 4, Ljubljana, Slovenia, pp 752-766. DOI: 10.15292/geodetski-vestnik.2015.04.752-766, http://issuu.com/mfoski/docs/gv_12015_4

Augmented Reality in der Stadt: Neue Potenziale durch die Entwicklung einer Lichtmarker-Technologie

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1 ABSTRACT

Panta Rhei – Städte befinden sich in kontinuierlicher Bewegung. In einem unaufhörlichen Prozess, der immer stärker der Digitalisierung unterworfen ist, findet eine Weiterentwicklung baulicher und kultureller Strukturen statt. Die Augmented Reality (AR)-Technologie eröffnet in diesem Kontext Möglichkeiten zur visuellen Unterstützung von Planungsprozessen und zur Erweiterung des städtischen Kulturgutes. Aktive Lichtmarker ermöglichen den Außeneinsatz der AR-Technologie im großen Maßstab.

Eine AR-Technologie mit aktiven Lichtmarkern befindet sich derzeit in der Entwicklung. Der folgende Beitrag geht systematisch auf die theoretischen Grundlagen ein, welche für die Entwicklung der Technologie zu berücksichtigen sind.

Im ersten Schritt werden mögliche Anwendungsszenarien für die AR-Technologie mit aktiven Lichtmarkern im städtischen Kontext vorgestellt. Es werden Potenziale und Chancen aufgezeigt, welche sich für Stadtplanung und kulturelle Entwicklung ergeben. Im zweiten Schritt werden anhand der einzelnen Szenarien technische Anforderungen betrachtet, die jeweils an die Technologie gestellt werden.

Der städtische Kontext umfasst lediglich einen Teilbereich des Anwendungsspektrums der Lichtmarker-Technologie. Daher ist dieser Beitrag als Auszug eines Katalogs von Anwendungsszenarien zu verstehen, der einführend einen Überblick für den Einsatz der Technologie in der Stadt bietet.

Die im Beitrag vorgestellten Ansätze erarbeitet das Fachgebiet Building Lifecycle Management (BLM) an der Architekturfakultät des Karlsruher Institutes für Technologie (KIT) derzeit im Rahmen eines Projektes, das sich mit der theoretischen Betrachtung von Anwendungsszenarien einer zu entwickelnden Lichtmarker-Technologie für die Darstellung von Augmented Reality Szenen befasst. Das durch das Zentrale Innovationsprogramm Mittelstand (ZIM) geförderte Forschungsprojekt ist eine Kooperation zwischen dem Karlsruher Institut für Technologie und der Firma iXpoint Informationssysteme GmbH, welche die Produktentwicklung der Lichtmarker-Technologie durchführt. Eine Grundlagenforschung erfolgte bereits im Rahmen des Projektes „Flying Augmented Reality“ (s. Koch 2013).

Keywords: Stadtmarketing, Öffentlichkeitsarbeit, aktive Marker, Augmented Reality, nachhaltige Stadtentwicklung

2 AUGMENTED REALITY (AR)

Augmented Reality bedeutet allgemein die Erweiterung der Realität um virtuelle Inhalte (z. B. 3D-modellierte Gebäude). Die Erweiterung ist ein kontinuierlicher Prozess, bei welchem die Erzeugung der Szene in Echtzeit abhängig vom Standpunkt des jeweiligen Betrachters stattfindet. Dabei wird eine Verschmelzung von Realität und Virtualität angestrebt. (vgl. Broll 2013)

Augmented Reality kann entsprechend der verwendeten technischen Ausstattung verschiedene Formen annehmen. Für ein breites Publikum bereits verfügbar ist die Video See-Through-AR, bei der die Überlagerung von Realität und Virtualität über die Aufahme eines Videobildes erfolgt und mit handelsüblichen Handheld-Geräten, wie Smartphones oder Tablets, dargestellt werden kann. Die weite Verbreitung der Geräte macht diese Form für neue AR-Entwicklungen besonders interessant und wird deshalb in diesem Beitrag fokussiert. Um virtuelle Geometrien maßstäblich und perspektivisch korrekt mit der Realität überlagern zu können, ist eine Positions- und Orientierungsbestimmung des Anwenders bzw. dessen Blickpunktes erforderlich, das sogenannte Tracking. Da die meisten AR-Systeme mobil und ortsunabhängig einsetzbar sind, haben sich GPS-basierte, sensorbasierte (Sensoren des mobilen Endgerätes) und kamerabasierte (optische Verfahren) Tracking-Lösungen etabliert. (vgl. Broll 2013)

Optische Tracking-Verfahren erlauben gegenüber GPS- und sensorbasiertem Tracking eine höhere Genauigkeit und können flexibel eingesetzt werden, weshalb sie immer häufiger verwendet werden. Dabei

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dienen Marker dazu, die Berechnungskomplexität zu verringern und bei unterschiedlichen Beleutungssituationen Fehleranfälligkeiten zu vermeiden. Diese Marker können passiv (nicht selbstleuchtend) oder aktiv (selbstleuchtend) sein. Im Bereich der AR handelt es sich bei passiven Markern vorwiegend um Schwarzweißmarker, die auf Papier ausgedruckt werden können. Sie kommen daher sehr häufig in eher kleinmaßstäblichen Szenen zur Anwendung. Als aktive Marker können beispielsweise elektrische Lichtquellen, Leuchtstäbe oder Infrarot-LEDs eingesetzt werden. (Grimm et al. 2013, 104 f.)

Aktive Marken bieten gegenüber passiven eine zuverlässigere Detektion, auch bei großmaßstäblichen Installationen im Außenbereich und können bei unbeleuchteten oder nächtlichen Szenen erkannt werden. Der Einsatz im Außenbereich ist jedoch stark von natürlichen Einflüssen abhängig. Derzeitige Systeme sind dadurch in ihrer Verwendbarkeit eingeschränkt. Als besonderes Potenzial für die Außenanwendung wird daher die Entwicklung der Lichtmarker-Technologie betrachtet.

2.1 Lichtmarker

Der zu entwickelnde Lichtmarker soll aus einer Anzahl von blinkenden Hochleistungs-LEDs bestehen. Durch eine Anpassung der Leuchtstärke an das jahres- und tageszeitlich schwankende Umgebungslicht soll die Erkennung der Lichtmarker im Außenraum verbessert werden. Um aus mehreren Richtungen erkannt werden zu können, soll der Lichtmarker in den gesamten oberen Halbraum strahlen. Die zuvor benannten Eigenschaften sollen eine Detektion der Lichtmarker mit handelsüblichen Mobilgeräten auch aus mehreren Metern Entfernung begünstigen, sodass eine Darstellung von virtuellen Geometrien im großen Maßstab städtischer Strukturen ermöglicht werden kann. Die Hinterlegung von Blinksequenzen macht einzelne Marker unterscheidbar und erlaubt dadurch eine gute Bestimmung der Raumkoordinaten. (vgl. Koch 2013)

Gebenüber anderen Markern ergeben sich einige zusätzliche Herausforderungen. Aktiv leuchtende Marken benötigen eine Energieversorgung beispielsweise in Form von Batterien, Netzanschluss oder Solarpaneelen. Weiterhin muss eine ausreichende Kühlung stattfinden können. Ein dauerhafter, fehlerfreier Betrieb erfordert Wartungsintervalle. Daraus können höhere Herstellungs-, Beschaffungs- und laufende Kosten als bei anderen Markern entstehen. Darüber hinaus können beim Einsatz im Straßenraum neue Gefahrensituationen für Passanten oder Verkehrsteilnehmer durch Blendung oder Irritation entstehen. Aber auch für Anwender oder Teilnehmer einer AR-Szene kann Gefahr durch Ablenkung entstehen.

Dennoch bieten aktiv leuchtende LED-Marker großes Potenzial für den Einsatz im Außenbereich, da sie im Gegensatz zu anderen Verortungsystemen einen Mehrwert durch höhere Tracking-Genauigkeit und gute Detektion auch bei ungünstigen Außeneinflüssen erwarten lassen. Im Projekt liegt darum ein Schwerpunkt auf der Entwicklung einer professionell anwendbaren Lichtmarker-AR-Technologie für den Außenraum.

3 POTENZIALE DER AR-TECHNOLOGIE

Augmented Reality ist eine Form der Visualisierung aus der Ich-Perspektive, die sowohl zur Unterhaltung als auch auf professioneller Ebene eingesetzt werden kann. Aktuelle Entwicklungen reichen beispielsweise von Videospielen (z. B. Pokémon Go) über fiktive Trainingseinheiten für Einsatzkräfte (z. B. der Feuerwehr) bis hin zur Unterstützung chirurgischer Eingriffe in der Medizin (vgl. Broll 2013, 288 ff.).

Die bildhafte Überlagerung von Realität und Virtualität in Echtzeit und die Mobilität der Technik bieten dabei einerseits die Möglichkeit, Unterhaltungsmedien physisch erlebbar und interaktiv zu gestalten und andererseits können komplexe Zusammenhänge visuell veranschaulicht und individuell erkundet werden. Die Visualisierung unterstützt dabei das Verstehen und Begreifen und kann somit die Informationsaufnahme merklich verkürzen (vgl. Stankowski 1994, 20). Der hohe Grad an Immersion[1], der durch die Verschmelzung von Realtiät und Virtualität erreicht werden kann, verspricht diesen Prozess noch weiter zu beschleunigen.

Deshalb eignet sich AR als interaktives visuelles Kommunikationsmittel. Diese Eigenschaft ist insbesondere für den Architektur- und Stadtplanungssektor interessant. Visualisierungen gehören zu den fachspezifischen Kommunikationsmitteln, die sowohl für den fachlichen Austausch als auch für die Kommunikation mit dem Laien genutzt werden. Für einen konstruktiven Diskurs kommt der Visualisierung damit eine besondere Wichtigkeit zu. Man kann sogar von „einer Art universell einsetzbarer Sprache“ (Anders et al. 2013c, 233) sprechen, die durch AR auf eine noch anschaulichere und verständlichere Ebene gehoben werden kann. Dennoch ist AR auf diesem Anwendungsgebiet noch wenig populär. Die zu erwartende höhere

[1] das Eintauchen des Nutzers in die Szene

Verfügbarkeit an virtuellen Gebäudemodellen durch die Etablierung des Building Information Modeling (BIM) kann jedoch die Durchsetzung von AR als Visualisierungsmethode begünstigen.

Eine zuverlässige Funktionstüchtigkeit der AR im Außenraum erweitert die Potenziale für den Unterhaltungssektor und den professionellen Einsatz. Durch die zuverlässige Verwendbarkeit sind feste und dauerhafte Installationen möglich. Das macht die AR-Technologie mit aktiven Markern alltagstauglich und befähigt zu einer zeitunabhängigen, öffentlichen Nutzung für jedermann. Außerdem ermöglicht eine Distanz von mehreren Metern des Betrachters zu den Markern die Darstellung und das Erfassen von realmaßstäblichen Strukturen (z.B. einem fiktiven Reihenhaus im Maßstab 1 zu 1 oder einer Kunstinstallation auf einem öffentlichen Platz).

In Bezug auf den Bausektor ergeben sich durch Überlagerung vor Ort in Echtzeit insbesondere Potenziale bei der Realisierung. Das können beispielsweise die Verfolgung des Fertigstellungsgrades oder die frühzeitige Detektion von Fehlern sein. Für die Stadt selbst ergeben sich Potenziale, die im Bereich der häufig schwierigen Kommunikation zwischen Experten und Laien bei Planungsprozessen und im Bildungs- und Unterhaltungssektors anzusiedeln sind und in diesem Beitrag fokussiert werden.

Es folgt eine Betrachtung möglicher Anwendungsszenarien für die AR-Technologie mit aktiven Markern im Kontext der Stadtentwicklung.

4 POTENZIALE DER AR-TECHNOLOGIE MIT AKTIVEN MARKERN IN DER STADT

Im Feld der Stadtentwicklung eröffnen sich zwei übergeordnete Aktionsbereiche, die ein hohes Potenzial zur Erzeugung eines Mehrwertes durch den Einsatz einer großmaßstäblichen, lichtmarkerbasierten Augmented Reality-Technologie erwarten lassen: (1) Öffentlichkeitsbeteiligung und (2) Stadtmarketing. Dieser Abschnitt beschreibt die Aktionsbereiche anhand ihrer Relevanz für die Stadtentwicklung und der Potenziale und Chancen, die durch den Einsatz der AR-Technologie mit aktiven Markern entstehen.

4.1 Aktionsbereich Öffentlichkeitsbeteiligung

4.1.1 Hintergründe und Relevanz

Stadtentwicklung ist ein vielschichtiger, gesamtgesellschaftlicher Prozess, der eine kontinuierliche Auseinandersetzung mit verschiedenen Interessen und Belangen einzelner Gruppen erfordert. Die Ermittlung dieser Interessen und Belange und eine gerechte Abwägung untereinander und gegeneinander ist über das Baugesetzbuch geregelt (Anders et al. 2013b, 199). Diese Definition deutet an, dass Stadtentwicklung ein multidiszipliäres Aktionsfeld von Akteuren mit unterschiedlichen Fähigkeiten und Interessen darstellt, die an sozialen, kulturellen, ökonomischen, ökologischen und baulichen Prozessen mitwirken können und sollten. Die Komplexität und Vielschichtigkeit der Planung erfordert sogar die Integration der Öffentlichkeit mit ihrem Wissen und Erfahrungen für eine nachhaltige Entwicklung. Aus sozial-psychologischer Sicht hat eine Integration der Öffentlichkeit in Planungsprozesse darüber hinaus das Potenzial, eine Identifikation mit den Projekten herbeizuführen, sodass die Bereitschaft, die Projektziele zu erreichen, zunimmt und die Chancen der Umsetzung steigen (Anders et al. 2013a, 85).

In diesem Zusammenhang sind durch die Gesetzgebung bereits eine Reihe von formellen Beteiligungsformen festgelegt. In deutschen Rechtsnormen ist eine formelle Beteiligung beispielsweise in Planfeststellungsverfahren (vgl. VwVfG), der Bauleitplanung und der städtebaulichen Sanierung und Entwicklung (beide vgl. BauGB) vorgesehen. Die Beteiligungsformen reichen von Anhörungsverfahren über frühe Öffentlichkeitsbeteiligung bis zur lediglichen Information der Öffentlichkeit, Behörden und Träger öffentlicher Belange. Darüber hinaus haben benachbarte Grundstückseigentümer bei Baugenehmigungsverfahren das Recht auf Information und Einspruch (vgl. LBO BW).

Diese Darlegung deutet bereits an, dass formelle Öffentlichkeitsbeteiligung einerseits lediglich eine informierende Funktion einnimmt und andererseits aber auch eine intensive Partizipation anstrebt. Leider ist die praktische Umsetzung dennoch häufig divergierend und wird nur der informierenden Dimension gerecht. Interessant ist das steigende, vehemente Bestehen der Bürger auf die Wahrung ihrer Rechte in Bezug auf Information und Mitbestimmung (Weinstock 2013, 83). Eine Studie im Auftrag des Zentralen Immobilien Ausschusses e. V. (ZIA) zeigt, dass die Mehrzahl der befragten Bürger wünschen, ihr persönliches Lebensumfeld mitzugestalten und auch bereit sind, sich dafür zu engagieren (Articus 2013, 64).

Für eine nachhaltige Stadtentwicklung liegt es daher nahe, eine Öffentlichkeitsbeteiligung über die Möglichkeiten formeller Beteiligungsformen auszuweiten. Es existieren bereits zahlreiche, erprobte Methoden und Formate intensiver informeller Partizipationsformen (vgl. Senatsverwaltung 2012, 321 ff.).

Trotz des bekundeten Interesses nimmt aber häufig nur ein begrenzter Bürgerkreis tatsächlich die angebotenen Beteiligungsmöglichkeiten wahr (Articus 2013, 64). Weiterhin ist zu beobachten, dass eine Partizipation in frühen Planungsphasen eher gering einzuschätzen ist, während das Interesse kurz vor dem Realisierungsbeginn am größten scheint. Gründe dafür können die Abstraktheit früher Planungsphasen und lange Realisierungsphasen sein (Weinstock 2013, 85). Dabei wird gerade der frühzeitigen Öffentlichkeitsbeteiligung das größte Erfolgspotenzial und die größte Einflussnahme zugeschrieben, da hier bereits grundlegende Entscheidungen mit Auswirkungen auf soziokulturelle Aspekte, Ökologie und Ökonomie getroffen werden (vgl. Messerschmidt et al. 2013, 43).

Die Aufgabe des Planers liegt dabei im Interesse einer nachhaltigen Stadtplanung nicht nur in der Konzipierung eines gestaltgebenden Entwurfes, sondern auch in der Organisation eines vielschichtigen Planungsverfahrens und der Moderation eines interdiszipliären Planungsteams und öffentlicher Akteure (Bott et al. 2013, 93). Dieser Vorgang erfordert eine Vermittlung zwischen einer Vielzahl an Interessen und Akteuren, die sich aus Fachplanern (berufständische Experten) und Vertretern der Bürgerschaft, Wirtschaft und öffentlicher Hand (überwiegend als planungsfachliche Laien einzustufen) zusammensetzen. Die inhomogene fachliche Wissensgrundlage der verschiedenen Akteure generiert für den Planer einen enormen Kommunikationsaufwand, um ein gemeinsames Wissensniveau aufzubauen, das dazu befähigt auf Augenhöhe zusammenzuarbeiten und mündige Entscheidungen treffen zu können (Frielinghaus 2013, 98). Für einen konstruktiven Austausch sollte eine Vertrauensbasis zwischen Experten und Laien aufgebaut werden, da die vom Laien empfundene fachliche Überlegenheitsposition des Experten zu Misstrauen und Missverständnissen führen kann. Eine Überwindung des Wissensgefälles kann durch die Schaffung einer neutralen Zone mittels kommunikativer Methoden erreicht werden, die eine Partizipation zulassen, ohne das Gefühl zu generieren, belächelt oder beschämt zu werden (Scarpa 2010, 267, 271). Klassische fachliche Kommunikationsmittel können für diese Problemstellung nur bedingt eine Lösung darstellen. Auch etablierte starre Visualisierungsmethoden, wie Renderings und Animationen, beschreiben lediglich beschränkte Blickwinkel von zukünftigen baulichen Eingriffe aus Expertenperspektive.

4.1.2 Potenziale durch die AR-Technologie mit aktiven Markern/Anwendungsszenarien

Ein größeres Potenzial besteht in der spielerischen Erlebbarmachung eines Bauwerkes mit der Möglichkeit eigener Interaktion und individueller Bewegungsmöglicheiten. Die AR-Technologie mit aktiven Markern bietet in diesem Feld eine niederschwellige Möglichkeit, sich frühzeitig mit der räumlichen und ästhetischen Wirkung von baulichen Eingriffen direkt vor Ort auf Augenhöhe mit den Planungsfachleuten auseinanderzusetzen. Aus der jedermann vertrauten Ich-Perspektive kann die tatsächliche Wirkung eines zukünftigen baulichen Eingriffes von Laien besser erlebt und persönlich bewertet werden, da durch die Projektion virtueller Inhalte in eine reale Szene ein hoher Grad an Immersion erreicht werden kann. Das befähigt Planer, ihre Vorhaben anschaulicher einem Laienpublikum zu erläutern und eine konstruktivere Diskussion anzustoßen. Die hohe graphische Qualität digitaler Medien und Videospiele erhöht aber auch die Ansprüche der Laien an die graphische Aufarbeitung der AR-Szene. Interaktionen, beispielsweise in Form von Projektion unterschiedlicher Modellvarianten oder direkter Bearbeitung der virtuellen Modelle, können eine unmittelbare Erarbeitung gemeinsamer Lösungen während einer Planungsveranstaltung fördern. Die Möglichkeit der Nutzung von Handheld-Geräten, wie Smartphones oder Tablets, für die AR-Technologie mit aktiven Markern und die Verbreitung dieser Geräte in der Bevölkerung lassen eine hohe Akzeptanz der Technologie erwarten. Durch die Vertrautheit mit den Handheld-Geräten und den dadurch intuitiven Umgang mit dieser Technik könnte im Idealfall auch die Hürde, sich aktiv in öffentlichen Bauvorhaben zu engagieren, überwunden werden. Der Spaßfaktor, der ähnlich wie bei einer Spielekonsole entstehen kann, könnte auch jüngere, auf diesem Genre geübte Gruppen zu einer Beteiligung animieren und Jugendlichen die Chance geben, einen höheren Realitätsbezug und Spürsinn für ihre bauliche Umwelt herzustellen.

Im Umkehrschluss können, durch das erwartete höhere Verständnis des Laien für die planerische Aufgabe, Wünsche und Bedenken klarer spezifiziert werden, was deren Integration in die Planung erleichtern kann. Weiterhin kann der Vermittlungsaufwand für den Planer teilweise vereinfacht werden. Je nach aufbereitetem Informationsgehalt der AR-Szene könnten interessierte Laien auch ohne moderierten Input eines Experten einen geplanten baulichen Eingiff zeituunabhängig vor Ort erkunden. Die AR-Technologie mit aktiven Marken birgt für den Einsatz im Stadtraum also das Potenzial, eine neue Verfahrensqualität bei Öffentlichkeitsbeteiligungen zu etablieren.

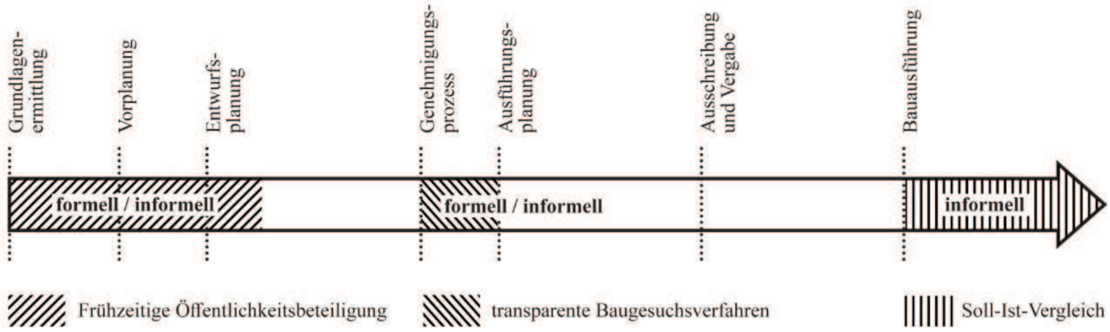

Abb. 1: Zeitliche Einordnung von Öffentlichkeitsbeteiligung während des Gesamtprojektablaufes

Mögliche Anwendungsszenarien der AR-Technologie mit aktiven Marken in der Öffentlicheitsbeteiligung lassen sich in drei Stufen während des Planungsprozesses gliedern (Abb. 1): Frühzeitige Öffentlichkeitsbeteiligung in den ersten Planungsphasen, im Zuge von Baugesuchsverfahren und während der Bauausführung zur Verfolgung des Fertigstellungsgrades eines Bauvorhabens (Soll-Ist-Vergleich).

Frühzeitige Öffentlichkeitsbeteiligung meint den Zeitraum von der Initiierung eines Projektes, über die Vorplanung und zu Beginn der Entwurfsplanung. Virtuelle Geometrien, die in die in der augmentierten Szene dargestellt werden, können von einfachen „Klötzchen"-Modellen bei der Grundlagenermittlung bis hin zu einem ausformulierten Baukörper während der Entwurfsphase reichen. Die Veranschaulichung durch die AR-Technologie mit aktiven Markern ermöglicht es, die Arbeitsprozesse zu vereinfachen und die Effizienz zu steigern.

Der Einsatz dieser Technologie im Rahmen von Baugesuchsverfahren bietet sowohl für Vertreter der öffentlichen Hand als auch für Angrenzer die Möglichkeit, sich bei geplanten Eingriffen vor ihrer Einwilligung ein möglichst realitätsnahes Bild von der zukünftigen Situation machen. Dadurch kann die Transparenz im Genehmigungsprozess erheblich erhöht werden – was beispielsweise bei geplanter Unterschreitung der Abstandsflächen oder bei Befreiungen und Abweichungen vom Bebauungsplan notwendig ist, sollten öffentlich-rechtlich gesicherte Interessen der Angrenzer betroffen sein.

Die Verfolgung des Fertigstellungsgrades eines Bauvorhabens mittels einer AR-Technologie mit aktiven Markern für den Einsatz im Stadtraum kann während der Bauphase zur Verfügung gestellt werden. Sie kann als spielerischer Informationskanal dienen und die Transparenz für die interessierte Öffentlichkeit erhöhen. Durch die gebotene Interaktionsmöglichkeit besteht die Aussicht, die Toleranz gegenüber persönlichen Beeinträchtigungen während langer Realisierungsphasen zu stärken, da Fortschritte aus erster Hand mitverfolgt werden können.

4.2 Aktionsbereich Stadtmarketing

4.2.1 Hintergründe und Relevanz

Soziale und wirtschaftliche Kriterien sind wichtig für eine nachhaltige Stadtentwicklung. Sie richten sich sowohl an die Belange der Stadtbürger selbst als auch an Besucher. Für ihre Bürger stiftet eine nachhaltige soziale Stadt ein Gefühl von Heimat und bietet Möglichkeiten zur Identifikation mit dem Lebensraum. Ein Heimatgefühl kann dort entstehen, wo sich die unverwechselbare bauliche Struktur und Kultur zu einer lokalen Identität verbinden. Dazu zählen unter anderem der historische Stadtgrundriss, Bauten und Stadträume aber auch die Geschichte, Inszenierungen und Stadtevents. Ein anderer Aspekt der sozialen Stadtentwicklung ist die wachsende Bedeutung des öffentlichen Raumes, der zunehmend von Stadtbürgern als Erholungs-, Begegnungs- und Kommunikationsfläche beansprucht und als Erweiterungsfläche privaten Wohnens betrachtet wird. (vgl. Harlander 2013, 51) Für Besucher bietet die Stadt kulturelle Weiterbildungs- oder Freizeitgestaltungsmöglichkeiten, was der Stadt im Umkehrschluss wirtschaftliche Wertschöpfung sichert.

Das Stadtmarketing ist dabei ein Instrument, die lokale Identität der Stadt zu stärken, weiterzuentwickeln und zu kommunizieren. Die Stadt kann dadurch zu einer Art Marke wachsen, was ihre Bekannheit steigert

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und sie an positive Assoziationen knüpft. Positive Assoziationen wirken sich nicht nur nach außen (z. B. auf den Tourismus) aus, sondern können auch den Stadtbürgern selbst ein Gefühl von Gemeinschaftlichkeit geben und die Identifikation mit der Stadt fördern. (vgl. Schneider 2007, 73, 75)

4.2.2 Potenziale durch die AR-Technologie mit aktiven Markern / Anwendungsszenarien

Die AR-Technologie mit aktiven Markern für die Anwendung im Außenraum hat das Potenzial in diesem Kontext neue Qualitäten zu erzeugen. Das Kulturgut der Stadt kann um großmaßstäbliche virtuelle Inhalte erweitert werden, die durch Zerstörung oder Modifikation nicht mehr greifbar sind oder die eine fiktive Perspektive eröffnen. Diese Technologie stellt also ein neues attraktives Format für die Vermittlung von historischem und kulturellem Wissen bereit. Gleichermaßen wie die Technologie zur Darstellung geplanter zukünftiger Gebäudestrukturen in realmaßstäblichen Szenen aus der Ich-Perspektive befähigt, können auch historische Bauzustände einzelner Quartiere, Bauten oder Anlagen, die als virtuelles Modell aufgearbeitet wurden, auf diese Weise im Stadtraum visualisiert werden. Ein Alleinstellungsmerkmal ist dabei, dass historische Informationen nicht mehr nur in Museen anhand von starren kleinmaßstäblichen Modellnachbildungen oder Visualisierungen nachvollzogen werden müssen, sondern direkt im Stadtraum an ihrer Originalposition erlebbar gemacht werden und nach Bedarf des Betrachters unabhängig von Öffnungszeiten und Tageszeit auf spielerische Art und Weise erkundet werden können. Stadtbürger und Besucher können mit dem realen und fiktiven Stadtraum direkt in Interaktion treten und in eine andere Epoche eintauchen. Die virtuellen baulichen Strukturen können ergänzend um dynamische, animierte Sonderelemente angereichert werden. So können beispielsweise Besucher von Schlössern, Burgen, mittelalterlichen Städten, Freilichtmuseen oder auch von landschaftlichen Schauplätzen bedeutende historische Ereignisse auf einer physisch erfahrbaren Ebene erleben. Ähnlich der historischen Ereignisse könnten als neues Kunst- und Unterhaltungsmedium fiktive Inszenierungen (vergleichbar zu Film und Theater), Spiele oder interaktive Installationen in augmentierten Umgebungen im Stadtraum erlebt werden. Solche Produktionen könnten sowohl “on demand” zeitlich unabhängig wie auch als “Livecast” zur Verfügung gestellt werden. Diese Attraktionen, insbesondere die Darstellung historischer Bauzustände, erheben den Anspruch auf Einzigartigkeit, da sie ein exklusives Kulturgut der einzelnen Stadt darstellen. Die spielerische Herangehensweise und der Spaßfaktor, der durch die Nutzung einer zeitgemäßen Technik entsteht, verspricht eine positive Resonanz beim Publikum. Die Technologie kann so die Markenbildung der Stadt unterstützen und durch die Erlebbarmachung der Stadtgeschichte die Identifikation der Bürger mit der Stadt und ihr Heimatgefühl stärken.

5 ANFORDERUNGEN AN DIE AR-TECHNOLOGIE MIT AKTIVEN MARKERN

Dieser Abschnitt gibt die Einschätzung der technischen Anforderungen wieder, die für eine Anwendung im jeweiligen Szenario bedeutsam erscheinen.

5.1 Definition der technischen Anforderungen: Qualitätsmerkmale und Kano-Modell

Der qualitative Wert eines Produktes für den Anwender kann anhand seiner Zufriedenheit mit den Produkteigenschaften gemessen werden. Als Grundlage zur Einschätzung der Zufriedenheit kann das Kano-Modell herangezogen werden. Um eine möglichst hohe Zufriedenheit bei der Anwendung der AR-Technologie mit aktiven Markern zu erreichen, werden daher Qualitätsmerkmale (Produkteigenschaften) definiert, die je Anwendungsszenario nach den Qualitätsattributen des Kano-Modells bewertet bzw. kategorisiert werden. Das Kano-Modell beschreibt die Qualitätsattribute wie folgt:

Basismerkmale werden implizit vorausgesetzt. Bei Erfüllung erzeugen sie keine höhere Zufriedenheit, bei nicht Erfüllung aber unmittelbar Unzufriedenheit. Leistungsmerkmale zeigen einen linearen Zusammenhang zwischen Erfüllung und Zufriedenheit und werden bewusst verlangt. Begeisterungsmerkmale erzeugen bei Erfüllung eine hohe Zufriedenheit oder Begeisterung, bei nicht Erfüllung wird aber nicht unbedingt Unzufriedenheit erzeugt. Das Merkmal wird nicht erwartet und erzeugt darum bei Erfüllung Begeisterung. Unerhebliche Merkmale sind nicht relevant. Sie erzeugen bei Erfüllung oder nicht Erfüllung weder Zufriedenheit noch Unzufriedenheit. Rückweisungsmerkmale sind nicht vorhanden und erzeugen dadurch Zufriedenheit. Bei Erfüllung entsteht Unzufriedenheit und damit Ablehnung. (Hölzing 2008, 77 ff.)

Aus den Qualitätsmerkmalen und deren Kategorisierung nach den Objektattributen von Kano lassen sich Tendenzen für die anzustrebende Entwicklungsebene einzelner technischer Eigenschaften der AR-

Technologie mit aktiven Markern ableiten (Definition der technischen Anforderungen). Die Qualitätsmerkmale werden anhand der Literaturrecherche zum Thema AR und der eingeschätzten Subjekt-Objekt-Beziehung bestimmt. Es werden zwölf Merkmale eingeschätzt, die nachfolgend hierarchielos aufgeführt sind: Tracking: hohe Genauigkeit, gute Handlichkeit, Handheld-Verwendung, hohe Berechnungseffizienz, unbeleuchtete Szenen, Anpassung an die Umgebungshelligkeit, dynamische Helligkeitsregelung, netzunabhängige Stromversorgung, geringer Wartungsaufwand, keine zusätzlichen Schutzvorkehrungen, erhöhte Unfallgefahr und geringe Anschaffungskosten.

5.2 Aktionsbereich Öffentlichkeitsbeteiligung

5.2.1 Frühzeitige Öffentlichkeitsbeteiligung in formellen und informellen Verfahren

Eine hohe Genauigkeit beim Tracking kann nach Stand der Technik noch nicht als grundlegende Voraussetzung gesehen werden und wird deshalb als Leistungsmerkmal eingestuft. Von nachgeordneter Bedeutung und daher unerheblich ist die Handlichkeit, da eine feste Installation für einen längeren Zeitraum eingerichtet werden kann. Als Voraussetzung ist die Darstellung der Szene auf Handheld-Geräten zu sehen, da nur so eine breite Öffentlichkeit adressiert werden kann. Es stellt somit ein Basismerkmal dar. Eine hohe Berechnungsgeschwindigkeit erscheint nicht grundsätzlich vorausgesetzt zu sein, sodass sie als Leistungsmerkmal eingestuft wird. Eine Erweiterung des Visualisierungsspektrums stellen unbeleuchtete oder Nachtszenen dar, was als Begeisterungsmerkmal eingeschätzt wird. Als Basismerkmal einzustufen ist eine Anpassung und Regelung in Abhängigkeit von der Umgebungshelligkeit für eine reibungslose Benutzung. Bei einer langfristigen Installation ist eine Stromversorgung über eine Kabelinstallation sinnvoll. Eine Akkuversorgung könnte hilfreich sein, wenn für den Test von Entwurfsvarianten eine Versetzung der Marken erforderlich sein sollte und wird als Leistungsmerkmal gewertet. Der aktive Marker sollte grundsätzlich wartungsarm und vor äußeren Einflüssen und Vandalismus geschützt sein. Diese Merkmale werden daher als Basismerkmale eingeordnet. Eine Unfallgefahr darf in jedem Fall nicht ausgelöst werden. Im Verhältnis zu anderen vergleichbaren Kostenstellen im Budget öffentlicher Planungen (Präsentationsmodelle, Werbefilme oder Informationskampagnen) sind die Anschaffungskosten der Technologie untergeordnet. Entscheidend ist hier eher der Nutzen bezüglich einer höheren Akzeptanz und einer reibungslosen Umsetzung von Projekten. (Abb. 2)

5.2.2 Baugesuchsverfahren: transparente Entscheidungsfindung

Die Tracking-Genauigkeit ist hier eher von untergeordneter Bedeutung und daher als Leistungsmerkmal einzugruppieren. Für eine mobile Anwendung werden Handlichkeit und Darstellung auf Handheld-Geräten vorausgesetzt, was sie als Basismerkmale einordnet. Unerheblich sind die Berechnungsgeschwindigkeit und die Darstellung unbeleuchteter Szenen. Voraussetzung für eine unkomplizierte Anwendung ist die Möglichkeit zur automatischen Anpassung und Regelung der Lichtstärke der aktiven Marker und somit als Basismerkmal zu werten. Weiterhin gelten als Voraussetzung und somit als Basismerkmal, eine netzunabhängige Stromversorgung, ein geringer Wartungsaufwand und ein ausreichender Schutz vor Umwelteinflüssen und Vandalismus. Auch hier dürfen keine Unfallgefahrenentstehen, was dieses Merkmal als Rückweisungsmerkmal eingliedert. In diesem Bereich sind die Anschaffungskosten von größerer Bedeutung und sollten plausibel eingeordnet werden können. Eventuell können Mietmodelle interessant werden. Die Kosten sind deshalb als Leistungsmerkmal einzuschätzen. (Abb. 2)

5.2.3 Verfolgung des Fertigstellungsgrades eines Bauvorhabens (Soll-Ist-Vergleich)

Dieses Anwendungsszenario entspricht in größten Teilen den Anforderungen der frühzeitigen Bürgerbeteiligung (siehe 4.2.1). Abweichend kann jedoch festgestellt werden, dass von einer langfristigen Installation ausgegangen wird und eine flexible Versetzung der aktiven Marker nicht erforderlich ist. Daher ist eine Akkuversorgung als unerhebliches Merkmal einzustufen. Weiterhin variiert die Relevanz der Anschaffungskosten in Bezug auf die Gesamtprojektkosten je nach Größe des Projektes. Die Kosten sind daher als Leistungsmerkmal zu bewerten. (Abb. 2)

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5.3 Aktionsbereich Stadtmarketing

5.3.1 Historischer Bauzustand

Die hohe Tracking-Genauigkeit soll hier als Leistungsmerkmal gewertet werden, da sich die AR-Technologie mit aktiven Markern dadurch gegenüber anderen auszeichnet, die ebenfalls eine Verbreitung für diesen Anwendungsfall finden können (z. B. Mustererkennung). Es sind überwiegend dauerhafte Installationen zu erwarten, weshalb die Handlichkeit von geringerer Bedeutung einzuordnen ist. Eine Grundvoraussetzung ist die Darstellung auf Handheld-Geräten, um eine Anwendung einer größtmöglichen Gruppe zu ermöglichen und somit ein Basismerkmal. Die Berechnungsgeschwindigkeit kann als Leistungsmerkmal gewertet werden, da sie nicht als grundlegende Voraussetzung zu sehen ist. Eine bedeutende Steigerung des Erlebnispotenzials für den Anwender findet durch die Darstellung unbeleuchteter nächticher Szenen statt, was dieses Merkmal als Begeisterungsmerkmal ausweist. Eine Anpassung und Regelungsmöglichkeit der Leuchtstärke der aktiven Marker ist eine Voraussetzung und somit ein Basismerkmal. Bei Dauerinstallation ist eine netzunabhängige Stromversorgung irrelevant. Basismerkmale sind ein geringer Wartungsaufwand und Schutz vor Witterung und Vandalismus. Unfallgefahren sind grundsätzlich zu vermeiden. Auf die lange Zeitspanne der Installation bemessen, erscheinen die Anschaffungskosten der AR-Technologie mit aktiven Markern eher unerheblich, jedoch wird die Erstellung hochwertiger und detaillierter Modelle einen bedeutenden Kostenfaktor darstellen. (Abb. 2)

5.3.2 Historische Ereignisse

Im Wesentlichen entspricht die Kategorisierung der Qualitätsmerkmale dem Szenario “Historischer Bauzustand”. Abweichend sind jedoch eine sehr hohe Genauigkeit des Trackings und eine sehr hohe Berechnungseffizienz als Begeisterungsmerkmale zu werten. Eine hohe Tracking-Genauigkeit fördert die Immersion, die als wichtige Voraussetzung für dieses Szenario gesehen wird. Eine weitestgehend latenzfreie Darstellung dynamisch bewegter Objekte (z.B. Figuren) oder interaktiver Szenen durch eine hohe Berechnungseffizienz erhöhen den Spaßfaktor. Je nach Kontext können anstatt der Verwendung von Handheld-Geräten auch AR-Brillen beim Einsatz in Museen interessant sein. (Abb. 2)

5.3.3 Kunst und Unterhaltung

Aufgrund der Verwandheit entsprechen die Qualitätsmerkmale bis auf eine Abweichung dem Szenario “Historische Ereignisse”. Durch die eher zeitlich begrenzte oder kurzzeitige Installation im Rahmen eines Events ist die Handlichkeit als Leistungsmerkmal anzusetzen. (Abb. 2)

	Tracking: hohe Genauigkeit	gute Handlichkeit	Handheld-Verwendung	hohe Berechnungseffizienz	unbeleuchtete Szenen	Anpassung an Umgebungshelligkeit	dynamische Helligkeitsregelung	netzunabhängige Stromversorgung	geringer Wartungsaufwand	keine zusätzlichen Schutzvorkehrungen	erhöhte Unfallgefahr	geringe Anschaffungskosten
Frühzeitige Öffentlichkeitsbeteiligung	L	U	B	L	E	B	B	L	B	B	R	U
transparente Baugesuchsverfahren	L	B	B	U	U	B	B	B	B	B	R	L
Soll-Ist-Vergleich	L	U	B	L	E	B	B	U	B	B	R	L
Historischer Bauzustand	L	U	B	L	E	B	B	U	B	B	R	U
Historische Ereignisse	E	U	B	E	E	B	B	U	B	B	R	U
Kunst und Unterhaltung	E	L	B	E	E	B	B	U	B	B	R	U

Merkmals-Kategorien: B = Basis; L = Leistung; E = Excitement (Begeisterung); U = Unerheblich; R = Rückweisung

Abb. 2: Kategorisierung der technischen Anforderungen an die AR-Technologie mit aktiven Markern nach dem Kano-Modell

5.4 Synthese der Anforderungen und Empfehlung

Die zuvor dargelegte Kategorisierung der Qualitätsmerkmale je Anwendungsszenario gibt eine nischenspezifische Einschätzung wieder. Für eine wirtschaftliche Nutzung sollte die AR-Technologie mit aktiven Markern jedoch szenarienübergreifend in der Stadtentwicklung eingesetzt werden können. Durch die Verwandheit der Szenarien ergeben sich hier bereits Konvergenzen. Für die voneinander abweichenden Qualitätsmerkmale wird eine Empfehlung ausgesprochen.

Konvergenzen ergeben sich bei den Merkmalen Handheld-Verwendung, Anpassung an die Umgebungshelligkeit, dynamische Helligkeitsregelung, geringer Wartungsaufwand, keine zusätzlichen Schutzvorkehrungen und erhöhte Unfallgefahr. Sie werden szenarienübergreifend als Basismerkmale eingeschätzt, mit Ausnahme der erhöhten Unfallgefahr, welche als Rückweisungsmerkmal eingestuft wird.

Als Ein- und Ausgabemedien sollten Handheld-Geräte im Mittelpunkt stehen, da sie durch ihre Verbreitung für einen großen Anwenderkreis verfügbar sind und dadurch eine Vertrautheit mit dem Medium vorausgesetzt werden kann. Zur Bedienung dieses Mediums wird somit kein Fachpersonal benötigt und kann deshalb von Planern und Bürgern gleichermaßen genutzt werden.

Die unterschiedlichen Belichtungssituationen je nach Tages- und Jahreszeit im Außenraum erschweren die Erkennbarkeit der aktiven Marker. Um häufige Benutzungsausfälle beispielsweise während Planungsbesprechungen zu vermeiden, sollte deshalb grundsätzlich in Abhängigkeit von der Belichtungssituation mit einer Anpassung der Leuchtstärke der aktiven Marker reagiert werden können. Die Anpassung sollte automatisch erfolgen, um den notwendigen Einsatz von Fachpersonal zu vermeiden.

Häufige Wartungen bedeuten einen Benutzungsausfall, schränken die Flexibilität der Verwendung ein und können hohe laufende Kosten erzeugen. Daher sollte grundsätzlich ein geringer Wartungsaufwand der aktiven Marker angestrebt werden.

Weiterhin sollte aufgrund der Anwendung im Außenraum ein Schutz vor Witterungseinflüssen und Vandalismus zur Grundausstattung gehören. Bei Fehlen wäre die Gebrauchsfähigkeit der aktiven Marker nicht gewährleistet.

Eine Unfallverhütung ist in Deutschland normativ vorgeschrieben. Deshalb sollten grundsätzlich keine Gefahren vom Gerät selbst ausgehen. Das betrifft zum einen die Verhinderung von Verletzungen durch beispielweise Stromschläge oder scharfe Kanten und zum anderen sollten geeignete Befestigungsmethoden gewählt werden, die einen sicheren Halt bieten.

Divergierend voneinander sind die Qualitätsmerkmale Tracking: hohe Genauigkeit, gute Handlichkeit, hohe Berechnungseffizienz, unbeleuchtete Szenen, netzunabhängige Stromversorgung und geringe Anschaffungskosten.

Je genauer virtuelle Objekte in einer realen Szene verortet werden können, desto besser kann ein Planer seinen Ideen Ausdruck verleihen und desto leichter kann ein Laie die virtuellen Inhalte begreifen. Eine hohe Tracking-Genauigkeit ermöglicht eine sehr exakte Positionierung des virtuellen Inhalts im realen Bildausschnitt und kann durch eine hohe Authentizität sogar Begeisterung auslösen. Betrachtet man die Tracking-Anforderung szenarienübergreifend wird aber eine Einschätzung als Leistungsmerkmal empfohlen. Das Merkmal bringt zwar einen Mehrwert für die Technologie gegenüber anderen Systemen, jedoch ist keine Notwendigkeit von Höchstleistungen für eine genaue Darstellung erkennbar.

Allgemein betrachtet ist überwiegend von einer festen Installation der aktiven Marker auszugehen. Um die einzelnen Marker dennoch auch spontan versetzen zu können und die Nutzbarkeit für Anwendungsfall „Baugesuchsverfahren" zu sichern, sollte der Marker handlich sein. Daher sollte eine gute Handlichkeit als Basismerkmal eingeschätzt werden.

Durch eine hohe Berechnungseffizienz kann eine AR-Szene flüssiger in Echtzeit dargestellt werden. Das begünstigt das Hineinversetzen bzw. „Eintauchen" in die Szene und kann den Spaßfaktor erhöhen. Gerade komplexe virtuelle Gebäudemodelle erfordern für eine flüssige Darstellung in Echtzeit eine hohe Rechenleistung. Werden die Szenarien miteinander verglichen, kann sich die Technologie über dieses Merkmal auszeichnen, jedoch sind auch hier Höchstleistungen für die Nutzbarkeit nicht vorauszusetzen. Das legt eine Einschätzung als Leistungsmerkmal nahe.

Unbeleuchtete Szenen im großmaßstäblichen Kontext sind noch weitestgehend unbekannt, stellen aber eine Erweiterung des Visualisierungsspektrums dar und können das Erlebnispotenzial steigern. Dieses fast schon Alleinstellungsmerkmal birgt hohes Potenzial bei Projekten im Stadtmarketingbereich. Die Technologie kann an dieser Stelle Begeisterung bei dem Anwender auslösen und sollte daher als Begeisterungsmerkmal eingestuft werden.

Eine netzunabhängige Stromversorgung ist szenarienübergreifend nicht grundsätzlich erforderlich. Sie trägt aber zur flexiblen und mobilen Anwendung der Technologie bei und sollte deshalb als Leistungsmerkmal angesehen werden.

Die Anschaffungskosten sollten geringgehalten werden. Je nach Größe eines Projektes kann das Verhältnis der Anschaffungskosten zum Gesamtbudget unverhältnismäßig hoch ausfallen. Deshalb wird die Einschätzung als Leistungsmerkmal empfohlen.

	Tracking: hohe Genauigkeit	gute Handlichkeit	Handheld-Verwendung	hohe Berechnungseffizienz	unbeleuchtete Szenen	Anpassung an Umgebungshelligkeit	dynamische Helligkeitsregelung	netzunabhängige Stromversorgung	geringer Wartungsaufwand	keine zusätzlichen Schutzvorkehrungen	erhöhte Unfallgefahr	geringe Anschaffungskosten
Synthese der Szenarien	L	B	B	L	E	B	B	L	B	B	R	L

Merkmals-Kategorien: B = Basis; L = Leistung; E = Excitement (Begeisterung); U = Unerheblich; R = Rückweisung

Mittelwert

Übereinstimmung, kein Mittelwert

Abb. 3: Synthese aller Anwendungsszenarien

6 CONCLUSION

Abschließend lässt sich festhalten, dass eine AR-Technologie mit aktiven Marken für den Einsatz im Stadtraum große Chancen für die Stadtentwicklung durch transparenter dargestellte Verfahren bei der Öffentlichkeitsbeteiligung birgt und eine Bereicherung des Kulturangebotes darstellen kann. Sie hat das Potenzial, die Kommunikation zwischen Experten untereinander als auch zwischen Experten und Laien zu vereinfachen und das Vertrauen der Stadtbürger in Planer und Entscheidungsträger zu stärken. Darüber hinaus besteht das Potenzial, die Identifikation der Bürger mit ihrer Stadt zu fördern und die Stadt als Marke zu festigen. Voraussetzung ist die Entwicklung einer technisch performanten und alltagstauglichen AR-Technologie mit aktiven Markern für den Stadtraum.

Im vorliegenden Kontext der Stadtentwicklung werden sich insbesondere Produkte und Technologien durchsetzen, die bei den Merkmalen Genauigkeit des Trackings, Berechnungseffizienz, Netzunabhängigkeit und geringe Anschaffungskosten wegweisend sind. Die Möglichkeit unbeleuchtete Szenen zu erzeugen wird ein Alleinstellungsmerkmal der aktiven Markertechnologie in diesem Anwendungsbereich sein.

7 REFERENCES

ANDERS, Stephan (2013a); WITTSTOCK, Bastian: Prinzipien. In: Bott, Helmut et al. (Hrsg.): Nachhaltige Stadtplanung: Konzepte für nachhaltige Quartiere, pp. 84-91. München, 2013.

ANDERS, Stephan (2013b); BOTT, Helmut; CHURCH Dominic; GRASSL, Gregor C.; MESSERSCHMIDT, Rolf: Umsetzungsstrategien. Akteure, Leitbilder und Instrumente. In: Bott, Helmut et al. (Hrsg.): Nachhaltige Stadtplanung: Konzepte für nachhaltige Quartiere, pp. 198-205. München, 2013.

ANDERS, Stephan (2013c); MESSERSCHMIDT, Rolf: Werkzeuge. Visualisierung. In: Bott, Helmut et al. (Hrsg.): Nachhaltige Stadtplanung: Konzepte für nachhaltige Quartiere, pp. 230-233. München, 2013.

ARTICUS, Stephan: Bürgerbeteiligung in der Stadtentwicklung. In: ZIA: Bürgerbeteiligung in der Projektentwicklung., pp. 62-71. Köln, 2013.

BOTT, Helmut; SIEDENTOP, Stefan: Regional-, Stadt- und Quartiersplanung. In: Bott, Helmut et al. (Hrsg.): Nachhaltige Stadtplanung: Konzepte für nachhaltige Quartiere, pp. 92-101. München, 2013.

BROLL, Wolfgang: Augm. Reality. In: Dörner, Ralf et al. (Hrsg.): Virtual und Augmented Reality, pp. 241-294. Heidelberg., 2013.

FRIELINGHAUS, Michael: Der Bürger als Experte. Einfluss von Bürgerbeteiligung auf Architektur und Baukultur. In: ZIA: Bürgerbeteiligung in der Projektentwicklung, pp. 95-100. Köln, 2013.

GRIMM, Paul; HEROLD, Rigo; HUMMEL, Johannes; BROLL, Wolfgang: VR-Eingabegeräte. In: Dörner, Ralf et al. (Hrsg.): Virtual und Augmented Reality, pp. 97-125. Heidelberg, 2013.

HARLANDER, Tilman: Herausforderungen. Mensch und Soziokultur. Soziales Gefüge. In: Bott, Helmut et al. (Hrsg.): Nachhaltige Stadtplanung: Konzepte für nachhaltige Quartiere, pp. 47-51. München, 2013.

HÖLZING, Jörg A.: Die Kano-Theorie der Kundenzufriedenheitsmessung. Wiesbaden, 2008.

KOCH, Volker: Flying Augmented Reality. In: http://blm.ieb.kit.edu/536_540.php. Aufgerufen am 12.06.2017.

MESSERSCHMIDT, Rolf; VON ZADOW, Andreas: Herausforderungen. Prozesse und Beteiligung. In: Bott, Helmut et al. (Hrsg.): Nachhaltige Stadtplanung: Konzepte für nachhaltige Quartiere, pp. 42-45. München, 2013.

SCARPA, Ludovica: Kommunikation und Stadtentwicklung. Für eine Wunschkultur in der Kommunikation. In: Becker, Elke et al. (Hrsg.): Stadtentwicklung, Zivilgesellschaft und bürgerliches Engagement, pp. 265-276, Stuttgart, 2010.

SENATSVERWALTUNG für Stadtentwicklung und Umwelt Berlin: Handbuch zur Partizipation. 2. Aufl. Berlin, 2012.

SCHNEIDER, Helmut: Die Stadt als Marke. In: Greipl, Erich et al. (Hrsg.): Zukunft der Innenstadt. Herausforderungen für ein erfolgreiches Stadtmarketing, pp. 73-77. Wiesbaden, 2007.

STANKOWSKI, Anton: Visualisierung. In: Stankowski, Anton/ Duschek, Karl: Visuelle Kommunikation. Ein Design-Handbuch, pp. 20-52. 2. Aufl. Berlin, 1994.

WEINSTOCK, Marc: E-Partizipation. Neue Möglichkeiten der Bürgerbeteiligung bei städtebaulichen Projekten. In: ZIA: Bürgerbeteiligung in der Projektentwicklung, pp. 83-88. Köln, 2013.

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Can an Economic Activities Inventory Fill the Knowledge Gap about the Economic Sector in a Policy Making Process?

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1 ABSTRACT

Nowadays, Brussels' population is growing and requires more and more space for housing. This constantly growing process tend to push the industrial and medium / large economic activities out of the city. These activities are wrongly perceived to be unsightly for an urban environment. Economic activities, often mixed with other functions play an important role within cities and their suburbs areas. However this role is not well understood. For that reason an analysis that identifies the different types of activities and their location can be fundamental in the early phase of a urban development project, to give at all the stakeholders a better and more complete view.

This work is based on the will to get a better and new kind of knowledge about the location and differentiation of economic activities in Brussels metropolitan northern area. The visualization of the diversity of types and scales of economic activities, and understanding trends and dynamics, can be considered as a useful set of information to be used in a urban development and economic policy making process.

The work, conceived as a pilot project, which could be extended and repeated in other areas, is based on an empirical research, done by a visual check of what is identifiable as economic or designed for an economic use directly on the site, aimed to identify, locate and classify all the different types of existing economic activities in the selected areas. This economic activities inventory is the only one existing for Brussels Capital and Flanders Regions based on field work.

In this paper we will explain the method used for the field work and inventarisation, the possible link with existing economic databases and the difficulties encountered during the work. We will also show how this new data is used in ongoing spatial planning processes and to what extend these new insights promote different spatial planning proposals and realisations.

Keywords: GIS, database, economy, knowledge, policy making

2 INTRODUCTION

Urban planning and related policies are frequently criticised for their poor ability to accommodate economic dynamics. This led to tensions between spatial and economic development and inneficient planning decision and instruments (Friedmann, 2005; Zhenshan, 2010). Planning policies and tools, to be efficient, should consider and include all the dimensions of urban development: Spatial, socio-cultural, economic and environmental (Allmendinger and Tewdwr-Jones, 1997; Mega, 2009). In this paper we decided to focus on the economic one, in order to understand and figure out how this sector is actually treated in a policy making process.

The economic sector plays an important role within cities and their surroundings. One obvious reason is because there are functions and activities that are fundamental to keep the city functioning, while providing goods and servicies to its businesses and residents, to deal with its waste, to provide materials for its construction, and so on (Ferm and Jones, 2016). For example we can consider the diversity of services and products consumed by the average office building. Activities related to catering, cleaning, furniture, maintenance and fit out, office equipment and supplies, print and copy, security, waste disposal and more are usually located away from the central areas, often clustered in the suburbs of even further out in the countryside. Despite this, those activities are vital to the efficient functioning of the city and in supporting its global role (Harris, 2013). For those reasons, in order to guarantee time deliveries to customers or just to have an adequate location for their showrooms and outlets, a central location for such business is important.

In the last decades, many cities around the world, have been characterized by the process of deindustrialisation. That happend when companies, mass production and large factories moves away from high value inner cities locations, where they are seen as unsightly for an urban environment, to lower land value spots on the edge of cities or in other parts of the country.

In Brussels, the renewal process of the European city was accompanied by the rapid growth of services and knowledge economy. That turned the city into an attractive living and working environment, while pushing a huge part of industries out of the city. Productive areas disappeared into the outskirts of the city or to low-wage countries. The city turned into a place of consumption, without production (Atelier Brussels, 2016). Despite this the Brussels-Capital Region on its own produces 18.9% of the national GDP (Vandermotten et al, 2009). From to end of World War I to the early 1970s Brussels was the country's main industrial city, and in 1970 it still held 158,000 jobs in industrial manufacturing. During this period Brussels was home to some 12% of the national manufacturing jobs. The deindustrialisation process that began in the late 1960s is still continuing. In 2009, at the beginning of the financial crysis, only 38,000 manufacturing jobs were left in Brussels, a mere 5% of the Region's total employment (Vandermotten et al, 2009). The Region's economy is dominated by the public administration sectors. This is even more so when we factor in the international public function (over 21% of the total employment, without counting public status jobs such as teaching, healthcare,etc), as well as financial services and business-support services: a total of 48% of jobs.

The mentioned deindustrialisation process, both in Brussels and in other cities, led to the creation of a new type of urban economy where the services sector plays the most important role in terms of both employment and GDP. This raises some questions: Despite this, what is left about the old industrial economy in the city? How is that related to today’s city? Is it possible to identify and locate the different types of economic activities? Can we predict what is where?.

In order to answer those questions we started exploring the available existing informations about the economic sector for Brussels capital and Flanders regions. Soon we realised that a lack of knowledge exist, even if some data about activities and companies are in place. For example, existing data are spread and fragmented in different databases, often hardly comparable or joinable, moreover even if two economic activities databases are actually available for both regions, they do not reflect the reality. This mean that even while using and combining existing data, a complete view on what kind of activities are really present and how are they spread and organised on the field simply do not exist in Brussels and Flanders regions. The result is that most of the time, stakeholders, developers and policy makers do not have an overall vision on the economy of the area they are working on. This lead to a twisted vision that can affect the efficiency of proposed policies and tools.

3 METHODOLOGY

3.1 Methodology definition

The methodology we followed from the start is based on an empirical research and a learn by doing process, with the aim of identify and map what is actually used or meant to be used by economic activities. A learning by doing process is essentially about getting involved in an activity and, through the process of doing this activity, learning about it in order to answer at some questions like: how that activity works, what the activity makes you think about and how can you improve it, or what doing this activity enables you to do.

In the first place we started mapping all visible economic activities in a small area located both in Brussels capital and Flanders regions. Fieldwork has been done whilst manually collecting data about economic activities like, companies names and a small description of what was visibile,while compiling a simple table and georeferencing the entities thanks to a map created by a combination between a topographic and a cadastral maps. While using this materials we were able to collect at the same time data for parcels and buildings, resulting in a considerable amount of data to be processed. Immediately afterwards we started processing field work data, at the time we did not think about creating a database to organize collected data. For that reason all the data where digitalize directly while working in ArcMap (GIS), while typing and adding informations to existing cadastral shapefiles, both parcels and building ones. At this point a first basic classification of economic activities were defined, in order to fit every different economic entity in a specific category. The aim was not to describe all the different types of activities, but to group them in macro categories able to describe urban interactions between economic units and among them and the environment in which they are located.

It is important to point out that in this early phase of the project, even while working just on 2D maps,buildings and parcels with multiple and different activities in it were splitted in parts, one for every single economic unit. Activities located on the same parcels but on different floors whe simply included inside the parcels, without distinguish on which floor they were located. The creation and presentation of maps about economic activities location and classification in the first mapped area, created as a result of previous phases, started to generate some discussion and suggestions on how to use and improve this metodology.

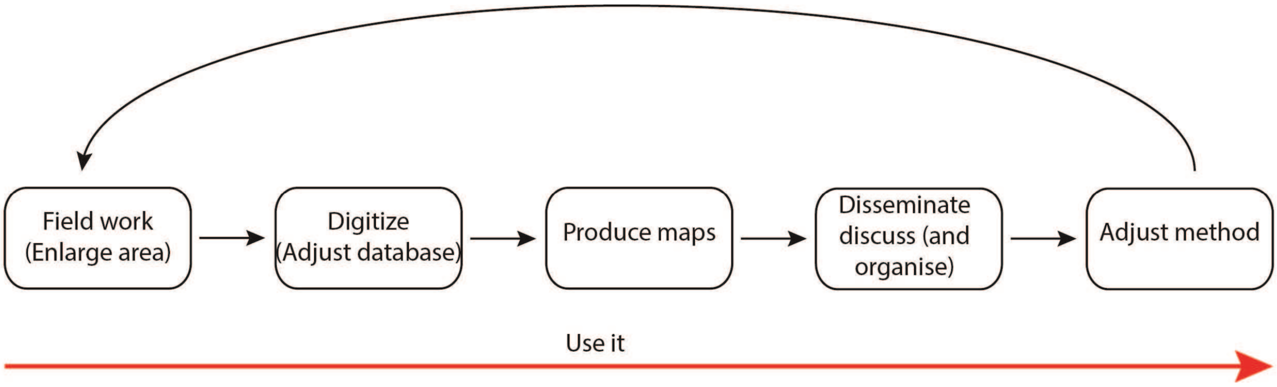

Fig.1: Project phases and cycle

First of all, at the end of the first project cicle (Fig.1) we realised that working on both parcels an buildings was too time consuming, because the same information about economic units needed to be typed twice, one for each layer. Splitting parcels and buildings to accommodate different activities in specific parts of those resulted first in a huge amount of work and then hardly updatable; every single cadastral parcel or building is characterize by a unique code called “Capakey”, an alphanumeric code made by a combination of alphabetic and numeric characters. Splitting polygons resulted into the loss of this code, making as mentioned before, an hypotetic update of collected data more and more difficult. In addition of this, in order to understand what really happend in a specific area and to contextualize it by an economic point of view, a greater amount of both data and mapped area is required. This translates into more time to be spent while doing field work, the need of a less time consuming digitalizing process and finally a bigger amount of data. Last but not least, while presenting the preliminary version and results of our project, the used classification resulted to be too generic and barely understandable. For that reason a more detailed version of it resulted to be paramount for the project continuation.

At a later time, considering all the interesting point explained above we decided to modify our metodology in order to make it more efficent, presentable and sharable with other stakeholders who started to show interest in the project and the obtained results. In the first instance the digitalization of activities in building layer has been abandoned, in order to save time. All collected data from that point onrward are referred to the parcel they are related to, identified by a unique alphanumeric code, the Capakey. As explained before this code is unique for every parcel. In addition of this, if a parcel is later divided in multiple parcels or merged with another one a new and also unique Capakey code is created and linked to it. Thanks to this, the creation of doubles inside the database is not possible, whereas is always possible to go back to the history and related data of an old parcel. Moreover some new data were collected during the fieldwork phase, like parcel dominant economic use, presence of housing, groundfloor use, number of buildings and storeys. Data collection on the field has been carried out using the same methodology previously explained, in short, a combination of a table where to write economic unit and parcels data and a map to locate them.

We decide also to look for a different way to deal with the rising amount of data, ending in the decision of creating a relational database using MS Access. Thanks to this software we were able to incorporate all data collected during the first phase and processing new data from field work in a more efficient, resilient and faster way. MS Access database allowed us to extend the amount on information that can be added to a single economic unit or parcel, data like photos or interviews are, when available, are just some examples of the potential of this tool. The creation of queries can easly improve the way of representing existing data, while producing more sofisticated and complex maps, instead of a simple “Dominant economic use” produced whit the previous methodology.

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As mentioned before, after the initial phase of the project the need for a new and more detailed economic activities classification became clear. The purpose of the second proposed and then used classification was the same as in the previous one: group activities in macro categories able to describe urban interactions between economic units and among them and the environment in which they are located. A total of 30 different categories were defined, based and developed on the work done by Mark Brearley and his students of Cass Cities (London Metropolitan University) where they studied economic activities distribution and differentiation along Old Kent Road in London. The motivation behind defined categories and a list is consultable at chapter 3.3.

During following months, once the method became clear, we started mapping and digitalizing new areas around the border between Brussels capital and Flanders regions and as a consequence, new maps showing an overall view and economic activities presence in the area were provided and used by stakeholders and policy makers in their discussions. Those discussions provide suggestions on how to adjust the methodology, mainly while changing and organising differently collected data and modifying database structure regarding different purposes and goals.

At this point the database use and creation process finally became an ongoing one. Thanks to a non stop field work and digitalization phase new areas were constantly added and, at the same time, the use and dissemination of the collected results and data in various discussions continually produced usefull feedbacks and tips. Figure 2 show mapped areas around Brussels capital region, our idea is to fill in next months the gap between the north and south areas, especially along Brussels canal.

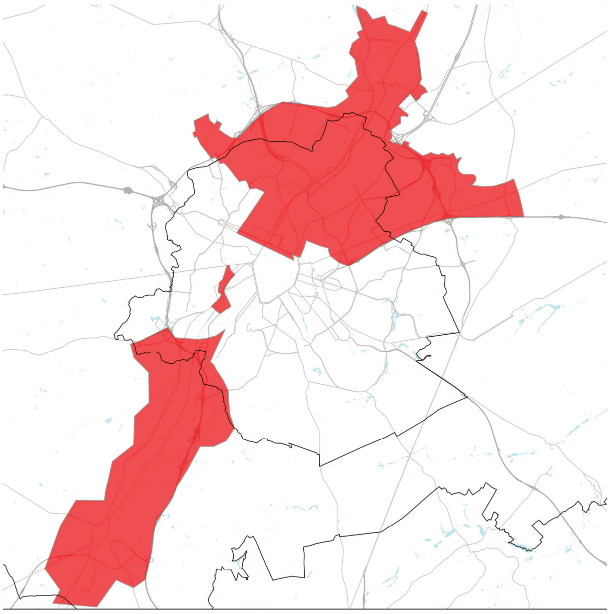

Fig. 2: Mapped areas

3.2 Economic spaces and units definition

The methodology we followed, as explained before, is based on an empirical research and a learn by doing process, aim of identify and map what is actually used or meant to be used by economic activities while directly observint at in on the field. In this project, economic activities are defined as places or units in which an economic use is visible and recognizable or as sites designed for an economic use. Shops, workshop warehouse, officies, schools and all other sites where people are actually working, or where they can work are considered. Places like former corner shops, or former industial buildings now coverted and used by housing are not taken into consideration, because in the current conditions they are not able to host an economic activity regardless their past.

It must be specified one more time that our work is not trying to describe all the different types of activities, for that there are already some more complex and sometimes not competely clear databases. What we are trying to do, is describe urban interactions between economic units and among them and the environment where they are located. For that reason all possible economic uses have been subdivided in a total of 30 differents categories representing with a good but not too deep level of the detail the economy main sectors.

As a result, we think that thanks to this categorisation is possible to give both a good overview and understandig of economy differentiation and distribution in a given area.

Manufacture: Agriculture	Vehicle Air	Wholesale: Food & Beverage
Manufacture: Metals & Machinery	Vehicle Bicycles	Wholesale: Other
Manufacture: Food, Beverages & Catering	Vehicle Cars & Trucks	Transport and storage
Manufacture: Other	Vehicle Railways	
Printing and publishing	Vehicle Water	

Servicies: Education	Retail: Food	Utilities
Servicies: Health care	Retail: Construction	Construction
Servicies: Public	Retail: Other	Arts, Culture, Leisure and sports
Servicies: Professional	Retail: Personal	Faith
Servicies: Others	Restaurants, Cafés & Takeaways	Unknown
	Hotels, B&B	Vacant

Fig. 3: Activities classification

It has to be pointed out that in our opinion not all activities have the same importance and weight in an urban environment, especially in Brussels capital and Flanders regions. For instance we decide to highlight and consider all vehicles related activities as the most important category, represented by five different subcategories, one for each way of moving and transport. Both regions are always facing problems related to traffic and congestion, due to car dependant mentality and behaviours. Consequently vehicle related activities and especially car related one, are widespread but usually not well understood in their distributions, dimensions and differentations. Be aware of those informations regarding vehicle related activities can for instance give a great knowledge support in transport related policy making process, that nowadays do not exist or is not properly considered.

We used decision trees to better explain how the coding process has been carried out, starting from how to define an economic space, then divide it into economic units, while making one record for each of the entities visible in the building or on the parcel and finally the definition of the activity code, based on the different weights defined for each one of the 30 categories showed in Fig.3.

3.3 Qualitative control and integration with other databases

This methodology works smoothly and quickly, and led us to cover big areas in a relative shot period of time producing a decent amount of new data. Despite of this considering that the majority of field and digitalize works are carried out manually, the possibility than some human errors are done exist and it is real. Some commons errors we are already facing are:

- Location of an economic unit on a wrong parcel;
- Typing and spelling mistakes in company name, description or code;
- Wrong choice of an activity code.

For that reason a phase of qualitative data controls is essential, in order to maintain the utility and a good overall quality for the proposed and created data. We think that multiple options are available but, they have not been yet applied to our database. It has be to pointed out that in our opinion a quality control is characterised mainly by two type of actions. Corrections, when data about an activiy are mainly correct but there are some errors which do not affect the final activity categorisation, and updates that are defined as incongruities between data on a specific location and the company actually located there.

Some examples of possible quality controls options are here explained. Drop-down menus for specific fields represent and easy and fast way to avoid typing errors in fields that are filled with a limited numbers or letters, i.e activity code or date. Queries could be used to double check the presence of doubles or incomplete rows and fields, like the dominant use or combined with housing ones. Quality field work done for limited samples and within a short period of time since the first visit can provide corrections and updates immediately applicables. The creation of a link with existing databases, even referred just to one or few economic categories, could integrate and help verify a part of the collected data. Last but not least,the diffusion,discussion and use of the database in existing planning programmes could lead to an overall quality improvement, thanks to the knowledge and experience of people actively involved in related processes.

4 ANALYSIS RESULTS

In this chapter we present some results obtained while analyzing collected data for the northern area between Brussels capital and Flanders regions. All maps showed below are made while importing and then processing database data from MS Access into Arcmap (GIS). Those maps represent just few example of the possible applications and uses of existing dataset and, are actually used as a base of common and shared knowledge in several discussions and projects in Brussels capital and Flanders regions.

4.1 Base maps and queries

The first and for the moment most used map we produced (Fig. 4), the “Dominant economic use” one, allow us to show mainly a complete overview of mapped areas and how and where economic activities are located. For each parcel only the dominant economic used is showed, even if more and usually different economic uses are present on the same parcel. A selection query about dominant uses of parcels done in MS Access led to the creation of this map.

Fig. 4: Dominant economic use map

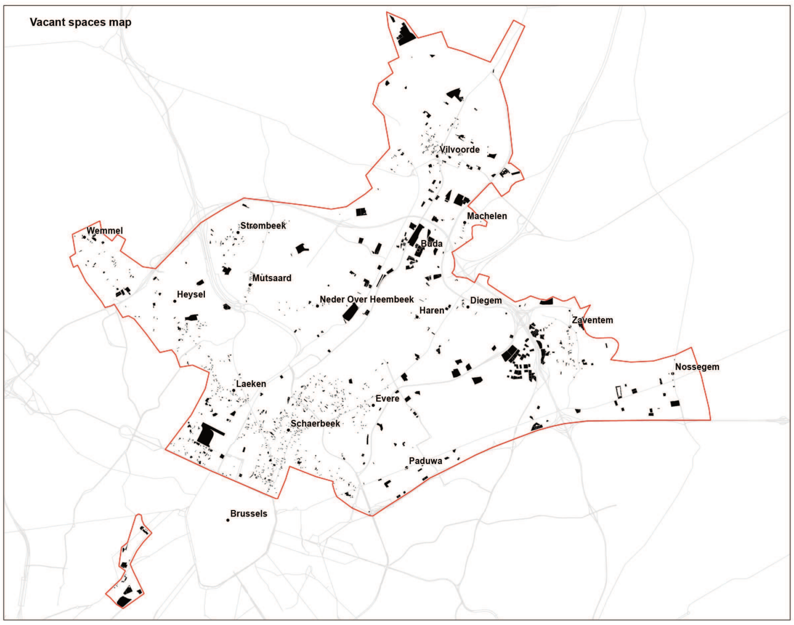

Fig. 5: Vacant economic spaces map

Thank to MS Access selection queries is also possible to extract and visualise just specific categories from the original dataset, that in a complete overview like the one showed above are sometimes not so easily visibles. One interesting example of this is shown in Fig. 5 and represent all the parcels with a vacant economic unit in it. Stakeholders, developers and companies are always looking for empty spaces informations, because those could represent new opportunities for each one of them. For that reason some data about vacant buildings or parcels are already available in both regions, representing a good possibility of double checking and integrating our database.

4.2 Hot spot Analysis

This analisy has been carried out using the Hot spot Analysis tool (Getis-Ord GI*) present in Arcmap (GIS). This tools work by looking at each feature withing the context of neighboring features. A feature with high value (i.e. number of economic units and companies within a parcel) is interesting, but may not be statistically significant hot spot. To be a satistically significant hot spot, a feature will have a high value and be surrounded by other features with high values as well (Zaman, 2014). In addition of this the result depend also by the distance band considered around every single point as shown by Fig. 6 and 7. The base of data used in this phase has been create by converting and clumping in a point layer all the data about economic units, in short, one point for each unit referred and located on the parcel centroid.

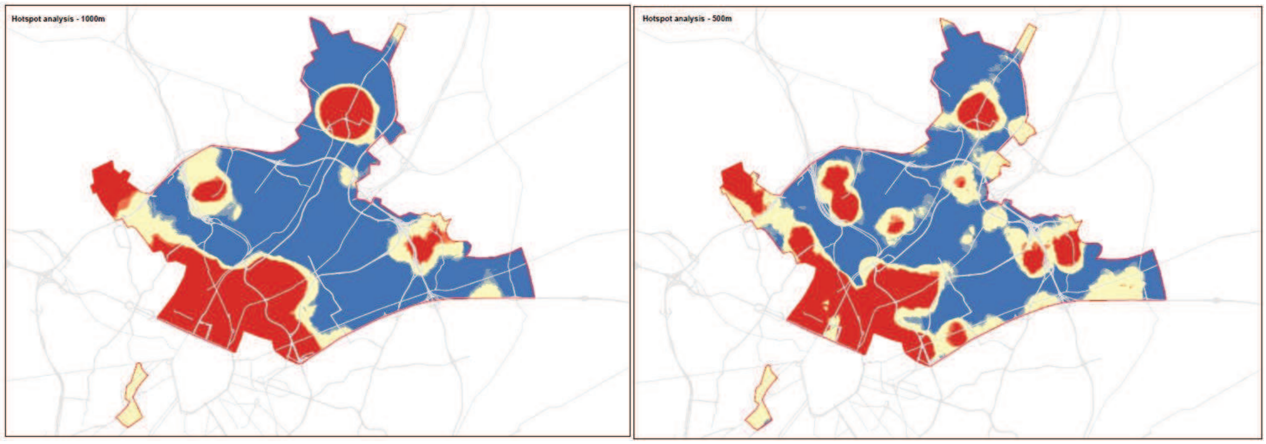

Fig 6: Hot spots Analisys with 1000m and 500m distance bands

Colour scale goes from more dense areas (Hot spots = Red ones), where more activities are located to low density areas (Cold spots = Blue ones) where density is lower. 1000m distance band map show areas with the highest density of economic activities in Brussels northern area, located mainly around the city and in Vilvoorde, the main small-medium size town in the area. Low density areas are not completely empty of economic activities, this became clear while looking at 250m and 150m distance band Hot spot Analysis versions (Fig. 7). Areas like village centers, office parks and industrial areas start being visibles giving a first detailed view of the economy structure and distribution in the area.

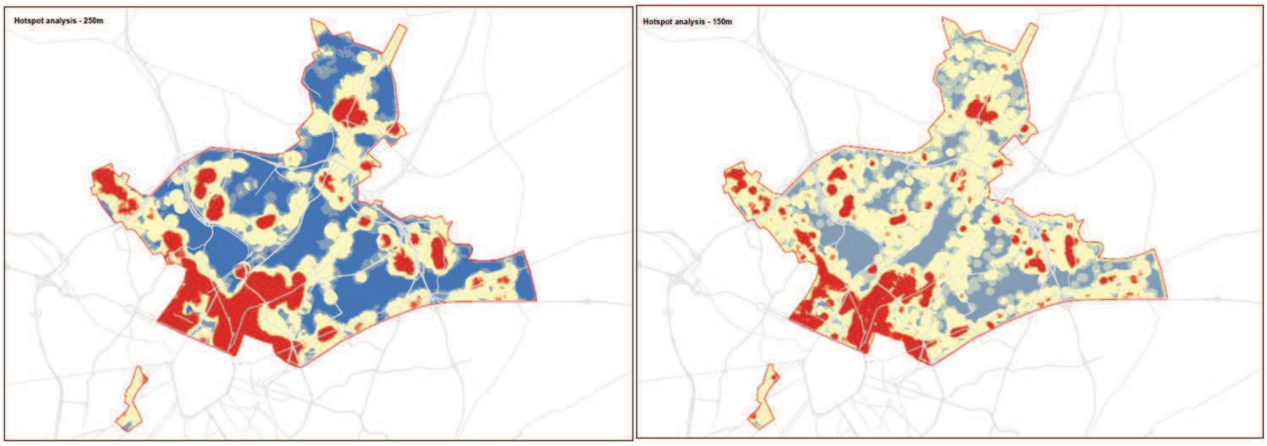

Fig.7: Hot spots Analisys with 250m and 150m distance bands

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4.3 Cluster Analysis

We decide to try move our analysis in a more specific level of detail while working on clusters level. First notable difference between the maps showed in previous chapters and the two presented here (Fig. 8a and 8b), is the difference of scale. This because cluster analysis results do not depend by the size of considered area, like Hot spot Analysis, and let you work both on a sample size or on the maximunt extent of you dataset while obtaining omogeneous results. In this case we choosed to work on a sample scale, in order to test our metodology and respresent results with a decent level of detail. The idea of analyse this specific type of clusters pop up after the creation of the previous explained “Dominant economic use“ map, where we noticed agglomeration of similar or probably related activities.

First map (Fig. 8a) represent an analysis about economic clusters of retail, restaurants, hotels and bars. An economic cluster refer to a relatively geographically bounded group of similar, related or complementary enterprises which are functionally interconnected and share commons infrastructures and servicies. Clustered shops, restaurants, hotels and bars that are either larger than 10000m^2 or less than 50m away from the next clusters are visible in pink. In blue outline others bars, shops etc. not included in clusters are represented as a reference. This analysis could be easly repeated for other categories (i.e. offices or vehicle related activities) and scaled up even if a 9 steps Arcmap (GIS) producure is needed to modify original dataset and obtain this result.

Fig. 8a: Economic Cluster analysis. Fig. 8b: Education activities in relation to retail clusters (education activities in Green scale, quantile classification in 5 classes)

In the second and last map (Fig. 8b) education related activities, like schools of every type and level are related with “retail, restaurants, hotels and bars“. The purpose was to identify if there were any relation between those two categories, considered that in our opinion schools are often served by bars, restaurant, snack bars and groceries shops in their surroundigs. Schools are represented while using a green coloured scale, where a darker greens are used when distance between schools and other activities is relatively small (i.e. between 0 and 30 meters) and light ones when distance became longer (i.e. more than 30m). In blue outline bars, shops etc. are represented as a reference. Thanks to obtained results is possible to declare that in our sample schools are frequently surrounded by the above mentioned activities, within a short walkable distance. In our sample area, around 20% of the education activities are next to retail activities, and a total of 80% of the schools have retail activities within 60 meters.

4.4 Shopping streets analysis

In the last part (Fig.9), thanks to the results obtained by the previous GIS analysis phase, we decided to focus on shopping streets, considered their constant presence and importance inside the project area. We identified and defined two different types of shopping streets: Regional (1) and local ones (2 to 5). The classification in this two categories is based on some specific characteristics and our knolwedge about each of the five sites, like for example the spatial and economic relevance. Regional shopping streets (1), like Rue de Brabant in

Brussels, are characterized by a monofunctional use (Retail, restaurants and bars), with an extremely low number of vacant spaces, and a similar scale of building sizes. The importance of this streets led to the creation of a solid structure that usually is not effected by changes in surroundigs areas or in the neighborhood. As a consequence shop prices tend to be higher than in other less relevant streets, and activities (Servicies, offices, grocery stores or agencies) that can not afford high rents or prices tend to be pushed out to other cheaper places. A quick rental market research about site n.1 showed that 480€/m^2 (Citydev.brussels, 2017) per year is a good and indicative value about rents inside a regional shopping street in Brussels.

Fig: 9: Shopping streets

On the other hand, local shopping streets (2 to 5) are characterized by differents uses. Retail, restaurant and bars remain the dominant activities, but despite this they are mixed with a lot of other different activities like hairdressers, travel or employment agencies, car repair, grocery shops, supermarkets and last but not least schools and hospitals. The last two mentioned activities are actually playing an important role in the structure of local streets, not just because their different and bigger scale but also for the reason that they function as attractors for other activities, like explained before in chapter 4.3 for schools. In addition of this the number of vacant spaces is higher in the local streets than in regional ones, this togheter with mixity reveals a more fragile structure. The creation of a new shopping center nearby, changes related to mobility or policies inside the street itself or in the surroundigs could really effect and damage this already fragile structure. Rental market prices for the considered local shopping streets, located in Brussels capital region (3 and 4) and not more than 20 Km away from the city center (2 and 5), result to be lower than previous ones, range between 260 and 375 €/m^2 per year (Immoweb, Realo, 2017). Finally, is possible to declare that local shopping streets are a good example of how different economic functions and scales can work togheter in the same environment, while sharing spaces and infrastructures.

5 CONCLUSIONS

Building a database showing the way economic activities are visible in the field is a much needed but achievable goal. Through the first phases of the project, we gradually made the data collection easier to do and the method is now widely accepted by the main actors. Discussions with people involved in spatial and economic data collection and visualisation were extremely helpful and each presentation and debate improved the database. We saw that the more territory that was covered by the database, the relevance of the maps increased, both as a policy instrument and for research purposes.

Now we have a coverage that is large enough to start spatial and economic analysis. In a next step we will try to highlight different patterns, similar to the cluster, and hot spot analysis shown in this paper. A more detailed analysis, like the shooping streets one, based on the combination between GIS data, morphology and other spatial or economic data will be required, in order to obtain a better understanding about economic dynamics.

The main challenge remains the use of the database as a first step in auditing the economy in relation to spatial policy preparation. The selection of the territory started from a need of better understanding the

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economy in specific areas in the Brussels Northern area, where we are using the database inside a spatial planning proces. To this moment, the use of the data is very promising and seems to guide us towards new insights in spatial and economic dynamics.

6 REFERENCES

ALLMENDINGER, Philip, TEWDWR-JONES, Mark: Post-thatcherite urban planning and politics: A Major Change?. In: International Journal of Urban & Regional research, pp 164 – 182. 1997.

ATELIER BRUSSELS, A good city has industries. Brussels, 2016

FERM, Jessica , JONES, Edward: Beyond the post-industrial city: Valuing and planning for industry in London. In: Urban studies. 2016

FRIEDMANN, Jone: Globalization and the emerging culture of Planning. In: Progress in Planning 64, pp 183 – 234

HARRIS, R. : Servicing the services and smart sheds. 2013

MEGA, Voula: Urban dimensions of sustainable development. In: Human settlement development, Vol. IV. 2009

VANDERMOTTEN, Christian, LECLERCQ, Els, CASSIERS, Tim, WAYENS, Benjamin : The Brussels Economy. In: Brussels studies. Brussels, 2016

ZAMAN, Jan: Competition between cities and regions in Europe. Can smart spatial planning interact with gravitational site locations models for external investment?. In: Real Corp 2014. Wien, 2014

ZHENSHAN, Yang: The role of economic clusters in improving urban planning support. 2010

Change Detection im städtischen Umfeld von Graz/Österreich mit sehr hoch auflösenden UltraCam-Daten

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1 ABSTRACT

Dieser Beitrag befasst sich mit der Analyse von Landnutzungsänderungen mittels hochauflösender UltraCam-Daten in einer städtischen Umgebung. Das Hauptziel ist es, herauszufinden, ob die Daten geeignet sind, um Landnutzungs- bzw. Landschaftsveränderungen in Städten, die sich durch hohe Heterogenität und rasche Veränderung auszeichnen, halbautomatisch zu erkennen. Die theoretischen Ansätze und Fernerkundungsänderungserfassungsprinzipien werden im ersten Teil des Beitrages behandelt. Die Anzahl der Änderungserkennungsmethoden ist enorm und daher wird ein "Stand der Technik" präsentiert. Der zweite Hauptteil widmet sich der Entwicklung einer Änderungserkennungsmethode für Testgebiete der Stadt Graz und deren Anwendung auf das gesamt Stadtgebiet. Dabei wird ein objektbasiertes, wissensbasiertes Hybridänderungs-Erkennungsverfahren, bzw. die Integration von „image differencing, image rationing and principle component analysis“ angwandt. Die Umwelteinflüsse und Dateneigenschaften, die einen großen Einfluss auf die Genauigkeit des Änderungserfassungsergebnisses haben, werden sowohl für die Befliegungszeiträume (September 2007, Juni 2011 und März/April 2015) dokumentiert und erörtert.

Der letzte Teil dieses Aufsatzes beschäftigt sich mit der Diskussion der Ergebnisse der Change Detection Analysen und der Eignung der erreichten Methodik für die Anwendungen in der städtischen Planung durch das Magistrat Graz.

Keywords: Fernerkundung, Stadtmodell, Ultracam,. Monitoring, Landnutzung

2 EINLEITUNG

Die Erforschung der Änderungserkennung („change detection“) mit sehr hochauflösenden Fernerkundungsdaten ist relativ neu. UltraCam X Luftbilddaten wurden noch kaum in einem Change Detection Ansatz für Städte verwendet. Vergleichbare Daten, z.B. DMC (Z/I IMAGING (www.ziimaging.com), ADS 40 (LEICA GEOSYSTEMS, www.gis.leicageosystems.com), HRSC-AX (DEUTSCHES ZENTRUM FÜR LUFT- UND RAUMFAHRT, www.dlr.de) oder ADAR 5500 (POSITIVE SYSTEMS, www.possys.com) wurden in verschiedenen Change Detection Projekten weltweit eingesetzt.

Das Hauptziel des hier vorgestellten Projektes war es, eine Methodik zur Change Detection Analyse mit High-End UltraCam X Daten in der Stadt Graz zu entwickeln Die Studie konzentriert sich auf drei verschiedene Arten von Veränderungen: Höhenänderung, zweidimensionale Veränderung von Objektformen und thematische Veränderungen (Bodenbedeckung/Bodennutzung). Besonderes Augenmerk wird auf Veränderungen der Gebäudeflächen, der versiegelten Flächen und der Vegetationsstrukturen gelegt.

Eine umfassende Kategorisierung von Change Detection Techniken ist eine schwierige Aufgabe und daher gibt es keine einheitliche Klassifizierung der verwendeten Methoden. Trotzdem haben mehrere Autoren ein Klassifizierungsschema für Änderungserkennungstechniken erstellt. SINGH (1989) ist einer der Pioniere auf diesem Gebiet. In seiner Arbeit fasst er den Stand der Technik der Veränderungserkennungstechniken im Jahr 1989 zusammen. Die beschriebenen Methoden beinhalten „image differencing, image regression, image rationing, vegetation index differencing, principle component analysis, post-classification comparison, direct multitemporal classification, change vector analysis, background subtraction“ und andere Methoden. Man könnte diese Methoden aus der gegenwärtigen Perspektive als "klassische" Techniken beschreiben, die in den letzten zwei Jahrzehnten erfolgreich in zahlreichen Anwendungen eingesetzt wurden. SINGHs Veröffentlichung ist daher eine der am häufigsten zitierten Publikationen in der Fernerkundung. DEER

(1995) teilt Veränderungserkennungstechniken in zwei grundlegende Ansätze: „comparative analysis of independently produced thematic labellings or classifications of imagery from different dates" und „simultaneous analysis of multi-temporal data". Innerhalb dieser beiden Ansätze unterscheidet er mehrere Methoden und Techniken, die bereits von SINGH (1989) erwähnt wurden, sowie statistische Tests und einige neue Techniken wie „computer vision" oder „image understanding". COPPIN et al. (2004) stellen fest, dass alle in der Literatur dokumentierten Änderungserfassungsalgorithmen in neun verschiedene Kategorien und eine hybride Gruppe zusammengefasst werden können (Tab.1). Die neun Kategorien sind:

post-classification comparison	change vector analysis
composite analysis	image regression
univariate image differencing	multi-temporal spectral mixture analysis
image rationing	multidimensional temporal feature space analysis
bi-temporal linear data transformation	

Tab. 1: Change-Detection-Kategorien nach COPPIN (2004).

IOANNIDIS et al. (2009) kategorisieren die fernerkungsbasierte Change Detection nach dem Maßstabsbereich, wobei zwischen kleineren und großflächigen Änderungserkennungsanwendungen unterschieden werden kann. Die kleine Maßstabsklasse enthält einfache, „low level" Algorithmen (wie „image differencing, image rationing" und „principal components analysis"), „medium level" („object oriented classification, feature and texture segmentation") und hochrangige, „high level" („knowledge based methods") Gruppen. Die groß angelegte Kategorie umfasst anspruchsvollere Ansätze wie künstliche neuronale Netze. Weitere Change Detection Algorithmen werden von YIANJA et al. (2008) und PACIFICI et al. (2007) beschrieben. YIANJA et al. (2008) stellen ein Klassifizierungskonzept von Änderungserfassungsalgorithmen vor, in dem festgestellt wird, dass für die bi-temporale Änderungserkennung die Algorithmen auf einen der folgenden drei Ansätze zurückzuführen sind: direktes Vergleichen verschiedener Datenquellen („direct comparison method"), Vergleich von getrennten Klassifikationen („post-analysis comparison method") oder die Integration aller Datenquellen in ein einheitliches Modell („uniform modelling method"). PACIFICI et al. (2007) unterteilen Veränderungserkennungsmethoden in „unsupervised" und „supervised" Ansätze. Der „unsupervised" Ansatz umfasst klassische Methoden wie „image differencing, image rationing" oder „change vector analysis" und einige andere statistische Ansätze, während der „supervised" Ansatz Methoden wie „post-classification comparison, direct multi-date classification" oder „neural networks" umfasst. LU et al. (2004) entwickeln eine umfassende Kategorisierung von Änderungserkennungsmethoden durch die Zuordnung jeder Technik zu einer von sieben spezifischen Gruppen von Änderungserkennungsmethoden: „algebraic operations, transformations, classification, advanced models, GIS, visual analysis" und andere Techniken.

Alle Kategorisierungsansätze und Überprüfungen von Change Detection Verfahren haben gemeinsam, dass sie aufgrund der großen Anzahl von Techniken nicht vollständig sind, wobei der Ansatz von LU et al. (2004) der Anspruchsvollste zu sein scheint. Alle Änderungserkennungsmethoden der „transformation category" haben gemeinsam, dass sie die Datenredundanz minimieren, um Änderungsinformationen in den abgeleiteten Komponenten zu extrahieren. Ähnlich wie bei algebraischen Methoden besteht der Hauptnachteil darin, dass sie keine vollständigen Änderungsmatrizen ableiten können und geeignete Schwellenwerte ausgewählt werden müssen. Die Interpretation und Kennzeichnung der Änderungsinformationen ist eine komplexe Aufgabe, weshalb der/die BearbeiterIn eine gute Kenntnis der verwendeten Daten und des Untersuchungsgebietes besitzen muss. Die Erkennungsmethoden der „transformation category" kann für eine Vielzahl von Anwendungen verwendet werden, einschließlich der Veränderung der Erkennung von Vegetation oder Wasser und der Extraktion von Änderungsinformationen in städtischen Umgebungen.

3 DATENGRUNDLAGEN UND UNTERSUCHUNGSGEBIET (FIG. 1)

Alle Daten wurden vom Stadtvermessungsamt der Stadt Graz bereitgestellt. Zusätzlich zu den an drei verschiedenen Befliegungen (2007, 2011 und 2015) aufgenommenen UltraCam-Daten wurden jeweils photogrammetrisch digitale Oberflächenmodelle (DSM) generiert. Als digitales Geländemodell (DEM) wurden Lidar-Datensätze verwendet. Die erste Bilderfassung wurde am 22. und 23. September 2007 mit der UltraCam X-Kamera von "FFM Forest Mapping Management" durchgeführt. Zudem wurden während des Fluges ein GPS-Empfänger und eine Inertial-Messeinheit (IMU) eingesetzt, um die Bildaufnahme zu unterstützen und die Bildrektifikation zu erleichtern. Die Kamera besteht aus acht unabhängigen Kameraeinheiten, von denen vier zum panchromatischen Bild beitragen und vier zum multispektralen Bild beitragen. Die zweite Bilderfassung von UltraCam-Daten fand am 22. Mai 2011 statt, wieder mit dem UltraCam X. Ähnlich wie bei dem Flug 2007 wurde Graz in zwei Blöcke aufgeteilt, aber diesmal wurden die Bilder mit einer räumlichen Auflösung von 6 cm statt 8 bzw. 16 cm aufgenommen. Die radiometrische Auflösung in der 2011 und 2015 Bilder beträgt 16 Bit, die aus dem Jahre 2007 8 Bit. Es wurden RGB- und CIR-Daten aufgenommen. Die UltraCam-X (SCHNEIDER und GRUBER 2008, GRUBER et. al 2009) Befliegungen wurden mit einer (resampled) geometrischen Auflösung von 25cm verwendet, da eine Prozessierung in der Originalauflösung an die Grenzen der Hard- und Software stößt.

Folgende Daten wurden verwendet:

- Ultracam X aus den Befliegungen 2007, 2011 und 2015:
  - RGB
  - CIR (25cm)
  - DSM (25cm) inkl. nDSM (2007-2011 und 2011-2015)
- DTM 2011 aus Laserscanner Daten (1m), Resampling auf 25cm

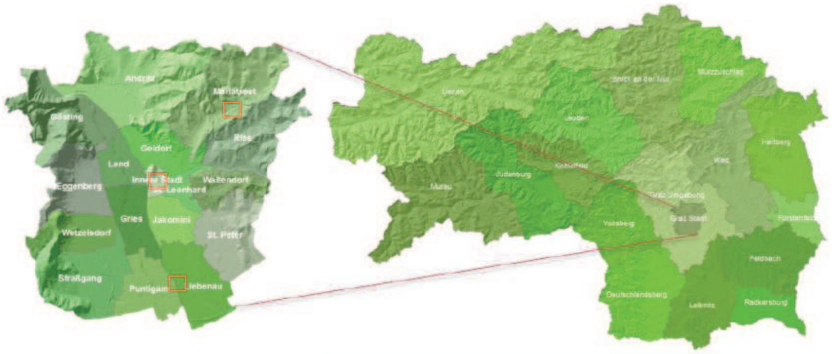

Fig. 1: Die Lage des Untersuchungsgebietes innerhalb der Steiermark (Österreich), die Bezirke der Stadt Graz und die Lage der Testgebiete (MUICK 2011)

4 METHODIK

Die Auswahl einer geeigneten Methode hängt stark von den Dateneigenschaften, dem Untersuchungsgebiet und der Forschungsfrage ab. Die Änderungserkennungsanalyse für diese Studie zeichnet sich durch eine hohe räumliche Auflösung der multispektralen Daten in einer städtischen Umgebung aus, die die Anzahl geeigneter Methoden begrenzt. Die offensichtlichste Änderungserkennungsmethode für diesen spezifischen Datenaufbau ist die „post-classification comparison“, die auch in einem anderen Projekt am Institut für Geographie und Regionalforschung (SULZER et al., 2013) verwendet wurde. EICHBERGER und SULZER (2005), SULZER (2016) analysierten den Urbanisierungsprozess in Graz zwischen 1944/1945 und 2015. Für die Langzeitstudien nutzten sie 12 Serien von Luftaufnahmen in Abständen von etwa fünf bis zehn Jahren. Das Hauptziel war es, eine homogene GIS-Datenbank zu erstellen, um Stadtplaner bei der Entscheidungsfindung zu unterstützen. SULZER UND KERN (2009) untersuchten die Entwicklung der Versieglung von Graz in einer mehrstufigen Veränderungsanalyse mittels multispektraler DAEDALUS Scannendaten.

Ziel der vorligenden Studie ist es daher, Änderungsinformationen zu generieren, ohne jedes Bild des multiltemporalen Datensatzes einzeln zu klassifizieren. Ein Ansatz, um dies zu erreichen, ist die spektral-zeitliche kombinierte Analyse, bei der alle Bilddaten in einen Datenlayer integriert werden, der dann auf Veränderungen hin analysiert wird. Diese Methode wurde gewählt, weil es in der Literatur als ein vielversprechender Ansatz für die Veränderungserkennung mit hoher räumlicher Auflösung betrachtet wird. Darüber hinaus wurden mehrere andere Methoden wie „image differencing, image rationing and principle component analysis“ berücksichtigt. Eine wissensbasiertes Regelwerk wurde erstellt und auf die UltraCam-Daten in der eCognition Developer-Softwareumgebung angewendet. Die objektbasierte Bildanalyse wurde aufgrund der sehr hohen räumlichen Auflösung gewählt. Die entwickelte Methodik kann als objekt- und

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wissensbasierte Hybridmethode zusammengefasst werden, die spektral-zeitliche kombinierte Analyse, Bilddifferenzierung, Bildratiobildung und Hauptkomponentenanalyse kombiniert.

Die dargestellte Methode kann keine komplette Änderungsmatrix liefern. Allerdings ist dies nicht das Ziel dieser Studie, weil veränderte Gebiete im Vergleich zum vollen Umfang des Stadtgebietes spärlich sind, so dass die meisten Änderungsklassen einer kompletten Änderungsmatrix höchst unwahrscheinlich sind (z. B. Wasser zu versiegelte Oberfläche, versiegelte Oberflächen zu hoher Vegetation oder Gebäude zu Wasser). Die Landnutzungs- und Bodenbedeckungsklassen "Gebäude", "Vegetation" und "versiegelte Flächen" werden separat behandelt, da einige spezifische Bereiche mehr als einer Veränderungsklasse entsprechen können (z.B. es könnte ein Baum gefällt und ein Neubau an der gleichen Stelle errichtet werden - daher gehört das Gebiet zu den Klassen "gefällter Baum" und "Neubau"). Für eine Änderungskarte können die Ergebnisse jedes Algorithmus in einem Nachverarbeitungsschritt kombiniert und visualisiert werden. eCognition Developer wurde verwendet, um eine objektbasierte Change Detection Analysis durchzuführen. Ein Klassifizierungsprozess innerhalb dieser Softwareumgebung umfasst immer zwei Hauptschritte: Segmentierung und Klassifizierung (STOW et al. 2008). Die Segmentierung des multitemporalen UltraCam-Datensatzes erfolgte mit den RGB- und Infrarotdaten. Darüber hinaus wurden die DSMs beider Termine integriert, um bessere Segmentierungsergebnisse zu erzielen.

Die Methode wurde von SALENTINIG (2012) im Rahmen seiner Masterarbeit am Institut für Geographie und Raumforschung entwickelt. Weitere Informationen können u.a. auch aus SULZER et al. (2008, 2009, 2013, 2016); entnommen werden. Die Analysen für den Datensatz von 2015 wurden von PFEILER und MOLLATZ durchgeführt. Für die Entwicklung der Change Detection Methodik wurden im Grazer Stadtgebiet zwei Testgebiete, die jeweils für eine bestimmte Bebauungsstruktur repräsentativ sind, ausgewählt (Fig.2 und Fig. 3) und anschließend auf das gesamte Stadtgebiet angewandt.

Fig.2: UltraCam Daten von 2007 (links), 2011 (Mitte) und 2015 (rechts).

Fig.3: UltraCam Daten von 2007 (links), 2011 (Mitte) und 2015 (rechts).

4.1 Veränderung von Gebäuden

Ähnlich wie bei BOUZIANI et al. (2010) wurde ein Regelwerk entwickelt, um Informationen über die Veränderung von Gebäuden zu extrahieren. Sie enthält Regeln, die Bildobjekte identifizieren, die entweder von einer Landnutzungs-/Landbedeckungsklasse auf "Gebäude" oder von "Gebäude" zu etwas anderes übertragen werden. Daher ist das Ergebnis des Algorithmus eine Klassifikation, die die Veränderungsklassen "Neubau" und "abgerissenes Gebäude" umfasst (Fig. 4). Da das Regelwerk stark hierarchisch aufgebaut ist, ist es wichtig, die Regeln Schritt für Schritt im eCognition-Developer zu implementieren, da die Ergebnisse jedes Prozesses die Grundlage für den nachfolgenden Klassifizierungsschritt bilden. Der komplette Gebäudewechselerkennungs-Workflow wird in Fig. 5 (links) visualisiert.

Fig.4: Mögliche 2D Gebäudeveränderungen

4.2 Änderungen der Vegetation (Fig. 5, rechts)

Die Vegetationsstruktur wurde in drei Höhenstufen eingeteilt: Hohe Vegetation (über 3,5 Meter), mittelhohe Vegetation (zwischen 1,5 und 3,5 Meter) und Bodenvegetation (unter 1,5 Meter). Dadurch wird es u.a. möglich zwischen Baum und Busch zu unterscheiden. Der Algorithmus für beide Vegetationstypen ist grundsätzlich gleich, aber die Schwellwerte für das Regelwerk mussten für die Erkennung der Buschänderung angepasst werden. Zuerst wurden alle Bäume und Sträucher in den Bilddaten von 2007, 2011 und 2015 klassifiziert, um eine Basis für die anschließende Klassifizierung von Vegetationsveränderungen in eCognition Developer zu generieren. Darauf folgte die Anwendung des bisher entwickelten wissensbasierten Regelwerks.

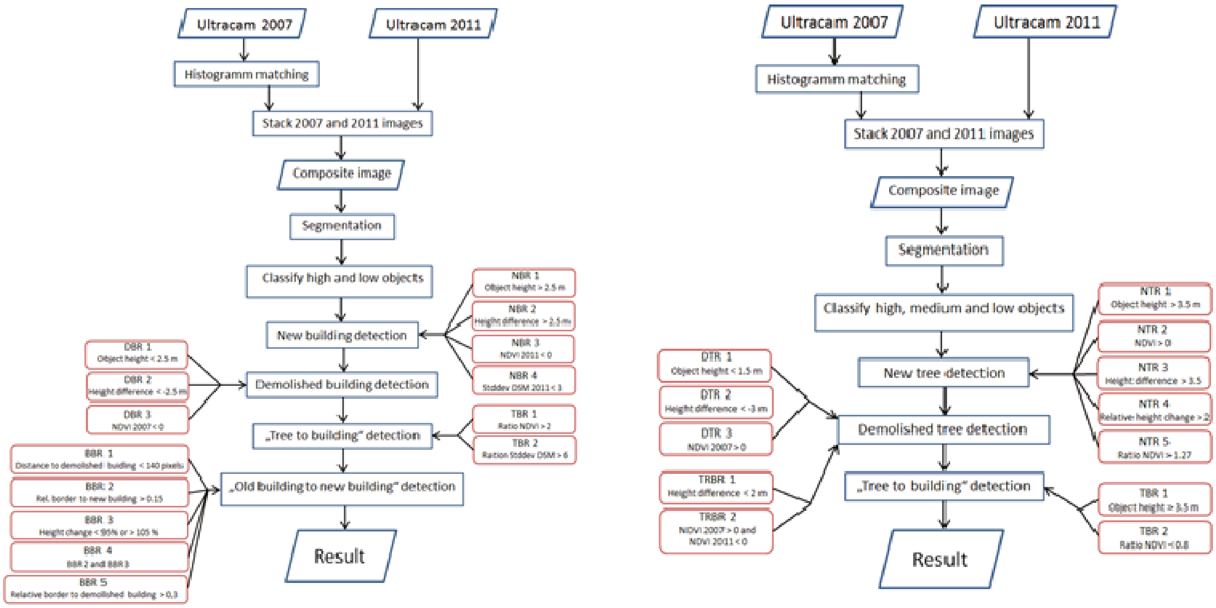

Fig. 5: „Gebäude Change Detection Workflow“ (links) und „Vegetation Change Detection Workflow" (rechts).

4.3 Änderungen der versiegelten Flächen

Der Change Detection Ansatz für die versiegelten Flächen stellt den einfachsten Algorithmus dar. Sobald ein Gebiet, das ursprünglich mit Vegetation bedeckt war, in eine versiegelte Fläche umgewandelt wird, ist dieser Prozess meist nicht mehr umkehrbar. Versiegelte Oberflächen sind Bodenobjekte. Erhöhte versiegelte Flächen (über 2,5m) wurden als Gebäude klassifiziert. Da versiegelte Bereiche fast keine photosynthetische Aktivität zeigen, ist auch der „normalisierte differenzierte Vegetationsindex“ (NDVI) sehr gut geeignet. Die Hauptkomponentenanalyse ist zudem ein sehr häufiger und geeigneter Ansatz zur Erkennung von Veränderungen in der Landnutzung/Landbedeckung und erwies sich auch als sehr nützlich für die Erkennung von versiegelten Oberflächen.

5 ERGEBNISSE

5.1 Veränderung von Gebäuden

Die ersten Schritte des Algorithmus sind der Erkennung neuer Gebäude gewidmet, die auf ehemals flachen Gebieten (z. B. landwirtschaftliche Felder oder Wiesen) gebaut wurden. Alle Gebäude mit einer Mindesthöhe von 2,5 Metern wurden dabei ausgewiesen. Objekte, die kleiner als 2,5 Meter waren, wurden nicht berücksichtigt, da diese im traditionellen Sinne nicht als "Gebäude" bezeichnet werden können. Allerdings wurden auch Anhänge an bestehende Gebäuden oder kleine Neubauten wie Gartenhäuschen (mit entsprechender Höhe) erfolgreich klassifiziert. Fig. 6 bis Fig.8 zeigen korrekt erkannte neue Gebäude in

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unterschiedlichen Bebauungsstrukturen. Die Gebäudeveränderungen („Change Map“) des gesamten Stadtgebietes werden in Form von einzelnen Mappenblättern dargestellt erfolgen (Fig. 9 und Fig 10).

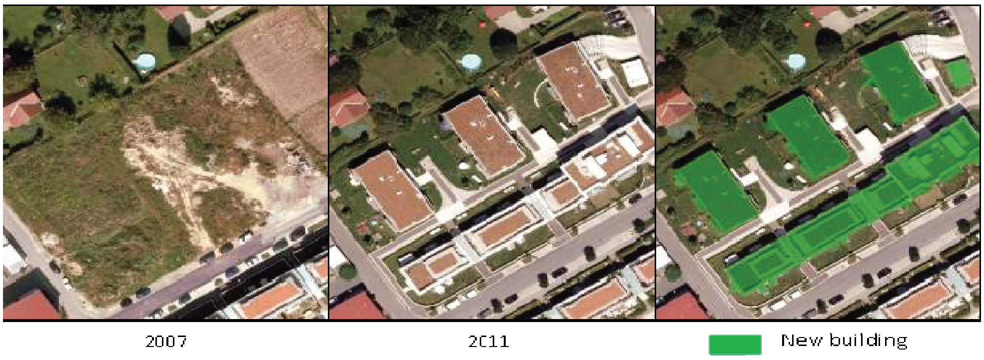

Fig. 6: Richtig detektierte neue Gebäude.

Fig. 7: Ein richtig klassifizierter Gebäudezubau.

Fig. 8: Korrekt klassifizierte Objekte der Klasse "old building to new building".

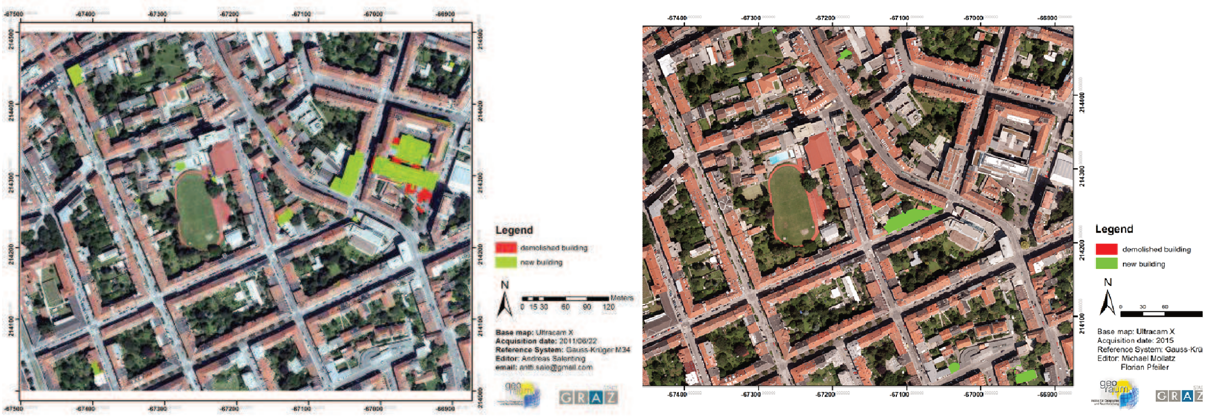

Fig. 9: Gebäudeveränderungen im Bereich der Neuen Technik (links: 2007 auf 2011, rechts: 2011 auf 2015).

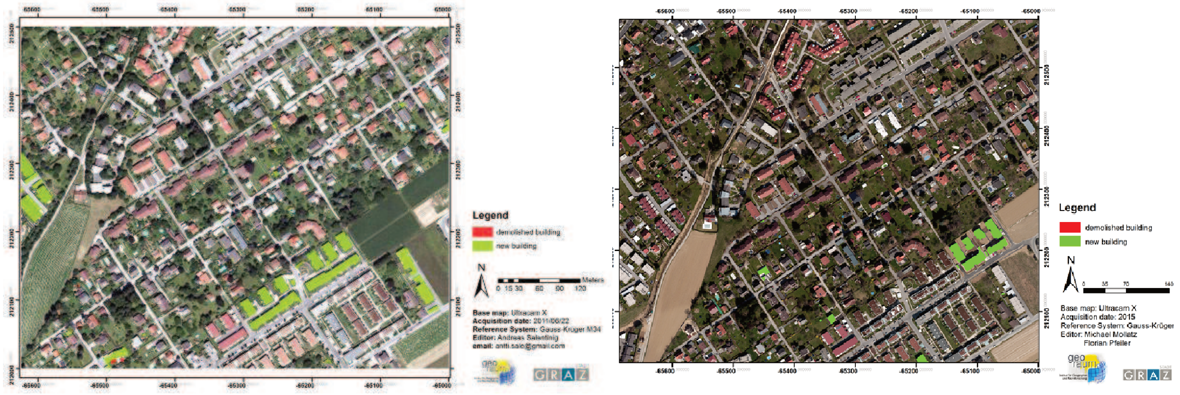

Fig. 10: Gebäudeveränderungen im Bereich Sternäckerweg (links: 2007 auf 2011, rechts: 2011 auf 2015).

5.2 Änderungen der Vegetation

Die Änderungserfassungsalgorithmen für Bäume und Büsche lieferten gute Ergebnisse. Neu gepflanzte sowie gefällte hohe und niedrige Vegetation wurden durch die Anwendung der Algorithmen auf die UltraCam Daten genau abgegrenzt. Fig. 11 und Fig. 12 zeigen Beispiele von Objekten, die korrekt als "Neupflanzung" und "gefällter Baum" klassifiziert wurden. Fig. 13 zeigt eine Darstellung der Veränderungen von Baumkronen. Der Algorithmus erzielte zufriedenstellende Ergebnisse für die Klassifizierung von Objekten, die zu diesen Klassen gehörten. Baumkronenwachstum und Baumkronenzuschnitt sind besonders im urbanen Bereich häufig vorkommende Phänomene und in Hinblick auf Biomassezuwachs/-abnahme von Bedeutung.

Fig. 11: Richtig klassifizierte neu gepflanzte und gefällte Bäume

Fig. 12: Korrekt klassifizierte neue Einzelbäume.

Fig. 13: Korrekt klassifizierte Baumkronenveränderungen.

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5.3 Änderungen der versiegelten Flächen

Neu versiegelte Flächen wie Straßen in der Nähe von Neubauten wurden erfolgreich erkannt. Geringfügige Ungenauigkeiten in den Klassifikationsergebnissen waren auf Fahrzeuge zurückzuführen, die auf den Straßen fuhren und Schatten verursachten. Fig. 14 dokumentiert einige neue Straßen, die als Teil des Bauprozesses in diesem Bereich versiegelt wurden. Die hohe räumliche Auflösung der UltraCam-Daten erlaubte sogar die Erfassung kleinere Oberflächenveränderungen wie Straßenvergrößerungen oder neugebaute Gehsteige im Hinterhof. Eine Gesamtdarstellung findet sich in Fig.15.

Fig. 14: Richtig klassifizierte Straßenverbreiterungen.

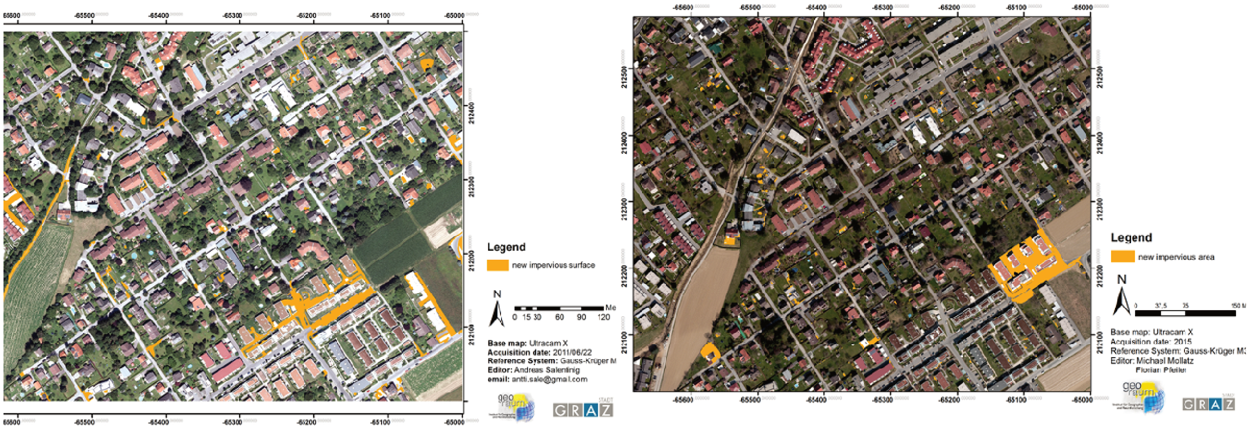

Fig. 15: Veränderungen von versiegelten Flächen im Bereich Sternäckerweg (links: 2007 auf 2011; rechts: 2011 auf 2015).

6 PROBLEME

Mehrere Probleme entstanden bei der Entwicklung der Änderungserfassungsalgorithmen. Alle im Algorithmus integrierten Veränderungstechniken haben gemeinsam, dass Schwellenwerte für veränderte Bereiche gefunden werden müssen. Die Methode kann somit bestenfalls als halbautomatisiert bezeichnet werden, da der/die BearbeiterIn die Schwellenwerte individuell bestimmen muss. Es wird eine gewisse Ungewissheit über die Veränderungen der Erkennungserfassung geben, da die Qualität des Regelwerks stark von der Erfahrung des der/die BearbeiterIn abhängt. Schatten erwiesen sich als das größte Problem bei der Entwicklung der Änderungserfassungsalgorithmen. Schatten sind generell ein großes Problem in der Fernerkundung. Bei der Änderungserkennung wird das Problem noch komplizierter, weil die Bilder zu unterschiedlichen Zeiten aufgenommen werden. Während in der monotemporalen Klassifikation Schattenbereiche separat ausgeschnitten und separat behandelt werden können (MUICK 2011), bedeutet es für die multitemporale Klassifikation, dass Schatten nicht den gleichen Bereich abdecken und daher zu schlechten Änderungserkennungsergebnissen führen können (Fig. 16 und Fig. 18). Die Bilder wurden in verschiedenen phänologischen Stadien (Frühjahr 2007, Frühsommer im Jahr 2011 und am Beginn (März/April) der Vegetationsperiode im Jahre 2015) aufgenommen, was zu zusätzlichen Problemen führt (Fig.17). Ein Vergleich des absoluten NDVI-Wertes war also nicht geeignet. Das Verhältnis der NDVI-Werte musste also berechnet werden, um einen sinnvollen Parameter für die Vegetationsänderungserkennung zu schaffen. Auch war ein nDSM (2011-2015) aufgrund der fehlenden Belaubung in den 2015er Bilddaten nur eingeschränkt verwendbar.

Die photogrammetrisch abgeleiteten DSMs der Daten waren aber allgemein von sehr hoher Qualität (Ausnahme sieh oben). Einige kleinere Unterschiede wurden zwischen dem 2007 und dem 2011 DSM beobachtet, vor allem bei Gebäudekanten. Die DSM-Unterschiede waren minimal und nur wenige

Dachkantenobjekte wurden falsch klassifiziert (Fig.18). LKW können ähnliche Höhen zu kleinen Gebäuden zeigen und ihre Oberfläche ist spektral vergleichbar mit Gebäudedächern. Deshalb wurden einige Lastwagen als "Neubau" eingestuft. Es wurden räumliche Beziehungen zu benachbarten Objekten benötigt, um LKW korrekt zu klassifizieren (Fig.19).

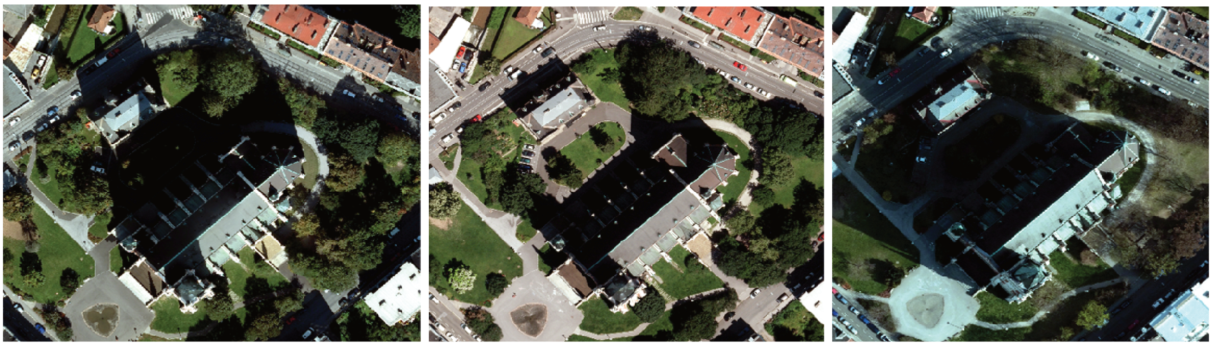

Fig. 16: Einfluss des Sonnenstands auf Schattenflächen (links: September 2007, Mitte: Juni 2011, rechts: April 2015).

Fig. 17: Fehlende Belaubung (März/April 2015).

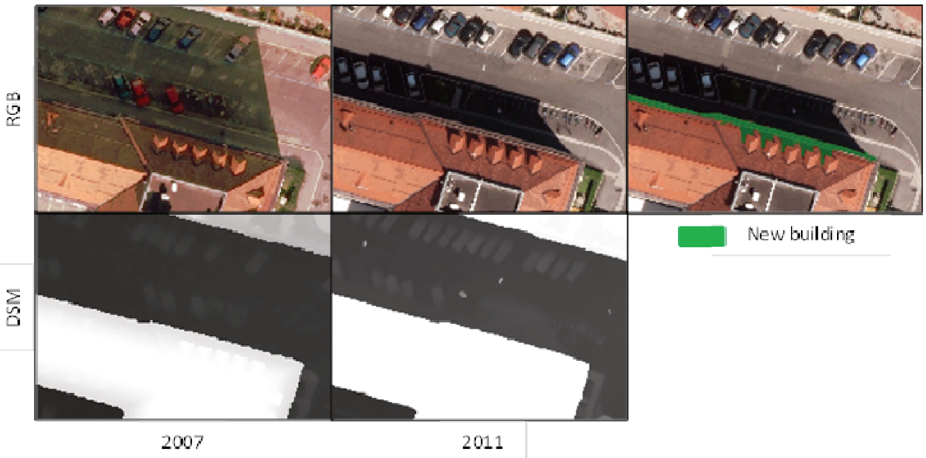

Fig. 18: Einfluss des Sonnenstands auf Schattenflächen (links: September 2007, Mitte: Juni 2011, rechts: April 2015).

Fig. 19: Ein Lastwagen, fälschlicherweise als neues Gebäude klassifiziert.

7 FUNKTION DER ERKENNTNISSE

Das Aufzeigen von Veränderungen stellt eine unverzichtbare Basis-Information in Planung und im Controlling dar. Lange Zeit wurde in der photogrammetrischen Datenerfassung primär auf Aktualität Wert gelegt. Aber seit der Entwicklung hochgenauer, rationeller und praxistauglicher Algorithmen bzw. Workflows, ist die (wiederkehrende) Feststellung, Ausweisung und Dokumentation der wesentlichen Veränderungen (Monitoring) in den hochverdichteten urbanen Räumen fixer Bestandteil der Nachbearbeitung und Auswertung von Fernerkundungsdaten. Ausgehend von den umfassenden und komplexen Aufgabenstellungen, werden die Ergebnisse von einer Vielzahl von Entscheidungsträgerinnen und Entscheidungsträgern, Planerinnen und Planern und anderen Interessenten genutzt (Fig. 20).

Fig. 20: User-Kunden-Struktur.

Die gewonnenen Erkenntnisse sind für eine moderne kommunale Organisation von größter Bedeutung. Sie bilden eine wichtige Grundlage für strategische Überlegungen und Planungen in den unterschiedlichsten Themengebieten. Des Weiteren ermöglichen sie vertiefende bzw. fortführende (GIS-)Analysen und aufgrund der hohen Genauigkeit und Aussagekraft, grundlegend auch eine Steigerung der Qualität von Entscheidungen.

Beispielhafte Einsatzgebiete der Analysen sind in Tab. 2 angeführt :

Stadt- und Raumplanung: Entwicklungskonzepte Gutachten in Bauverfahren	Forstwirtschaft: Bestandskontroll/ Bewirtschaftungsplanung
Hoch- und Tiefbau: Generelle Projekte u. Studien Detailprojekte Kontrolle	Rechtsprechung (z.B. Bau- und Forstgesetz, Baumschutzverordnung…): Beweis der Veränderung
Grünraum: Bestandskontrolle Planung	

Tab. 2: Beispielhafte Einsatzgebiete der Analysen.

Die wesentlichsten Vorteile der generierten Ergebnisse sind: die rationelle großräumige Erfassung des gesamten Stadtgebietes, die hohe Genauigkeit auf Basis der hochauflösenden Bilddaten, sowie die Generierung historisch wertvoller Vergleichsdaten der Veränderungen.

Die Ergebnisse und Erkenntnisse sind fester Bestandteil des städtischen Geographischen-Informations-System. Somit sind ein effizientes Datenmanagement, umfassende Analysemöglichkeiten und zeitgemäße Informationsbereitstellung (Auskunftstools/WEB-Services etc.), ein Garant für eine nachhaltige umfassende Nutzung. Die umfangreiche Aussage der erarbeiteten Ergebnisse hat sich in der Praxis als unverzichtbarer Standard etabliert.

8 SCHLUSSFOLGERUNGEN

Die entwickelte Change Detection Methode kann als objekt- und wissensbasiertes Hybridverfahren zusammengefasst werden, wobei die „image differencing, image rationing and principle component analysis“ kombiniert werden. Alle diese Methoden wurden in einen Algorithmus integriert. Eine der populärsten Methoden, die der „Post Classification Comparison“ wurde nicht berücksichtigt, weil sie in einem anderen Projekt an der Abteilung für Geographie und Regionalforschung verwendet wurde und auch weil das Ziel dieser Studie war, eine Methode zu entwickeln, die nur einen Klassifizierungsschritt erfordert. Die wertvollsten Parameter für den Änderungserkennungsprozess waren Höheninformationen (DSMs und nDSMs) und der NDVI. Die entwickelten Algorithmen lassen sich - wenn auch nicht ganz problemlos - auf weitere UltraCam-Befliegungen anwenden. Da die meisten Parameter den relativen Änderungen entsprechen, müssen nur wenige Schwellenwerte nach den Dateneigenschaften angepasst werden. Das Ziel war es, einen halbautomatisches Algorithmus, der für den Datensatz 2007-2011 entwickelt wurde, für die Änderungen 2011-2015 weiter zu entwickeln. In Zukunft sollte es möglich sein, dass neu erworbene UltraCam-Daten in das System geladen und automatisch auf Änderungen analysiert werden. Automatische Kartenaktualisierung mit Hilfe von vorhandenen Katastervektordaten erspart viel Arbeit und Zeit. Aufgrund seiner sehr hohen räumlichen Auflösung eignen sich UltraCam X Daten sehr gut für eine anspruchsvolle Change Detection Analyse. Darüber hinaus erfasst der Sensor Bilder im IR-Teil des elektromagnetischen Spektrums, was definitiv die Möglichkeiten der städtischen Veränderung erhöht. UltraCam X Daten sind wahrscheinlich die besten Daten, die derzeit für die städtebauliche Erkennung zur Verfügung stehen. Allerdings hängt die Qualität in einer Veränderungserkennung stark von der Ähnlichkeit der Bildakquisitionstermine ab, bedingt durch den reduzierten Einfluss von Umweltfaktoren. Die Methodik kann auich mit allen Schierigkeiten, die die frühe Befliegung 2015 bietet, auf das gesamte Stadtgebiet angewendet werden. Da die meisten Parameter den Höhenänderungen oder relativen Merkmalsänderungen entsprechen, müssen meist nur Schwellenwerte angepasst werden.

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10 REFERENCES

BOUTIANI, M., GOITA, K., HE, D.: Automatic change detection of buildings in urban environment from very high spatial resolution images using existing geodatabase and prior knowledge. In: ISPRS Journal of Photogrammetry and Remote Sensing, Vol. 64, pp. 143-153, 2010.

COPPIN, P., JONCKHEERE, I., NACKERTS, K., MUYS, B, LAMBIN, E.: Digital change detection methods in ecosystem monitoring: a review. In: International Journal of Remote Sensing, Vol.25, No. 9, pp.1565-1596, 2004.

DEER, P.: Digital change detection techniques: civilian and military applications. In: International Symposium on Spectral Sensing Research 1995 Report, Greenbelt, MD: Goddard Space Flight Center, 1995. http://ltpwww.gsfc.nasa.gov/ISSSR-95/digitalc.htm

DEFINIONS AG: eCognition Developer 8.0.1 – User Guide. – Definiens AG, Munich, Germany, 236 p., 2010.

EICHBERGER, ST., SULZER, W.: Urban development of Graz – a time series analysis with historical aerial photographs. In: Remote Sensing and GIS for Environmental Studies - Goettinger Geographische Abhandlungen, Vol. 113, pp. 63 – 70, 2005.

GRUBER, M., WIECHERT, A., LADSTÄDTER, R.: UltraCam – digitale Luftbildkameras für alle Fälle. In: Vermessung & Geoinformation, Issue 3, pp. 353 – 358, 2009.

IOANNIDIS, C, PSALTIS, C. AND POTSIOU, C.: Towards a strategy for control of suburban informal buildings through automatic change detection. In: Computers, Environment and Urban Systems, Vol. 33(1), pp. 64-74, 2009.

LU, D., MAUSEL, P., BRONDIZIO, E., MORAN, E.: Change detection techniques. In: International Journal of Remote Sensing, Vol. 25, No.12, pp. 2365 – 2401, 2004.

MUICK, M.: Objektorientierte Landbedeckungsklassifikation unter besonderer Beruecksichtigung der dritten Dimension, unpublished Master Thesis, Department of Geography and Regional Science, University of Graz, 86 p., 2011.

PACIFICI F., DEL FRATE, F., SOLIMINI, AND C., EMERY, W.: An Innovative Neural-Net Method to Detect Temporal Changes in High Resolution Optical Satellite Imagery. In: IEEE Transactions on Geoscience and Remote Sensing, Vol. 45, No. 9, pp. 2940 – 2952, 2007.

SALENTINIG, A.: Remote sensing change detection of urban environments with very high resolution ULTRACAM data, unpublished master thesis, Department of Geography and Regional Science, University of Graz, 112, 2012.

SCHNEIDER S., GRUBER M.: Radiometric quality of Ultracam – X images. In: The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. 37, Beijing 2008, pp. 539 – 544, 2008.

SINGH, A.: Digital change detection techniques using remotely sensed data. In: International Journal of Remote Sensing, Vol. 10, pp. 989–1003, 1989.

STOW, D., HAMADA, Y., COULTER, L., ANGUELOVA, Z.: Monitoring shrubland habitat changes through object-based change identification with airborne multispectral imagery. In: Remote Sensing of the Environment, Vol. 112, pp. 1051 – 1061, 2008.

STOW, D.: Geographic object-based Image Change Analysis. In: Handbook of Applied Spatial Analysis, edited by M. FISCHER AND A. GETIS, Springer, pp. 569 – 586, 2009.

SULZER, W., KERN, K.: Urban change extraction from aerial photographs and multispectral scanner – an applied study from Graz/Austria. In: Remote Sensing for a Changing Europe, edited by D. MAKTAV, IOS Press, pp. 551 – 557, 2009.

SULZER, W., KERN, K.: Urban change extraction from aerial photographs and multispectral scanner – an applied study from Graz/Austria. In: Remote Sensing for a Changing Europe, edited by D. MAKTAV, IOS Press, pp. 551 – 557, 2013.

SULZER, W, MUICK, M., GANSTER, W.: Objektorientierte Landbedeckungsklassifikation von Graz (Österreich) unter besonderer Berücksichtigung der dritten Dimension, in: M. SCHRENK, V. V. POPOPICH, P. ZEILE, P. LISEI (Hrsg): Proceedings REAL CORP 2013. 2013, 651 – 660, 2013.

SULZER, W.: Reale Abbildung der Stadtentwicklung Graz – Landnutzungskartierung 1945 – 2015. Magistrat Graz, 260p, 2016.

WENG, Q.: Remote sensing of impervious surfaces in the urban areas: Requirements, methods, and trends. In: Remote Sensing of Environment, Vol. 117, pp. 34-49, 2011.

YIANYA, G., HAIGANG, S., GUORUI, M., QIMING, Z.: A review of multi-temporal remote sensing data change detection algorithms. In: The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. 37, part B7, Peking, pp. 757 – 762, 2008.

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Co-Creation for Smart City Solutions – a Peer-to-Peer Process

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1 ABSTRACT

The development of sustainable smart cities builds upon integrated and inclusive societies that allow inhabitants to co-create their living environment, fostering consistent dialogue among all stakeholders. It is equally based on modern ICT technologies as well as citizen engagement and institutional governance to deliver smart and inclusive solutions.

The paper is based on an Horizon 2020 Project SMARTER TOGETHER, which is a joint project that aims to develop co-created smart and integrated solutions for low energy districts, sustainable mobility, integrated ICT infrastructures and citizen engagement within three lighthouse cities, further providing recommendations for follower cities and for all cities which are willing to support sustainable and resilient development.

Within this project "being smart together" implies the need for a joint co-creative process within and between city and regional administrations and all relevant stakeholders. Thefore it is necessary to design a process and project structure allowing for a continuous organizational and peer-to-peer learning process and knowledge exchange between them.

The questions that arise are how to get there and how to set up such a process? Therefore, the paper first presents the research methodology, consisting of the process itself as well as outlining the analog and digital peer-to-peer exchange vehicles developed for this purpose. On the one hand, so called "Project books" will provide the knowledge base for a fruitful peer-to-peer knowledge exchange among the cities and all local stakeholders and experts on an analog basis. On the other hand, the "Knowledge carrier" will be the major digital peer-to-peer "capsule" for information exchange and as measure for "information growth" within Smarter Together. The paper will exemplary draw upon the e-mobility projects to be realized in the three project lighthouse cities Lyon, Munich and Vienna.

Finally, the paper discusses the transferability of the identified approaches and tries to illustrate possible strategies to replicate the co-creative process itself as well as the the innovative solutions in the field of e-mobility with the help of the tools.

Keywords: Smarter Together, E-Mobility, Peer-to-peer, Co-creation, Knowledge exchange

2 SMARTER TOGETHER

2.1 Project scope and objectives

In January 2016, the cities of Vienna, Munich and Lyon together with 30 partners from 8 countries (among those: key smart cities industrial players, dynamic SMEs, building owners, universities, research & technology organisations, major European networks and major standardisation institutes) were awarded with funds for a joint research and city development project within the EU SCC1 call. The title “SMARTER TOGETHER” can be taken in the literal sense of implementing “smart” and innovative actions in the three lighthouse cities and sharing their gained insights and knowledge in cooperation with three so called follower cities - Santiago de Compostela, Sofia und Venice.

SMARTER TOGETHER will deepen the knowledge and know-how in the fields of data management, eco-refurbishment and e-mobility through large-scale demonstration activities, user-centric innovation and sustainable smart city business models. Research and business stakeholders will benefit from the in-depth transfer of the results, which will prepare the ground for a large-scale replication of successful solutions in other cities, contributing to positive societal dynamics in European countries and beyond.

The project strives to demonstrate large-scale smart city solutions in six districts under various urban and governance conditions covering the European diversity. Therefore new business models will be developed to turn the demonstration activities into economically sustainable and replicable solutions for other cities. User-centric innovation will be fostered by involving even more people and stakeholders in the co-creation and

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design of new services and solutions. Furthermore experiments with low energy districts will provide energy-efficient buildings with local renewable heat and electricity. Also existing data networks will be integrated into citizen-oriented open data platforms to deliver new services to locals. Finally new e-mobility solutions for local citizens and companies will be developed and implemented.[1]

Figure 1: SMARTER TOGETHER Lighthouse and Follower Cities

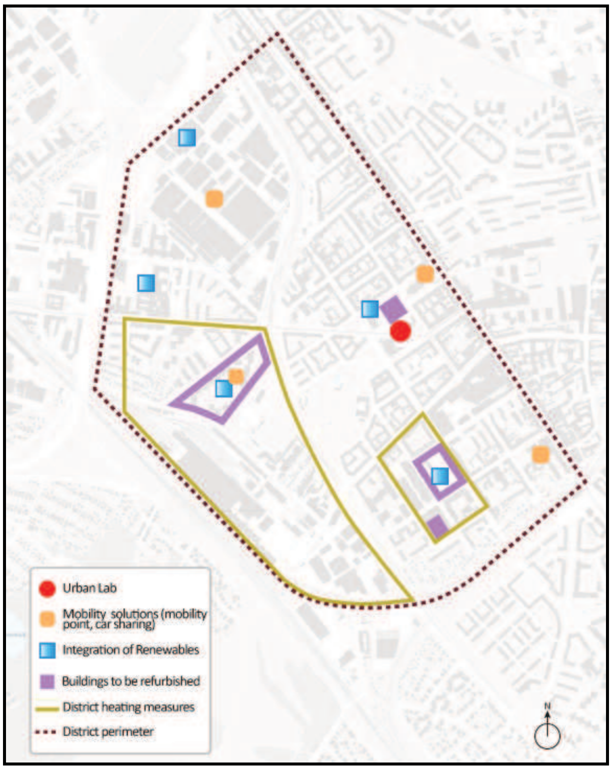

Figure 2: Vienna-Lighthouse project area

[1] Gaiddon, B. et al. (2016): Three Cities – Lyon, Munich, Vienna – Will be SMARTER TOGETHER.

2.2 The Lighthouse City Vienna

The project demonstration area in Vienna is located in the central part of the south-eastern district of Simmering between Simmeringer Hauptstraße and the eastern railway line. In total, 21 000 inhabitants will benefit from smart project solutions within the fields refurbishment, energy, mobility and information and communication technologies. An emphasis is made on dialogue, in line with the Vienna Smart City Framework Strategy where the human dimension of the Smart City is the focus of attention. Dialogue includes all generations and backgrounds aiming at contributing to an integrated societal dynamic. The local network of partners includes all actors, from government to citizens to business players, where everyone has a specific responsibility towards achieving the common goals.

Vienna strives to:

- refurbish three residential neighborhoods with 1,300 inhabitants and a total floor surface of 75,000 m²
- ensure savings of 6,000,000 kilowatt hours (kWh) per year in all refurbished housing complexes together. This corresponds to the energy use of about 700 housing units
- guarantee more sustainable and future-oriented energy supply with 9,000,000 kWh provided by renewable energy sources (thermic as well as electric energy), which will result in considerable savings for the tenants in energy and heating costs.
- save about 550 tons of CO_2
- secure and/or create 900
- promote an intensive governance learning process by involving eight departments of the City of Vienna's administration, ensuring that the experiences and results of the project will be integrated in a sustainable way all over the city[2]

2.3 The Lighthouse City Munich

Neuaubing-Westkreuz/Freiham is the project district in which Munich is implementing the pioneering smart city solutions. Around 30,000 people live in this district on the western edge of the city. Whereas Freiham is a new housing development area, many of the residential properties in Neuaubing-Westkreuz were built in the 1960s and 1970s. Their energy-efficiency standards are comparatively poor.

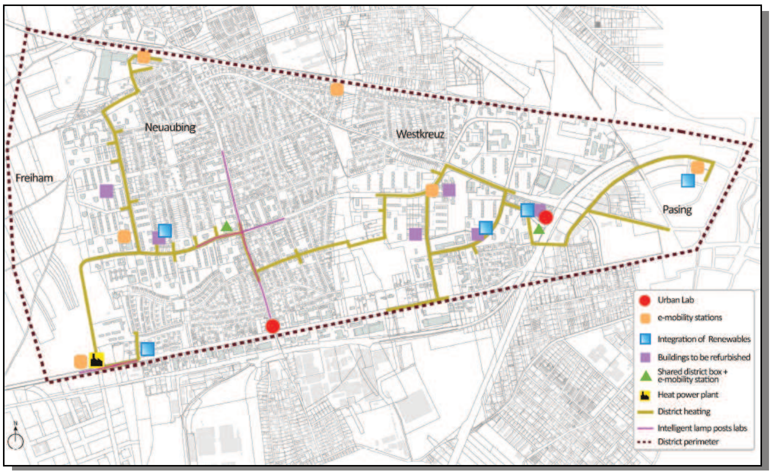

Figure 3: Munich-Lighthouse project area

Munich strives to:

- Refurbish houses in order to reduce energy consumption
- Construct multimodal mobility stations with multifunctional district sharing boxes that increase e-mobility and serve as exchange and delivery stations for goods
- Install smart street lamps that consume less energy and facilitate new services

[2] http://smarter-together.eu/cities/vienna

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- Design a neighbourhood app which creates intelligent links between all services to drive better acceptance and wider use of the offerings described above[3]

2.4 The Lighthouse City Lyon

Lyon's demonstration area is Lyon Confluence - one of the largest urban redevelopment projects in France (150 ha – 600 000 m² existing floor area – 1.000.000 m² of new buildings). It is the first WWF approved urban development in France and it is the largest urban redevelopment area in France with such an ambitious target such as the zero carbon objectives: the annual greenhouse gases emissions at the end of the urban project must not be superior to the level of emission at the project start.

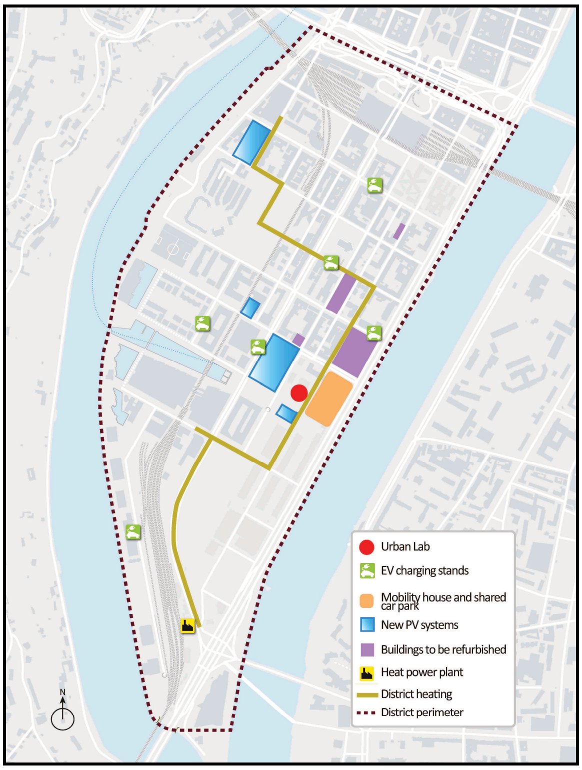

Figure 4: Lyon-Lighthouse project area

Lyon strives to:

- refurbish 35,000 m² of existing buildings to reduce their energy consumption
- develop local renewable energy production: photovoltaic systems (1MWp) and a wood-fired co-generation power plant (2MWe/4MWth)
- reduce the use of conventional cars by providing alternative means of transport for inhabitants: smart charging stands, electric-vehicle car-sharing system and an autonomous driverless electric shuttle
- develop a data platform to monitor energy production and consumption in the area, and the actual effects and benefits of measures implemented to reach the zero carbon objective
- involve citizens in the redevelopment of the Lyon Confluence area and the implementation of new services (creation of an urban living lab to allow citizens and users to co-design the smart city solutions).
- increase the quality of life of inhabitants through construction of comfortable and affordable dwellings and office places, convenient public spaces, easy access to the district, etc.[4]

2.5 Project Structure

The overall project is divided into ten work packages (WPs):

[3] http://smarter-together.eu/cities/munich/
[4] http://smarter-together.eu/cities/lyon/

- WP1 Innovation Action Framework provides a first action framework for the successful implementation of smart solutions, striving for capacity building, common perceptions and consistent workflows in the later Work Packages.
- WP2 Co-Creation for Smart City Solutions – a peer to peer process establishes reference processesand tools for co-creation, building on the inputs of WP1 to define thematic guidelines for successful implementation of co-created city solutio ns in cities.
- WP3 Lighthouse Demonstration Lyon implements the demonstration activities in the lighthouse target area of Lyon, ensures their monito ring during the implementation and prepares the replication phase.
- WP4 Lighthouse Demonstration Munich implements the demonstration activities in the lighthouse target area of Munich, ensures their monitoring during the implementation and prepares the replication phase.
- WP5 Lighthouse Demonstration Vienna implements the demonstration activities in the lighthouse target area of Vienna, ensures their monitoring during the implementation and prepares the replication phase.
- WP6 Monitoring & Evaluation ensures the 3-years post-implementation monitoring phase, running the monitoring infrastructures, collecting data and evaluating processes and impacts.
- WP7 Integrated strategies in Follower Cities supports the replication of successful demonstration solutions and services in the Follower Cities target areas.
- WP8 Replication of smart city solutions ensures the replication of results and outcomes of the demonstration phase as well as replication of monitoring actions both at the city level in the Lighthouse cities and in other cities and at commer cial and industrial levels, allowing the scaling-up and deployment of the developed smart city solutions in Europe.
- WP9 Dissemination and Communication ensures effective communication actions and dissemination of project results, which will support transferability towards scientific, policy and industrial communities.
- WP10 Project Management ensures the steering and planning of all activities, time schedule, quality and cost management to meet the project’s objectives from both technical and administrative perspective.

3 CO-CREATION FOR SMART CITY SOLUTIONS

3.1 Main Challenges

Even though the three lighthouse cities seem to be very different, they do face very comparable challenges and problems. This is also reflected in the great number of highly different but in parts also very comparable projects within the Demonstration WPs. In order to be able to design co-created and integrated solutions and produce replicable results, particularly the following four main challenges need to be addressed when designing a general concept for such a project.

(1) Cross-Silo Thinking:

Overcome thematic silos in order to allow knowledge exchange between experts of projects with a highly diverse thematic orientation (e.g. IT-experts of e-mobility and smart district projects), helping to overcome specific emerging problems and generating a basic knowledge set of recommendations for co-created solutions.

(2) Cross-City Thinking:

Allow a knowledge exchange within a thematic silo but in between all respective experts of that silo (e.g. all refurbishment experts of all cities) in order to address and solve specific thematic problems.

(3) Stakeholder Involvement:

Involve relevant external stakeholders in order to include all available knowledge into the co-creation process. This step should include both local experts as well as external domain experts.

(4) Knowledge Transfer:

Disseminate generated knowledge in between the project and over its borders in order to actively perform a co-creation process and to provide a set of recommendations for co-created and integrated smart city solution for cities.

Naturally, the success of the co-creation process will depend on an adequate handling of all four outlined main challenges, allowing for Cross-Silo as well as for Cross-City-Thinking, including all Stakeholders and ensuring a transfer of the generated knowledge into project and cities.[5]

3.2 A concept for co-created smart city development

In order to encounter the outlined main challenges and to foster co-creation within the Smarter Together project, the overall concept of the project consists of two general groups of work packages. While the work packages 3 to 5 are dedicated to the demonstration projects to be implemented within the three cities, all other work packages are foreseen to enable the development of co-created and integrated solutions, addressing the organizational and peer-to-peer knowledge exchange, allowing for impact monitoring and striving for high replicability. Therefore, a strong interaction between the so-called Enabler and Demonstration work packages will be established.

The peer-to-peer knowledge exchange process of WP2 will try to bring together the experts and affected stakeholders of the demonstration projects at different stages of the implementation process (months 18, 24 and 30) in order to overcome common challenges and to beneft from lessons learned. WP2 will develop the recommendations further, finally aiming for a set of proven recommendations ready to be used by other interested cities, specifically by the follower cities in WP7.

The organizational and peer-to-peer knowledge exchange to be established within the Enabler WP2 is of utmost importance to develop co-created and integrated solutions within the project itself and to develop recommendations based on the lessons learned during the implementation process.[6]

3.3 Project Books – Analog peer-to-peer exchange

As outlined above the aim of WP2 within the Project Smarter Together is to learn from other cities on an expert level. Therefore a learning method is necessary and needs to be developed within the project. A first step is to provide information about the different projects and solutions and find a “common ground” for further discussions. After having a better understanding of the single projects and solutions it will be easier to find similarities in between the projects, raise questions and look at the own project(s) from a different point of view. This may influence upcoming projects and solutions as well as specific activities within the ongoing project development processes. This way the peer-to-peer learning can be supported very efficiently.[7]

3.3.1 Introduction to the project book

The so-called “project books” provide the knowledge base for a fruitful peer-to-peer knowledge exchange among the cities and all local stakeholders/experts. Peer-to-Peer is a key method of knowledge management that addresses the “human dimension of learning” through a very personal exchange of process based formal knowledge and subjective project experiences of practitioners. The respective knowledge is always related to a context and very concrete challenges. Furthermore it is a result of the subjective exchange process and the dynamics of the dialogue itself. The personal exchange provides also an emotional level of communication linked to the very subjective experience of concrete communication, which allows the unlocking of (sensitive/subjective) information that would never be written down. A major added value are the establishment informal knowledge networks that last in time. They also contribute to the development of organizational culture.

The project books and their respective contents are – besides the very personal experiences and knowledge exchange of the SMARTER TOGETHER partners – central part of WP2 and its respective outcomes. For

[5] Gaiddon, B. et al. (2016): Three Cities – Lyon, Munich, Vienna – Will be SMARTER TOGETHER
[6] Gaiddon, B. et al. (2016): Three Cities – Lyon, Munich, Vienna – Will be SMARTER TOGETHER.
[7] ibidem.

each WP2 task a project book will be developed, describing all projects (including the development status) of one of the five Smarter Together key topics:

- City Engagement
- Holistic Refurbishment in Smart Districts
- District Heating & Renewables
- Data Management Platform & Smart Services
- E-Mobility

The five project books will be iteratively developed until 2020, offering an insight in the development process of the innovative city development projects in the lighthouse cities. By presenting challenges and experiences the projects are facing over the project lifetime and respectively their conceptualisation and implementation phase, the project books will provide a highly informative set of lessons learned.

Each project book will provide a general overview over all projects in the context of the respective thematic field and its solutions, developed and implemented within the HORIZON 2020 Lighthouse Project Smarter Together.

3.3.2 Main objectives

The project book tries to accomplish three main objectives:

- Documentation for all project partners (everyone gets to know the other projects and is enabled to understand current challenges and best practices)
- Support Peer-to-Peer processes, the report feeds into the task “Knowledge exchange network and recommendations design”, which will bring together experts of the different projects in order to work on yet unresolved problems and on how to get newly acquired knowledge shared among all partners
- Help to understand the applicability of the best practices and recommendations gathered in workpackage 1 of the SMARTER TOGETHER project. Based on this, the recommendations will be adapted and potential focus questions can be addressed.

3.3.3 Data collection process

The collection of information for the project books is integrated within a project internal common reporting process. Not only workpackage 2 is collecting specific project information, rather workpackages focusing on monitoring or external dissemination also seek for specific project information. Therefore a common reporting questionnaire was developed, integrating all questions to be reported and allowing for an easy information sharing among all workpackages. Accordingly the reporting periods were aligned among all workpackages.

The reporting on the project development status will occur three times during the project lifetime in the months 16, 22 and 28 exactly two months in advance of the peer-to-peer knowledge exchange workshops. By that, all the results can be taken into account, being able to address identified common problems (cross-silo and cross-city).

3.4 Knowledge Carrier - Digital peer-to-peer exchange

Based on identified, evaluated and tested existing tools and approaches for Co-Creation a set of tools for subsequent use within the Co-Creation Processes for implementation in all three cities was defined. These tools and processes built the foundation to foster the collaboration and knowledge exchange between experts and local stakeholders in the lighthouse projects on a digital basis. As an important measure a mobile “knowledge carrier” is being designed and realized which acts as “capsule” for information exchange and as measure for “information growth” within SMARTER TOGETHER.

3.4.1 Introduction to the Knowledge Carrier

The “knowledge carrier” provides the knowledge base for a fruitful peer-to-peer knowledge exchange among the cities and all local stakeholders/experts at predefined points in time during the course of the project

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(Month 0, 18, 24 and 30) with the focus on visualization. Therefore the carrier and its respective content builds upon the information basis of the project books which will be updated in the same time steps.

For the frontend development and design the german provider for 3D spatial data infrastructures virtualcitySYSTEMS was contracted. Anyways, as final outcome of the conceptualisation of the knowledge carrier a set of mock-ups was developed (compare figure Figure 5 below).

Figure 5: Mock-Up of the Knowledge Carrier [modified][8]

The final design of the web interface will consist of two main elements. First, a three-dimensional map of the respective lighthouse city district, allowing for a free movement within the model for the user. The second part of the screen is designed as an overlay and will consist of the contextual knowledge collected with the help of the project books, providing the user information on the project status of all projects in the district.

Further, by including a timeline, the user can track the changes and process steps of the projects visually (in the 3D-model) and content wise (project book information).

[8] https://i.ytimg.com/vi/9NhyDiiaXic/maxresdefault.jpg

Figure 6: Reference interface Berlin Business Location Centre by virtualcitySYSTEMS

The knowledge carrier will visualize three different levels of information:

(1) City level: General information on the concepts, goals and visions of Lyon, Munich and Vienna

(2) Thematic level: Specific information such as recommmendations, challenges or best practices on City Engagement, Holistic Refurbishment in Smart Districts, District Heating & Renewables, Data Management Platform & Smart Services and E-Mobility

(3) Solution level: Presenting the project status over the whole development cycle for all projects.

The operation of the system is designed as easy and intuitive as possible, providing a webbased frontend; allowing for multi-touch navigation and offering multiple languages (German, English, French). According to the common reporting process, the project developed a common content management system (CMS) based on DRUPAL, allowing all project partners to use the gathered information for their services and needs (e.g. Web-page or knowledge carrier). The content management system was developed by the project partner Gopa.com.

3.4.2 Main objectives

The Knowledge Carrier tries to accomplish the following main objectives:

- Visual preparation of the documentation for all project partners and local experts (everyone gets to know the other projects and is enabled to understand current challenges and best practices in an illustrative visual form)
- Supports Peer-to-Peer processes, which will bring together experts of the different projects in order to work on yet unresolved problems and compare them with similar ones
- Helps to understand the three different levels of action (city, thematic field, project) and allows to track their development over the course of the project

Besides that the Knowledge Carrier will be a very powerful tool, providing cities and experts of all cities of the world a deep insight in development and implementation processes of innovative city development projects and therefore enabling them to understand potential challenges and to identify promising solutions.

3.4.3 Development of to the Knowledge Carrier

In order to be a useful tool, the cities were deeply involved in the design process of the Knowledge Carrier. This included both lighthouse cities as well as follower cities, naming different demands and use-cases.

First of all, both sides defined particularly experts and city employees as key end-user group. Anyways, the lighthouse cities set a focus on staff that works on the field, being responsible for the implementation of the projects themselves. The main hope: If other cities face the same problems, we could either way try to solve challenges together or learn from a city that solved an issue already. On the other side the follower cities named a key audience which is located at a more strategical level, trying to prepare decisions and to proactively prevent possible challenges in designing the future city.

Anyways, the Knowledge Carrier needed to match both perspectives in order to be a tool that is useful for all kinds of cities, regardless of their specific state of development in a topic area.

4 TRANSFERABILITY OF APPROACHES

SMARTER TOGETHER seeks to develop methods, solutions and processes that are transeferable to all kind of other cities. As a first step, the replicability of the solutions to be developed in the SMARTER TOGETHER lighthouse cities will be tested by transferring them towards the follower cities. As outlined, the project books and the knowledge carrier are the key tool within the project to forward deep project insighs towards these cities.

Within the reporting process, the follwoer cities are informed about the identified common challenges a month before the peer-to-peer workshops in order to allow them to identify topics of interest and to delegate key personel for the workshop sessions.

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5 OUTLOOK AND CONCLUSION

Since SMARTER TOGETHER is an ongoing project and the first reporting period just ended, the full capacity of the process is not yet proven. First benefits (e.g strenghtening of partner network) as well as shortcomings (e.g. high reporting efforts) have already been identified.

Anyways, a set of interviews with responsibles of the cities is planned in order to optimize the reporting process. Further by analysing the outcomes of the common reporting and the first peer-to-peer workshop a final adaptation of the reporting questionnaire is foreseen.

Although the project books are planned to be project internal, the knowledge carrier is intended to be opened after the project lifetime if proven to be a helpful tool for the partner cities. By that other cities could learn from the insights of the SMARTER TOGETHER projects and even share their own knowledge.

6 REFRENCES

Gaiddon, B., Girardi, J., Neumann H.M., Thielen, K., Vignali, E., Wendt, W. (2016): Three Cities – Lyon, Munich, Vienna – Will be SMARTER TOGETHER, REAL CORP 2016 Proceedings, Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER (eds.), 22-24 June 2016, Hamburg.

http://smarter-together.eu/cities/vienna/, project website of the SMARTER TOGETHER project, gopa.com (eds.), 2016, Brussels

http://smarter-together.eu/cities/munich/, project website of the SMARTER TOGETHER project, gopa.com (eds.), 2016, Brussels

http://smarter-together.eu/cities/lyon/, project website of the SMARTER TOGETHER project, gopa.com (eds.), 2016, Brussels

reviewed paper

CommunityHub: Potenzialanalyse für die gemeinschaftliche Nutzung innerstädtischer Logistikflächen

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1 ABSTRACT

Problemstellung:

Durch kontinuierliche Urbanisierungsprozesse und die voranschreitende Wohnraumverdichtung sowie die Zunahme der Bevölkerungs- und Verkehrsdichte ist ein sparsamer Umgang mit der Ressource Boden von Nöten. Die steigende Bedeutung des E-Commerce sowie die sich daraus resultierende Veränderung von Konsumentinnen- und Konsumentenanforderungen und zunehmenden Anzahl an Sendungen stellt vor allem die innerstädtische Logistik im Hinblick auf eine effiziente Abwicklung bzw. Organisation der First- und Last-Mile vor eine große Herausforderung.

Beim Zusammentreffen unterschiedlicher Akteurinnen und Akteure (Stadt, Endnutzerinnen und Endnutzer, Wirtschaft) sind – bedingt durch verschiedene Interessen und Zielsetzungen – Entwicklungs- und Nutzungskonflikte – im Speziellen bei knappem Platzangebot – kaum vermeidbar. Es existieren jedoch auch im urbanen Raum ungenutzte Logistikkapazitäten, die durch ungleichmäßige Aufteilung von Wohn- und Lagerraum entstehen. Besonderes Augenmerk wird hierbei auf leerstehende Erdgeschoßzonen gelegt.

Zielsetzung:

Das Projekt CommunityHub[1] zielt auf eine optimale Allokation der Ressource Raum ab. Unter dem Begriff CommunityHub werden Mikro-Logistikknotenpunkte verstanden, welche eine Versorgung der Bevölkerung mit logistischen Dienstleistungen und eine gleichberechtigte Zugänglichkeit für alle Akteurinnen und Akteure (Stadt, Endnutzerinnen und Endnutzer, Wirtschaft) gewährleisten. Dabei werden in städtischen Erdgeschoßzonen logistische Leistungen (Lagerung, Paketzustellung etc.) mit weiteren koppelbaren (Dienst-)Leistungen (Entsorgung, Versicherungen, Umkleidekabinen etc.) bereit gestellt.

Die unterschiedlichen Komponenten der Partizipation, Nahversorgung und Mehrfachnutzung existieren für sich allein, wurden bisher jedoch noch nicht im Rahmen eines innovativen Konzeptes vereint. Mittels Primär- und Sekundärdatenerhebung wird die Grundlage für die Durchführung einer Potenzialanalyse am Anwendungsbeispiel Wien und die Untersuchung möglicher Risiken von CommunityHubs geschaffen. Darauf aufbauend werden konkrete Lösungsvorschläge und Implementierungsstrategien für (inner-)städtische Multi-Use-Konzepte erarbeitet.

Ergebnisse:

Auf diese Art kann das Projekt CommunityHub einen Beitrag für die Lösung der First- bzw. Last-Mile-Problematik leisten, wodurch die Zustellbarkeit von Paketen erhöht und gleichzeitig CO_2-Emissionen (z. B. durch Bündelung von Ressourcen) reduziert werden können. Des Weiteren werden durch die Umnutzung von – z. B. leerstehenden Geschäfts- und Bankfilialen zu (inner-)städtischen CommunityHubs – Erdgeschoßzonen aufgewertet und die Nahversorgung im urbanen Raum sichergestellt.

Keywords: multi-use, communitybasiert, Mikrologistik-Hub, last mile, e-commerce

[1] Finanziert im Rahmen des Programms „Mobilität der Zukunft“ durch das Bundesministerium für Verkehr, Innovation und Technologie. Projektlaufzeit: Februar 2017 – Jänner 2018.

2 AUSGANGSLAGE UND PROBLEMSTELLUNG

In den letzten Jahren konnten auf mikro- und makroskopischer Ebene einige Entwicklungen (z. B. Urbanisierungseffekte, Boom des E-Commerce, Marktdurchdringungsgrad von Smartphones, durch veränderte Arbeits- und Lebensgewohnheiten bedingte Nachfrageänderung) beobachtet werden, die sich in (1) räumlichen, (2) verkehrlichen, (3) logistischen und (4) organisatorischen (Problem-)Aspekten manifestieren.

(1) Räumliche Aspekte: Urbanisierungsprozesse und ein kontinuierliches Städtewachstum bewirken eine Zunahme der Bevölkerungs- und Verkehrsdichte in den Ballungsräumen. Im Jahr 2023 wird erstmals seit hundert Jahren die Zwei-Millionen-Grenze in Wien überschritten werden (Statistik Austria 2016: 1). Trotz der vielfältigen und großangelegten Stadtentwicklungsprojekte, wie Seestadt-Aspern, scheint die bestehende Fläche nicht auszureichen und auch die (Verkehrs-)Infrastruktur stößt langsam an ihre Grenzen. (BMVIT 2013: 17; Taniguchi 2012: online)

Bedingt durch die begrenzte Ressource Raum kann es beim Aufeinandertreffen unterschiedlicher Akteurinnen und Akteure (Stadt, Endnutzerinnen und Endnutzer, Wirtschaft) zu verschiedenen Nutzungsansprüchen und infolgedessen zu potenziellen Zielkonflikten kommen.

Einerseits zwischen der Stadt, die Platz für Infrastruktur und Wohnbau schafft, und den Bewohnerinnen und Bewohnern, die mehr Wohnraum bzw. Freizeitflächen fordern. Andererseits beanspruchen die vielen privatwirtschaftlichen Unternehmen wie Einzelhandel, Logistikdienste, klassische Selfstorage-Anbieter ebenfalls Flächen für ihren Bedarf (z.B. Lager- und Liefertätigkeit).

Im Spannungsfeld steht im Zuge der zunehmenden Wohnraumverdichtung dabei nicht nur der öffentliche Raum (z. B. zeitliche und örtliche Nutzungsbeschränkungen), sondern auch der private Raum. Die Grundrisse von Wohnungen sind nicht mehr mit den heutigen Haushaltssituationen und -anforderungen konform. Personen haben das Bedürfnis, ihre erworbenen Konsumgüter und persönlichen Gegenstände aufzuheben, doch meist reicht der Platz in den eigenen Wohnungen nicht aus.

(2) Verkehrliche Aspekte: Im Hinblick auf den steigenden Transport auf der Straße besteht Handlungsbedarf, um die durch den wachsenden Güterverkehr resultierenden negativen Effekte zu reduzieren. Bearbeitungsgegenstand sind nicht nur negative Umweltwirkungen (z. B. Schadstoff- und Lärmemissionen) durch Verkehr, sondern auch die Lösung der Stau- und Unfallproblematik durch die Überlastung der Verkehrswege im städtischen Raum.

(3) Logistische Aspekte: Der zunehmende Flächenanspruch stellt eine wesentliche Herausforderung für eine flächendeckende infrastrukturelle und verkehrliche Versorgung dar. Dabei spielt die Sicherstellung der Daseinsvorsorge durch die beispielsweise effektive bzw. effiziente Abwicklung logistischer Prozesse/kleinräumige Warenverteilung sowie die Gewährleistung der Zugänglichkeit zu bestehenden baulichen Infrastrukturen in innerstädtischen Gebieten eine zentrale Rolle. (Kujath 2003: 9f)

Die zunehmende Bedeutung des E-Commerce stellt die innerstädtische Logistik vor große Herausforderungen, insbesondere was die Organisation der First und Last Mile betrifft. So verläuft im B2C-Paketsegment beispielsweise der erste Zustellversuch in 11 % erfolglos, da Empfängerinnen und Empfänger bei der Sendungsanlieferung nicht anzutreffen sind. (Österreichische Post AG 2014: 64)

Bei der Abwicklung der Paketsendungen ergeben sich durch z. B. ineffiziente Be- und Entladungsprozesse Kapazitätsengpässe entlang der letzten Meile. Nicht außer Acht zu lassen sind die steigenden Anforderungen an die Lieferzeiten (z.B. Same-Day-Delivery, Zustellfenster) und die zunehmende Zahl an Retourensendungen. (Schrampf et al. 2013: 19)

(4) Organisatorische Aspekte: Die bestehenden Paketübergabestellen in Form von Boxensystemen bzw. Paketzustellboxen werden von unterschiedlichen KEP-Diensten angeboten. Als problematisch stellt sich dabei heraus, dass nur der anbietende KEP-Dienst die Infrastrukturen nutzt und der Konkurrenz den Zugriff verweigert. Um die Bedürfnisse der Endkundinnen und Endkunden zu berücksichtigen, ist die An- und Ablieferungsmöglichkeit unterschiedlicher KEP-Dienste von großer Bedeutung.

Eine weitere Stellschraube betrifft die Vernetzung der Übergabestelle mit der Zentrale des KEP-Dienstes. Es muss die Möglichkeit bestehen, das System online zu betreiben, sodass die Information über eine Paketeinlagerung an den KEP-Dienst weitergeleitet wird. Diese Datenweitergabe ist notwendig, um Transportressourcen zeitgerecht zu planen und zu bündeln.

Forderungen wie Sendungsverfolgung, (sehr kurzfristige) Paketumleitung, mehr Zustellalternativen bzw. Zeitfensterzustellung (Samstags-, Abend- und Nachtzustellungen) und Montagetätigkeit werden stärker nachgefragt (Winter 2015: 1f).

Die Anwesenheit der Empfängerinnen und Empfänger bei der Paketanlieferung bzw. -abholung sowie das mangelnde Angebot an einheitlichen Paketübergabestellen bedingt mehrere Zustellversuche, was wiederrum zu einem erhöhten Verkehrsaufkommen führt.

3 DIE IDEE

3.1 Definition CommunityHub

Im Fokus des CommunityHubs, also eines Mikro-Logistikknotenpunktes, steht die Erarbeitung eines stakeholderinvolvierenden (Berücksichtigung von Interessen unterschiedlicher Akteurinnen und Akteure wie Endkundinnen und Endkunden, Stadt, Wirtschaft) Multi-Use-Konzeptes, welches logistische (Dienst-)Leistungen und daran koppelbare (Dienst-)Leistungen in (inner-)städtischen Erdgeschoßzonen ermöglicht.

Solche Leistungen können beispielsweise die Bereitstellung und den Betrieb von Paketübergabestellen (z. B. Zustell-, Abhol-, Empfangs- und Versandboxen) in Kombination mit Lagermöglichkeiten (z. B. Kellerabteile) bzw. weiteren Value-Added-Services (z. B. Entsorgungsstation von Verpackungsmaterial oder Installierung von Umkleidekabinen zum direkten Anprobieren online bestellter Waren) sein.

Das Vorhaben vereinigt unter der Prämisse des nachhaltigen Sharing-Gedankens eine gleichberechtigte Zugänglichkeit aller Akteurinnen und Akteure mit logistischen Dienstleistungen (sowohl nachfrageseitig z. B. Sendungsempfängerinnen und Sendungsempfänger als auch angebotsseitig z. B. KEP-Dienste) und basiert auf einer akteursübergreifenden Online-Plattform, welche alle KEP-Dienste implementieren können.

3.2 Methodische Herangehensweise

Die Erarbeitung dieser bisher noch wenig erforschten Thematik erfolgt in Form einer umfassenden und fundierten Analyse bestehender und potenzieller Multi-Use-Konzepte. Unter Zuhilfenahme von internationalen Best Practices und bereits existierenden State-Of-The-Art-Lösungen werden Konzepte auf den Untersuchungsstandort Wien angepasst sowie raum- und verkehrsplanerische Anforderungen für den Untersuchungsraum analysiert.

Des Weiteren soll eine Potenzial- bzw. Risikoanalyse Aufschluss über die Erfolgschancen von möglichen Optimierungsmaßnahmen sowie die Erarbeitung von Lösungsvorschlägen organisatorischer und technologischer Art – unter Berücksichtigung genderspezifischer Aspekte – für innerstädtische Multi-Use-Konzepte geben.

Auf Basis der Potenzialanalyse werden konkrete Implementierungsstrategien organisatorischer und technologischer Art entwickelt, um leerstehende (Erdgeschoß-)Flächen nachhaltig zu nutzen. Auch mögliche Risiken solcher Konzepte werden mittels eines eigens dafür konzipierten Framework-Designs evaluiert, um weiteren Forschungsbedarf aufzudecken.

3.3 Zielsetzung des Papers

Im vorliegenden Paper werden die bisherigen Ergebnisse des laufenden Forschungsprojektes CommunityHub als Werkstattbericht vorgestellt. Aufbauend auf den identifizierten Problemstellungen wird ein Abriss der Konzeptionierung geboten. Im Speziellen sollen mögliche Potenziale und etwaige Grenzen sowie geeignete Lösungsmöglichkeiten vom Multi-Use-Konzept CommuntiyHub dargelegt werden.

4 IMPLEMENTIERUNGSSTRATEGIE

4.1 Konzeption von CommunityHub

Das innovative Konzept, das in dieser Form europaweit noch nicht existiert, soll unterschiedliche (Logistik-)Aktivitäten (z. B. Lagerung, Umschlag, Reparatur, Recycling, Nahversorgung, Versicherung) bzw. Transaktionen (z. B. verkaufen, vermieten, verleihen, tauschen, verschenken) vereinigen und auf einem Open-Source-System basieren, welches alle Akteurinnen und Akteure implementieren können. Das Konzept baut auf funktionale Prinzipien wie Partizipation, Nahversorgung und Mehrfachnutzung auf, die für sich selbst einzeln bereits existieren, jedoch bisher als keine gemeinsame Anwendung umgesetzt wurden.

- Partizipation von Endkundinnen und Endkunden bei der Gestaltung und Produktion von Sachgütern und Dienstleistungen ist eine intensive Form der Endkundenorientierung und garantiert oftmals einen hohen Endkundennutzen. Die Einbindung involvierter Akteurinnen und Akteure (auch die Stadtverwaltung) spielt eine wesentliche Rolle, um das Interesse und die Akzeptanz von solchen Konzepten zu erhöhen. Das Prinzip wird vielfach von Unternehmen im Konsumgüterbereich genutzt, spielt jedoch in der Logistik eine eher untergeordnete Rolle. Im B2C-Bereich finden sich vereinzelt Ansätze dazu, wie beispielsweise die Möglichkeit der Umleitung von Paketen durch eine dynamische Endkundeninteraktion.
- Die Nahversorgung mit Gütern und Dienstleistungen ist kein neues Konzept, bedarf aber durch sich ändernde Rahmenbedingungen einer Neuausrichtung. Aktuelle Entwicklungen in der Logistik sind die zunehmende Ausweitung des E-Commerce auf Güter des täglichen Bedarfs beziehungsweise das Anbieten von Same-Day-Delivery. Diese Trends bedürfen entsprechender Prozesse und Infrastrukturen, wobei insbesondere die Schnittstelle zu Endkundinnen und Endkunden – trotz zahlreicher Innovationsansätze (z. B. Kofferraumzustellung, Empfangsboxen) – noch erhebliches Verbesserungspotenzial birgt.
- Mehrfachnutzung von Infrastruktur ist ein Schlüssel zur Effizienzsteigerung und kann zur wirtschaftlich erfolgreichen Erbringung von Dienstleistungen beitragen. Bestehende Lösungsszenarien in der Logistik sind jedoch begrenzt. Ein weitverbreitetes Beispiel sind Paket-Shops, welche KEP-Dienste mit anderen, auch branchenfremden Geschäftstätigkeiten kombinieren.

Die drei genannten Prinzipien sollen durch Übertragung bestehender Lösungen auf Logistikanwendungen beziehungsweise Neuentwicklung von Lösungen im Rahmen von leistungsfähigen CommunityHubs eine innovative Integration erfahren.

Bei der Umsetzung werden vorteilhafte und nachteilige Standortgegebenheiten identifiziert und im Zuge dessen die Praktikabilität sowie Flexibilität (inner-)städtischer Sharing-Konzepte analysiert. Dabei werden relevante Rahmenbedingungen und Einflussfaktoren wie städtebauliche (z. B. Raumtypologien, Bebauungsdichte), gebäudetypologische (z. B. Gebäudenutzung/-höhe, Zugänglichkeit), infrastrukturelle (z. B. Park- und Lademöglichkeiten), verkehrsgeographische (z. B. Anbindung, Lage), gesetzliche (z. B. Fahrverbote) und demographische (z. B. Bevölkerungsstruktur) Gegebenheiten aber auch organisatorische Aspekte (z. B. Zugangsberechtigungen, Einlieferungsbeleg, Vernetzung mit der Zentrale, Mehranbietersystem, Sicherheitssystem) berücksichtigt.

Die Abschätzung für die Implementierung eines CommunityHubs erfolgt nach maßgeschneiderten Bewertungskriterien in den Bereichen Wirtschaftlichkeit, Realisierbarkeit, Kundenzufriedenheit und Nachhaltigkeit.

4.2 Potenziale von CommunityHub

CommunityHub zielt auf eine bedarfsgerechte, nutzerinnen-und nutzerfreundliche und durch die Gemeinschaft organisierte Versorgung der Bevölkerung mit logistischen Dienstleistungen ab.

Im Fokus steht die Nutzbarkeit, Zugänglichkeit und Verfügbarkeit solch nachhaltiger Versorgungsstrukturen. Es bedarf einerseits eines annähernd flächendeckenden Angebots und andererseits einer partizipativen bzw. kooperierenden Einstellung seitens der Nutzerinnen und Nutzer (Endkundinnen und Endkunden, Betreiberinnen und Betreiber, KEP-Dienste etc.). Besonderes Augenmerk wird im Rahmen des Multi-Use-Konzeptes auf die Reduzierung von Leerständen und die Belebung von Erdgeschoßzonen gelegt.

Weiters soll CommunityHub einen wesentlichen Beitrag zur Lösung der First- und Last-Mile-Problematik u. a. durch die Reduzierung der Transportwege (CommunityHub fungiert als Miko-Umschlagsknotenpunkt, wobei die Feinverteilung mit dem Lastenrad abgewickelt werden kann) und die Entkoppelung von der Anwesenheit der Paketempfängerinnen und Paketempfänger leisten. Durch die Integration von zeitungebundenen Übergabestellen (z. B. Boxensystemen) in bestehende Lagerraumkonzepte sowie ausgedehnte Öffnungszeiten von Nahversorgungseinrichtungen soll beispielsweise die Paketzustellung und -abholung entkoppelt von der Anwesenheit der Endkundinnen und Endkunden erfolgen. Doch auch andere Gütergruppen können an einem CommunityHub umgeschlagen bzw. gelagert werden wie beispielsweise Waren des täglichen Bedarfs, Nahrungs- und Genussmittel, Arzneimittel, IT-Ware, Werkzeuge, Bücher, Fahrräder, Abfall oder auch Freizeitartikel.

Durch Vermeidung weiterer Zustellversuche und den Einsatz neuartiger Verkehrsmittel (z. B. Lastenrad, Fahrzeuge mit alternativen Antriebstechnologien) sowie über den CommunityHub organisierte Fahr- und Einkaufsgemeinschaften können CO_2-Emissionen reduziert und Wege verkürzt werden. Mittels Boxensystemen besteht unter anderem für KEP-Dienste die Möglichkeit, die Distributions- mit der Retourenlogisitk zu verknüpfen und paarige Verkehre zu generieren. Auf diese Art und Weise wird der Energie- und Ressourcenverbrauch reduziert.

Somit wird eine optimale Ressourcenallokation (Raum, Personal, Zeit etc.) bei gleichzeitiger Reduktion der Transportwege angestrebt. Durch das Multi-Use-Konzept wird auch der Sharing-Gedanke forciert sowie der kommunikative Austausch in der Nachbarschaft im Rahmen von Social Entrepreneurship gefördert.

Wie in Abbildung 1 ersichtlich, fördert das Projekt CommunityHub proaktiv die Nachhaltigkeit in der Gütermobilität auf allen drei Ebenen, und zwar:

- Ökologisch nachhaltig: durch die Einbindung von umweltbewussten Logistik- und Transporttechnologien (Einsatz von alternativen Zustellfahrzeugen bzw. Konzepten)
- Ökonomisch nachhaltig: durch die Wiederverwendung bzw. Teilen von bestehenden Lagerflächen oder Gütern (Sharing-Economy)
- Sozial nachhaltig: durch die aktive Förderung vom Austausch in der Nachbarschaft (im Grätzl)

Abbildung 1: Zielsetzungen des Projekts CommunityHub

4.3 Grenzen von CommunityHub

Generell stehen logistische Dienstleistungsprozesse im Spannungsfeld zwischen Schlankheit und Agilität. Schlanke Prozesse sind kosteneffizient, erfordern jedoch ein hohes Maß an Standardisierung. Dem stehen agile Prozesse gegenüber, welche zwar in der Lage sind dynamischen Anforderungen mit Reaktionsfähigkeit zu begegnen, dies jedoch zu entsprechend hohen Kosten.

Das Konzept CommunityHub orientiert sich tendenziell nicht an Standardisierung und Kosteneffizienz, sondern fordert eine relativ hohe Agilität. Dies ist dem Umstand geschuldet, dass die Interessen unterschiedlicher Akteurinnen und Akteure sowie die Anforderungen vielfältiger Prozesse im Rahmen eines Multi-Use-Konzeptes gebührend Berücksichtigung finden müssen.

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Ein CommunityHub stößt dann an seine Grenzen, wenn die resultierende Komplexität nicht kontrollierbar beziehungsweise wirtschaftlich abbildbar ist. Für ein funktionierendes Geschäftsmodell (unabhängig von öffentlichen Förderungen) ist es daher essentiell, dass die Komplexität möglichst reduziert wird und Services, welche eine Grundfinanzierung sicherstellen, im Fokus stehen.

5 PRAKTISCHE ANWENDUNG UND MEHRWERT

Für die relevante Zielgruppe – sowohl für die privaten (Endkundinnen und Endkunden) als auch für die gewerblichen (KEP-Dienste) Nutzerinnen und Nutzer – entfaltet sich das Potenzial der geplanten Ergebnisse in vielerlei Hinsicht: Bereits existierender, jedoch ungenutzter Raum wird nach den Prämissen des Sharing-Gedankens geteilt.

Zusätzlich können beim Multi-Use-Ansatz durch mehrmalige bzw. fehlgeschlagene Zustellversuche oder die räumliche Bündelungen von Gütern bzw. (Dienst-)Leistungen unnötige Transportwege vermieden werden. Dies fördert ein nachhaltiges Geschäftsmodell im Sinne der „Stadt der kurzen Wege“ bzw. etabliert den Gedanken der „Smart City“.

Zudem werden auch Stakeholder wie die Stadt Wien und die Wirtschaft durch die Projektergebnisse profitieren: Die Stadt kann die verfügbaren Infrastrukturflächen dank der ausgelagerten Bewirtschaftung effizienter nutzen und Logistik- bzw. Versorgungsdienste können einen technisch hochinnovativen Logistik-Hub für ihre Leistungserbringung nutzen. Für die lokale Nachbarschaft entsteht ein Treffpunkt und ein Ort bei dem der soziale Austausch gefördert wird (z. B. in Form von Tausch- und Leihbörsen, Veranstaltungen wie Flohmärkte, Austragen von Sportkursen, Schulungstätigkeiten).

Ein weiterer Vorteil des Multi-Use-Konzepts liegt darin, dass durch die gemeinsame Nutzung von Anlagen Kosten der einzelwirtschaftlichen Akteurinnen und Akteure eingespart werden können und eine höhere Flexibilität bei z. B. der Lagerung diverser Konsumgüter, der Paketzustellung und -abholung sowie gemeinsamen Nutzung von Flächen, Infrastrukturen und Gütern gegeben ist. Somit entsteht durch das Projekt CommunityHub eine Win-Win-Situation. (DHL 2013: online)

Aus Abbildung 2 sind potenzielle Nutzerinnen und Nutzer sowie wesentliche Charakteristika eines potenziellen CommunityHubs ersichtlich.

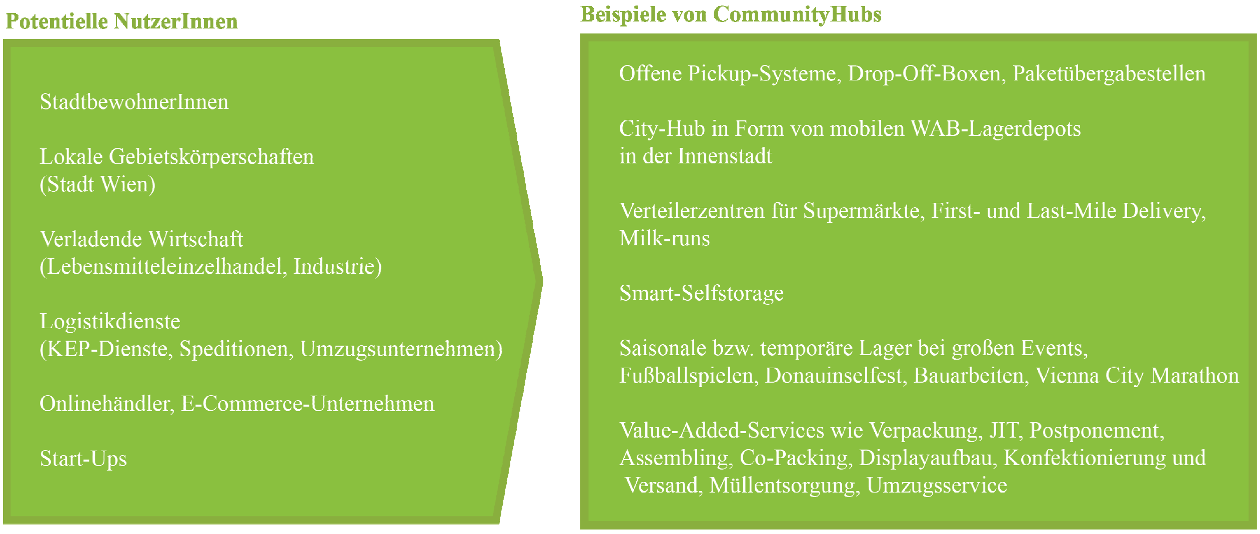

Abbildung 2: Potenzielle Nutzerinnen und Nutzer und Beispiele von CommunityHubs

Um die wirtschaftliche Verwertbarkeit mit der sozialen Nachhaltigkeit zu vereinen sind offene Lösungsvorschläge gefragt. Es soll an den vorhandenen städtischen Strukturen angeknüpft werden, wobei einerseits Lösungen an die Community angepasst und andererseits mit der Community entwickelt werden können. Dies setzt neben der Involvierung relevanter Stakeholderinnen und Stakeholder einer sehr heterogenen Akteurinnen- und Akteurslandschaft, das Aufbrechen von vorhandenen (Kooperations-)Strukturen und -Mustern, eine gute Kenntnis der Community voraus.

Für einen längerfristigen Betrieb ist die Entwicklung eines fundierten Geschäftsmodelles ebenso wie die Erstellung eines Business Case essenziell.

6 REFERENZEN

BMVIT (2013): Programm Mobilität der Zukunft. Ausschreibungsleitfaden, 3. Ausschreibung. Gütermobilität neu organisieren, Fahrzeugtechnologien alternativ entwickeln. Version 1.1.8.11.2013. Bundesministerium für Verkehr, Innovation und Technologie Wien.

DHL (2013): Multi-user, Shared-user and Dedicated Warehousing, DHL International GmbH. Internetauftritt, verfügbar unter: http://www.dhl-healthcare.co.uk/products/multi-user-shared-user-and-dedicatedwarehousing.html, Zugriff am 17.05.2017, Wien.

Kujath, Hans Joachim (2003): Logistik und Raum – Neue regionale Netzwerke der Güterverteilung und Logistik. Leibnitz-Institut für Regionalentwicklung und Strukturplanung (IRS), Ekner.

Österreichische Post AG (2014): Grenzenlos zuverlässig. Geschäftsbericht 2013. Österreichische Post AG. DAS MAGAZIN. Niederösterreichisches Pressehaus, St. Pölten.

Schrampf, Jürgen, Zvokelj, Alexander, Hartmann, Gerda (2013): Strategisches Gesamtkonzept. Smart Urban Logistics. Effizienter Güterverkehr in Ballungszentren. Klima- und Energiefonds, Wien.

Statistik Austria (2016): Vorausberechnete Bevölkerungsstruktur für Wien 2015-2100 laut Hauptszenario. Erstellt am 11.11.2016 Internetauftritt, verfügbar unter: https://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/bevoelkerung/demographische_prognosen/bevoelkerungsprognosen/index.html, Zugriff am 01.06.2017, Wien.

Taniguchi, Eiichi (2012): Die Zukunft der City-Logistik. Internetauftritt, verfügbar unter: http://www.delivering-tomorrow.com/de/the-future-of-city-logistics/, Zugriff am 17.05.2017, Wien.

Winter, Bernd (2015): Eine Sekunde nach dem digitalen Urknall. In: Verkehr. Nr. 37/71. Jahrgang. Ausgabe vom 11.09.2015.

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🏆 *reviewed paper*

Datenplattform Smarter Together

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1 ABSTRACT

Smarter Together ist ein gemeinsames EU Projekt von Lyon, München und Wien. Die Laufzeit beträgt 5 Jahre (2016-2020). Es sollen Erfahrungen der Stadt Wien zum Thema Smart City international kommuniziert werden. Da bei diesem Projekt sehr viele Daten – IoT (Internet of Things) Gebäudedaten, Umweltdaten erhoben werden und das Monitoring eine zentrale Rolle spielt ist auch die Implementierung einer Datenplattform ein Bauteil in den EU Projekt.

Keywords: Fiware, EU-Projekt, Smarter Together, Datenplattform, Wien

2 DAS PROJEKT – SMARTER TOGETHER

2.1 Die Programmteile

Eine schnell wachsende Stadt wie Wien hat viele Herausforderungen zu meistern (Zuzug, Klimawandel, Globalisierung, etc.), deshalb besteht ein hohes Interesse an smarten Lösungen (Mobilität, Infrastruktur, Energie, etc.).Neue Wege und Konzepte sollen in Wien entwickelt und verifiziert sowie als technische und soziale Innovationen umgesetzt werden. Die Partizipation von Bürgerinnen und Bürgern hat für die Stadt Wien einen besonders hohen Stellenwert. Durch die Einbindung können vermehrt innovative und akzeptierte Lösungen entwickelt werden. Am Wirtschaftsstandort Wien sollen EU-Fördergelder gezielt genutzt werden. Simmering hat als Zielgebiet besonderen Wert, weil der große Anteil an Nachkriegsbauten repräsentativ und innovationsbedürftig ist.

2.2 WP5 – Lighthouse Demonstration Vienna

2.2.1 <u>Programmziele</u>

- Eine breite Bürgerinnen- und Bürgerbeteiligung mit unterschiedliche Zielgruppen
- Ausgewählte Ergebnisse aus Bürgerinnen- und Bürgerbeteiligung sind berücksichtigt.
- Internationale Best Practices sind in Wien umgesetzt.
- Maßnahmen zur Senkung des Energiebedarfes von Objekten sind umgesetzt
- Neue Möglichkeiten der Energieversorgung (für Wien) sind umgesetzt (Integrated Infrastructure & Services), diese schließen die Bereiche Mobilität und Energiegewinnung ein.
- Die neuen vorgesehenen Mobilitätslösungen sind im Zielgebiet unter Berücksichtigung des Wohnbaues und Wohnumfeldes angeboten.

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- Eine smarte Mobilitätsstrategie für das Zielgebiet liegt vor.

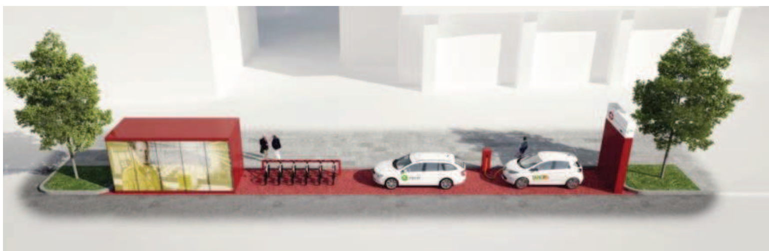
3 BEISPIELE DER UMSETZUNG

Anbei ein paar Beispiele, was umgesetzt werden soll:

Es wird einen Strawberrytree vor der Schule geben . Der soll zum Verweilen einladen, als WLAN-Hotspot diesen und Stromanschlüsse zum Laden von Handys und Tablets anbieten.

Ein Zero-Energy-Turnsaal für die Schule soll ohne zusätzliche Einspeisung die Energie selbst gewinnen (Sonnenkollektoren).

Ein Mobilitypoint soll E-Fahrräder und E-Cars mit Strom versorgen. Eine entsprechende App soll alle wichtigen Infos zu Carsharing, öffentlichem Verkehr und den nächsten Mobilitypoints zeigen.



Firmen wie die im Zielgebiet angesiedelte Firma Siemens und die Post werden E-Cars einsetzen.

4 DIE DATENPLATTFORM

4.1 Fiware – Das EU Projekt

FIWARE ist seit 2011 als EU-Projekt im Rahmen Future Internet PPP (500 Mill EUR) mit 470 Partner-Unternehmen und 27.000 Entwicklerinnen und Entwicklern entwickelt worden (z. B. Atos, Telefonica, Fraunhofer, Orange…)

- Phase 1: Konzeption einer Future-Internet-Plattform
- Phase 2: Implementierung einer Referenz-Plattform - Output ist FIWARE-Plattform
- Aktuell Phase 3 :– „Zum Leben erwecken“

4.2 Fiware – Umsetzung in Wien

Die Stadt Wien ist im Dezember 2016 gemeinsam mit der Wirtschaftsagentur Wien der Fiwarefoundation als Goldmember beigetreten. 2017 soll Fiware im Rechenzentrum der Stadt Wien etabliert werden. Fiware soll als Datenplattform für Smarter Together und über den Projektzeitraum hinaus für Smart City Projekte der Stadt dienen. Das soll ein Beitrag zu Digital City und Wirtschaftsstandort Wien sein.

4.2.1 Fiware in Wien Eckdaten

- Erstellen eines Konzeptes welche Komponenten wir vom Fiwarekatalog benötigen. – mit externer Unterstützung
- Umsetzung mit externer Unterstützung
- Installation und Konfiguration Betriebssystem und Core-Komponenten
- Installation und Konfiguration Fiware Basis
- Installation und Konfiguration von ca 5 zusätzlichen Paketen

5 CONCLUSION

Mit der Umsetzung der Plattform sollen die Möglichkeiten von Fiware und deren Module gezeigt werden. Weiters sind Daten nicht nur als Open Data sondern auch als Closed Data in der Datenplattform verfügbar.

Die Projektpartner sollen ihre Daten von ihren Backendsystemen in die Datenplattform spielen. Die Sensorendaten werden in den Backendsystemen der Projektpartner geliefert.

Determinants of Transport Mode Choice in the Austrian Province of Vorarlberg

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1 ABSTRACT

Almost all countries have policies to reduce the usage of private car and to raise the usage of public transport by reducing the distance of travel, increasing density, increasing the access to public transport and so on. All of these developments are effective strategies for reducing car dependency. The factors which determine travel behavior of people are relatively broad. Besides the factors such as urban form and transport infrastructure, one important factor is the personal attribute which has a strong effect on the modal choice. By better understanding of this fact, the settlement development and transport planning can be integrated in a more sustainable way. This paper addresses the influence of socio-demographic and geographic factors on the selection of mode choice in the Austrian province of Vorarlberg. We used the mobility survey "Österreich unterwegs" from 2014 and applied bivariate and multinomial logit model in order to quantify the influence of factors on mode selection. Result show that the household size, age, gender, income and motivation of travel have a significant effect on the modal choice.

Keywords: Sociodemography, Transport policy, Logit model, Alpine space, Modal choice

2 INTRODUCTION

Urban structure and mobility appear to be inextricably linked (Hickman, et al., 2009). Urban transport is more complex than other transport sectors; it should integrate different transport systems with spatial development. The interrelation between urban structure and travel is complex and sustainable cities create balance between physical dimension, urban form and transport, social dimensions, people and their requirements (Banister, 2011).

The province of Vorarlberg is situated in Austria's alpine west and borders Switzerland, Liechtenstein and Germany. It is an economically vibrant region with a steadily growing population. Most of the homes and work places are concentrated in the Alpine Rhine Valley. In the last 50 years, this part of the region has gone through an intense urbanization process, and is now characterized in many parts by urban sprawl (Zech & Gassner, 2006), and clear spatial boundaries of the build-up areas are missing (Hoffmann-Bohner, 2013). This leads to a car-dependent lifestyle and high transport-related carbon emissions and one of the most important issues in this region is the link of settlement and transport planning. A better understanding of the factors influencing mode choice in the region is needed to develop strategies for a more sustainable regional mobility.

The aim of this article is to evaluate the role of spatial indicators such as population density, accessibility to public transport, type of area as well as gender, age and employment on the transportation modal choice. This research mainly focuses on the relation between urban structure and travel mode choice. We want to highlight to what extend spatial indicators can change and touch the travel behavior. The first research question relates to explore the factors which affect the modal choice in this region. We consider three main transportation modes including car (PKW), public transport (PT) and bike or walk (W-B). The second research question concerns in the magnitude of the impact of these factors on modal choice.

According on the utility theory, we assumed that individual travelers prefer to choose modes of transport that has higher utility for them e.g. residences prefer to choose car in long distance travel to reduce travel time. If each factor considered by the individual are known to the analyst for every alternative, modal choice could be developed to predict with certainty every choice (Mcfadden, 1974)

We first summarize the literature on modal choice in section 2. In section 3, we apply a descriptive statistical analysis and multinomial logit model to describe and estimate the effect of different factors on modal share. The results are discussed in section 4 which is followed by conclusion.

2.1 Literature Review

This section briefly summarizes some main features of modal choice from different decades. The most extensive cited review on determinant of modal choice is done by (De Witte, et al., 2013). He distinguished three major approaches in determining of modal choice which are a rationalist approach, a socio-geographical approach and a socio-psychological approach (De Witte, et al., 2013). In the rationalist approach travelers take decision based on the utility maximization and individual will selects rational from the alternatives base on his preferences. As mentioned above this theory published by Mcfadden and after that is used by many authors e.g. Shen 2009, Buehler 2011 and Arbués 2015.

The socio-geographical approach describes two set of indicators; socio-demographic indicators and spatial indicators. The socio-demographic indicators describe the personal attributes of the travelers as well as their social communications. These factors are age, gender, education, employment, income, household size, car ownership and driver license (De Witte, et al., 2013). Internationally, income and automobile ownership are good predictors for mode choice. In industrialized countries where most households have a car, also demographic variables such as age, gender and life style are highly relevant for mode choice (De Witte, et al., 2013).

According to (Axhausen & Simma, 2003) elderly people prefer to use more public transport and young generation does not have resources to own car. But (Schwanen, et al., 2001) reported that age is not much influence factor on modal choice, rather than car ownership is more significant on the selection of mode and he also studied that men are more likely to use car while women are more dependent on public transport.

Income highly relates to the social status and higher educated people are more likely to have higher income levels and as the result they are more prone to use the car to go to work (De Witte, et al., 2013). In contrast, (Schwanen, et al., 2001) states that higher educated people use public transport more frequently than the car.

The spatial factor indicates the geographical characters of travel in which the trip and modal choice takes place such as density, type of area, access to public transport and distance to achieve destinations (De Witte, et al., 2013).

A famous and frequently quoted study on the impact of density on travel demand is that by Newman and Kenworthy (Newman & Kenworthy, 1989) on energy use by cars in 32 large cities in Europe, the US, Australia, Asia and Canada. He and Laube reported in 1996 that the balance between public transport use and private transport use is strongly related to urban density and high densities area may be expected to reduce the need to travel long distances for all modes and expands the usage of public transport and walking and cycling (Kenworthy & Laube, 1996). Furthermore, distance impacts the modal choice by increasing the preference to faster travel.

According to Axhausen & Simma income and automobile ownership are internationally good predictors for mode choice, but in industrialized countries where most households have a car, also demographic variables such as age, gender and life style are highly relevant for mode choice (Axhausen & Simma, 2003).

The distance of residential area from city center and job location has strong influence on modal split as well as living close to jobs will reduce the vehicle miles traveled (Gordon & Richardson, 1989) and increase the potential of bike and walking modes. In the other way if residence areas are in far distance from cities, increase the priority to use rapid modes of transport to reduce travel time, thus these residents often use individual motorized transport modes as the best variable transport.

In the line with previous research, we expect that modal choice is influenced by combination of socio-demographic characteristics and geographical factors. Our result provide evidence that the socio-demographic factors such as gender, gender, income, car ownership and reason of travel have a stronger effect on modal choice than the geographical factors.

3 ANALYSIS

3.1 Data sources and variables

3.1.1 Data description

Data for this study are derived from mobility survey questionnaire of “Österreich unterwegs” in 2014. The survey includes questions on four main parts which are household demographics, personal information of travelers, vehicle information and traveling attributes such as mode choice, duration, and distance.

For preparing the data, appropriate answers for each variable are selected and irrelevant answers are skipped from data set. For instance, observations within the category of no answer are deleted. After skipping the irrelevant answers, the analyzed dataset includes 6214 trip observations.

The analyzed survey consists of three separated SPSS files which all have the same column codes. For running the bivariate and multinomial model these tables are joined together based on each specific trip to have overview about all characters of each trip.

3.1.2 Descriptive statistics

Table 1 provides a detailed description of the characteristics of participants in the questionnaire. Interviewers that participate in the survey cover 21% of all households in the Vorarlberg. A comparison of age profiles which is illustrated in Table 1 shows that majority of participants are between 44 to 64 years old by 44%.

Table 1 shows the cumulative percent of households that majority of the families contain two or four persons. Among all participants, almost 75% of them have anytime access to car and almost 19% of them have opportunity to use car as transportation mode.

In figure 1, we conduct a descriptive cross tabulation of car ownership by different household sizes. Results show a dominant reliance on car for all households regardless of the household size. Besides, an increase in household size results in lower number of households without cars decreases and higher number of car ownership.

The cross tabulation of gender and modal choice is shown in figure 2. Results show that males are more dependent on car mode, while women prefer to use more bike and walking modes.

The travel motive is an important factor that highly effects on the mode choice. In this paper four types of travel reasons including business, education, shopping and entertainment are considered. Table 1 shows that the majority of travels belong to pleasure purpose by 47.1%, whereas just 4% of travels are made for education reason and 34% of travels for work reason. Besides, 65% of business travels are done by men and 35% by women, while 53% of education travels are done by women and 47% by men.

As shown in figure 3 the trips by education reason rely heavily on public transport while business trips as well as pleasure and shopping travels are done mostly by car. One assumption for high usage of public transport for education travel can be that the education travels are done by young age category, which most of them do not possess a valid driving license and may not own a car compared to those in the higher age groups. The usage of public transport in other types of travel reasons is very low, considering the fact in this region urban structure and transport planning are not successfully interlink to each other.

Figure 4 presents the percentage of modal share for shopping and pleasure travels in different age categories. As mentioned, 62 % of travels have pleasure and shopping reasons. More than 60% of these trips rely on car at the all age categories. Young and old participants, both are more interested to use PT and Walk or Bike as transportation mode than middle ages. One assumption for this can be that the students have less access to car ownership and senior prefer to choose less stressful transport modes such as walking or bike. For instance, the usage of public transport for young participants is more than other age categories by 16%. However, increases in the age results decreasing the usage of public transport.

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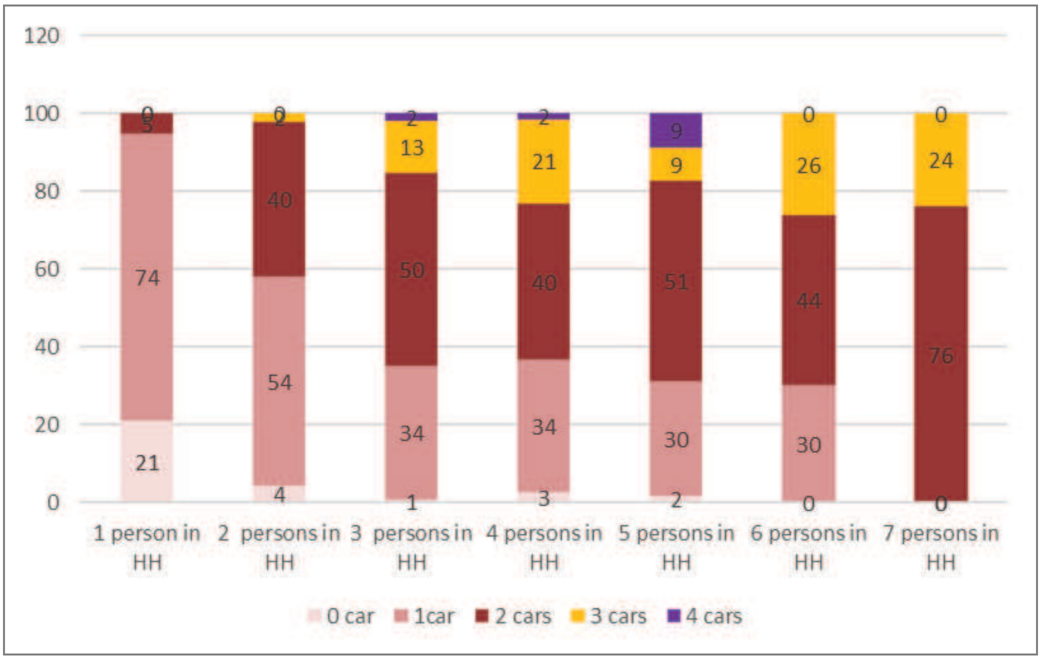

Fig 1: Percentage of number of car ownership by Household

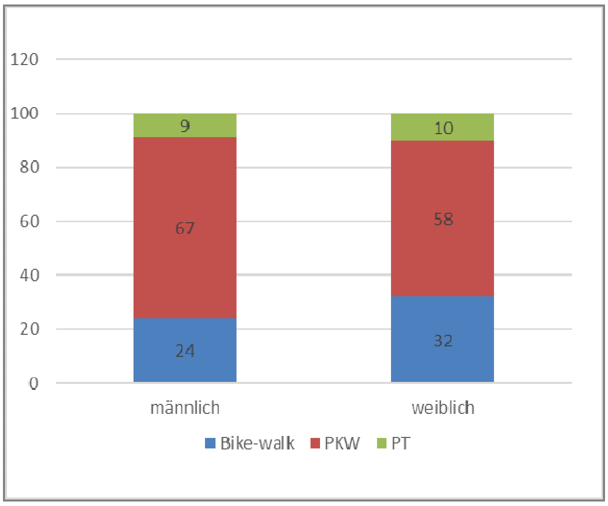

Fig. 2: percentage of modal share by gender

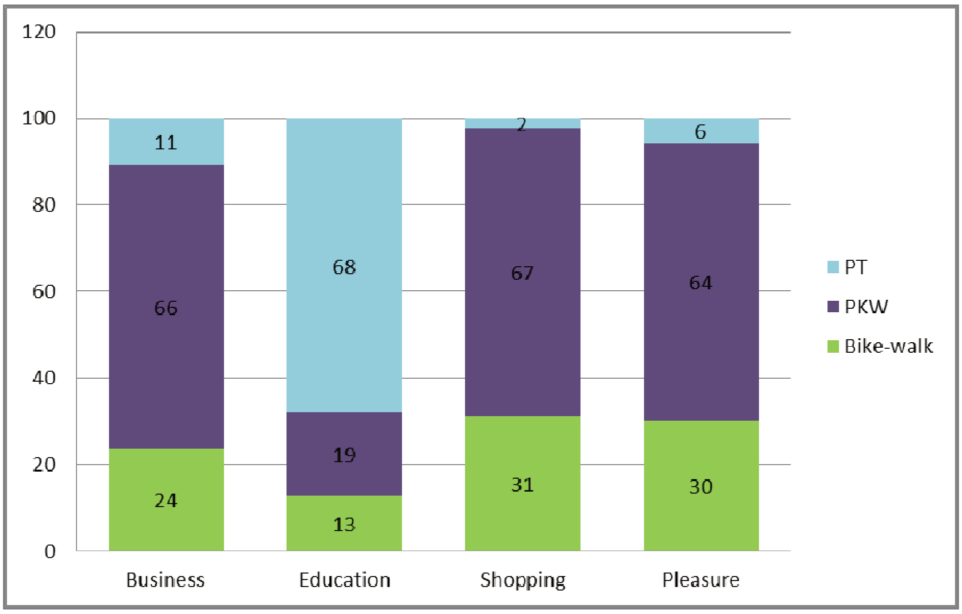

Fig 3: Percentage of modal share by reasons of travels

Income has a positive correlation with car ownership and higher income leads to an increase the probability of car usage. In this study five level of income including very low “less than 750 euro”, low “between 751 to 1250 euro”, middle “between 1250 to 1750 euro” and high income “1751 to 2250 euro” and very high incomes which is up than 2251 euro per month are considered. As shown in table 1 the level of income for 49% of participants is high, while 35% of participants have middle income and just 3% have low and very low income. Figure 5 shows that an increase in the level of income leads to a decrease the usage of public transport. For example, participants with very low income use public transport by 22%, however travelers with very high level of income prefer to choose public transport just by 7%. Besides, an increase in level of incomes results in a higher preference to choose biking or walking as transportation modes.

Another important factor in modal choice is the travel distance. Table 1 shows that 19% of travels were shorter than 1 km, 35% of travels between 1 to 5 km, 32% among 5 to 20 km, 12% among 20 to 50 km and only 2% longer than 50 km. Indeed, longer trips constitute a higher share of car choice. One reason for using more cars can be the long average trip distance and not suitable access to public transport. Figure 6 illustrates that 73% of short trips are made by walk or Bike and an increase in distance of travels results in an escalation in usage of faster travel modes e.g. car and public transport and less usage of bike or walking.

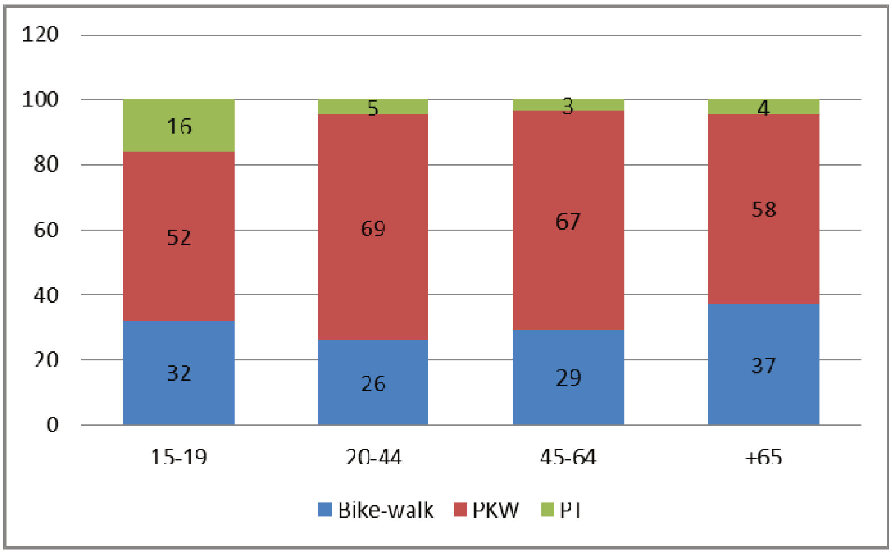

Fig 4: Percentage of modal share for Pleasure and Shopping reasons by age category

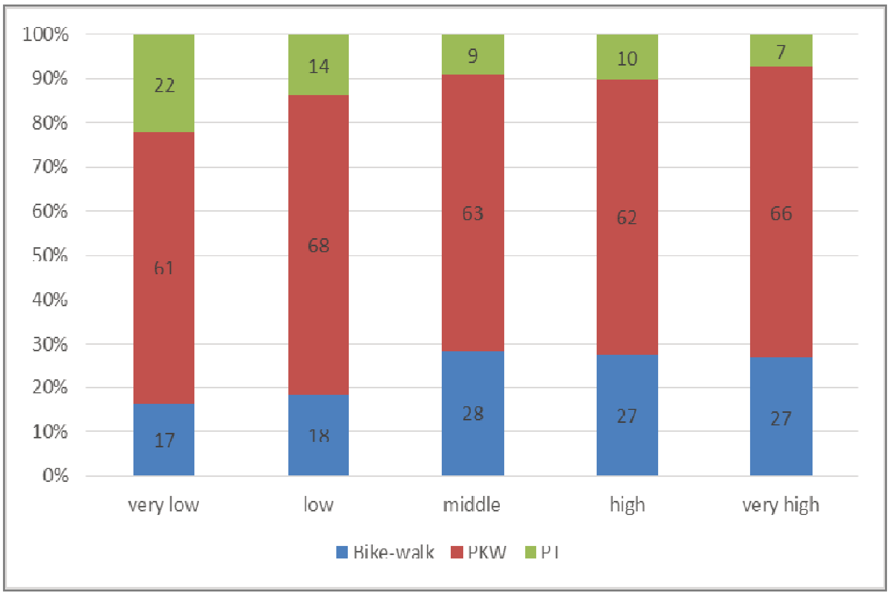

Fig 5: Percentage of modal share by level of incomes

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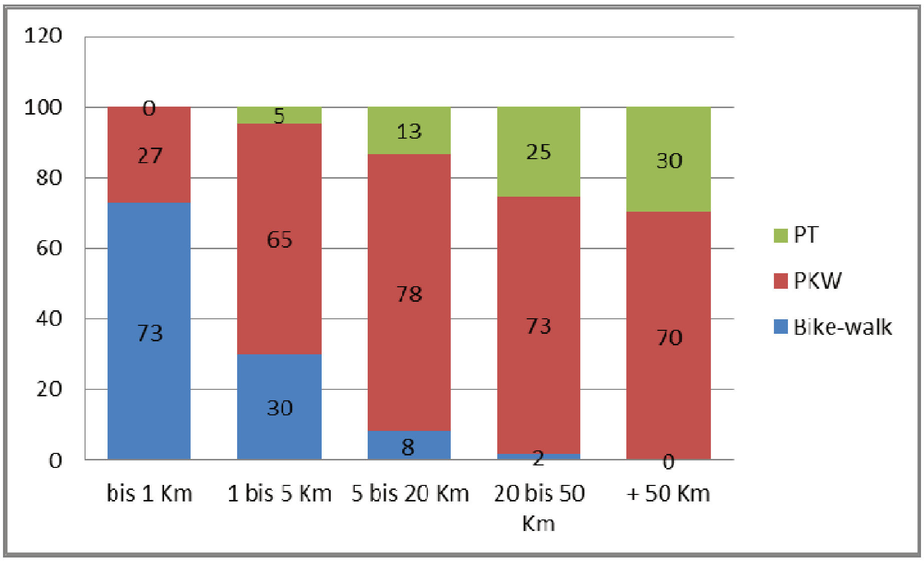

Fig 6: Percentage of modal share by distance of travels

According to (Kenworthy & Laube, 1996) usually high population densities are related to less car use and more walking or Bike and public transport use. Table 1 shows that 50% of participants live in the relatively dense areas which are more than 300 people per km2. As illustrated in figure 7 the share of car mode declines by increasing the population density might be interrelated to the raised usage of Bike or Walk in Vorarlberg by 37%.

Figure 8 shows that travelers from rural area are more likely to select faster modes such as car and public transport to reach central areas, while travels originated from center to rural areas are highly dependent on car mode by 72% and the main reason for these travels is pleasure. This means pleasure facilities are more likely to reach by car modes rather than public transport, walking or biking. Also, many leisure activities like hiking and skiing take place in the mountains, which are also easier to reach by car than by any other transport mode.

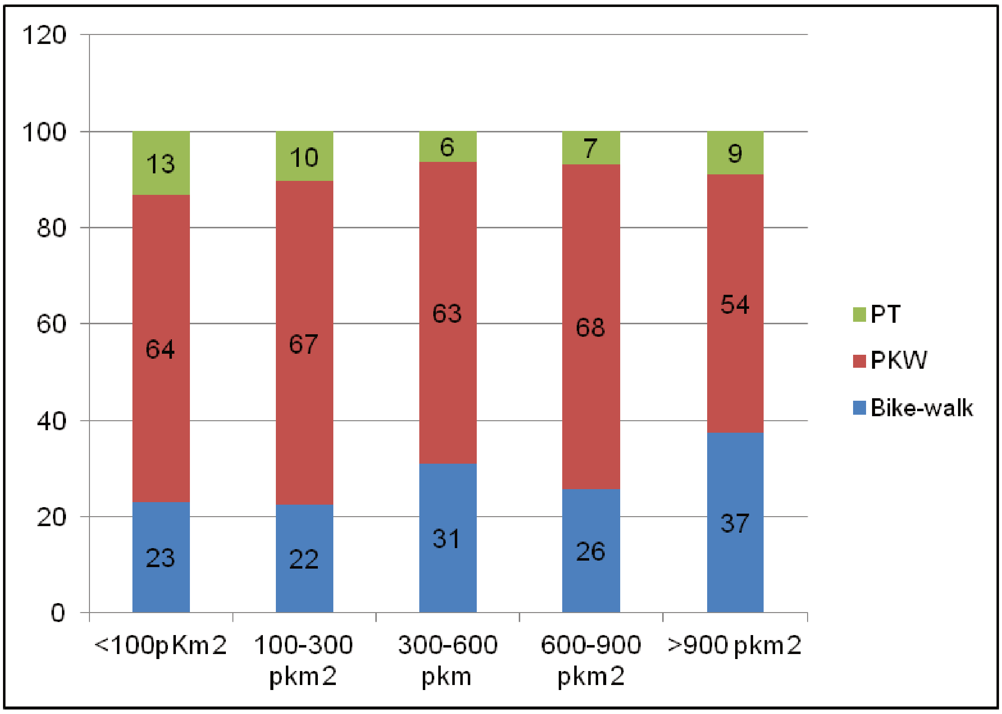

Fig 7: Percentage of modal share by population density

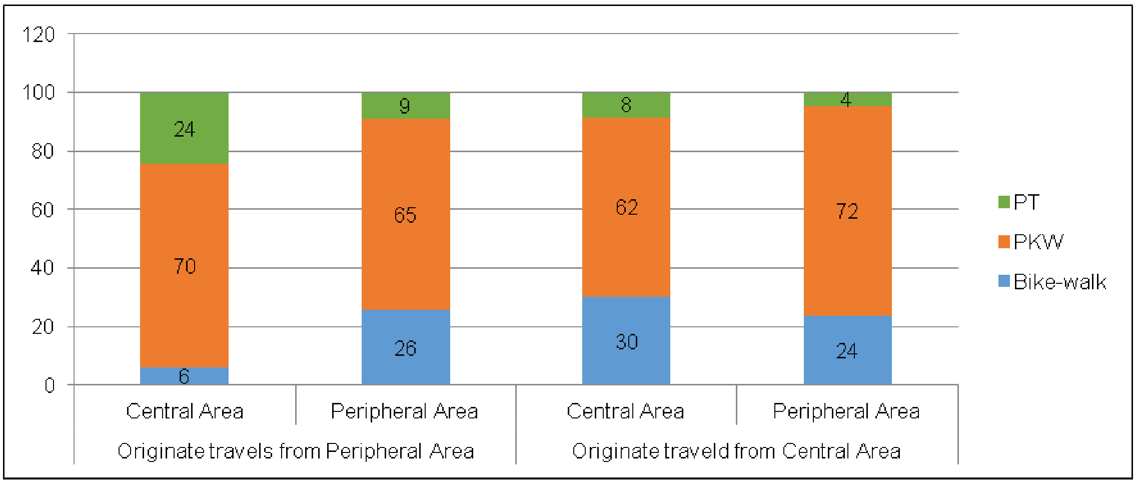

Figure 8: Percentage of modal share by destinations in central and peripheral areas

Explored variables	Frequency	Percentage	Cumulative Percentage
Number of people in a household			
1	584	9	9
2	2083	34	43
3	1406	23	66
4	1564	25	91
5	483	8	99
6	73	1	100
7	21	0	100
Car availability			
Jederzeit	4303	75	75
Gelegenheit	1109	19	94
Nie	342	6	100
Age category			
15-25	985	16	16
25-44	1569	25	41
45-64	2722	44	85
65	938	15	100
Reason of travel			
Business	2118	34	34
Education	256	4	38
Shopping	912	15	53
Pleasure	2928	47	100
Level of Income			
very low	18	0.3	0.3
low	174	2.8	3.1
middle	2150	34.6	37.7
high	3026	48.7	86.4
very high	846	13.6	100
Distance of Trips			
bis 1 Km	1195	19	19
1 bis 5 Km	2154	35	35
5 bis 20 Km	1996	32	32
20 bis 50 Km	732	12	12
+ 50 Km	137	2	2
Duration to PT			
5 Min	4567	74	74
6-15 Min	1470	24	97
16-30 Min	150	2	100
31-60 Min	18	0	100
61-120 Min	5	0	100
Population Density			
<100 km2	1736	27.9	27.9
100-300 km2	1379	22.2	50.1
300-600 km2	1771	28.5	78.6
600-900 km2	474	7.6	86.3
+900	854	13.7	100.0

Table 1: Frequency of explored variable

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3.2 Utility theory and Multinomial Logit Model

Theory of random utility is the most common theory for analyzing travel behavior particularly in the field of travel demand. Daniel McFadden received the Nobel Prize in 2000 for this theory which is used for analysis of discrete choices such as travel mode choice.

Based on the utility theory we assumed that when individual want to make a choice from set of discrete alternatives, he always selects the best option which has the highest utility for him. If every factor considered by the individual were known to the analyst for every alternative, discrete choice model could be developed to predict with certainty every choice (Mcfadden, 1974). The utility of alternatives is not known with certainty and part of it is random (Mcfadden, 1974), therefore, the utility function for each alternative is supposed to be the sum of two components which are shown in equation (1)

(1) $U_i = V_i + \varepsilon_i$

Where Ui is the utility function of individual i, Vi is the systematic and deterministic component of utility which is a linear combination of the observed variables, and εi is the random component of utility function which is unobserved part of utility function. It is important to note that the utility function is purely deterministic from decision maker's perspective and it is random from the Researcher's point of view because some of the determinants of the utility function are unobserved. Therefore, the choice can only be analyzed in terms of probabilities (Mcfadden, 1974)

According to the definition of the utility function, alternative j will be chosen if and only if the condition given in equation (2) is satisfied. (Bhat, 1999)

(2) $\forall \mathrm{j} \neq \mathrm{i}: \quad U_j > U_i$

The equation (2) can be rewritten as in equation (3) and equation (4). (Bhat, 1999)

(3) $\forall \mathrm{j} \neq \mathrm{i}: \quad V_j + \varepsilon_j > V_i + \varepsilon_i$

(4) $(P_j|\varepsilon_j) = P(U_j > U_1, \ldots, U_j > U_{iJ})$

By considering these assumptions, the probability of choosing each alternative can be calculated in a closed from which corresponds to the logit transformation of the deterministic part of the utility function. The probability of choosing alternative j is given in equation (5) (Mcfadden, 1974)

(5) $$P_j = \frac{e^{V_j}}{\sum_{i=1}^{J} e^{V_j}}$$

3.2.1 Model Result

Table 2 present odd ratios for the explored variables in Multinomial logit model. We consider the car mode as baseline mode and compare the Public transport and biking and walking to this baseline. The result of significant testing of variables and pseudo-R^2 e.g. McFadden confirms that the model is appropriate and can explain the influence of variable on mode choice. The values of R^2 vary from 28% to 47%. This means the model can predict correctly the modal share in the case study by different assumptions.

As we expected, the influence of sociodemographic factors is significantly stronger than then influence of spatial factors. In the used model three covariates including population density, distance to closest public transport station and distance of trips are considered. The population density dose not vary much over the alternatives and odd ratio is almost zero. The coefficient value for the distance to closest public transport station is negative by -0.02 and -0.03. A negative coefficient means that if the population density increases the likelihood to choose public transport and biking or walking over car decreases by 2% and 3%. The coefficient for distance of trips by public transport is 0.01 which means by increasing the distance of trip the likelihood to choose public transport over car is almost similar and just slightly differ by 1%, while the likelihood of selecting bike or walk over car decreases by 26%. As we displayed, the density and distance to public transport are quite weakly related to different modes of transport which is in contrast to the Kenworthy's result. This can be studied in more detail for further work in order to find an efficient way for public transport.

According to the results of social factors, females are 1.3 times more likely compared to males to choose public transport over car and they choose walk or biking 1.4 times more than males. The odd ratio by age categories shows that young generation at the age 15 to 19 use public transport over car 5 times more than seniors older than 65, whereas they choose bike or walk almost as same as old generation. In the case of the travelers between 20 to 44 years, their preference to choose public transport over car is 10% more than seniors, but the likelihood of choosing biking or walk over car by them is 15% less than seniors. For the age category between 45 to 64 years, the likelihood of selecting of biking and walking over car shrinks by 21% compared to the senior generation.

As we expected increasing the number of car owners in each household is highly correlated to decreasing the usage of public transport and biking or walking. For instance, households with one car use public transport and walking or biking two times more than households which own four cars. The odd ratio of household without car shows almost 16 times more likelihood to use of public transport and 9 times more likelihood to select walking or biking over car compared to households with 4 cars.

According to the regression results, trip reason has a strong correlation with mode choice. Travelers with business reason prefer to select public transport over car almost 2.3 times more than travelers with pleasure reason. Travels for education purposes are highly dependent to the mode choices other than car compared to the travels for pleasure purpose. For instance, travels by education reason are done 2.6 times more with bike or walking over car and also almost 19 times more with public transport in comparison to the travels by pleasure reasons.

Explored Variables	Odd ratios	Exp (B)	Odd ratios	Exp (B)
	Public Transport		Bike-Walk	
Constance	-1.74	-1.74	-17.28	-17.28
Geographical Factors				
Population Density	0.00	1.00	0.00	1.00
Distance to closest Public Transport Station	-0.02	0.98	-0.03	0.97
Distance of trip	0.01	1.01	-0.30	0.74
Wohnraum Type				
Zentrale Bezirk	-0.26	0.77	0.10	1.11
Social Factors				
Age category				
15-19	1.60	4.96	0.04	1.04
20-44	0.10	1.11	-0.17	0.85
45-64	0.12	1.13	-0.24	0.79
Gender				
Women	0.27	1.30	0.32	1.38
Number of car owner				
Number of car owner-0	2.76	15.75	2.16	8.69
Number of car owner-1	0.69	1.99	0.62	1.85
Number of car owner-2	-0.37	0.69	-0.21	0.81
Number of car owner-3	-1.19	0.30	-0.35	0.70
Reason of Travel				
Business	0.82	2.26	0.07	1.07
Education	2.93	18.81	0.97	2.63
Shopping	-0.79	0.45	-0.41	0.67
Income				
Low	-0.04	0.96	-0.99	0.37
Middle	-0.32	0.73	-0.02	0.98

Table 2: Result of Multinomial logit model of transport mode choice, PKW as reference

4 CONCLUSION

We have analyzed the influence of personal characteristics and the attributes of spatial variables on the mode choice. The results show that even though the usage of car is the dominant transport mode choice in Vorarlberg region, but socio-demographic variables including age, gender, population density, level of incomes and travel motive are highly correlated with the modal choice as well. Besides, percentage of modal share by densities illustrate that the high-density areas related to more usage of biking and walking.

In the Vorarlberg region, many leisure activities are hiking and skiing which take place in the nearby mountains which are easier to reach by car. As the major purpose of travels in this region is for pleasure, thus the car is the dominant travel mode choice. For instance, 62 % of travels have pleasure and shopping reasons which more than 60% of these trips are done by car. This means future transport policy in this region should therefore pay specific attention to develop low carbon transportation infrastructure for travels with leisure purpose, and to exploit the cohort effect resulting from the presumed change in mode preferences.

Results show that an increase in household size results in more likelihood to own a car and increasing car ownership results in less usage of public transport, biking and walking. For instance, households with no car use almost 16 times more public transport over car and 9 times more walking or biking over car compare to households with 4 cars.

According to the results, women are less dependent on car than men and they prefer to choose public transport more than men. The majority of travels for education purpose are done by young generation and they have limited car ownership. Therefore, these travels are mainly done by public transport. For young people at the age between 15 to 19, the odds ratio of using public transport over car is 5 times more than older generation.

Income status shows that by increasing the level of income the usage of public transport decreases. In the Vorarlberg region, participants with a very low income use public transport by 22%, while travelers with a very high level of income use public transport just by 7%. Besides, an increase in the level of income leads to a slight increase in biking or walking modal choices.

This paper has clearly highlighted the positive correlation of personal attributes on the modal choice in Vorarlberg region. The results provide a better assessment to find out if there is a potential for improvement in public transport and change in mode preferences. The future strategies should address these potentials and make alternatives to the car more attractive.

5 REFERENCES

Axhausen, K. & Simma, A., 2003. Fundamental relationships specifying travel behavior – an international. Transportation Reasearch Board Annual Conference. Washington.

Banister, D., 2011. Cities, mobility and climate change.

Bhat, C. R., 1999. A multi-level cross-classi®ed model for discrete response. Transportation Research, pp. 567-582.

Buehler, R., 2011. Determinant of transport mode choice: a comparisaon of Germany and USA. Transport Geography, pp. 644-657.

De Witte, A., Hollevoet, J., Dobruszkes, F. & Hubert, M., 2013. Linking modal choice to motility: A comprehensive review. Transportation Research Part A, pp. 329-341.

Gordon, P. & Richardson, H., 1989. Gasoline consumption and cities. Americam Planning Association, pp. 342-345.

Hickman, R., Headicar, P. & David, B., 2009. Planning for sustainable travel: integrating spatial planning and transport.

Hoffmann-Bohner, K.-H., 2013. Raumübersicht Plus, s.l.: s.n.

Kenworthy, J. & Laube, F., 1996. Automobile dependence in cities: an international comparison of urban transport and land use patterns with implications for sustainability. Environmental Impact Assessment, pp. 279-308.

Mcfadden, D., 1974. Conditional logit analysis of qualitative choice behavior. In: Analysis of qualitative choice behavior. s.l.:s.n., pp. 105-142.

Newman, P. & Kenworthy, J., 1989. Gasoline consumption and cities: a comparison of US cities with a global survey. the American Planning Association, pp. 24-37.

Schwanen, T., Dijst, M. & Dieleman, F., 2001. Leisure trips of senior citizens: determinants of modal choice.. Tijdschrift voor economische en sociale geografie, pp. 347-360.

Zech, S. & Gassner, R., 2006. Vision Rheintal. Dokumentation 2006. Räumliche Entwicklung und regionale Kooperation im Vorarlberger Rheintal, Bregenz, s.l.: Amt der Vorarlberg Lanesregierung.

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Developing Effective Measures for Reduction of the Urban Heat Island based on Urban Climate Model Simulations and Stakeholder Cooperation

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1 ABSTRACT

The climate change projections for the Austrian cities indicate that the observed warming trend, including frequent occurrences of extreme heat events, is expected to continue in the coming decades. Due to the Urban Heat Island (UHI) effect, caused by modification of energy balance in the built-up environment, the cities are warmer than their rural surroundings and therefore more exposed to negative impacts of climate change. During prolonged heat wave events, the excess in heat combined with reduced night-time cooling, decreased ventilation and possible air pollution can cause severe health impacts on the urban population. Developing measures for reduction of the UHI effect is important in the context of sustainable urban development and climate sensitive urban planning. Number of counteracting measures such as increase in vegetation, green open spaces, green roofs, unsealing of paved surfaces, decreasing absorption of solar radiation by increasing the reflectiveness of buildings and paved surfaces, are considered in the scope of climate change adaptation strategies. Nevertheless, the effectiveness of these measures, as well as their applicability in the existing urban structure, especially in the densely-built environments is not well known. Moreover, the expected cooling effects need to be quantified and the possible application should be communicated and appropriately planned with the relevant stakeholders in order to anticipate a large-scale implementation.

This study investigates the effective methods for application of climate adaptation measures to reduce the UHI effect in a densely built-up environment on an example of the residential and business district of Jakomini in the city of Graz/Styria. The current local climate conditions are simulated with the urban climate model MUKLIMO_3 of the German Weather Service (DWD) using meteorological, geomorphological and land use data from the city of Graz. The simulations with altered land use characteristics corresponding to application of different UHI counteracting measures are calculated and compared to the reference simulation. The gradual increase in green areas, existing potential for green roofs implementation, modification in reflectivity of roofs and façades as well as unsealing of paved surfaces is considered. The resulting difference in heat load is evaluated as the potential cooling effect for the area of the Jakomini district and its surroundings. Based on the model results, a set of measures with optimal climatic impact is identified in close cooperation with the city's planning department and in accordance with already existing concepts, plans and projects. This information is communicated with the relevant stakeholder groups both from private and public sectors to get their commitment to definitely undertake measures in the test-district. Considering the respective interests and role of action of different stakeholder groups a set of target measures is selected for further technical, financial and administrative planning of implementation.

The study is supported by the Austrian Research Promotion Agency (FFG) and the Climate and Energy Fund (KLIEN) within the Smart Cities project "JACKY_cool_check" (Project Nr. 855554).

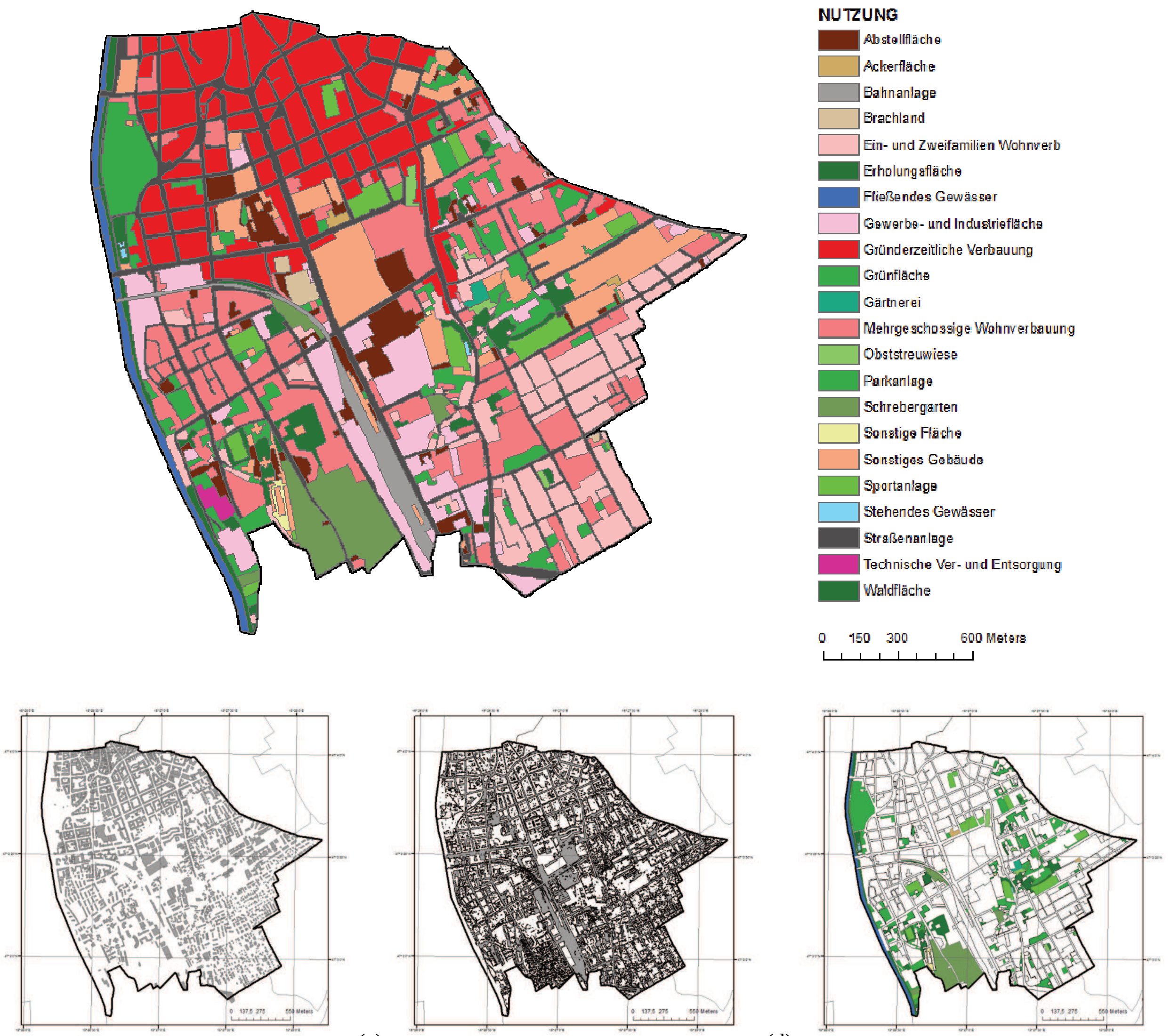
Keywords: stakeholder cooperation, cooling effect, climate adaptation measures, green roofs, urban heat island

2 METHODS AND DATA

2.1 Urban Morphology

The geomorphological data for the Jakomini district were provided by the city administration of Graz, (Stadtplanungsamt and Stadtvermessungsamt der Stadt Graz). The data include land use and land cover data, digital surface model (DOM) and the green roof potential for the Jakomini district. The orography data are based on the EU-Digital Elevation Model (DEM) of 25 m horizontal resolution provided by Copernicus Land Monitoring Services of European Environmental Agency (EEA). Additional information on tree density per land use class was calculated from the Pan-European High Resolution Layers of Copernicus Land Monitoring Services.

Based on the availble data from the time period 2011/2012, the Jakomini district covers an area of 406.1 ha, of which 64% or 259.9 ha are paved and built-up surfaces. The paved surfaces cover 136.3 ha and the building area is 101.9 ha of which 11% of roofs (11.2 ha) are adequate for greening. The transportation infrastructure accounts for 16.2 % of the Jakomini area or 65.7 ha. Green surfaces cover 74.3 ha or 18.3% of the district area and water surface amount to 1.5% or 6.2 ha. The land use distribution, including built-up, paved and green areas is given in Fig. 1. The land use dataset has 23 different land use types. For each land use type a set of parameters is defined to describe urban structures and surface properties: fraction of built area, mean building height, wall area index, fraction of pavement, fraction of tree cover, fraction of low vegetation, tree height, height of the low vegetation, albedo of roofs, walls and paved surfaces and fraction of green roofs. The land use parameters calculated for the Jakomini district are applied in the model for the district surroundings as well, assuming that the typical characteristic of the building types do not differ significantly.



(a)

(b) (c) (d)

Fig. 1: Land use distribution in the district Jakomini, city of Graz/Styria (a). In the lower panel are shown buildings (b), paved areas (c) and green surfaces (d). The data are provided by the city administration of Graz (Stadtplanungsamt and Stadtvermessungsamt der Stadt Graz).

2.2 Urban Climate Model Simulations

In this study, the urban climate model MUKLIMO_3 (in German: 3D Mikroskaliges Urbanes KLImaMOdell) developed by the German Weather Service (DWD) is used to simulate the urban heat load in the Jakomini district with focus on day-time conditions during the summer period. The MUKLIMO_3 model (Sievers and Zdunkowski, 1985; Sievers, 1990; Sievers, 1995; Sievers, 2012; Sievers, 2016) is a micro-scale z-coordinate model based on Reynolds-averaged Navier–Stokes (RANS) equations, which was designed to simulate atmospheric flow fields in presence of buildings. The thermo-dynamical version of the model (Sievers, 2016) includes prognostic equations for air temperature and humidity, the parameterization of unresolved buildings using the porous media approach (Gross, 1989), short-wave and long-wave radiation, balanced heat and moisture budgets in the soil (Sievers et al., 1983), vegetation model based on Siebert et al. (1992) and calculation of short-wave irradiances at the ground level, the walls and the roof of buildings in an environment with unresolved built-up ass described by Sievers and Früh (2012). The model takes into account the cloud cover and its effects on the radiation. However, it does not include cloud processes, precipitation, horizontal runoff nor anthropogenic heat (e.g. traffic or heat generated from air conditioning). The vegetation in the canopy model has three vertical layers and a 15-layer soil model is included in the simulations. The model differentiates between four main land use types: buildings, trees, free surfaces and water. The grid cells with buildings do not include trees, but it is possible to define the percent of the low vegetation, which is also considered in the simulations with green roofs. The fraction of sealed and unsealed surfaces is taken into account in all grid cells except water. The modelling approach takes into account complex terrain and land use distribution including a detailed register of green roof potential. The model domain covers the Jakomini district and its immediate surroundings with a domain size of 138 x 135 x 25 grid points. The horizontal grid spacing is 20 m. The vertical resolution of 1D model with 52 levels varies from 10 to 100 m with higher resolution near ground level and lower resolution at the maximum height of about 2000 m.

The changes in urban heat load are evaluated using the method for calculation of climate indices called the "cuboid method" (Früh et al., 2011; Zuvela-Aloise et al. 2014), which allows analysis of heat load changes on a longer temporal timescale. The cuboid method refers to a tri-linear interpolation of meteorological fields deriving from single-day 3-D simulations from the urban climate model MUKLIMO_3. Eight idealized simulations representing the cuboid corners with duration of 24 hours for the two prevailing wind directions (northwest and southeast) are calculated. Calculation of climate indices for a 30-year period is based on interpolated Tmax fields from the eight single-day simulations using climatological data from a reference station as input. The time series of daily mean temperature, relative humidity, wind speed and hourly wind direction for the period 1981–2010 from the monitoring station Graz Flughafen are used as input meteorological data. The mean annual number of summer days (SU: Tmax≥25°C), based on ETCCDI indices (Expert Team (ET) on Climate Change Detection and Indices; Zhang et al., 2011) is taken as index for evaluation of the urban heat load. For further information on model initialization and the description of the boundary conditions please refer to Zuvela-Aloise et al. (2011; 2014; 2016; 2017).

2.3 Methods for Stakeholders Cooperation

The project JACKY_cool_check is following an innovative approach and explores and elaborates on the necessary requirements for measures against Urban Heat Islands not only from a technical side but also from the side of urban planning as well as the social viewpoint. Basic assumption of this approach is that public and private stakeholder groups are able to identify and use their own scope of action to set measures against Urban Heat Islands, if they are provided with prior technical information ("informed stakeholders") and are supported by a targeted communication process.

Although Urban Heat Islands are causing measurable negative physical and mental effects, approaches to decrease these effects are opposing other interest (e.g. trees vs. parking lots, green surfaces vs. façade protection). Therefore, it is the key to adapt technical measures to the social system they are designed for. The Urban Heat Island Strategy Plan for Vienna (UHI 2015) showed that information and communication, within the city departments and beyond, public relations and the opportunity for citizens to actively participate in the identification, planning and implementation of Urban Heat Island measures is fundamental.

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For the project JACKY_cool_check, all relevant stakeholders in the district of Jakomini were identified in a first step. Special attention was set on the inclusion of all different kinds of stakeholders, public and private ones:

- Old and young people;
- People who have been living there for a long time, new residents and immigrants (which account for almost a quarter of the population in this district);
- Associations, collectives and parishes
- Enterprises, especially those with big potential concerning (free) surfaces
- Big housing complexes
- City departments linked to the topic, like urban planning, environment, transport planning, etc.
- The district administration

This list is complemented by additional stakeholders who are being mentioned within the interviews and group meetings.

All these stakeholders have been contacted at the beginning of the project and have been provided with information on the project, its goals and different activities and the possible role of the stakeholders. In interviews and group meetings, all different interests, their attitude to Urban Heat Islands and already existing engagement and initiatives were surveyed.

3 RESULTS

A reference simulation based on the current urban morphology of the Jakomini district using climatological data for the period 1981-2010 is shown in Fig. 2. The modelling results indicate higher heat load in densely built-up areas in the northern and central part of the district and lower heat load in the areas with higher fraction of vegetation or water. Unfortunately, no climatological monitoring station in the period 1981-2010 is available in the Jakomini district and the results for mean annual number of SU cannot be directly validated. A dense network of monitoring stations would be required for a detailed quantitative analysis of the modelling results. However, the resulting mean annual number of SU is in expected range of variation for the City of Graz (Graz Flughafen: 66.6 SU; Graz UNI: 63.0 SU). Due to the spatial grid resolution and porous media modelling approach, the micro-scale processes on the level of buildings in the model are parameterized. Therefore, the model results are not necessarily accurate on a level of single building and a micro-scale modelling approach with resolved buildings and individual building geometry is required for more detailed analysis.

A set of simulations with altered land use characteristics is performed to evaluate the cooling potential of different climate adaptation strategies. The change in heat load is expressed in difference in mean annual number of SU when compared to the reference simulation. The reduction of heat load by more than -10 SU in annual mean is considered as strong cooling effect, while change of about -5 SU is taken as moderate cooling effect. The heat load difference of less than 1 SU (equiv. to approximately 0.1 K) is considered to be below model accuracy.

In Fig. 3 are shown selected simulations intended to demonstrate the cooling effect of climate adaption strategies applied on paved and built-up surfaces. The model sensitivity simulations include reduction of sealed surfaces by 50%, implementation of green roof on 50% of buildings and increase in wall and roof albedo from standard values, 0.3 for the walls and 0.2 for the roofs, to 0.7 which is approximately the reflectivity value of white ceramics (Prado and Ferreira 2005).

The simulation with reduction of sealed surfaces by 50% (Fig3.a) shows a reduction of heat load over a large area of Jakomini district. The cooling effect is of minor to moderate intensity. In the Jakomini district, about 70 ha of paved surfaces have been in this case replaced with low vegetation (48.5 ha) or free soil (21.1 ha). The strongest cooling effect is found in the transportation and densely built-up areas where the high fraction of paved surfaces is reduced. Moderate to strong cooling effects are found in the model simulations with increased wall (Fig3.b) and roof albedo (Fig3.c). The cooling effect of the increased wall reflectivity is stronger in intensity on a local scale in vicinity of buildings. However, the cooling effect on the surroundings is larger in the simulation with the increased roof albedo. The model simulations with green roofs indicate minor to moderate cooling effects if vegetation is implemented on 50% of the roofs (Fig.3.d). The cooling effect of green roofs is strongly dependent on the area to which the greenery is applied. The higher the fraction of green roofs, higher is the cooling effect. However, given the realistic values for the green roof potential in the Jakomini district of only 11%, the cooling effect is considerably reduced leading only to minor changes in heat load.

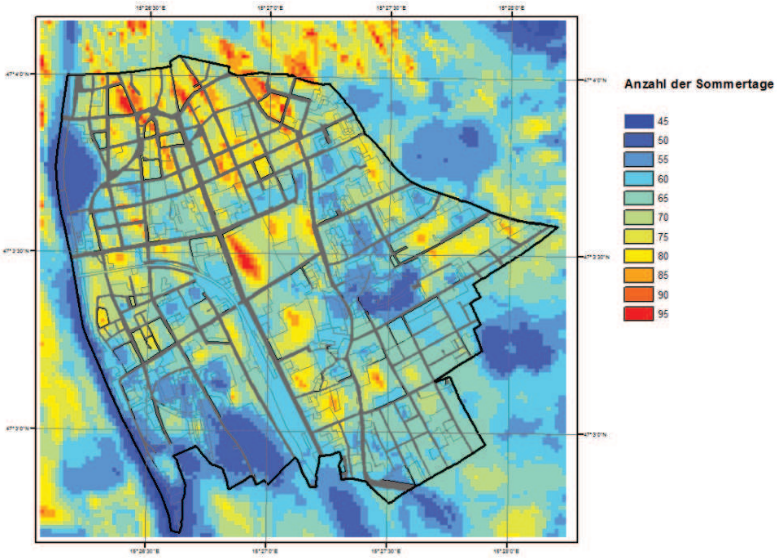

Fig. 2: Mean annual number of summer days (SU: Tmax ≥ 25°C) in Jakomini district calculated with the urban climate model MUKLIMO_3 (Sievers, 2016) and the cuboid method (Früh et al. 2011; Zuvela-Aloise et al. 2014) based on the climatic data for the period 1981–2010.

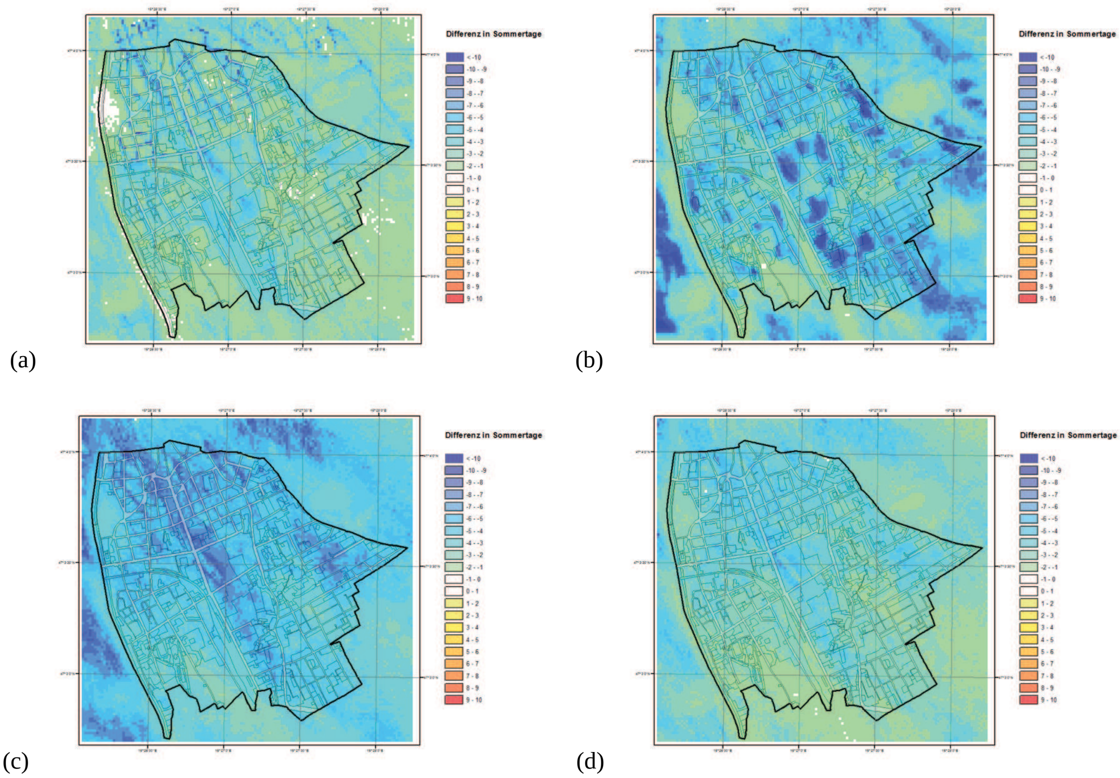

Fig. 3: Difference in mean annual summer days (ΔSU) compared to the reference simulation (Fig. 2) in the simulations with reduction of paved surfaces by 50% (a), increased wall reflectivity (b) and roof albedo to 0.7 (c) and implementation of green roofs on 50% of buildings (d).

4 DISCUSSION AND CONCLUSIONS

This study investigates the potential for implementation of climate adaptation strategies in existing densely built-up environment of Jakomini district in Graz based on the urban climate model simulations and cooperation with the relevant stakeholders. The analysis of the urban heat load is focus on day-time conditions during the summer period and the climate index mean annual number of summer days (SU: Tmax≥25°C) is used for the evaluation of thermal changes.

The modelling simulations show that a strong cooling effect (more than -10 SU) can be achieved by applying materials with high albedo values (~0.7) on building's walls and roofs and also by significantly (more than 50%) reducing fraction of pavement or increasing vegetation on roofs. The mitigation measures should be applied extensively to have a sizeable effect. However, the potential for implementation of green roofs in Jakomini district is limited. Therefore, the best cooling performance could be achieved by combining different adaptation measures on the available surfaces.

To find appropriate measures that provide a good cooling performance in the test-district as well as fit into the already existing cityscape is a big challenge. As no large-scale new city developments will be possible in the areas of the inner city, measures will focus on the adaptation of the current building stock. As this is also an intervention with the social environment of the people living in these areas, a good communication process is necessary throughout the whole project. The urban climate model simulation provided a basic scenario that shows the maximum local cooling potential that is possible in theory. This scenario, together with the results from the first interaction with the stakeholders was discussed with the department of urban planning and will result in a "realistic" scenario that shows what is really possible in terms of measures, taking into account the Land Utilization Plan, the Urban Development Plan, building regulations, Green Space Service Planning and other regulation and guidelines of the city of Graz, influencing climate adaptation measurers.

In a next step, this realistic scenario is presented to the different stakeholder groups, initiating the communication and discussion process on concrete and practical ideas where stakeholders can bring in their own ideas. As the stakeholder groups will be quite diverse, different, tailor-made methods will be used (e.g. workshops, world-café, discussion forum, etc.) in this phase. The overarching goal of this step is the identification of concrete measures and the commitment of the stakeholders to these measures that will be implemented in a demonstration project, following JACKY_cool_check.

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6 REFERENCES

FRÜH, B, Becker P, Deutschländer T, Hessel J-D, Kossmann M, Mieskes I, Namyslo J, Roos M, Sievers U, Steigerwald T, Turau H, Wienert U: Estimation of Climate-Change Impacts on the Urban Heat Load Using an Urban Climate Model and Regional Climate Projections. Journal of Applied Meteorology and Climatology 50, 167-184. 2011

GROSS G: Numerical simulation of the nocturnal flow systems in the Freiburg area for different topographies. Beiträge zur Phys. Atmos. 62, 57–72. 1989

PRADO R. T. A., Ferreira F. L.: Measurement of albedo and analysis of its influence the surface temperature of building roof materials, Energy and Buildings 37, 295–300. 2005

SIEBERT J, Sievers U, Zdunkowski W: A one-dimensional simulation of the interaction between land surface processes and the atmosphere. Bound.-Layer Meteor. 59, 1–34. 1992

SIEVERS U, Forkel R, Zdunkowski W: Transport equations for heat and moisture in the soil and their application to boundary layer problems. Beiträge Physik der Atmosphäre 56, 58-83. 1983

SIEVERS U, Zdunskowski W: A numerical simulation scheme for the albedo of city street canyons. Boundary-Layer Meteorology 33, 245-257. 1985

SIEVERS U: Dreidimensionale Simulationen in Stadtgebieten. Umwelt-meteorologie, Schriftenreihe Band 15: Sitzung des Hauptausschusses II am 7. und 8. Juni in Lahnstein. Kommission Reinhaltung der Luft im VDI und DIN, Düsseldorf. S. 92–105. 1990

SIEVERS U: Verallgemeinerung der Stromfunktionsmethode auf drei Dimensionen. Met. Zeit. 4, 3-15. 1995

SIEVERS U, Früh B: A practical approach to compute short-wave irradiance interacting with subgrid-scale buildings. Met. Zeit. 21, 349-364. 2012

SIEVERS U: Das kleinskalige Strömungsmodell MUKLIMO_3. Teil 2: Thermodynamische Erweiterungen. Berichte des Deutschen Wetterdienstes 248. 155 pp, ISBN 978-3-88148-490-9. 2016

UHI 2015: Urban Heat Island strategy plan for Vienna: https://www.wien.gv.at/umweltschutz/raum/pdf/uhi-strategieplan.pdf

ZHANG X., Alexander L, Hegerl GC, Jones P, Tank AK, Peterson TC, Trewin B, Zwiers FW: Indices for monitoring changes in extremes based on daily temperature and precipitation data. Wiley Interdisciplinary Reviews: Climate Change, 2(6), 851-870. 2011

ŽUVELA-ALOISE M, Nemec J, Oberzaucher J, Kossmann M: SISSI-II: Simulationen von Städtischen KlimaSzenarIen 2, BMWF project report ZAMG, pp. 65. 2011

ŽUVELA-ALOISE M, Koch R, Neureiter A, Böhm R, Buchholz S: Reconstructing urban climate of Vienna based on historical maps dating to the early instrumental period. Urban Climate 10, 490-508. 2014

ŽUVELA-ALOISE M, Koch R, Buchholz S, Früh B.: Modelling the potential of green and blue infrastructure to reduce urban heat load in the city of Vienna, Climatic Change 135.3-4 (2016): 425-438. 2016

ŽUVELA-ALOISE M., Andre, K., Schwaiger, H., Bird, D. N., & Gallaun, H.: Modelling reduction of urban heat load in Vienna by modifying surface properties of roofs. Theoretical and Applied Climatology, 1-14. 2017 doi:10.1007/s00704-016-2024-2.

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Development of a Communication Tool to Frame a Vision for Changing Neighbourhoods

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1 ABSTRACT

Post war neighborhoods all over Europe are facing different kind of challenges in order to adapt them for the use in the future. The predominant factor in many concepts of neighborhood refurbishments is the energy demand of the buildings. In connection, many research projects focus on the reduction of CO_2 emissions omitting the fact that this specific value does not have any immediate benefit on the residents themselves, neither on a psychological nor on an economical level. Benefits are solely on a macro-economic level, which rarely is calculated and most likely cannot be communicated as a benefit to the residents in a comprehensible fashion.

The methodological approach presented in this paper reflects an iterative process of establishing a vision for a neighborhood development strategy. Its core is an iterative process, using the tools of questionnaires, workshops and focus group discussions, which includes the owners of the buildings, the local energy provider, policy makers, representation of the residents and research experts. Singular priorities were harmonized in the form of a questionnaire and multiple workshops. Based on this process, five key areas of action (energy, living space, open space, social and mobility) have been identified. It is valid for an urban area with mostly social housing, erected between 1966 and 1976. The reference neighborhood houses approximately 2,500 inhabitants and is situated in the town of Salzburg/Austria. The developed iterative process is multipliable and transferrable to comparable urban areas, which share a set of similarities. It is the basis for future decisions and gives orientation to the building owners, the energy provider and policy makers.

Besides the methodology the outcome of this process are a poster, a folder and a detailed catalog of measures. The poster and the folder visualise the neighborhood development strategy. A set of characters, icons and photos including easily comprehensible comics were developed. Those design features are important in order to create a recognition value and to stimulate acceptance among the inhabitants of the neighborhood. Moreover, the low-threshold approach of the design facilitates future communication with the concerned public.

The methodology of the neighborhood development strategy guarantees the inclusion of all stakeholders and supports a prioritization in order to decide on future measures that can lead to a more energy-efficient and liveable development of neighborhoods in need of adaptation.

Keywords: neighbourhood, communication tool, adaptation building stock, stakeholder inclusion, energy efficiency

2 INTRODUCTION

The need to mitigate the threats of climate change is undisputable. (Kennedy & Sgouridis 2011: 5,259) There is strong scientific consensus that anthropogenic influences are the dominant cause for a range of developments, e. g. warming of the atmosphere and the oceans, changes in the global water cycle as well as a rise in global mean sea level. (IPCC 2013: 17) Carbon dioxide concentration in the atmosphere has reached unprecedented levels in at least the last 800,000 years and has increased by approximately 40 % since pre-industrial times. The primary cause is the combustion of fossil fuels. (IPCC 2013: 11)

As a result, it can be observed that a large number of communities follow a trend to announce targets for carbon emissions and develop plans for reduction of energy and resources consumption. The aim is to lower their carbon footprint in order to become “zero carbon”, “carbon neutral” or “CO_2 neutral” communities (Kennedy & Sgouridis 2011: 5,259), eventually even “climate neutral”.

Especially post-war neighborhoods all over Europe are posing different kinds of challenges in regard to their adaptation for the use in the future. The predominant factor in many concepts of neighborhood refurbishment is the energy demand of the buildings, which sums up to 40 % of the global energy demand. (Bindra & Scanlon 2010) As mentioned above, many research projects focus on the reduction of CO2 emissions,

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omitting the fact that this specific value does not have any immediate benefit for the residents themselves, neither on a psychological nor on an economic level. Benefits are solely on a macro-economic level, which rarely is calculated and most likely cannot be communicated as a benefit to the residents in a comprehensible fashion.

2.1 Definitions

The research project "SmartItzGoes – Smarte Stadtteilsanierung Itzling -Goethesiedlung", on which this paper is based, also aimed to examine the possibilities of redeveloping the reference neighborhood into a carbon neutral urban district. In order to avoid misinterpretations, a definition of these two key terms, often referred to in this paper, is necessary.

A wide variety of definitions of the term "neighborhood" exists and an elaborate discussion is ongoing among planners and sociologists. Albert Hunter states: "undoubtedly, there is consensus that the neighborhood is a 'social/spatial' unit of social organization […] larger than a household and smaller than a city" (Hunter 1978: 270). Mostly, this is where the consensus ends. In this paper a neighborhood is "a social space, smaller than an administrative district, but more multifaceted than a residential area, which is strictly defined for residential purposes by law." (Alisch 2002: 60) Current literature offers a multitude of different categorizations of concepts (Erman 2014: 831) which aim at reducing CO_2 emissions. They include but are not limited to "zero carbon", "carbon neutral", "CO_2 neutral" or "climate neutral" concepts. Carbon neutral or CO_2 neutral are synonyms, describing a condition, in which the activities of an individual, an organization, a city or a country do not contribute to the gross input of global CO_2 emissions. Either the activities themselves do not cause CO_2 emissions or compensation alternatives, respectively "offsets" within or beyond the system counterbalance the emissions. The term "CO_2 neutrality" only refers to carbon dioxide and does not take the other greenhouse gases[1], in total responsible for the greenhouse effect, into consideration. (Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung 2017: 29)

Within the concept of "climate neutrality" or "net-zero GHG emissions" the effect of all GHG emissions on the atmosphere (according to the Kyoto protocol), expressed in the unit of CO_2 equivalent (CO_2e), is being accounted for. This does not imply that these concepts are "emission free". There is a slight difference between the two concepts. "Climate neutrality" can be reached if all GHG emissions can be compensated through analog reduction. The goal of "net-zero GHG emissions" can only be accomplished if the emissions are counterbalanced with real negative emissions, e. g. through CCS (carbon capture and storage). (Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung 2017: 31-32)

Recent research, e. g. the CLUE project (Climate Neutral Urban Districts in Europe[2]), are guided by the idea that climate neutral urban districts should function as test beds for new planning approaches in order to accomplish a transformation towards low carbon societies. Primarily new developments are in focus, although the biggest challenge is the conversion of the existing urban fabrique. It has to be stated that there is no climate neutral urban district today, which can serve as an example. Only a patchwork of experiences and good practices exists, which in their totality would eventually lead to a climate neutral urban district. (Erman 2014: 831)

2.2 Description of the reference neighbourhood

This paper deals with the methodology and the visualization of a participatory neighborhood development strategy for an urban area in Salzburg. This neighborhood incorporates mostly social housing, which was erected between 1966 and 1976, in a period of reconstruction and housing shortage in Salzburg. At that time, the welfare state established numerous collective housing structures, still known as social housing. The reference neighborhood is situated in the district of Itzling in the North of the town of Salzburg/Austria. The district is shaped by heterogeneous forms of housing developments with varying densities and manifold uses (residential area, trade, industry, education). The reference neighborhood itself consists of 26 buildings,

[1] There are natural and anthropogenic greenhouse gases. The primary greenhouse gases in the earth's atmosphere are water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3). Besides those gases exists a number of entirely human-made greenhouse gases. (IPCC 2013: 1,455)

[2] More information can be obtained here: http://www.clue-project.eu/

housing approximately 2,500 inhabitants in 1,257 apartments on a gross floor area of almost 100,000 m². Figure 1 offers an aerial view of the neighborhood.

Figure 1: aerial view of the reference neighborhood (Source: Google Earth, 2016)

It can be observed that the neighborhood was built at the verge of a transition from the urban concept of the "structured and loosened town" to the model of "urbanity through density". Those settlements are products of a time when modernism as a method of urbanism was at its heyday. A strict separation of functions into places for housing, work, education, recovery and provision was predominant. Mobility by car was the central feature of a city. Hence, many of those settlements are situated in former suburban locations, now encircled by the encroaching urban development from the past forty years.

In the North of the area, a big sealed space is used predominantly for parking. The zone between the buildings is characterized by green space with a smooth transition between public and private free spaces. The building stock, characterized by uniform height and following the row typology, is undergoing thermal renovation in a gradual manner. The institutional framework of social housing provides favourable conditions for change due to less complex ownership structures and the established system of residential building subsidies. Nevertheless, many of the buildings still have sub-standard insulation and inadequate HVAC systems, which no longer meet today's energy-efficiency standards. Migrant communities, low-income households and an aged population (more than 40 % of the inhabitants are over 60 years old) have replaced the original target group. The settlement will be exposed to strong pressure for change over the next few years, mainly caused by a foreseeable generational change in the tenant base, the demand for higher quality accommodation and the increasing requirements for energy efficiency and climate protection.

3 METHODOLOGY

In order to be able to formulate a neighborhood development strategy, a detailed inventory of the building stock and an urbanistic analysis followed by a SWOT-analysis is performed. The main goal of the neighborhood development strategy is to frame and visualise a desired target condition, which is shared by all relevant stakeholders (i. e. building owner, policy makers, energy provider and the institution representing the residents). It must create inward orientation and project a positive image to the public. Chapter 3.1 explains the iterative development of the content. Chapter 3.2 elaborates on the components as well as the graphical structure of the poster and folder representing the neighborhood development strategy visually. It should serve as a powerful communication tool for future projects concerning similar neighborhoods in need of adaptation.

3.1 Content

The methodology proposed in this paper includes three different instruments (questionnaires, workshops, focus group discussion), which are explained in chapter 3.1.1. At the core of the neighborhood development strategy is an iterative development process, which is shown schematically in Figure 2 and presented in detail in chapter 3.1.2. Participants in this process include the owners of the buildings, the local energy provider, policy makers, an institution representing the residents and research experts.

3.1.1 Instruments

Detailed and tested questionnaires are the instrument of choice in providing a strong foundation for the neighborhood development strategy. They are necessary in order to harmonize singular priorities of the building owners and in a following step prioritize the possible measures.

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The method of workshops was chosen because it provides the opportunity to work on many different topics and problems in a short period of time. The involvement of experts and relevant stakeholders as a valuable resource of knowledge and experience as well as a high degree of interaction secure an arranged approach in the development process. Utilizable results and valuable input can be deducted and allow a refinement of the neighborhood development strategy. Moreover, workshops enable a clarification of opinions and the identification and discussion of different perceptions. In an iterative process, all information was collected, structured, combined and evaluated. The result of this collective effort is a common understanding among the stakeholders.

Figure 2: schematic representation of the iterative process of neighborhood development strategy (Salzburg University of Applied Sciences)

Another important instrument in the development process is the moderated focus group discussion. It is organized and carried out by a trained sociologist. Participants are an institution serving as the representation of the residents, the housing office of the city of Salzburg, representatives of the urban planning and traffic department of the city of Salzburg as well as the building owners and the building management. Within this workshop, the opinions, interests and sentiments of the stakeholders are collected. The results are included in the process of the neighborhood development strategy leading finally – together with the other two instruments – to a common vision of the neighborhood.

3.1.2 Iterative Process

The results from the urbanistic analysis as well as the conclusion drawn from the SWOT-analysis serve as the basis for the formulation of possible measures for the future neighborhood development. Regarding the political frame conditions, a first catalog of measures is developed by the research experts, building owners as well as the energy provider.

The presentation of this first draft in a workshop in front of the policy makers in the city of Salzburg and the discussion of the measures is leading to a concretization of the objectives from the city government's point of view. Including policy makers in the process is a vital step in order to create acceptance and support for the project. Research experts document and reflect on the results of this workshop with the aim to provide suggestions for a necessary adaptation of the neighborhood development strategy.

A questionnaire targeted towards the building owners is developed. Within this questionnaire, the building owners are asked to prioritize the envisioned measures. The responses from the returning questionnaires are collected, structured, evaluated and graphically treated. This serves as a preparation for the following workshop with the building owners. The neighborhood development strategy is adapted accordingly. In the workshop with the building owners, the evaluation results of the questionnaire are presented and discussed. Additional input, as well as clarification and concretion of the suggested measures are the output of the workshop. The iterative process continues with the graphic treatment of the results from the workshop, deducting a voting questionnaire from the findings, which is sent to the building owners and the energy provider in order to deliver a second round of prioritization.

The results are structured and harmonized leading to an adaption of the neighborhood development strategy and the catalog of measures. The moderated focus group discussion follows and the recommendations are included. In a final workshop with policy makers, the objectives are further concretized and a final version of suggested measures under a mutual understanding is established. According to the results the neighborhood development strategy is finalized.

Figure 3 shows the workflow of the iterative development process chronologically.

Figure 3: workflow of the iterative process of the neighborhood development strategy (Salzburg University of Applied Sciences)

Based on this iterative harmonization and prioritization process, five key areas of action (energy, living space, open space, social and mobility) have been identified. They are visualized in Figure 4. For each key area of action, an illustrative icon with a high recall value is designed.

Figure 4: five key area of action (Salzburg University of Applied Sciences)

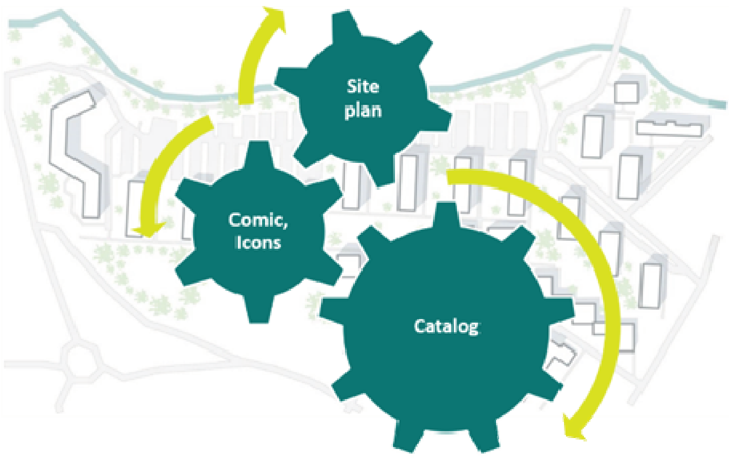

Figure 5: components of the neighborhood development strategy (Salzburg University of Applied Sciences)

3.2 Components and Design

The visual representation of the neighborhood development strategy follows a low-threshold approach. It is necessary to establish an original and aesthetically appealing concept in order to use it for future communication with relevant stakeholders and the concerned public. For this reason, a set of characters representing the residents is developed . The neighborhood development strategy consists of three components, which differ in scale and content according to the addressed target group. Starting with sketches of the agreed measures the following three components are developed:

- The site plan is graphically enhanced according to aerial pictures. It serves the purpose of localisation and gives an overview of the neighborhood.
- During site visits the situation in the neighborhood was captured. These photographs are enhanced with an individual set of characters, a visionary statement concerning the key area of action as well as generally understandable messages. The concept follows a comic style, which helps to simplify complex content.

- A detailed catalog of measures for each key area of action, including keywords, a visionary statement and background information relevant to the examined neighborhood forms the backbone of the neighborhood development strategy. This catalog is the basis for future decisions and gives orientation to the building owners, the energy provider and policy makers.

Figure 5 visualises the three components of the neighborhood development strategy graphically.

4 RESULTS

As an outcome of the iterative development process, a poster (see Figure 6, Appendix 1) with a unique concept serves as the visual representation of the neighborhood development. The set of characters, icons, photos and visionary statements are easily comprehensible. It represents a collective identification and action basis for all stakeholders and should stimulate acceptance among the residents.

A folder (see Figure 7, Appendix 2) was designed as an additional communication tool and a basis for future action. It is especially targeted towards the residents of the neighborhood to support a direct communication. They should be well informed and welcome in the process of change. Moreover, it is of great importance for the residents to realize that the planned changes will improve their quality of life.

Finally, the catalog of proposed measures (see an overview in Table 1) provides a detailed insight into the desired target condition from the viewpoint of the involved stakeholders.

Key area of action	Exemplary measure
ENERGY	Thermal improvement of building stock; use of renewable energy; increase in efficiency
PUBLIC SPACE	increased attractiveness; improved usability
MOBILITY	Sufficient space for bikes; e-mobility; car-sharing
LIVING SPACE	Careful densification; new forms of dwelling; room for interaction and health care
SOCIAL	Energy efficient lighting; reduction of fear causing open spaces; social and technical interconnection

Table 1: overview of the catalog of measures (Salzburg University of Applied Sciences)

In the course of the research project, all partners agreed that this iterative neighborhood development process should be integrated in the planning process of future projects. The focus on establishing a CO2 neutral neighborhood should not be the sole driver of change, although it is an important step for the transformation of a neighborhood in need of transition in order to reach climate and comfort goals. Only an integrated planning and developing process, incorporating energy, living space, public space, social and mobility guarantees direct benefits for the residents and visitors alike.

5 CONCLUSION

The methodology of the neighborhood development strategy guarantees the inclusion of all stakeholders and supports a prioritization in order to decide on future measures that can lead to a more energy-efficient and liveable development of neighborhoods in need of adaptation. It can provide assistance to meet the present and future comfort demands of its inhabitants, reach climate goals and react to demographic and social phenomena.

The developed concept is multipliable and transferrable to comparable urban areas, which share a set of similarities. In Austria 11 % (Statistic Austria 2011) and in Europe 18 % (Birchall et al. 2016) of the building stock are multi-family homes erected in the same time period as the reference neighborhood.

The proposed visual representation of the neighborhood development strategy is a powerful communication tool, which can be a vital element in the process of implementing ambitious redevelopment plans applicable to social housing in Europe.

Support, acceptance and identification with the redevelopment plans of urban neighborhoods needs to be gained by residents and other relevant actors alike. In Austria, there is no legal basis for resident participation. Building owners and political decision makers are aware of the power of the residents and hence often fear their participation at early stages of a project. Understandably, if information is transported in a non-coordinated manner, it can get a self-propelling power. Mixed with personal sentiments and perceptions of people with no deep understanding of the situation, it can cause a downward spiral up to the point where there is strong resistance against any measures. Comprehensible information for the residents, even at an early stage of a project, with the possibility to participate, should be seen as a potential for redevelopment of the existing social housing stock and its immediate environment.

6 ACKNOWLEDGEMENTS

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Layout & Design of the poster and folder: Salzburg University of Applied Sciences in cooperation with 2|4 Designbureau

7 REFERENCES

ALISCH: Soziale Stadtentwicklung. Politik mit neuer Qualität. In Uwe Jens Walther (Ed.): Soziale Stadt - Zwischenbilanzen. Ein Programm auf dem Weg zur Sozialen Stadt? Opladen: Leske + Budrich, 2002.

BINDRA, Scanlon: UNEP annual report 2009. Seizing the green opportunity. Nairobi: United Nations Environment Programme (UNEP). United Nations / Environment Programme: Annual report 2009. 2010

BIRCHALL, Gustafsson, Wallis, Dipasquale, Bellini, Fedrizzi et al: Survey and simulation of energy use in the European building stock. Accessed at: http://www.diva-portal.org [01/03/2017), 2016

BUNDESINSTITUT FÜR BAU-, STADT- UND RAUMFORSCHUNG (BBSR) im Bundesamt für Bauwesen und Raumordnung (Ed.): CO2-neutral in Stadt und Quartier. Die europäische und internationale Perspektive. BBSR-Online-Publikation 03/2017. Accessed at: http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/BBSROnline/2017/bbsr-online-03-2017.html?nn=1187544 [01/03/2017], 2017

ERMAN: Climate Neutral City Districts - the Smartest Form of a City's District? In: Schrenk M., Popovic V., Vasily V., Zeile P. (Ed.), Plan it smart. Clever solutions for smart cities. proceedings of 19th International Conference on Urban Planning, Regional Development and Information Society. 831–838. Accessed at: http://www.corp.at/archive/CORP2014_171.pdf [01/03/2017], 2014

HUNTER: The Urban Neighborhood. Its Analytical and Social Contexts. In: Urban Affairs Quarterly, 14, 267–288, 1978

IPCC: Climate change. The physical science basis. Contribution of Working Group I to the fifth assessment report of the Intergovernmental Panel on Climate Change. 1. publ. Stocker T., Qin D., Plattner G.-K., Tignor M., Allen S. K., Boschung A. et al (Ed.). Cambridge, United Kingdom and New York, NY, USA, 2013

KENNEDY, Sgouridis: Rigorous classification and carbon accounting principles for low and Zero Carbon Cities. In Energy Policy, 39 (9). 5259–5268, 2011

STATISTIC AUSTRIA: Gebäude 2011 nach überwiegender Gebäudeeigenschaft, Errichtungsjahr und Bundesland. Accessed at: https://www.statistik.at/web_de/statistiken [03/03/2017], 2016

Die Crowd-Community als Lieferant auf der letzten Meile?

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1 ABSTRACT

In der Last-Mile-Logistik werden zunehmend neue Trends diskutiert. Dazu zählen automatisierte Fahrzeuge, Drohnen oder auch emissionsfreie Zustellungen unter Einsatz von E-Fahrzeugen und (Lasten-)Rädern. Aber auch Crowd Delivery (oder auch Crowd Logistics) wird als neue Form der (urbanen) Logistik gehandelt (Botsman 2014, Kunze 2016). Crowd Delivery beschreibt unter anderem das Mitbringen (z. B. von Paketen oder Gegenstände aus Geschäften) durch Privatpersonen, die ohnehin gerade unterwegs sind, sich in dem Geschäft aufhalten oder sich als Bote etwas dazu verdienen möchten. Dadurch sollen Wege eingespart, Ressourcen geschont und Städte verkehrlich entlastet werden. Doch wie kommt man zu einer lokalen "Liefer-Crowd-Community" und wie lassen sich Personen dazu motivieren?

Innerhalb eines Feldtests am Grazer Fesch'Markt soll aufgezeigt werden, wie eine Crowd-Community rekrutiert, aufgebaut und auf ihre Funktions- und Motivationslogiken beim „Mitnehmen" getestet werden kann. Es wird dabei bewusst auf Geldleistungen verzichtet, um die intrinsischen Motive wie Spaß und Neugier auf ihre Anreizwirkung auszuprobieren. Die Annahmme war unter anderem, dass bei dem Fesch'Markt mit 140 Ausstellern und etwa 10.000 Besuchern eine ausreichende Nutzerfrequenz sowie ein junges, Rad-affines Publikum vorzufinden ist.

Keywords: Feldtest, Incentivierung, Last-Mile-Logistik, Crowd Delivery, LoMaCro+

2 METHODEN IM FORSCHUNGSPROJEKT LOMACRO+

Das Forschungsprojekt LoMaCro+ analysiert, konzipiert und evaluiert am Fallbeispiel Graz, wie das Lieferkonzept der Crowd-Delivery in Verknüpfung mit dem lokalen Marktplatz realisiert werden kann. Als einer der ersten Projektbausteine wurde im Rahmen des Forschungsprojektes eine quantitative Online-Umfrage realisiert. Die Stichprobe der Online-Umfrage setzt sich aus 61 Personen zusammen. Aufbauend auf den Erkenntnissen der Umfrage erfolgte die Planung und Konzeption von Feldtest in Graz. In diesem Feldtest unter realen Bedingungen mit „echten" potenziellen Nutzerinnen und Nutzern sollten Erkennisse gewonnen werden, wie und ob eine Liefer-Crowd zu motivieren ist. Eine Fokusgruppe (n=10) zur Ermittlung der Bedeutung des lokalen Marktplatzes wurde ebenso rekrutiert und befragt. Die Ergebnisse der Umfrage, Fokusgruppe und Feldtest fließen in diesen Beitrag ein.

3 AUSGANGSLAGE UND RAHMENBEDINGUNGEN DER CROWD DELIVERY

Crowd-Delivery-Konzepte basieren meist auf dem Grundsatz, dass eine Person aus der Crowd eine Lieferung übernimmt und somit als Bote fungiert. Crowd Delivery ist auch ein Teil des kollaborativen Konsums im Sinne der Share Economy (Botsman 2014). Dieser Lieferkonzept wird vor allem für die letzte Meile interessant, da besonders dieser kurze Abschnitt der teuerste in der Distributionskette ist (Bretzke 2010). Hinzu treten verkehrliche Herausforderungen der Stadt: So ist der Wirtschaftsverkehr für rund 40 Prozent der urbanen Schadstoff- und Lärmbelastung verantwortlich (VCÖ 2015).

Im Laufe des Projektes LoMaCro+ zeigt sich immer wieder, dass Crowd-Boten von Start-Ups und Unternehmen meist über eine Art Anstellungsverhältnis verfügen und die Lieferung monetär vergütet wird. Dies stellt natürlich in Frage in wie weit noch von Crowd Delivery im Sinne des kollaborativen Konsums die Rede sein kann, wenn ein Bezahlmodell dahintersteht und dies dadurch eher an einen „traditionellen" Kurierservice erinnert. Im Crowdsourcing ist zwar auch häufig eine Entlohung gekoppelt, dennoch impliziert es meist eine Unterbezahlung von Leistungen, die normalerweise in einem Beschäftigungsverhältnis erledigt werden könnten (Howe 2006, Thiel 2015).

Während die Motivationen zur Teilnahme bei Crowdsourcing-Initiativen weitgehend gut erforscht sind (Howe 2008, Brabham 2013), fehlen Erkenntnisse zu Beweggründen einer Liefer-Crowd. Die Crowd ist ein freiwilliger Zusammenschluss von Personen basierend auf einer gemeinsamen Identität. Dennoch ist die Crowd sehr divers: Sie existiert als loser, anonyme Gruppe zur Erledigung von Aufgaben (z. B. Task

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Rabbit), bis hin zu Communites mit enger sozialer sowie persönlicher Bindung und unterscheiden sich somit auch hinsichtlich der Motivation. In diesem Zusammenhang wird häufig von intrinsischer Motivation wie der Spaß an etwas Neuem oder Neugier gesprochen. Dem gegenüber steht die extrinsische Motivation wie Selbstverwirklichung oder die Erreichung gemeinsamer Ziele (Mladenow et al. 2016). Anreizsysteme bzw. Incentivierung sind ein wichtiger Katalysator zur Aktivierung einer Crowd (Leimeister et al. 2016).

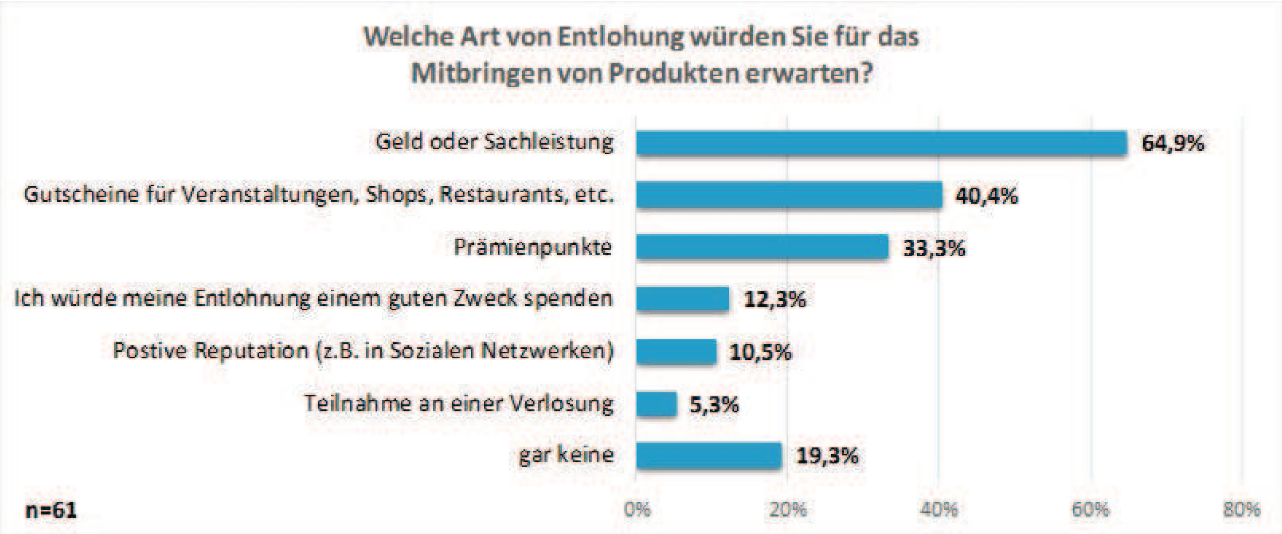

Abbildung 1: Incentivierung des Mitbringens

Dennoch haben alle gängigen Crowd-Delivery-Anbieter bzw. die sich so bezeichnen – sei es Deliv, Postmates, Uberrush etc.) – eines gemeinsam: Kuriere, die die Lieferung für eine Entlohnung tätigen. Freiwilligkeit bzw. das Mitbringen aus rein intrinsischer Motivation geschieht wohl eher auf informellen Wegen (zwischen Freundinnen und Freunden, Nachbarinnen und Nachbarn) und ist dadurch nicht dokumentiert bzw. schwer nachvollziehbar. Auch in der Umfrage konnte ermittelt werden, dass Geld oder eine Sachleistung als Entlohnung gewünscht ist, wobei auch 19 % darauf verzichten würden (siehe Abbildung 1).

Ein wichtiges Argument bei der Crowd Delivery ist die Gewährleistung der Zustellung am gleichen Tag („Same day delivery“). Die Zustellung innerhalb eines Kalendertags ist vor allem in Städten im Vormarsch. Das Online-Shopping wird dadurch mit der Produktverfügbarkeit des stationären Einzelhandels verknüpft. Liefery, die eine Zustellung innerhalb von 90 Minuten bewirbt, hat sich auf dem Markt der „Same Day Delivery“ etabliert. Liefery ist bereits in 50 deutschsprachigen Städten aktiv und ein Kooperationspartner größerer Player wie Sportcheck oder Media Markt. Die Kundinnen und Kunden haben die Wahl zwischen zwei Zeitfenstern am Abend. Somit wird nicht nur die Lieferung am gleichen Tag angeboten, es wird auch auf den persönlichen Tagesablauf eingegangen und vermieden, dass der Kunde/die Kundin nicht zuhause anzutreffen ist.

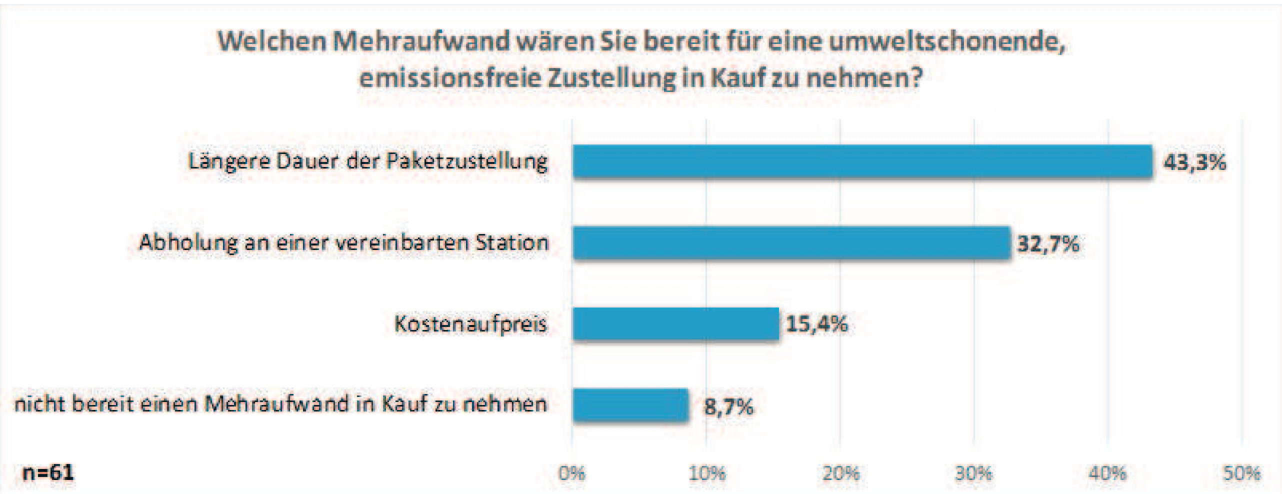

Abbildung 2: Bereitschaft des Mehraufwands bei einer umweltschonenden, emissionsfreien Zustellung

Dennoch sind nach wie vor 2/3 der Befragten (n=61) bereit, bis zu einer Woche auf eine Bestellung zu warten. Der Wunsch nach schneller Verfügbarkeit hängt auch stark vom Produkt ab. Lebensmittel und andere Güter des täglichen Bedarfs werden schneller benötigt, Luxusartikel könne vielleicht warten. Ein Test mit einer kleinen Fokusgruppe im Rahmen des Projektes hat gezeigt, dass obwohl die Möglichkeit bestand, Dinge am gleichen Tag zu erhalten, die meisten Probandinnen und Probanden einen späteren Tag gewählt haben, damit sich die Lieferung gut in den Tagesablauf eingliedert. Ein umweltfreundlicher Transport (z. B. Fahrrad, E-Fahrzeug) steht bei Same Day Delivery allerdings nicht im Fokus. Meist hat der Kurier, wie im Falle von Liefery, die freie Wahl des Transportfahrzeugs.

Die umweltschonende Zustellung gewinnt dennoch vor allem im urbanen Raum immer mehr an Bedeutung. Wie aber Abbildung 2 zeigt, wird für eine umweltfreundliche Zustellung lieber eine längere Zustelldauer (43 %) sowie die Abholung an einer Station (32 %) in Kauf genommen, als dafür einen Kostenaufpreis zu zahlen (15 %). Essenszustellung wird aber zunehmend durch umweltfreundliche Verkehrsmittel übernommen. Radfahrer mit pinken Boxen auf dem Rücken oder am Rad prägen zur Zeit das Wiener Stadtbild. Die Rede ist von Foodora (www.foodora.at): Lieferanten stellen Essen von Restaurants zu, die keinen eigenen Lieferservice anbieten. „Rita bringt's“ (www.ritabringts.at) bringt nicht nur mit Lastenrädern das bestellte Mittagessen, sondern kocht die Gerichte auch selbst. Die Sichtbarkeit im Stadtraum als Teil des Konzepts ist wichtig: Viele kennen nun die pinken Boxen von Foodora oder die grünen Lastenräder von „Rita bringt's“.

3.1 Konzepte der Crowd-Delivery in der Last Mile Logistik

Im Zusammenhang mit Crowd Delivery wurden zwar schon übergreifende Organisationenformen wie b2b, b2c etc. diskutiert, dies wird allerdings noch in Bezug auf die letzte Meile zu wenig differenziert. Carbone et al. (2015) entwickelte eine Typologie anhand von zwei Merkmalen, zum einen die Art des Logistikmanagements, die entweder zentral oder dezentral sein kann und zum anderen der Bedeutung der Logistik, die einfach eine Unterstützung für die Initiative darstellen, oder grundsätzlich der Zweck der Zusammenarbeit sein kann. Durch die Kombination dieser beiden Merkemale können vier Arten von Logistik im kollaborativen Konsums identifiziert werden, die in folgender Tabelle dargestellt werden.

	dezentrales Logistikmanagement	zentrales Logistikmanagement
Logistik als unterstützendes Element	Peer-to-Peer Logistik *selbstgesteuerte logistische Prozesse*	Business Logistik *Plattform steuert den Peer-to-Peer Austausch*
Logistik als Zweck	**Crowd-Party Logistik** *Crowd wird für logistische Prozesse rekrutiert*	Crowd-driven Logistik *Crowd hat die Kontrolle über logistische Prozesse*

Tabelle 1: Typologien von Crowd Delivery in der Logistik

In dem Typ der „Crowd-Party-Logistik“ lässt sich das vorliegende Projekt einordnen. Bei der Definition von Use Cases sind immer wieder Fragen aufgetaucht, an welchen Punkten der Distributionskette in urbanen Räumen Crowd Delivery eigentlich eingesetzt werden kann. Vor diesem Hintergrund wurde eine weitere Differenzierung vorgenommen. Diese wird im folgenden mit Hilfe der Grafik sowie Beispielen erklärt und diente als Basis zur Einordnung des Feldtests.

3.1.1 Fall 1: Vom Geschäft bzw. mehreren Geschäften nach Hause

Angenommen, jemand befindet sich in der Innenstadt und bekommt die Information, dass sein/ihr Nachbarin oder Nachbar etwas aus den Läden dort braucht. Es wäre einfach, dieses mitzubringen. Die größte Herausforderung liegt vermutlich im Matching: Wie kann jemanden einen Lieferwunsch äußern und gleichzeitig findet sich jemand, der zufällig in der Nähe ist und die Bestellung auf dem Heimweg vorbeibringen kann? Apps bieten eine Möglichkeit diese Informationen zu koppeln und Kundin oder Kunde sowie Crowd-Lieferantin oder Crowd-Lieferant miteinander zu verbinden. Doch um solch eine App zu nutzen, muss ein gewisser Anreizmechanismus dahinterstehen. Uber beispielsweise hat sich mittlerweile auch auf dem Logistikmarkt breit gemacht und zwar mit seinem Lieferservice Ubereats und Uberrush. Die

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Kommunikation und Zuweisung von Lieferaufträgen läuft über eine App. Das Prinzip ist nichts Neues: Angemeldete Kuriere transportieren Essensbestellungen von A nach B. Dabei können diese ihre Aufträge selbst auswählen. Die Bezahlung variiert zwischen 8-12 Euro laut Stellenanzeige. Auch Shippie hat ein ähnliches Prinzip verfolgt, allerdings hat sich dieses Unternehmen zu einem Service für Reisegepäck umorientiert.

3.1.2 Fall 2: Vom Geschäft bzw. mehreren Geschäften zum Sammelpunkt (Pick up Points)

Eine weitere Möglichkeit für Crowd Delivery bieten zentrale Abholpunkte. Es lassen sich hierbei zwei Typen unterscheiden. Zum einen können Bestellungen in Geschäften gesammelt und abgeholt werden. Zum anderen können in abschließbaren Boxen an zentralen Punkten Waren gesammelt werden, welche mit einem PIN geöffnet werden können (Hayashi et al. 2015). So genannte Pick up Points schießen vermehrt in deutschen Städten aus dem Boden. Amazon hat mittlerweile mehr als 50 Locker in Berlin und München aufgestellt. Möglich war dies durch die Kooperation mit Shell Tankstellen, wo die Locker aufgestellt wurden. Das Potenzial für Crowd Delivery besteht bei diesem Konzept darin, dass das Problem, niemand ist zu Hause anzutreffen, umgangen werden kann. Darüber hinaus könnte ein Crowd-Bote mehrere Bestellungen einsammeln und muss diese nur an wenigen Punkten hinterlegen.

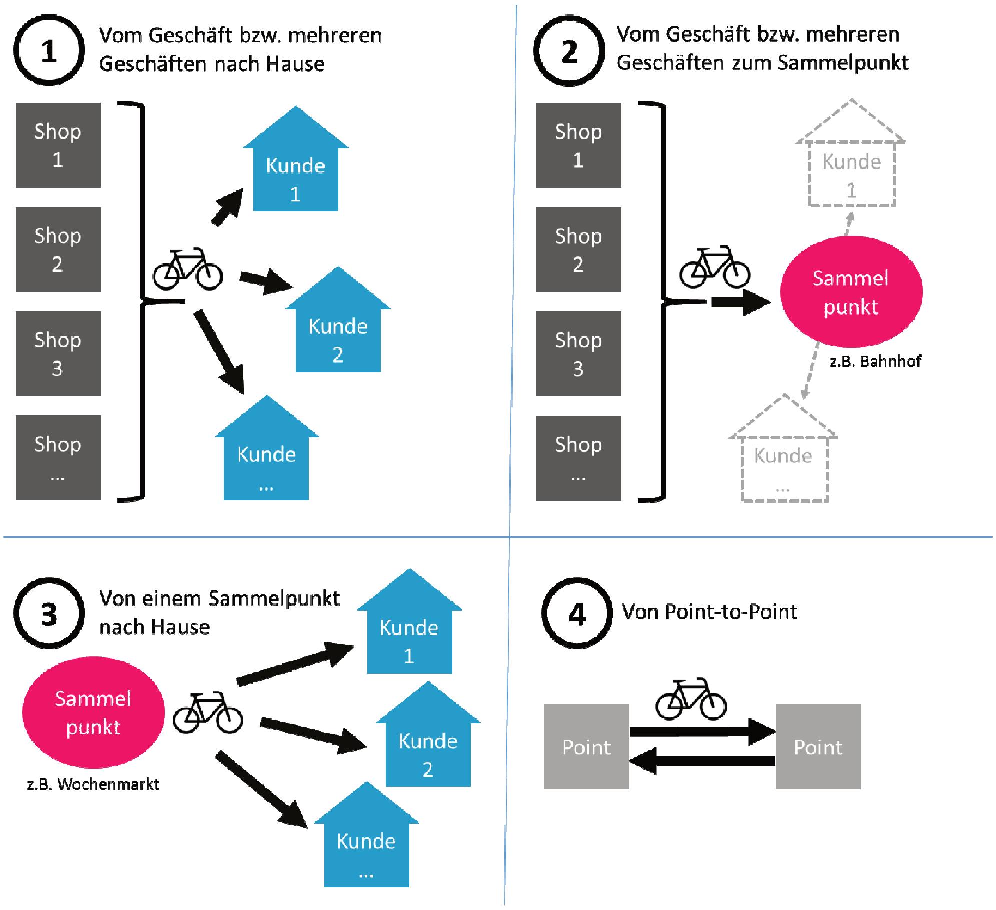

Abbildung 3: Crowd-Delivery-Konzepte

3.1.3 Fall 3: Von einem Sammelpunkt (z.B. Markt) nach Hause

Crowd Delivery kann nicht nur von vielen Geschäften aus zu einem Sammelpunkt erfolgen, sondern von einem Sammelpunkt aus zum Kunden. Ein Beispiel sind die Pick-up Points (siehe oben), einem großen Geschäft mit einem breiten Angebot (z. B. Baumarkt, Ikea etc.) oder auch ein Markt (Floh-, Bauern,-Designmarkt) als zentraler Ort vom dem aus Kundinnen und Kunden beliefert werden können. Das Konzept von Ikea aus viele Kundinnen und Kunden zu erreichen, wurde bereits in dem Start-up „BringBee" verfolgt – leider ohne Erfolg.

	Fall 1: Vom Geschäft nach Hause	Fall 2: Vom Geschäft zum Sammelpunkt (z.B. Bahnhof)	Fall 3: Von einem Sammelpunkt (z.B. Markt, Messe) nach Hause	Fall 4: Point-to-Point (z.B Fimenstandorte, Abteilungen von Universitäten)
Relevanz für Forschungsprojekt (geplant/ realisiert)	3-wöchiger Test mit Fokusgruppe und 5 Kleinbetrieben in Graz	Geplanter Test	Im Rahmen des „Fesch'Markt" wurde eine Gratis-Zustellung angeboten	Eine Idee
Zielgruppe	(Stamm-)Kundinnen und Kunden der Betriebe, sowie neue Kundschaft	Pendlerinnen und Pendler	Besucherinnen und Besucher des Marktes	Mitarbeiterinnen und Mitarbeiter, (Studierende)
Kundinnen und Kunden	Schwer zu erreichen, weil nicht zentral ansprechbar	Hohe Frequenz am Verkehrs-kontenpunkt	Viel Kundenfrequenz am Markt; kritische Masse dadurch leichter zu erreichen und anzusprechen	Geschlossener Kreis an Nutzerinnen und Nutzer
Matching von Kundin oder Kunde und Crowd-Bote	Am Beginn unmöglich durch Fehlen kritischer Masse; Abfedern durch Botendienst, digitale Dienste nötig (App)	Möglich, wenn es gelingt, Pendlerinnen und Pendler am Weg anzusprechen	Analog möglich durch direkte Ansprache und Matching vor Ort	Informelle Absprache zwischen Kolleginnen und Kollegen
Bedarf	Gering, könnte mit Anzahl der Geschäfte steigen	Hoch	Eher Gering	Gering
Umsetzbarkeit	Anspruchsvoll	Aufwendig	Leicht	Leicht
Innovationspotenzial	Mittel	Hoch	Hoch	Gering
Technische Anforderungen	- Website zur Vernetzung und Darstellung des Angbotes - API zu Logistik Software - IT auf Seiten der Händlerinnen und Händler	- Aufbauend Website und API zu Logistiksoftware - Lagerbereich zur Übernahme der Lieferungen	- Stand und Informationsmaterial am Markt - Mobiltelefon und (Offline-)Datenbank	- Webseite/ Monitor, auf dem Bedarf abgebildet wird
(mögliche) Incentivierung	- Gutscheine	- Gutscheine - Bonuspunkte	- Gutscheine - Geschenke	- betriebsinterne Gewinnspiele/ Verlosungen

Tabelle 2: Einordnung der Crowd-Delivery-Konzepte

Diese Tabelle diente als Basis zur Einschätzung der Potenziale verschiedener Feldtests. Der Feldtest am Grazer Fesch'Markt, der in Folge beschrieben wird, greift Fall 3 (Von einem Sammelpunkt (z. B. Markt, Messe) nach Hause) auf und konkretisiert die in Tabelle 2 getroffenen Annahmen.

Gründe dafür sind zu wenige Mitbringer in der Crowd aber auch das Fehlen von strategischen Partnern u. a. im Handel. Eine weitere Erkenntnis daraus ist, dass eine Art Rückfallnetz in Form von professionellen Botendiensten notwendig ist, um „Mitbringer-Engpässe" abfedern zu können und ein gewisses Servicelevel zu gewährleisten (Hüsing 2014). Ein ähnliches Prinzip wäre dann für einen Markt gegeben, außer dass der/die Kundin oder Kunde eventuell schon vor Ort ist und sich selbst bzw. jemand anderen Produkte (z. B. als Geschenk) zukommen lassen will. Das Potenzial für Crowd Delivery ergibt sich daraus, dass bereits viele Kundinnen und Kunden und auch viele potenzielle Crowd-Boten an einem Ort gebündelt sind. Das Matching von Kundin oder Kunde und Bote wäre daher zentral zu organisierbar. Diese und andere Beweggründe sprachen für einen Feldtest in Graz am Fesch'Markt (siehe Kapitel 4).

3.1.4 Fall 4: Von Point-to-Point

Viele Unternehmen und Orginationen haben verschiedene Standort – auch oft im gleichen Stadtgebiet, wie es beispielsweise bei der Technischen Universiät Wien der Fall ist. Da Mitarbeiterinnen und Mitarbeiter oder auch Studierende sich zwischen diesen Standorten oft bewegen, könnten diese für Kolleginnen und Kollegen z. B. Bücher von der Hauptbibliothek mitnehmen bzw. zurück bringen. Meist besteht zwar ein internes Kuriersystem, Crowd Delivery könnte aber dazu eine Ergänzung darstellen.

3.2 Wie können genügend Nutzerinnen und Nutzer und Crowd-Lieferanten zusammenkommen?

Für einen Feldtest wurden die verschiedenen Funktionsweisen diskutiert und bezüglich Umsetzbarkeit bewertet. Besonders wichtig war die Frage, ob genügend Kundinnen und Kunden vorhanden sind und Fahrten durch eine Crowd zustande kommen können – und das rein durch intrinsische Motivation. Zur Einordnung und Abschätzung möglicher Feldtests wurden Hypothesen zu u. a. kritische Masse (also eine genügende Anzahl an potenziellen Nutzerinnen und Nutzern), den Bedarf (wird dieser Service benötigt?), Umsetzbarkeit bzw. die Realisierung des Feldtest und technischen Anforderungen untersucht.

4 FELDTEST AM GRAZER FESCH’MARKT

Im Rahmen des Grazer Fesch’Markts wurde ein Test durchgeführt. Mit über 140 Ausstellerinnen und Ausstellern und gut 10.000 Besucherinnen und Besuchern an drei Tagen ist diese Messe fixer Bestandteil des Grazer Eventkalenders (Fesch’Markt 2017). Es wurde angenommen, dass die überwiegend jungen Besucherinnen und Besucher der Messe für den Feldtest zu begeistern sind. Ein weiterer Punkt, der im Vorfeld klar wurde und der versucht wurde für den Feldtest einzusetzen, war der gleichzeitige Muttertag.

Vor diesem Hintergrund wurden folgende Ziele formuliert:

- Mindestens 15 Lieferaufträge durch Fesch’Markt Besucher
- Mindestens 10 Crowd-Boten und somit 10 Lieferfahrten mit dem Fahrrad (sollte dies nicht gelingen, werden die Fahrten vom Team durchgeführt)

Mit Hilfe von leitfadengestützten Interviews sollten vertiefende Informationen eruiert werden. Dazu sollen sowohl die Crowd-Botinnen und –Boten als auch die Auftraggeberinnen und Auftraggeber zur Motivation, Hemm- und Erfolgsfaktoren befragt werden. Gespräche mit Händlerinnen, Händlern, Besucherinnen und Besuchern des Fesch’Markts werden darüber hinaus gesucht, um Meinungen zu Crowd Delivery und eventuelle Potenziale zu erfassen.

Grundlegend für die Entscheidung zur Realisierung eines Tests im Rahmen einer (Groß-)Veranstaltung war die Annahme, dass die persönliche Ansprache vor Ort sowohl der Incentivierung (durch persönlichen Bezug), als auch dem Matching (durch gezielte Suche bzw. Ansprache) zuträglich sein wird (siehe auch Tabelle 2).

Der persönliche Kontakt wird in der Literatur als der wesentliche Vorteil des stationären Einzelhandels gegenüber der E-Commerce-Konkurrenz vorgebracht. (Heinemann, 2008, Zentes 2008, Heinemann 2009) Die führt zu Lösungen wie „Click & Collect“, oder allgemeiner dem „store pickup“ in denen der persönliche Kontakt zum Kunden beim Abholen der Ware für zusätzliche Wertschöpfung genutzt werden soll. Auch bei „ambulanten“ Formen des Einzelhandels, wie Märkte und Messen in der Fachliteratur genannt werden, wird die Bedeutung des persönlichen Kontaktes hervorgehoben. (Lerchenmüller 2011)

Die Umsetzung kann mit dem Blick auf die selbstgesetzten Ziele nicht als Erfolg gewertet werden. Abgesehen von äußeren Einflüssen – Regenfall – stellten sich die Hypothesen zu Bedarf, kritischer Masse und Matching mit der in den Feldtest gegangen wurde als nichtzutreffend heraus.

Für die Umsetzung des Feldtestes wurde ein vermeidlich idealer Platz gefunden: Nahe dem zentralen Außenbereich und neben der Fahrradwerkstatt war die Sichtbarkeit gut gewährleistet. In der Vorbereitung wurden zwei wesentliche Tools entwickelt: Das Fahrtenbuch, um die Fahrten, Boten und erfolgten Lieferungen zu erfassen, und die Fahrtentafel, um gut sichtbar das Angebot „Lass Geschenke kostenlos liefern“ zu vermitteln und offene Fahrten zu kommunizieren. Drei Personen des Projektteams waren den ganzen Tag vor Ort, sicherten den Austausch zu den Händlerinnen und Händlern und die Kommunikation des Angebotes an die Besucherinnen und Besucher des Fesch‘Marktes. Die drei Personen hätten auch

Fahrten übernommen, wenn keine Crowd-Boten gefunden werden können. Für die Crowd-Boten wurden vorab Baumwolltaschen gefertigt und am Stand aufgelegt.

Während des gesamten Messe wurde kein Auftrag erteilt. Mögliche Gründe dafür werden weiter unten diskutiert. Das Feedback der Händlerinnen und Händler war durchwegs positiv. Viele fanden die Möglichkeit, ihr Angebot in Richtung Lieferung zu erweitern, schlüssig. Die Idee, den Muttertag auch für die Kommunikation des Angebotes der Gratislieferung zu nutzen, wurde sehr positiv bewertet. Auch in den Gesprächen mit möglichen Kundinnen und Kunden war prinzipielles Interesse vorhanden, nur der Bedarf schien in dem Moment nicht gegeben zu sein.

5 ERKENNTNISSE

Der Rückschlag des Feldtestes bei der Design-Messe wurde intern intensiv diskutiert. Die Tatsache, keine Learnings aus tatsächlichen Fahrten gewonnen zu haben, hat das Projektteam dazu bewogen, den Misserfolg gründlich zu hinterfragen und daraus Erkenntnisse zu ziehen, die in einem nachfolgenden Feldtest berücksichtigt werden.

5.1 Kundinnen- und kundenzentrierter Ansatz

Prinzipiell ist das Projektteam auf Grund des positiven Feedbacks von Händlerinnen, Händlern, Kundinnen und Kunden davon überzeugt, dass die Nähe zum Kunden und persönliche Gespräche eine entscheidende Qualität bleibt. Doch diese Möglichkeiten wurden an entscheidender Stelle überschätzt: Steinemann (2010) unterstreicht, dass der Kundinnenkontakt und Kundenkontakt kein Ereignis darstellt, sondern vielmehr eine Sequenz an Kontakten in denen unterschiedliche Medien und Kanälen verwendet werden, um eine Vielzahl von Informationen zu kommunizieren. Abbott (1995) geht soweit, die Komplexität von Sequenzen als „Universe of Events" zu bezeichnen. Ebenen dieser Sequenz können die Bekanntmachung des Angebots, Information zu Umfang und Leistungen, Kaufentscheidung, Beschwerde etc. sein.

5.2 Mangelhaftes Bekanntmachen des Angebotes

In zahlreichen Nachgesprächen wurde der Mangel an Informationen vorab (Bekanntmachen des Angebots) als entscheidend angesehen. Besucherinnen und Besucher des Designmarktes, der abseits des Grazer Zentrums in der Seifenfabrik angesiedelt war, konnten vorab nicht mit einem Lieferangebot rechnen und waren dementsprechend nicht darauf eingestellt, Entscheidungen in diese Richtung zu treffen. Eine Ankündigung des Projektpartners evolaris auf Facebook (ca. 850 Follower) wurde gemacht, Flyer verteilt und bei ausgewählten Händlerinnen und Händlern aufgelegt, aber diese Maßnahmen können im Nachhinein nur als unzureichend beschrieben werden. Eine breitere Bewerbung über Fesch'Markt-Kanäle (z. B. Facebook) und vor allem über die Händler selbst wäre sinnvoll gewesen. Diese hätten dann Kundinnen und Kunden auf den Service der kostenlosen Zustellung aufmerksam machen und auf unseren Stand verweisen können.

5.3 Sichtbarkeit

Der Stand war zwar im Gastronomiebereich, wo sich viele Menschen besonders zur Mittagszeit aufhielten, aber der Stand konnte ihre Aufmerksamkeit nicht dauerhaft fesseln. Die Vermutung ist, dass der Stand zu unauffällig war, kein Bedarf bestand, das Konzept der Crowd Delivery teilweise zu abstrakt ist und/oder man einer „kostenlosen" Lieferung nicht vertraut (nach dem Motto „Was nichts kostet, ist nichts wert"). Eine bessere Positionierung (vielleicht direkt am Eingang) und ein auffälligerer Stand hätte eventuell mehr Aufmerksamkeit gebracht.

5.4 (Rad-affine) Zielgruppe

Eine weitere Annahme auf deren Basis der Feldtest geplant und umgesetzt wurde, konnte nicht bestätigt werden. Das Projektteam ist davon ausgegangen, dass die überwiegend jungen, design-affinen Kundinnen und Kunden auch überdurchschnittlich Interesse an Fahrradkultur hätten. Wir haben angenommen, dass viele mit dem Rad anreisen und als potentielle Crowd-Boten in Frage kommen. Vereinzelt waren Radfahrerinnen und Radfahrer zu sehen, dennoch ist die Mehrheit der Besucherinnen und Besucher mit Auto dem angereist.

6 FAZIT

Es ist festzuhalten, dass Crowd Delivery nach wie vor ein recht neuer Ansatz ist. Er bietet dennoch eine umwelt- und ressourcenschonende Möglichkeit, den Versand bzw. das Mitbringen durch Personen erledigen zu lassen, die bereits unterwegs sind. In den Medien wird Crowd Delivery, vor allem im Zuge der Share Economy, oft thematisiert und meist im Kontext von Logistikmanagement im Allgemeinen beschrieben. Die letzte Meile, die besonders interessant ist, findet wenig Beachtung und es fehlt an Grundlagenforschung. Mögliche Auswirkungen auf das Verkehrssystem, Motive und Anreize zum Mitmachen, Voraussetzungen für den erfolgreichen Betrieb (unter Nutzung bereits vorhandener aktiver Mobilität) etc. sind nur einige Aspekte, die weiter zu ergründen sind. Auch der Feldtest konnte zeigen, dass es in diesem Bereich nicht viele Erfahrungen gibt, auf die man hätte aufbauen können.

Die Erkenntnisse, wie frühzeitige Einbindung von Kundinnen und Kunden und zielgruppenspezfische Bewerbung des Konzepts über veschiedene Kanäle, werden in künftige Tests innerhalb des Projektes mit einfließen. Vor allem der Aufbau von Kundenbeziehung ist ein Aspekt, woran das Projekt noch wachsen muss. Geplant ist des Weiteren ein Test mit einem oder mehreren größeren Einzelhandelunternehmen in Graz in Kombination mit Verkehrsknotenpunkte als zentrale Pick-up-Points (siehe Tabelle 2, Fall 2). Hierbei soll vor allem die Zielgruppe der Pendlerinnen und Pendler näher betrachtet werden. Des Weiteren werden vertiefende Interviews mit Personen aus erfolgreichen bzw. auch gescheiterten Start-Ups und Unternehmen im Bereich der Crowd Delivery bzw. anderen innovativen Lieferkonzepten geführt.

7 ANMERKUNG

Das Forschungsprojekt „LoMaCro+“ wird im Rahmen von „Mobilität der Zukunft“ vom BMVIT für 30 Monate gefördert und von der FFG administriert. Das Konsortium besteht aus evolaris next level GmbH (Projektleitung), TU Wien Fachbereich Verkehrssystemplanung (IVS), Büro Mathias Mitteregger e.U., Fuhrwerk Logistik GmbH sowie EN GARDE Interdisciplinary GmbH.

8 REFERENCES

ABBOTT, Andrew. Sequence Analysis: New methods for old ideas. in: Annual Review of Sociology, Vol. 21, No. 2, pp. 93-113, 1995.

BOTSMAN, Rachel: Collaborative Logistics: Ripe for Disruption, verfügbar unter: http://www.collaborativeconsumption.com/2014/10/08/collaborative-logistics-ripe-for-disruption/, 2014.

BRABHAM, Daren: Crowdsourcing, MIT, 2013.

BRETZKE, Wolf-Rüdiger: Logistische Netzwerke, Springer Verlag, München, 2010.

CARBONE, Valentina; ROUQUET, Aurélien; ROUSSAT, Christine: “Carried away by the crowd”: what types of logistics characterise collaborative consumption?, 1st International Workshop on Sharing Econom, Utrecht, Netherlands, 2015.

HAYASHI, Katsuhiko, et al: E-commerce and City Logistics Solution City Logistics, in: Mapping The Future, Tanigutschi, Eiichi; Thompson, Russel (Ed.), CRC Press, Boca Raton, 2015.

HEINEMANN, Gerrit. "Multi-Channel-Handel." Erfolgsfaktoren und Best Practices, Wiesbaden, 2008.

HEINEMANN, Gerrit. Der neue Online-Handel. Springer Gabler, 2009.

HOWE, Jeff: Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business, 2008.

HOWE, Jeff: The Rise of Crowdsourcing, Wire, verfügbar unter: https://www.wired.com/2006/06/crowds/, 2006.

HÜSING, Alexander: Mitbringservice BringBee war kein Erfolgsmodell, Deutsche Startups, verfügbar unter: https://www.deutsche-startups.de/2014/11/03/mitbringservice-bringbee-war-kein-erfolgsmodell/, 2014

KUNZE, Oliver: Replicators, Ground Drones and Crowd Logistics, A Vision of Urban Logistics in the Year 2030 International Scientific Conference on Mobility and Transport Transforming Urban Mobility, Transportation Research Procedia 19, pp. 286 – 299, Munich, 2016.

LEIMEISTER, Jan Marco, ZOGAJ, Shkodran, DURWARD, David, BLOHM, Ivo: Systematisierung und Analyse von Crowd-Sourcing-Anbietern und Crowd-Work-Projekten, in: Hans Böckler Stiftung (Hrsg) Study Nr. 324, Düsseldorf, 2016.

LERCHENMULLER, M., VOCHEZER, R., & VOGLER, T.: Lexikon Betriebsformen. Frankfurt a. M.: Deutscher Fachverlag, 2011.

MLADENOW, Andreas Mladenow, BAUER, Christine, STRAUSS, Christine: “Crowd logistics”: the contribution of social crowds in logistics activities", International Journal of Web Information Systems, Vol. 12 Issue: 3,pp. 379-396, doi: 10.1108/IJWIS-04-2016-0020, 2016.

STEINMANN, Sascha. "Kundenkontakte und Kundenkontaktsequenzen im Multi Channel Marketing." Kundenkontakte und Kundenkontaktsequenzen im Multi Channel Marketing. Gabler, 2011. 7-51.

THIEL, Thomas. Acht Stunden sind kein Tag. Crowdwork, Klickwork, Abrufarbeit - neue, flexible Arbeitsformen erobern den Arbeitsmarkt. Bedrohen sie das europäische Sozialmodell?. verfügbar unter http://www.faz.net/aktuell/feuilleton/forschung-und-lehre/der-klickarbeiter-acht-stunden-sind-kein-tag-13853241.html, 17.05.2015.

VCÖ: Der urbane Gütertransport der Zukunft ist emissionsfrei. Factsheet. Wien, 2015.

ZENTES, Joachim. "Handbuch Handel." Gabler, Wiesbaden, 2006.

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e-Quartier Hamburg – Möglichkeiten von Elektromobilität als fester Bestandteil von Wohnquartieren

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1 ABSTRACT

Wohnen und Mobilität sind wesentliche Daseinsfunktionen aller Menschen. Insbesondere innerhalb stark ausdifferenzierter Gesellschaften ist Mobilität der Schlüssel zu gesellschaftlicher Teilnahme und Teilhabe (z. B. Altenburg, Gaffron & Gertz 2009). Allerdings basiert Mobilität noch immer großteils auf endlichen fossilen Energieträgern mit entsprechend negativen Auswirkungen für Mensch und Umwelt, die mit Lärm und Schadstoffbelastungen besonders deutlich in den Städten und Quartieren zu Tage treten (z. B. Held & Würdemann 2006). Die räumliche Entflechtung von Funktionen trägt erheblich zur Verkehrserzeugung bei und mit dem Wohnstandort als Start- und Endpunkt der meisten verkehrlichen Handlung wird die Verkehrsbelastung in das direkte Wohnumfeld getragen. Nur der Trias aus Vermeidung, Verringerung und Verlagerung von Verkehr (z. B. Beckmann & Klein-Hitpaß 2013) bietet einen Lösungsweg aus diesem mobilitätsbedingten Dilemma. Dabei gilt es, Verkehr zu vermeiden, auf umweltfreundliche Verkehrsträger umzusteigen und klimagünstige Energieträger einzusetzen.

Neben dem Ausbau des ÖV und der Fahrradinfrastruktur sind Carsharing und Elektromobilität zwei wichtige Bausteine einer stadtverträglichen Mobilität. Das Förderprojekt e-Quartier Hamburg, das vom Bundesministerium für Verkehr und digitale Infrastruktur im Rahmen des Programms „Modellregionen für Elektromobilität" gefördert wird, verfolgt den Ansatz, elektromobile Carsharing-Angebote auf Quartiersebene sowohl im Bestand als auch im Neubau zu integrieren. Die HafenCity Universität Hamburg begleitet das Vorhaben wissenschaftlich, mit dem Ziel erfolgskritische Rahmenbedingungen für die standortbezogene Umsetzung von Elektromobilitätskonzepten zu identifizieren. In diesem Zusammenhang richtet sich der Fokus dieses Beitrags auf die Erfahrungen der Nutzenden mit den Quartiersangeboten und den darauf beruhenden Ableitungen für die weitere Verstetigung und ggf. den Ausbau der im Rahmen von e-Quartier geschaffenen Angebote.

Keywords: E-Quartier, Hamburg, Begleitforschung, Carsharing, Elektromobilität

2 EINLEITUNG

2.1 Gesellschaftliche und politische Rahmenbedingungen

2.1.1 Wohnen & Mobilität: Daseinsgrundfunktionen neu zusammendenken

Klimaschutzerfordernisse und Stadtwachstum haben zur Folge, dass sich der Blick auf die Funktionen Wohnen und Mobilität weiter ausdifferenziert. 70-80 % aller Wege, die Menschen täglich unternehmen, beginnen und enden am Wohnstandort (hierzu z. B. ILS / LEG Arbeitsmarkt und Strukturentwicklung GmbH 2009, VCD 2017), weshalb Maßnahmen zur Reduzierung oder klima- und umweltbezogenen Verbesserung des Verkehrs im Wohnumfeld ansetzen sollten.

Betrachtet man Verkehr als soziotechnisches System, das durch menschliches Handeln konstituiert wird (hierzu Geels 2012), dann ist es theoretisch möglich, diese Systeme zu ändern und an neue Bedingungen anzupassen (vgl. Watson 2012). Vorherrschende Regime können durch Innovationen modifiziert, ja sogar abgelöst werden, oder es können durch Veränderungen der soziotechnischen Landschaft neue Erfordernisse entstehen, auf die reagiert werden muss. Wenn vormals der politische Wunsch nach Massenmotorisierung entsprechende Kräfte freisetzen konnte, dann kann diese Möglichkeit auch aufgrund der Notwendigkeit und dem Wunsch nach einem klimafreundlichen und stadtverträglichen Verkehrssystem und auf der Grundlage neuer, attraktiver Mobilitätsangebote bestehen.

2.1.2 Die Bedeutung des Umwelt- und Klimaschutzes

In dieser Arbeit wird davon ausgegangen, dass dem Umwelt- und Klimaschutz weiterhin ein hoher Stellenwert beigemessen wird und damit auch Anforderungen an den Sektor Verkehr gestellt werden. Dies drückt sich bspw. im „Hamburger Klimaplan“ aus, der vorsieht, eine klimagerechte Entwicklung auf Quartiersebene voranzutreiben (siehe Bürgerschaft der Freien und Hansestadt Hamburg 2015). Dafür sollen Entwicklungskonzepte erstellt werden, die „hohe Gebäudestandards, intelligente Energieversorgung, erneuerbare Energien [und] klimagerechte Mobilitätskonzepte […] kombinieren“ (ebd. S. 18). Im Handlungsfeld Mobilität (vgl. ebd. S. 37) sollen dahingehend Möglichkeiten effizienter und neuartiger Technologien genutzt, innovative, intermodale und auf ein sich veränderndes Mobilitätsverhalten gerichtete Angebote implementiert sowie die Änderung des Modal Split zu Gunsten des Umweltverbunds unterstützt werden. Als konkrete Maßnahmen werden u.a. der „Ausbau […] eines flexiblen und ortsgebundenen Carsharings“ (ebd.) und die „Optimierung von Abstellmöglichkeiten für Carsharing-Fahrzeuge mit einer Priorisierung von E-Fahrzeugen“ genannt (ebd. S. 38). Zudem sollen die Quartiersplanungen/Umsetzungen, sowohl im Bestand als auch im Neubau, um Mobilitätskonzepte erweitert werden (vgl. ebd.).

Quartiersbezogenem E-Carsharing wird seitens der Stadt ein hoher Stellenwert eingeräumt. Damit besteht auch eine planerische Basis für die Integration entsprechender Mobilitätsangebote in Quartiere.

2.1.3 Städtewachstum als treibende Kraft für alternative Mobilitätskonzepte

In dem Bekenntnis der Stadt Hamburg zur Unterstützung klimagerechter Mobilitätskonzepte auf Quartiersebende liegt ein großes Potenzial, das gerade vor dem Hintergrund des anhaltenden Stadtwachstums (siehe bspw. FHH / Behörde für Gesundheit und Verbraucherschutz 2014) wichtige Impulse setzen kann. Dazu zählt, dass der Wohnungsbau erleichtert, das Wohnumfeld lebenswerter und Flächenkonkurrenz und vor allem der motorisierte Individualverkehr (MIV) reduziert bzw. auf einem vertretbaren Niveau gehalten werden kann. Es wird davon ausgegangen, dass Hamburg bis zum Jahr 2030 von aktuell rd. 1,82 Mio Einwohnern auf bis zu 1,85 Mio wachsen wird (siehe ebd. S. 9). Um den Anforderungen einer wachsenden Bevölkerung nach bezahlbarem Wohnraum gerecht zu werden, fördert die Stadt Hamburg den Wohnungsbau seit 2011 mit dem „Bündnis für das Wohnen“ intensiv. In diesem Zusammenhang wurde die Stellplatzpflicht für Pkw im Wohnungsbau abgeschafft, um preiswerteres Bauen zu ermöglichen (siehe § 48, Abs. 1a HBauO).

Mehr Einwohner bedeuten im Regelfall aber auch mehr Verkehr. Auch hier wird mit einer Zunahme gerechnet – beim MIV um ca. 19 % bis 2025 im Vergleich zum Jahr 2004 (vgl. Handelskammer Hamburg 2014, S. 64), wenn nicht gegengesteuert wird. Mehr Verkehr bei gleichzeitig weniger hergestellten Stellplätzen im Neubau bedeutet wiederum, dass die Flächenkonkurrenz im öffentlichen Raum zunimmt (bspw. Stellplätze versus Erholungsraum) und sich die Stellplatzsituation vor allem in innenstadtnahen Quartieren weiter verschärft. Insgesamt können negative Folgen des Verkehrs wie Umweltbelastungen und Gesundheitsgefährdung durch Abgase, Lärm, Unfallrisiken und Stress weiter zunehmen.

Für nachhaltige Mobilitätskonzepte wie elektromobiles Carsharing eröffnet eine solche Entwicklung allerdings auch Gelegenheitsfenster. Die Bereitstellung von alternativen Mobilitätsangeboten im direkten Wohnumfeld kann zu einer Reduzierung des MIV und damit einhergehend einem reduzierten Flächenbedarf führen.

2.1.4 Der Trend Nutzen statt Besitzen

Positiven Einfluss auf die Verbreitung nachhaltiger Mobilitätskonzepte hat die im Deutschen als „Nutzen statt Besitzen“ bekannt geworde Entwicklung. Im englischen Sprachraum als „Collaborative Consumption“ bezeichnet, gewinnen Formen des gemeinschaftlichen Konsums weltweit in vielen Bereichen an Bedeutung. Beispiele hierfür sind Wohnungstausch, Kleidertauschparties, Autogemeinschaften, Gemeinschaftsgärten, Tauschringe für Werkzeuge, Drucker oder DVDs u.v.m. Ursprünglich in der Ökologiebewegung der 1970er Jahre entstanden, gewinnt die Bewegung mit den erweiterten Möglichkeiten der Digitalisierung zunehmend an Popularität (vgl. Gsell et al. 2015).

Seit 2012 ist eine deutliche Zunahme der Kundenzahlen im Carsharing zu verzeichnen und diese Entwicklung wird sich voraussichtlich fortsetzen. Einen großen Anteil an den hohen Zuwachszahlen haben die bestehenden stationsunabhängigen Carsharing-Angebote wie „Car2Go“ und „DriveNow“, die über ihre hohe Sichtbarkeit im Straßenraum den Bekanntheitsgrad des Carsharings stark erhöht haben. Von dieser zunehmenden Bekanntheit und Akzeptanz des Konzepts Carsharing profitieren auch die stationsgebundenen Angebote (siehe Abb. 1) (vgl. Bundesverband Carsharing 2017).

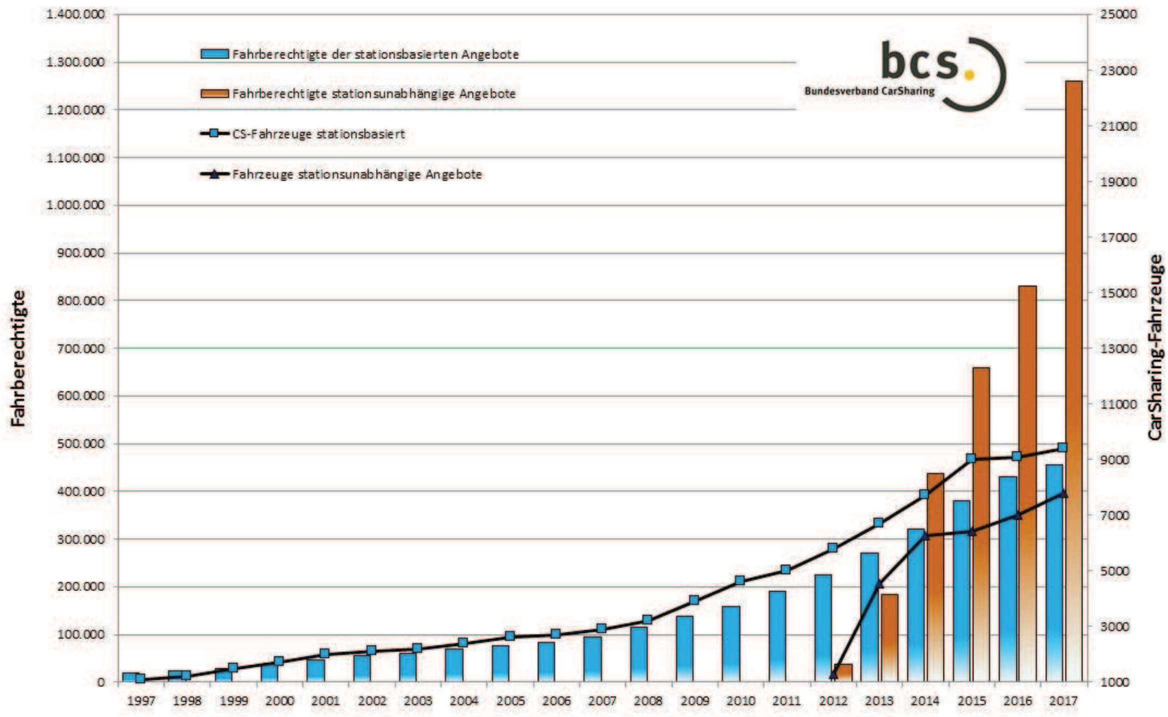

Abbildung 1: Entwicklung der Carsharing-Varianten (Quelle: Bundesverband CarSharing e.V. 2017)

Während im Bereich des flexiblen Carsharings noch nicht eindeutig belegt ist, ob und in welchem Maße die Angebote eine Abnahme des privaten Pkw-Besitzes zur Folge haben, führen stationsgebundene Angebote nachweislich zu einer deutlichen Reduzierung privater Pkw (Bundesverband CarSharing e.V. 2016). Die Förderung von Carsharing-Angeboten ist daher ein wichtiger Baustein zur Reduzierung der zunehmenden Flächenkonkurrenz - gerade in wachsenden Städten.

2.2 Carsharing und Elektromobilität –Win-Win-Kombination für verkehrsgeplagte Quartiere

2.2.1 Verkehrliche Belastungen auf Quartiersebene

Verkehrliche Belastungen auf Quartiersebene ergeben sich aus Durchgangsverkehren, Quell- und Zielverkehren, Parkplatzsuchverkehren und dem ruhenden Verkehr. Sofern diese Verkehre durch planerische Lösungsansätze wie Verdichtung, Stärkung der Nahversorgung und Verkehrsberuhigung nicht oder nur mit großem Aufwand realisierbar sind, können auch technische oder organisatorische Innovationen, die den nicht vermeidbaren Verkehr besser organisieren oder reduzieren helfen, eingeführt werden. Elektromobilität, insbesondere in Kombination mit Carsharing, stellt eine solche Innovation dar.

2.2.2 Elektromobilität und Carsharing

Bei der Kombination von Elektromobilität und Carsharing vereint sich eine lokal schadstofffreie, geräuscharme und effiziente Form der Fortbewegung mit einer gemeinschaftlich genutzten und dadurch ressourceneffizienten und kostengünstigen Form. Durch die gemeinschaftliche Nutzung von Elektroautos können die derzeit noch hohen Anschaffungskosten besser kompensiert werden. Elektroautos haben das Potenzial, sich bei hohen Fahrleistungen kostengünstiger betreiben zu lassen als konventionelle thermische Fahrzeuge, da zum einen die Kosten je gefahrenen Kilometer bei aktuellen Strom- und Benzinpreisen niedriger ausfallen, zum anderen Wartungsarbeiten wie z. B. Ölwechsel beim Elektroauto entfallen und der Verschleiß aufgrund der geringeren Anzahl mechanischer Komponenten niedriger ausfällt. Zudem werden durch die gemeinschaftliche Nutzung der Fahrzeuge und der damit einhergehenden Verringerung des privaten Pkw-Bestands natürliche Ressourcen gespart und die Kapazität vorhandener Fahrzeuge besser ausgenutzt.

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Ein wirtschaftlicher Einsatz von E-Fahrzeugen im Carsharing außerhalb von Förderprogrammen ist aktuell allerdings noch schwer darstellbar. Dies betrifft die vergleichsweise hohen Anschaffungskosten für E-Fahrzeuge ebenso wie die geringeren Nutzungszeiten – bedingt durch nutzungsfreie Ladezeiten und die Kosten für die Ladeinfrastruktur, aber auch die Tatsache, dass Nutzer die Fahrzeuge eher für kurze Wege und Buchungszeiträume nutzen. Niedrige Stromkosten allein können diese Aufwände aktuell noch kaum kompensieren. Mit der dynamischen Entwicklung des elektromobilen Angebots, z. B. mit neuen Modellen mit höheren Reichweiten und sinkenden Kaufpreisen, werden sich dann auch Elektroautos im Carsharing wirtschaftlich betreiben lassen.

2.3 Das Projekt e-Quartier Hamburg – Zielstellungen, Strukturen, Prozesse

Das Projekt e-Quartier Hamburg bringt Mobilitätsdienstleister und die Immobilienbranche als wesentliche Akteure bei der Umsetzung von Elektromobilität auf Quartiersebene zusammen und startete als F&E-Projekt mit der Zielsetzung, elektromobile Carsharing-Standorte in Neubau- und Bestandsquartieren umzusetzen und in der konkreten Nutzung zu evaluieren. Das Projektkonsortium umfasst neben Carsharing-Unternehmen, Partnern aus der Immobilienentwicklung und der Projektleitung/-steuerung auch eine Vielzahl an assoziierten Partnern. Diese repräsentieren den Bereich der Wohnungswirtschaft, sowohl von öffentlicher als auch privater Seite sowie Verkehrsverbünde und weitere strategisch relevante Akteure. Das zentrale Ziel der wissenschaftlichen Begleitung ist die Identi¬fikation von erfolgskritischen Rahmenbedingungen für die standortbezogene Umsetzung von Elekt¬romobilitätskonzepten. Da die empirische Datengrundlage für dieses Forschungsgebiet noch begrenzt ist, liegt im Aufbau dieser Empirie der Schlüssel, um Erkenntnisse generieren zu können. Der Fokus der Forschungstätigkeiten liegt daher auf der Datenerhebung und der Auswertung der im Rahmen des Projekts umgesetzten Quartiersangebote. Die Untersuchung des Nutzerverhaltens und der Nutzerakzeptanz bilden in dieser Arbeit den Schwerpunkt.

Abbildung 2: Verortung der e-Quartier-Standorte im Hamburger Stadtgebiet und Umland

2.4 Erkenntnisinteresse und Forschungsfragen

Ein wesentliches Erkenntnisinteresse im Projekt e-Quartier lag in der Frage, ob elektromobiles Carsharing auf Quartiersebene unter den aktuellen Rahmenbedingungen bereits so umgesetzt werden kann, dass sich ein für alle Beteiligten tragfähiges Konzept ergibt. Daraus ergeben sich im Hinblick auf Nutzende und Nichtnutzende, die im Fokus dieses Beitrags stehen, folgende Forschungsfragen:

- Wie groß ist das Interesse am elektromobilen Carsharing in den Quartieren?

- Werden E-Carsharing-Angebote in den Quartieren akzeptiert und für einen wirtschaftlichen Betrieb ausreichend genutzt?
- Wirken sich E-Carsharing-Angebote auf das Mobilitätsverhalten der Anwohner aus? Wenn ja, wie?

3 METHODOLOGIE UND OPERATIONALISIERUNG

3.1 Methodologie

Die Untersuchung des Nutzerverhaltens und der Nutzerakzeptanz bilden den Schwerpunkt bei der Auswertung der im Rahmen des Projekts e-Quartier umgesetzten Mobilitätsangebote. Die Evaluation lässt sich in sechs aufeinander folgende Schritte unterteilen (siehe Abb. 3): 1. Die Voruntersuchung (T0), 2. die Anwohnerbefragung mit Inbetriebnahme der Stationen (T1), 3. Quartiersworkshops, 4. Mobilitätstagebücher, 5. die Teilnehmerbefragung (T2) und 6. der Workshop zum Abschluss des Untersuchungszeitraumes.

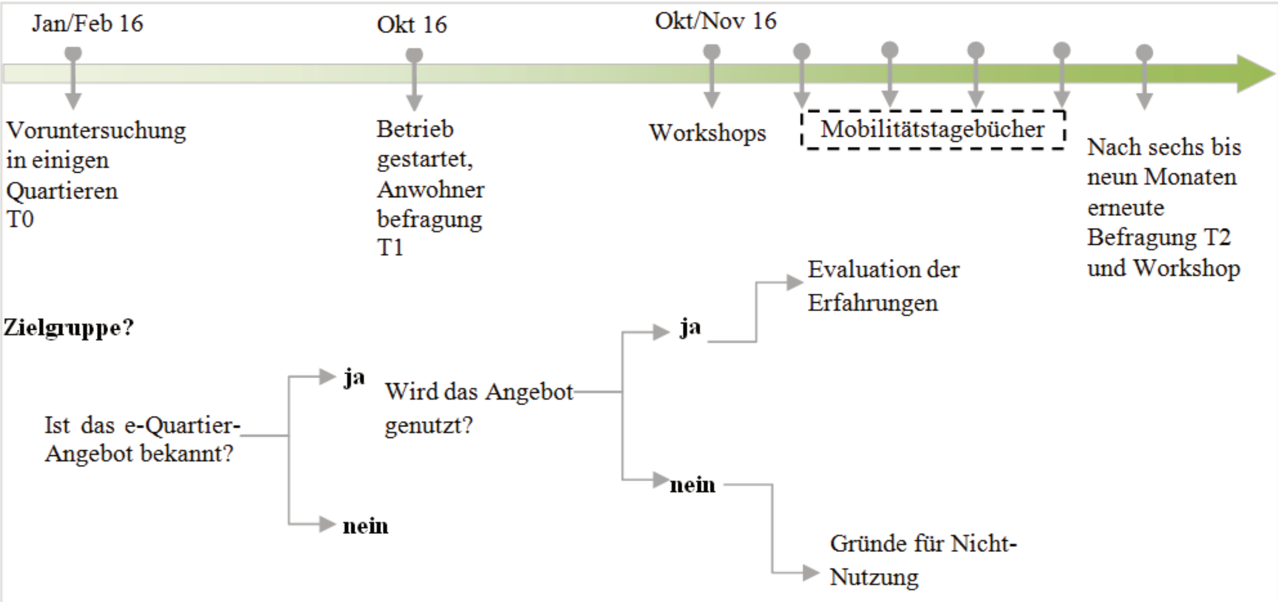

Abbildung 3: Zeitlicher Ablauf und Methoden, eigene Darstellung

Noch vor der Inbetriebnahme der E-Carsharing Stationen wurde im Januar und Februar 2016 eine Voruntersuchung in fünf Hamburger Quartieren durchgeführt. Ziel war es, erste Aussagen über die Voraussetzungen für E-Carsharing treffen zu können.

Mit Inbetriebnahme der Standorte ab September 2016 folgte die Anwohnerbefragung T1. Im Rahmen dieser Erhebung wurde auch auf die Möglichkeit der Teilnahme an der wissenschaftlichen Begleitforschung über einen mehrmonatigen Forschungszeitraum hingewiesen.

In den Quartiersworkshops wurden das Forschungsdesign und die Teilnahmebedingungen im Detail vorgestellt und intensiv über die bereits vorhandenen Erfahrungen mit Elektromobilität und Carsharing und die Erwartungen an ein entsprechendes Angebot diskutiert. Mit Hilfe von Mobilitätstagebüchern wurde das tatsächliche Mobilitätsverhalten der Teilnehmerinnen und Teilnehmer in vier je einwöchigen Zeiträumen verteilt über den Forschungszeitraum erfasst. Die Abschlussbefragung fokussiert auf die Erfahrungen mit dem Angebot und Anregungen seitens der Nutzerinnen und Nutzer. Im Rahmen des Abschlussworkshops war auch der direkte Austausch mit den Mobilitätsdienstleistern möglich.

3.2 Operationalisierung

In der Voruntersuchung T0 wurden zunächst Passanten in den verschiedenen Quartieren befragt (CAPI-Befragung[1]). Es stellte sich aber heraus, dass dieses Vorgehen sehr zeit- und personalintensiv und zudem stark witterungsabhängig ist.

Für die Befragung T1 wurde eine webbasierte Befragung gewählt. Dafür wurden Bewohnerinnen und Bewohner der Nähe von e-Quartier-Angeboten über eine Zufallsstichprobe aus dem Einwohnermelderegister

[1] Computer Assisted Personal Interview

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ausgewählt. Diese umfasste Personen im Alter zwischen 18 und 65 Jahre (m/w), die in einem 500m-Radius und damit dem erfahrunggemäßen Einzugsbereich der Carsharingstationen wohnen. Da sich die Quartiere in Bezug auf Einwohnerdichte und sozio-demographische Merkmale deutlich voneinander unterscheiden, wurde eine disproportional geschichtete Zufallsstichprobe gewählt. Dabei sind die Quartiere mit weniger Einwohnern und solche, in denen die Bereitschaft zur Studienteilnahme als eher gering eingestuft wird, überproportional vertreten. So sollte gewährleistet werden, dass aus jedem Quartier genügend Rücklauf erzeugt wird, um eine aussagekräftige Datenbasis zu generieren. Insgesamt wurden 8.000 Briefe versendet. Da die Teilnahme an der Befragung freiwillig war, handelt es sich außerdem um eine selbstselektierte Stichprobe.

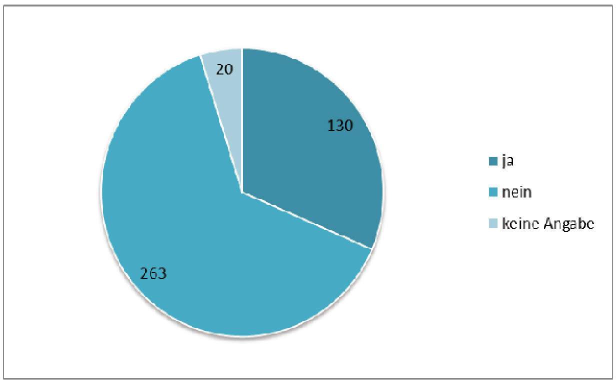
Die Befragung verlief über ein Online-Portal. Über Briefe mit persönlicher Ansprache erhielten die Bewohnerinnen und Bewohner Zugang zur Befragung. Der Rücklauf liegt nach Bereinigung bei 413 korrekt ausgefüllten Fragebögen und damit bei einer Rücklaufquote von 5,16 %. Diese verteilen sich allerdings sehr ungleichmäßig über die verschiedenen Standorte, sodass trotz des beschriebenen Vorgehens nicht für jedes Quartier eine umfassende Datenbasis generiert werden konnte. Dennoch ermöglichen die erhobenen Daten Aussagen über die Potenziale für E-Carsharing in den verschiedenen Hamburger Quartieren.

Der Inhalt des Fragebogens umfasst bisherige Erfahrungen mit Elektromobilität und Carsharing, das allgemeine Mobilitätsverhalten sowie sozio-demographische Merkmale. Es handelt sich mehrheitlich um geschlossene Fragen, teilweise mit offenen Antwortmöglichkeiten zur Aufnahme von nicht antizipierten Antworten und der Option, Sachverhalte über die vorgegebenen Möglichkeiten hinaus zu konkretisieren.

4 ERGEBNISSE DER WISSENSCHAFTLICHEN BEGLEITFORSCHUNG

4.1 Wissensstand und Interesse der Befragten

Das Konzept des Carsharings ist mit knapp 96 % der großen Mehrheit der Befragten (T1, N=413) bekannt und knapp 4 % kennen den Begriff, sind sich seiner Bedeutung aber nicht sicher. Zudem geben ca. 47 % der Befragten an, Kundin oder Kunde eines oder mehrerer Carsharing-Anbieter zu sein. Davon sind knapp über 60 % bei einem (teilweise auch beiden) Anbieter des flexiblen Carsharings registriert. Bei den stationsgebundenen Angeboten verzeichneten die Projektpartner cambio CarSharing und SHARE A STARCAR 23 % und 8 % der Befragten als Kundin oder Kunde. Der vergleichsweise hohe Anteil an cambio-Kundinnen und cambio-Kunden an den Befragten kann u.a. darauf zurückgeführt werden, dass die Stationen, an denen das E-Carsharing angeboten wird, bereits seit langem als konventionelle Stationen bestehen und daher einen höheren Bekanntheitsgrad haben, als die noch vergleichsweise neuen SHARE A STARCAR-Stationen. Zudem liegen diese Stationen überwiegend in hochverdichteten Quartieren mit großer Flächenkonkurrenz, in denen die Bewohner vergleichsweise offen sind für alternative Mobilitätskonzepte.



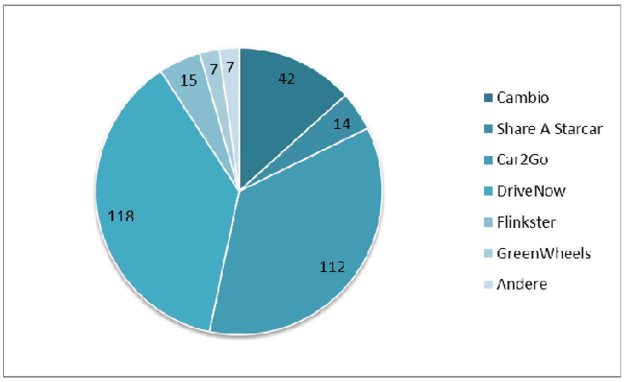


Abbildung 4: Mitgliedschaft bei Carsharingunternehmen, N=413; Abbildung 5: Verteilung der Mitgliedschaften auf verschiedene Carsharinganbieter, N=315 (Mehrfachnennungen möglich).

Die tatsächliche Nutzung der flexiblen Angebote wurde im Rahmen der Studie nicht abgefragt, es scheint aber die Tendenz zu geben, unterschiedliche Sharingangebote je nach Bedarf zu nutzen oder sich zumindest die Option hierfür durch die Mitgliedschaft zu schaffen. Zwei Drittel der cambio-Kundinnen und cambio-Kunden sind außerdem bei dem Fahrradleihsystem StadtRAD Hamburg registriert, was ebenfalls für eine bedarfsorientierte Nutzung verschiedener Mobilitätsangebote spricht.

Erfahrungen mit Elektroautos sind noch kein Standard unter den Befragten. Nur ca. 33 % der Teilnehmerinnen und Teilnehmer waren zum Befragungszeitpunkt bereits ein Elektroauto gefahren, während 67 % noch keine Fahrerfahrung mit Elektroautos hatten (zur Bewertung der E-Fahrzeuge vgl. 4.2).

Durch den hohen Bekanntheitsgrad und die einfache Zugänglichkeit von Carsharing bietet die Verknüpfung von Carsharing und Elektromobilität eine Möglichkeit, Elektromobilität für viele Menschen „erfahrbar" zu machen und ggf. Vorbehalte abzubauen.

4.2 Nachfrage und Akzeptanz elektromobiler Angebote

Von den 413 Personen, die an der T1-Befragung teilnahmen, gaben 89 % an, das im Rahmen von e-Quartier realisierte Angebot zum Umfragezeitpunkt nicht zu nutzen. Als Grund wurde von ca. 51 % der Nichtnutzer genannt, dass sie das Angebot nicht kennen. 20 % wissen nicht, wo sie das Angebot finden. Demnach hat erwartungsgemäß die Bekanntheit und die Sichtbarkeit des Angebots einen großen Einfluss auf die Nutzung. 66 % geben hingegen an, dass sie keinen Bedarf an dem e-Carsharing-Angebot haben, weil sie entweder das eigene Auto (31 %) oder andere Verkehrsmittel (35 %) nutzen. 13 % haben keinen Bedarf, weil sie bereits ein anderes Carsharingangebot nutzen.

Erklärtes Ziel der Implementierung von E-Carsharing ist, die Pkw-Besitzquote zu reduzieren und in der Folge die Flächenkonkurrenz zu mindern. Daher soll vor allem denjenigen, die ein eigenes Auto nutzen (ein knappes Drittel der Befragten), durch das E-Carsharing ein alternatives Mobilitätsangebot zur Verfügung gestellt werden.

Für eine Mehrzahl der Befragten wäre eine Nutzung erst von Interesse, wenn sie das eigene Fahrzeug nicht mehr nutzen können (36 %) bzw. sie es sich nicht mehr leisten können oder wollen (18 %). Es gilt also, Angebote bereitzustellen, die bei Eintreten eines dieser Fälle eine Alternative zur Anschaffung eines neuen Pkw bieten.

243 Teilnehmerinnen und Teilnehmer machten in der Befragung Angaben zur Fahrleistung der in ihrem Haushalt vorhandenen Pkw, 109 davon kommen auf mehr als 10.000 km jährlicher Fahrleistung je Pkw. Damit liegen mehr als die Hälfte von ihnen in einem Bereich, in dem nach Einschätzung der Carsharing-Branche ein Umstieg auf Carsharing wirtschaftlich wäre (weniger als 10.000km/Jahr[2]).

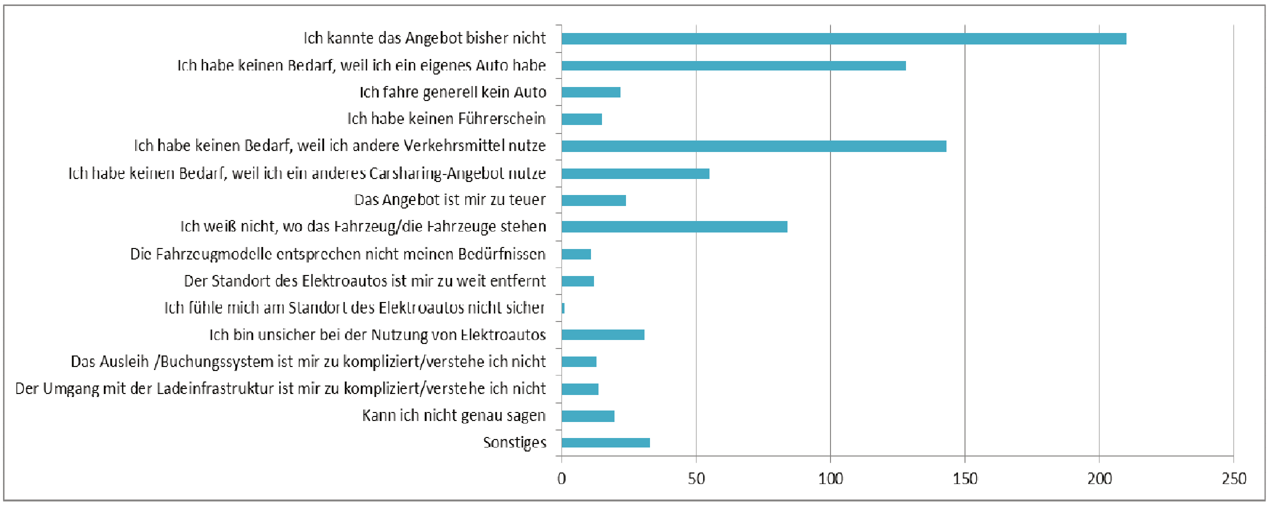


Abbildung 5: Antworten der Teilnehmer auf die Frage „Warum haben sie das e-Quartier Angebot bisher nicht genutzt?"; N=368, Mehrfachnennung möglich

Außerdem wurden eine zu geringe Reichweite (ca. 18 %) sowie zu hohe Kosten (ca. 20 %) als Gründe für die Nichtnutzung genannt. Diese Angaben zeigen, dass Vorbehalte gegenüber elektromobilem Carsharing bestehen, da viele Befragte (89 %) das konkrete Angebot nach eigener Aussage nicht kennen und damit auch nicht wissen können, wie hoch die Reichweite und Mietpreise der vorhandenen Fahrzeuge sind.

Da zwischen Stationseröffnung und der Befragung teilweise nur ein Monat gelegen hat, kann ein genaues Bild der Leistungsentwicklung der einzelnen Stationen, wenn überhaupt, erst am Ende des Untersuchungszeitraumes gezeichnet werden.

[2] Erfahrungswert der Projektpartner aus der Carsharingbranche

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Es wird aber auch deutlich, dass die bestehenden Vorbehalte durchaus abgebaut werden können. So wird das Fahren mit einem Elektroauto von denjenigen, die hier bereits Erfahrung haben, überwiegend positiv bewertet. 97 % von 126 Personen hat die Fahrt mit einem Elektroauto gut oder eher gut gefallen und nur 3 % eher schlecht. In der weiteren Konkretisierung zeigt sich, dass besonders die starke Beschleunigung und das leise Fahren positiv gewertet werden. Negativ werden u.a. die Reichweite, aber auch die geringe Transportkapazität hervorgehoben. Weitere Antworten sind in Abb. 6 dargestellt. Gefragt nach der Wichtigkeit von Gründen für die Nutzung von E-Autos, wird ebenfalls der hohe Stellenwert der Reichweite deutlich. 85 % der Befragten geben an, dass dieser Aspekt sehr wichtig bzw. wichtig ist. Das trifft auch auf den Umweltschutz zu, wobei dieser von mehr Personen für „sehr wichtig" gehalten wird. Einen hohen Stellenwert haben außerdem das Lärmminderungspotenzial von Elektroautos, die Möglichkeit kostenlos zu laden, der Fahrspaß und die Möglichkeit des kostenlosen Parkens. Hier zeigen sich Handlungsmöglichkeiten der Kommunen, die in diesem Bereich Anreize schaffen können. Aber auch die Carsharinganbieter können ihr Angebot attraktiver gestalten, indem sie z. B. ihren Kundinnen und Kunden ermöglichen, die Carsharingfahrzeuge an jeder öffentlichen Ladesäule zu laden und dadurch die Reichweite durch Zwischenladen zu erhöhen. Weit weniger wichtig werden die Nutzung von Busspuren und die Kaufprämie gewertet. Letzteres wird besonders mit der Frage, ob die Anschaffung eines Elektroautos in Frage kommt, erklärbar. Während das für 15 % mit Sicherheit eine Option darstellt und 29 % noch darüber nachdenken, geben immerhin 48 % an, dass sie E-Autos nicht selber kaufen, sondern im Carsharing nutzen wollen. Die Wichtigkeit des Umweltschutzes zeigt sich in der Frage nach der Stromquelle für die E-Fahrzeuge. Das Laden mit Ökostrom ist für 41 % der Befragten sehr wichtig und für 35 % wichtig.

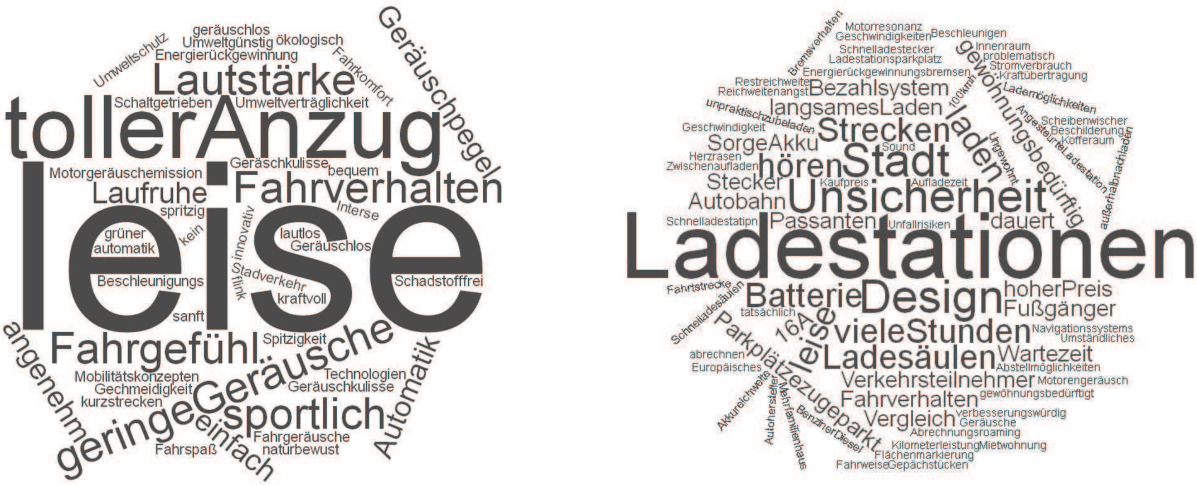

Abbildung 6: Antworten der Teilnehmer als Wortwolken. links: „Was hat Ihnen am Elektroauto bzw. der Fahrt mit dem Elektroauto gut gefallen?" rechts: „Was hat Ihnen am Elektroauto bzw. der Fahrt mit dem Elektroauto nicht gut gefallen?"

4.3 Mobilität auf Quartiersebene – Nutzungszwecke und Verkehrsmittelwahl

40 % der Befragten leben zum Befragungszeitpunkt bereits in autofreien Haushalten. Dabei ist der am häufigsten genannte Grund, kein Bedarf nach einem eigenen Pkw zu haben (29 %), gefolgt von ca. 25 %, denen ein eigener Pkw zu teuer ist. Bewusst verzichten 16 % der Befragten, bspw. aus ökologischen Gründen. In vielen der untersuchten Quartiere liegen die Versorgungsmöglichkeiten in unmittelbarer Nachbarschaft und auch eine Anbindung an den ÖPNV sowie weitere Mobilitätsangebote sind vorhanden. Gleichzeitig macht ein hoher Parkdruck die Nutzung des eigenen Pkw unattraktiv (Abb. 7).

Es stellt sich die Frage, ob in diesen Quartieren die angebotenen E-Fahrzeuge die Nutzungserfordernisse erfüllen können. Der häufigste Nutzungszweck, nämlich Einkauf im Baumarkt, Möbelgeschäft u.ä. (54 %), übersteigt u.U. die Transportkapazitäten der Fahrzeuge und der zweithäufigste Zweck – Ausflüge oder Besuche ohne Übernachtungen (45 %) – übersteigt unter Umständen die Akku-Kapazität. Es muss allerdings berücksichtigt werden, dass Carsharing allgemein für diese Zwecke durchaus genutzt werden kann, wenn auch (noch) nicht oder nur eingeschränkt mit elektrischen Fahrzeugen. Es gibt aber auch angegebene potenzielle Nutzungszwecke, für die E-Carsharing durchaus geeignet ist. 39 % würden Carsharing zum Einkaufen verwenden sowie zum Bringen und Holen von Personen und 31 % würden für sonstige Erledigungen wie Arztbesuche darauf zurückgreifen – dies sind Zwecke, die im städtischen Bereich

Obwohl in der Theorie viele der Befragten eher auf ein Elektroauto als auf einen Verbrenner zurückgreifen würden, kann dieses Verhalten in der Realität nicht nachgewiesen werden. Hierzu wurden die Daten aus den bisher vorliegenden Mobilitätstagebüchern ausgewertet. Bislang wurde lediglich bei rund 11 % der Wege, die mit Carsharing zurückgelegt wurden, auf ein Elektroauto zurückgegriffen (vgl. Abb. 8). Dies muss jedoch nicht in einer mangelnden Eignung der E-Fahrzeuge für die Nutzungszwecke begründet sein: Auf die Frage, ob immer ein Elektroauto zur Verfügung steht wenn eines benötigt wird, verneinten dies 60 % der Nutzer. In solchen Fällen greift die Mehrzahl (93 % der Beantwortungen) auf ein anderes Fahrzeug, meist mit Verbrennungsmotor, zurück.

überwiegend im Aktionsraum aktueller Elektroautos wahrgenommen werden können.

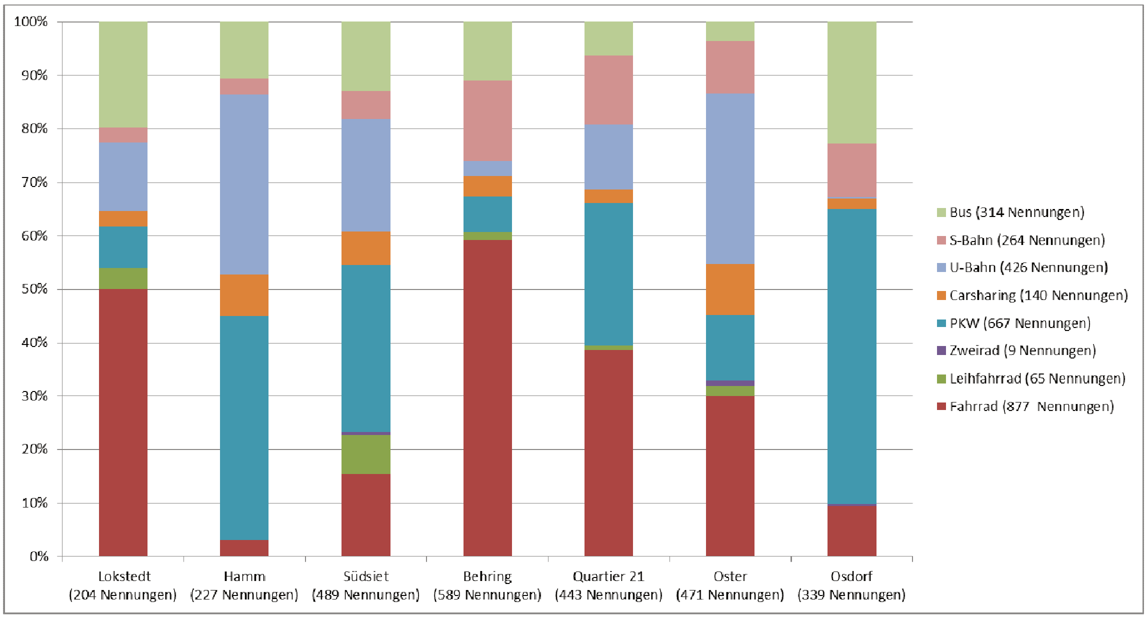

Abbildung 7: Nutzungshäufigkeit verschiedener Verkehrsmittel in den e-Quartieren (Mobilitätstagebuch Erhebungsrunde 1-3, N=2.868, je Weg können mehrere Verkehrsmittel angegeben werden). Je dichter das Quartier, umso höher der Anteil an Rad- und ÖV-Wegen, und umso niedriger der Anteil an Pkw-Fahrten.

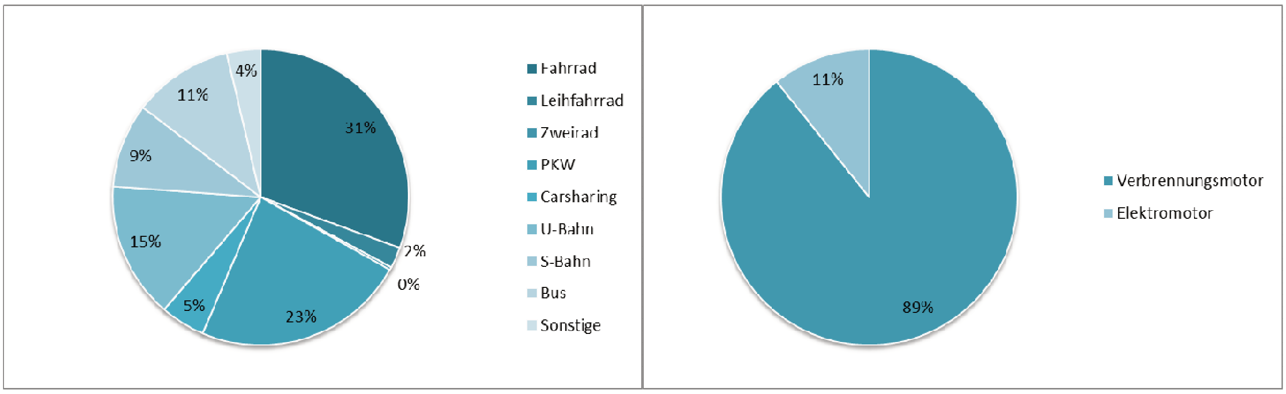

Abbildung 8: Mit Carsharingfahrzeugen zurückgelegte Wege anteilig an allen zurückgelegten Wegen (ohne Fußwege; N=2.868) sowie Carsharingwege nach Antriebsart in Erhebungsrunde 1 - 3 der Mobilitätstagbücher

5 ERKENNTNISSE UND AUSBLICK

Die Ergebnisse aus den Hamburger „e-Quartieren“ können zwar nicht den Anspruch auf Repräsentativität erheben, zeigen aber doch Chancen und Potenziale für elektromobiles Carsharing auf. Viele der untersuchten Quartiere bringen bereits gute Voraussetzungen für autofreie Mobilität mit: Sie verfügen über eine gute Anbindung an den ÖV, gute Nahversorgungsangebote und eine niedrige Pkw-Besitzrate. Viele Bewohnerinnen und Bewohner bewältigen ihre Alltagsmobilität in diesen Quartieren bereits heute autofrei. Dennoch leiden viele der untersuchten Quartiere unter hohem Parkdruck, damit einhergehenden Parkplatzsuchverkehren und zunehmender Flächenkonkurrenz im öffentlichen Raum. Ziel muss sein, hier ein Angebot zu schaffen, dass die verbleibenden Bedarfe der Bewohner nach einem Pkw (Transporte, Fahrten ins Umland) befriedigen kann. Dafür müssen Preisstruktur, Flexibilität und Zuverlässigkeit mit einem

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eigenen Pkw konkurrieren können. Die Untersuchungen haben gezeigt, dass bei den Befragten durchaus Interesse an elektromobilen Carsharing-Angeboten besteht, dass die Angebote selbst aber noch nicht so genutzt werden, dass sich quartiersbezogenes E-Carsharing wirtschaftlich selbst tragen kann. Hier gilt es zu prüfen, welche Voraussetzungen dafür erforderlich sind oder ob neue Formen der Trägerschaft in Frage kommen. Obwohl unter den Anwohnern mit eigenem Pkw Potenzial besteht, die Mobilitätsbedarfe durch Carsharing abzudecken, hat der eigene Pkw weiterhin eine große Bedeutung, und wird vielfach mit individueller Unabhängigkeit gleichgesetzt. Die Information über alternative Mobilitätsangebote ist daher von großer Bedeutung. Personen müssen zu Zeitpunkten, an denen sie besonders offen für eine Änderung ihres Mobilitätsverhaltens sind, von wohnortnahen Angeboten wie E-Carsharing wissen. Solch ein Zeitpunkt kann ein Umzug sein, oder der Verlust des eigenen Pkw. Hier kann auch die Immobilienwirtschaft tätig werden, indem Carsharingangebote in das Portfolio aufgenommen werden und Neumieterinnen und Neumieter als Mehrwert kommuniziert wird.

Es sind aber auch die Kommunen gefragt, die über Instrumente wie Parkraumbewirtschaftung Anreize zur Abschaffung privater Pkw schaffen können. Eine Inwertsetzung des öffentlichen Raums könnte zu einer Reduzierung des privaten Pkw-Bestands beitragen und den Druck auf öffentliche Flächen mindern.

Ein zuverlässiger, flächendeckender ÖV, eine gut ausgebaute und sichere Fahrradinfrastruktur sowie wohnortnahe Nachversorgungsangebote, sind außerdem integrale Bestandteile auf dem Weg zu nachhaltigen Mobilitätskonzepten auf der Quartiersebene, aber auch darüber hinaus, da diese eine Mobilitätsgestaltung ohne eigenen Pkw erst ermöglichen. Das zuverlässige Vorhandensein von Ladeinfrastruktur und Carsharingstellplätzen im öffentlichen Raum kann die Attraktivität von E-Carsharing-Angeboten zudem erhöhen.

Elektromobiles Carsharing erfüllt derzeit lediglich eine ergänzende Funktion im Mobilitätssystem. Im verbleibenden Forschungszeitraum wird geprüft, ob dieser Status festgeschrieben werden muss oder ob Ausbaupotenziale aktiviert werden können.

6 ACKNOWLEDGEMENT

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7 REFERENCES

ALTENBURG, S., GAFFRON, Ph. & C. GERTZ: Teilhabe zu ermöglichen bedeutet Mobilität zu ermöglichen. In: WISO Diskurs der Friedrich-Ebert-Stiftung. Bonn, 2009

BECKMANN, K., A. KLEIN-HITPAß: Nicht weniger unterwegs – sondern intelligenter? Difu-Berichte 2/2013. Berlin, 2013

BUNDESVERBAND CARSCHARING E.V.: Mehr Platz zum Leben, wie CarSharing Städte entlastet. Berlin, 2016

BÜRGERSCHAFT DER FREIEN UND HANSESTADT HAMBURG: Mitteilung des Senats an die Bürgerschaft. Hamburger Klimaplan. Hamburg, 2015.

FHH / BEHÖRDE FÜR GESUNDHEIT UND VERBRAUCHERSCHUTZ: Demografie-Konzept Hamburg 2030. Hamburg, 2014.

GEELS, F. W.: A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. In: Journal of Transport Geography Vol. 24, S. 471–482. Amsterdam, 2012.

GSELL, M. et al.: Nutzen statt Besitzen: Neue Ansätze für eine Collaborative Economy. Dessau-Roßlau, 2015.

HANDELSKAMMER HAMBURG: Stadtmobilität in Hamburg 2030. Eine lebenswerte Stadt in Bewegung. Hamburg, 2014.

HBauO (Hamburgische Bauordnung): (§48) Stellplätze für Kraftfahrzeuge und Fahrradplätze, 2005.

HELD, M., G. WÜRDEMANN: Auf dem Weg zur postfossilen Mobilität. Informationen zur Raumentwicklung, Heft 8.2006, S. 397-404, 2006

ILS / LEG ARBEITSMARKT- UND STRUKTURENTWICKLING GMBH: Mobilität trifft Wohnen – eine aussichtsreiche Begegnung! Dortmund, 2009.

RITTHOFF, M. & K. O. SCHALLABÖCK: Ökobilanzierung der Elektromobilität. Themen und Stand der Forschung. Wuppertal, 2012.

VCD: Wohnen leitet Mobilität. Vorhaben zur Förderung klimaverträglicher Mobilität am Wohnstandort. Berlin, 2017

WATSON, M.: How theories of practice can inform transition to a decarbonised transport system.In: Journal of Transport Geography Vol. 24, S. 488–496. Amsterdam, 2012.

Ecological Monitoring Network for the Gulf of Finland

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1 ABSTRACT

Ecological situation in the Baltic region has notably worsened in the last 20 years. On the one hand, public organizations are bringing investments in order to build clear transport, green cities, to lower energy consumption in the region. On the other hand, construction of a new building of Leningrad Nuclear Power Plant not far from St. Petersburg is planned in the nearest future. In order to control the level of air pollution, to study the impact of pollution on the environment, to identify the most endangered regions, we would like to propose a new permanent ecological monitoring network for the Gulf of Finland. We hope this network will join together environmental specialists from different countries, which will allow to design a global ecological monitoring network. The major tasks for this network are the following: organization of ecological monitoring for the Baltic region and research of air pollution distribution along the Baltic sea; assessment of affects on the environment, health risks for atomic power plant staff and inhabitants of the nearest regions (North-West Russia, Estonia, Finland, Sweden); investigation of seasonal and daily changes of atmospheric temperature, pressure, humidity, wind and their effect on distribution of air pollution; creation of specialized social network for environmental scientists for data and research exchange. An example of ecological monitoring network operation in the Gulf of Finland along with description of means and results of monitoring are given in this paper.

Keywords: meteorology, measurement, ecology, monitoring network, GIS

2 INTRODUCTION

At present time, there are a lot of different atmospheric dispersion models designed by Environmental Agencies in different countries all over the world. One of the most widely-used and respected atmospheric dispersion models is called CALPUFF (Thongplang, 2016). It uses a meteorological model, a dispersion model and a post processing package as major inputs (Thongplang, 2016).

Among atmospheric dispersion models, we can distinguish ones that operate in the Baltic region, e.g. CMAQ (HZG), EMEP (IVL) and SILAM (FMI).

SILAM (System for Integrated Modelling of Atmospheric Composition) was developed in Finnish Meteorological Institute. It is used to predict consequences of emergency situations and contains record modules of dispersal of radionuclide, different-sized aerosols and natural allergens. For numerical modelling, SILAM either uses meteorological data bases (Sofiev et al., 2006) of the European Centre on Medium-Range Weather Forecast (ECMWF, http://www.ecmwf.int), or numerical prediction models in HIRLAM (Unden, 2002).

CMAQ (Community Multi-scale Air Quality) was released by US Environmental Protection Agency. It estimates deposition of ozone, particulates, toxics and acid (CMAQ). CMAQ combines meteorological models, emissions models and an air chemistry-transport model, which allows to use it for predicting the dispersal of multiple air pollutants and for generating air quality estimates (CMAQ).

EMEP (European Monitoring and Evaluation Programme) is a cooperative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe. It relies on three main elements: collection of emission data, measurements of air and precipitation quality and modelling of atmospheric transport and deposition of air pollutions (EMEP). It provides assessment and regularly reports on emissions, concentrations and depositions of air pollutants, the quantity and significance of transboundary fluxes and related exceedances of critical loads and threshold levels (EMEP).

Input data for atmospheric dispersion models are usually the following:

- characteristics of emission source (concentration of pollutants, flow rate, temperature, height of emission source and etc.);
- meteorological characteristics (wind velocity, type of atmospheric stability, temperature and etc.);
- characteristics of terrain (city or village, relief, nearby buildings and their shape and etc.).

Among meteorological characteristics that influence pollution dispersion can be velocity and direction of wind and vertical temperature stratification. Air quality standards, e.g. annual average, are usually based on statistical data. Therefore, a vast volume of statistical data about meteorological characteristics taken over a lengthy time period is required. Also, sets of meteorological data should be representative for a given region, i.e. they should represent all regional peculiarities.

It should be noted that currently existing atmospheric dispersion models do not fully take into account all peculiarities of the atmosphere. Major meteorological parameter required for dispersion models is atmospheric mixing height (Seibert et al., 2000). The atmospheric mixing height is the layer adjacent to the ground over which pollutants or any constituents emitted within this layer or entrained into it become vertically dispersed by convective or mechanical turbulence within a time scale of about a hour (Stull, 1988; Seibert et al., 1998). Vertical profile of atmospheric mixing height depends on variation of air temperature, atmospheric pressure and wind velocity. Variation of air temperature depends on the type and parameters of underlying surface. Temperature can increase and decrease with altitude variation depending on the time of day and the season.

Monitoring of lower levels of the atmosphere is conducted with special means like radiosondes, wind profilers (Angevine et al., 1998), ceilometers (Eresmaa et al., 2006), remote sounding systems: lidars (Hennemuth and Lammert, 2006), sodars (Russell and Uthe, 1978) and etc. However, application of such means has a number of limitations connected with weather conditions, high costs of experiments, resolution and accuracy of measurements.

Successful implementation of said models for modelling of prevalence of pollution over the observation region and efficient estimation of air pollution depend, first of all, on the model of atmosphere and on meteorological information. We propose to create totally new ecological monitoring network, which will allow to monitor changes of meteorological parameters, radiation and others parameters in real time on different heights above the sea surface. For this network we propose to use a specialised measurement module that allows to measure basic meteorological parameters (air temperature, relative humidity, atmospheric pressure, direction and velocity of wind) in lower levels of the atmosphere with high vertical resolution. Also, these data can be used as initial data for numeric modelling of prevalence of pollution over the observation region.

3 ECOLOGICAL MONITORING NETWORK

Ecological monitoring network consists of two or more measurement modules connected to each other. Each module includes a set of meteorological and gamma-radiation sensors. Sensors are located vertically on the pole (Fig. 1) or other suitable vertical surface at the set distance from each other and provide measurements of the atmospheric and radiation parameters. Power can be provided from standard power unit or other electrical source with the range of 7-14 volt with the current of at least 2 ampere.

Each measurement module consists of:

- wind velocity and direction sensor;
- set of integrated sensors that measure relative humidity, atmospheric pressure and air temperature;
- gamma-ray radiation sensor;
- cross-connect equipment.

The major tasks of ecological monitoring network are the following:

- collection, processing, storage and visualisation of information about atmospheric and radiation parameters;
- data analysis for identification of the anomalous regions and regions that threaten the ecological safety;

- study and research of daily and seasonal changes of atmospheric and radiation parameters and their effect on distribution of air pollution;
- creation of regional model of the atmosphere;
- study of applicability of this atmosphere's regional model for prediction of distribution of radiation and air pollution above the sea surface and its other applications;
- creation of specialized social network for environmental scientists for data and research exchange.

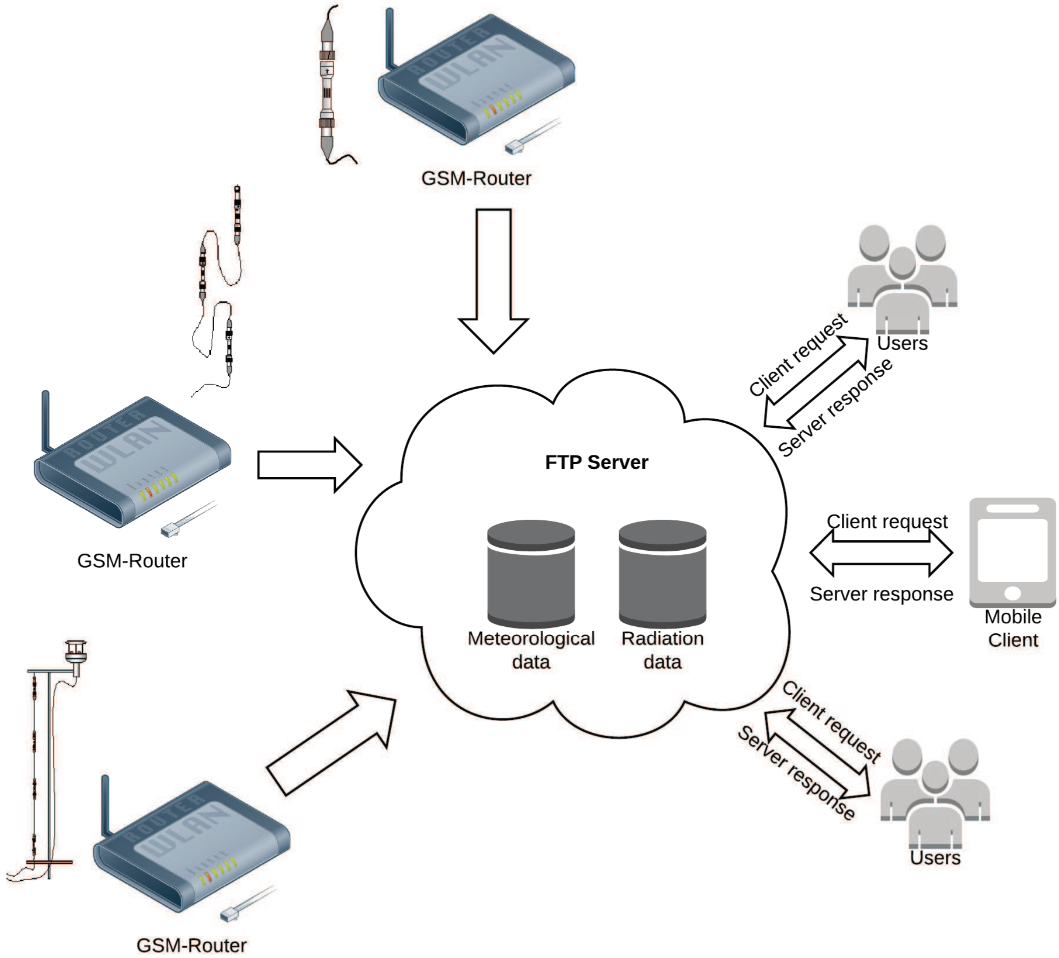

Fig. 1: Scheme of the ecological monitoring network.

The measurement module includes several meteorological multisensors which are located on the predetermined height from the earth surface. It collects the major meteorological data (air temperature, relative humidity, atmospheric pressure and wind velocity and direction) and radiation at intervals of every 5 minutes. Obtained data is transmitted to FTP-server through information channels. FTP-server is a special application for data storage and users' requests processing for the purpose of meteorological and radiation information retrieval under various search conditions. With the use of specially developed script, after every cycle of measurement, obtained data is converted into structured text files.

These files contain data about time of the beginning and the end of measurement process, size of measurements, description of measurements (data name, data type, variable's type: analogous or digital) and values of measured parameters. Structured text files are stored at FTP-server. With the use of developed application, contents of these files can be visualized in form of tables and graphics upon users' request.

4 CASE STUDY: EXAMPLE OF ECOLOGICAL MONITORING NETWORK IN THE GULF OF FINLAND

4.1 Description of proposed ecological monitoring network in the Gulf of Finland

At present time, ecological monitoring network is established along the route: Vasilievsky Island (Saint-Petersburg), Kronshtadt, Seskar Island, Moshchny Island, Gogland Island. It allows to take measurements of meteorological parameters and of radiation in the region of about 30 000 square km. Data is transmitted to FTP-server in real time and are stored in form of structured text files.

Moreover, from time to time, measurements of meteorological parameters are taken from the helicopter. On the 5-th September 2016 at 09:07:50 (MSK) offshore in the Gulf of Finland, an experiment was conducted with purpose of comparing theoretical and experimental data. Measurements were taken with the use of network of meteorological multisensors, constructed by "SPIIRAS-HTR&DO Ltd.". This network was collecting measurements of tree major parameters: air temperature, relative humidity and atmospheric pressure. Measurements were taken from a helicopter Robinson R44 over a region size of about 50 square km.

In the Table 1, information about actual weather in the observation region from Russian Federal Service for Hydrometeorology and Environmental Monitoring [15] is given.

Parameter	Value
Atmospheric pressure on the station's level, mm Hg	756
Air temperature, 0C	15.3
Minimal temperature, 0C	11.6
Relative humidity, %	81
Wind direction (At time of experiment, direction of wind changed multiple times)	S-W
Wind velocity, mps	2
General visibility, ball	4
Horizontal visibility, km	10
Atmospheric precipitation in 12 hours, mm	0
Water temperature in the Gulf of Finland, 0C	16

Table 1: Information About Actual Weather in the Observation Region

Measurement network consisted of two meteorological multisensors, attached to a conducting rope. Schematics of multisensors' fixation on the helicopter and outside appearance of meteorological multisensor is shown in Fig. 2.

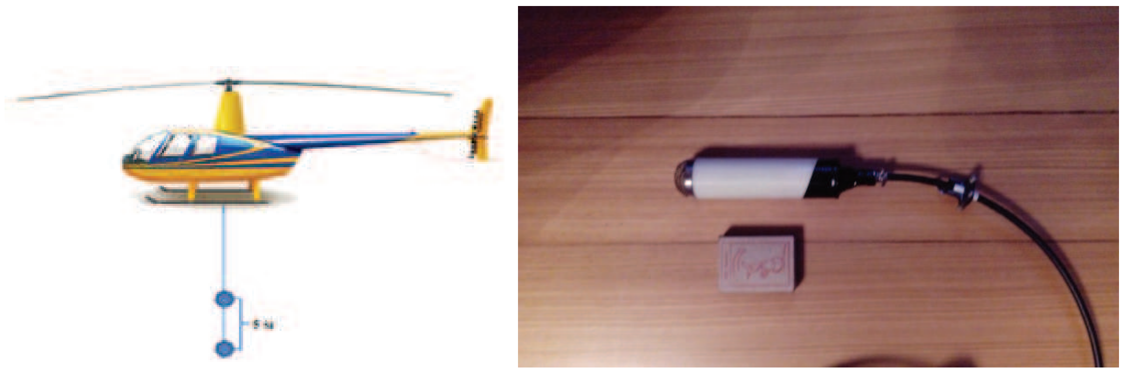

Fig. 2: Schematics of multisensors' arrangement during the experiment and outside appearance of meteorological multisensor.

4.2 Observations and analysis

During the experiment, the following scheme of measurement taking was chosen. The helicopter followed previously developed and approved flight plan over the region of the Gulf of Finland. In the determined points of flight route, during the smooth decent of the helicopter, vertical measurements of meteorological parameters (air temperature, relative humidity and atmospheric pressure) were taken. Moreover, meteorological measurements were taken during horizontal flight from one point to another. Overall, 10 measurements were taken vertically and 4 – horizontally.

Documentation of obtained data was executed by specialised software. All data was later exported into structured text files. Vertical profiles of variation of air temperature, relative humidity and atmospheric pressure with dependence on height alteration obtained in the first point on route are shown in Fig. 3.

Obtained meteorological data, after proper processing, can be successfully used for numerical modelling of air pollution propagation over the Baltic Sea. Variability (volatility) of vertical profiles of meteorological parameters, that can be clearly seen on Fig. 3, significantly influences trajectories of air pollution propagation in lower levels of the atmosphere.

So, profiles of meteorological data are available to user at any time. Vertical resolution for measurements may change from a few centimetres up to ten meters.

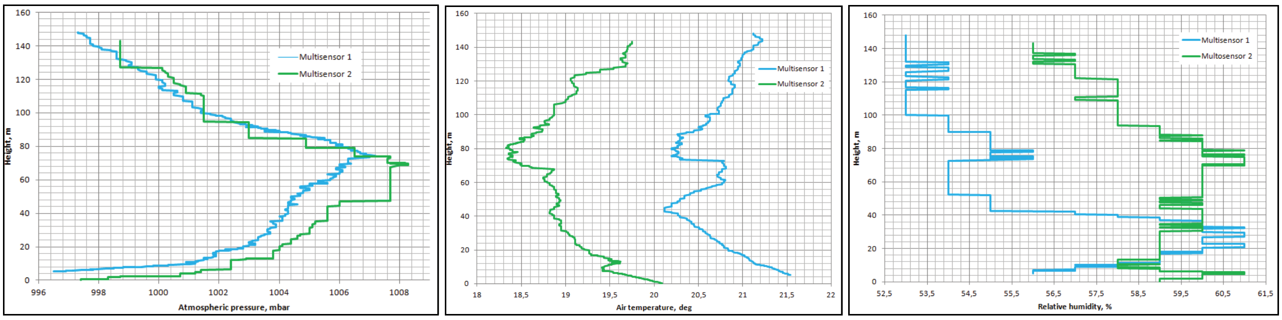

Fig. 3: Vertical profiles of atmospheric pressure, air temperature and relative humidity distribution in relation to height.

5 CONCLUSION AND FUTURE WORK

In this paper, we have proposed a new permanent ecological monitoring network for the Gulf of Finland, that will allow to organise the ecological monitoring for Baltic region and to assess effects of air pollution on the environment. In the future, we plan to use obtained experimental results to advance and modernise algorithms of modelling and predicting of air pollution propagation in inhomogeneous environment above the sea surface. Also, we intend to conduct further experiments in order to study the influence of variation of meteorological characteristics in circadian and seasonal cycles over the sea surface. For this, we suggest to establish an ecological monitoring network along the route: Vasilievsky Island (Saint-Petersburg), Kronshtadt, Seskar Island, Moshchny Island, Gogland Island, Helsinki and Stockholm. This network will help to predict distribution of harmful emissions, influence of technological companies' operation (thermal and atomic power stations, integral emissions in the atmosphere of large and small megalopolis and etc.) on environmental conditions. Our company is interested in international collaboration with all countries of the Baltic region (Estonia, Lithuania, Latvia, Finland, Sweden), national and international businesses for the sake of production of suitable measurement devices and hardware, production, placement, exploitation and maintenance of specialised monitoring systems. We are also keen to share informational resources of the proposed network with any interested users (science, business and government).

6 REFERENCES

ANGEVINE et al., 1998: Angevine Wayne M., Bakwin Peter S. and Davis Kenneth J. Wind profiler and RASS measurements compared with measurements from a 450-m tall tower // J. Atmos. Oceanic Technol. – 1998. – 15. – p. 818–825.

CMAQ: United States Enviromental Protection Agency, URL: https://www.epa.gov/air-research/community-multi-scale-air-quality-cmaq-modeling-system-air-quality-management

ECMWF, European Centre on Medium-Range Weather Forecast, URL: http://www.ecmwf.int (accepted on 05.06.2017)

EMEP: URL: http://emep.int/models.html

ERESMAA et al., 2006: Eresmaa, N., Karppinen, A., Joffre, S. M., Räsänen, J., and Talvitie, H.: Mixing height determination by ceilometer // Atmos. Chem. Phys. – 2006. – 6. – p. 1485-1493.

HENNEMUTH AND LAMMERT, 2006: Hennemuth B. and Lammert A. Determination of the atmospheric boundary layer height from radiosonde and lidar backscatter // Bound.-Layer Meteorol. – 2006. – 1. – p. 181–200.

RUSSELL AND UTHE, 1978: Russell Philip B. and Uthe Edward E. Regional patterns of mixing depth and stability: Sodar network measurements for input to air quality models // Bull.Am. Meteor. Soc. – 1978. – 59. – p.1275–1287.

SEIBERT et al., 1998: Seibert P., Beyrich F., Gryning S.E., Joffre S., Rasmussen A. and Tercier P., 1998. Mixing layer depth determination for dispersion modeling. In: COST Action 710 Final Report (Eds by B.E.A. Fisher, J.J. Erbrink, S. Finardi, P. Jeannet, S. Joffre, M.G. Morselli, U. Pechinger, P. Seibert and D.J. Thomson). Harmonization of the pre-processing of meteorological data for tmospheric dispersion models. L-2985 Luxembourg: European Commission.

SEIBERT et al., 2000: Seibert P., Beyrich F., Gryning Sven-Erik, Joffre S., Rasmussen A., Tercier P. Review and intercomparison of operational methods for the determination of the mixing height // Atmospheric Environment. – 2000. – 34(7). – p. 1001-1027.

SOFIEV et al., 2006: Sofiev M.: A dispersion modeling system SILAM and its evalution against ETEX data/ M. Sofiev, P. Siljamo, I. Valkama, M. Ilvonen, J. Kukkonen // Atmospheric Environment. – 2006. - №40. – p.674-685.

STULL, 1988: Stull R. B., 1988. An introduction to boundary layer meteorology. Kluwer Academic Publishers, Dordrecht.

THONGPLANG, 2016: Thongplang J. Air pollution modelling: what is it and what can it tell us? Aeroqual, August 11, 2016. http://www.aeroqual.com/air-pollution-modelling

UNDEN, 2002: Unden P. (Ed.) HIRLAM-5 Scientific Documentation. HIRLAM Project, SMHI, S-601 76, 2002, Norrkoping, Sweden.

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Effects of Central or Decentralized Charging Stations for Electric Buses on Route Planning and Travel Time in Public Transport – A Case Study of Aachen, Germany

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1 ABSTRACT

Public buses are well-suited to electrification (Folkesson et. al, 2003). Electric drive systems have advantages over conventional technologies, for example lower travelling costs, a higher level of energy efficiency, and the chance to reduce emissions (Imaseki, 1998; Electric Power Research Institute, 2007a; Electric Power Research Institute, 2007b; Sioshansi and Denholm, 2009; Sioshansi et al., 2010; Doucette and McCulloch, 2011; Sioshansi and Miller, 2011; Liu et al., 2013; Brouwer et al., 2013; Paulley et al., 2004). Additionally, their operation is easy to plan. Public buses usually run in urban areas in which diesel-powered buses cause air and noise pollution, thus affecting the local quality of life. Financial support and public visibility help spread the new technology. In order to render the use of electric buses in public service possible, the battery needs to be charged during operation. Setting up charging infrastructure is prerequisite for the successful use of electric vehicles (Boulanger et al., 2009; Hatton et al., 2009; Silvester et al., 2009). Different concepts need to be considered when selecting sites for the charging stations. Installing the infrastructure centrally may yield higher efficiency of the stations but is likely to cause operational problems – using the turning time at a scheduled route's terminal stop is easier to organize but requires more charging infrastructure. The vehicles themselves add further restrictions due to their limited cruising range. But how do the different concepts affect demand or transportation companies' operation planning? Is it even possible to use electric buses in the existing public transport networks using central or decentralized charging and the existing vehicle scheduling without further ado?

This paper analyzes the positioning of charging infrastructure for electric buses. The objective is to study the influence of charging electric buses on the demand for public transport. Therefore we analyze two scenarios in a case study of Aachen by modelling effects of charging in an macroscopic transport model. The first scenario explores a central positioning of the charging infrastructure. The second scenario analyzes a decentralized positioning. The analysis of the scenarios has shown that charging time is critical. A longer travel time significantly impacts demand. Extending the dwell time at the central bus station negatively affects public transport use: Use declines from 9.2% to 2.3% and is mainly shifted to private transport. In order to keep up the current level of quality, the transport companies would have to adapt their planning. That way, passengers could, for example, change from an empty electric bus to a charged one. Waiting for the buses to charge has proved to have a much stronger negative impact on demand than having to change to another bus. Aside from affecting demand, central charging would require an adaption of the schedules and would thus also impact the timetable and vehicle scheduling of transport companies. In addition, central charging would pose a logistic challenge and would require an improvement of the queuing policies (De Filippo et al., 2014).

The analysis of the timetable and vehicle scheduling has shown that decentralized charging is easier to integrate into the existing structures of local public transport. Decentralized charging using the buses' turning time comes with the advantage that the charging process does not affect the travel time provided the cycle plan is adapted accordingly and a sufficiently high charging speed is achieved. For example, the minimum turning time in Aachen is 3 minutes on average. In order to operate the charging infrastructure at maximum capacity, the ends of routes could be combined. In Aachen, radial routes are especially suited to the use of electric buses and to combining the terminal stops. When it comes to network planning in Aachen, this type of route, at an average 8.66 km, a duration of 34:34 mm:ss, and a turning time of 09:03 mm:ss, should be preferred to the other types. In addition, radial routes often have a common origin so that some of the routes already share a terminal stop.

The concepts need to be adapted and reviewed individually for each city. Whether the infrastructure can be integrated into each urban design needs to be verified as well. We may conclude that successfully integrating

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the charging process into the existing structures of public transport requires a complex and holistic concept that takes numerous aspects into account.

Keywords: public transport, electric mobility, charging, scheduling, Aachen

2 INTRODUCTION

Public buses are well-suited to electrification (Folkesson et. al, 2003). Electric drive systems have advantages over conventional technologies, for example lower travelling costs, a higher level of energy efficiency, and the chance to reduce emissions (Imaseki, 1998; Electric Power Research Institute, 2007a; Electric Power Research Institute, 2007b; Sioshansi and Denholm, 2009; Sioshansi et al., 2010; Doucette and McCulloch, 2011; Sioshansi and Miller, 2011; Liu et al., 2013; Brouwer et al., 2013; Paulley et al., 2004). Additionally, their operation is easy to plan. Public buses usually run in urban areas in which diesel-powered buses cause air and noise pollution, thus affecting the local quality of life. Financial support and public visibility help spread the new technology. In order to render the use of electric buses in public service possible, the battery needs to be charged during operation. Setting up charging infrastructure is prerequisite for the successful use of electric vehicles (Boulanger et al., 2009; Hatton et al., 2009; Silvester et al., 2009).

Different concepts need to be considered when selecting sites for the charging stations. Installing the infrastructure centrally may yield higher efficiency of the stations but is likely to cause operational problems – using the turning time at a scheduled route's terminal stop is easier to organize but requires more charging infrastructure. Site selection is determined by a number of factors. The vehicles themselves add further restrictions due to their limited cruising range. In addition, factors of urban development may restrict the planning as well.

But how do the different concepts affect demand or transportation companies' operation planning? Is it even possible to use electric buses in the existing public transport networks using central or decentralized charging and the existing vehicle scheduling without further ado? And are there certain types of routes that are more suitable for the use of electric buses than others? With this paper we seek to address these questions.

In the following sections, we present the theoretical background (Section 2), our methods including the scenario development and the analysis of the routes in public transport networks (Section 3), the results from our scenario simulation (Section 4) and, finally, a discussion and our conclusions (Section 5).

3 BACKGROUND

The main difference between private and public electric vehicles is that public electric buses have to keep to a schedule. This comes with the advantage that the routes and energy consumption are easily predictable. However, it also necessitates high-speed charging during the vehicles' operation so as not to interfere with the schedule (Ding et al., 2015). In addition to the advantages, e.g. low pollutant emission and reduced noise pollution, electric buses differ from diesel buses in disadvantages such as their low range and long charging times. The mileage constraints of electric buses are there-fore stricter than those of diesel buses.

The range of electric buses is so far not enough to replace conventional diesel-powered public buses without limitations. A conventional bus can operate throughout its entire deployment without needing to refuel. In contrast, electric buses may need to be charged several times a day. As they run on a schedule, installing fast-charging stations is thus prerequisite for using electric buses successfully. For electric buses to be able to compete with diesel buses, an innovative electric bus system is necessary (Rohlfs, Mareev, Rogge, 2015). A simulation of an electric transportation system at the Ohio State University has already shown that employing 22 electric buses on six lines using one 500 kW or two 250 kW charging stations at appropriate service rates is unproblematic (De Filippo et al., 2014).

Public transport planning consists of a number of interconnected components: First of all routes are planned (1). Subsequently, a schedule is developed (2) and vehicles are assigned to trips (3) and drivers to vehicles (4) (Chao and Xiaohong, 2013). The location of the charging stations and the integration of the charging process into the operating schedule may already cause problems for the planning of the route and the development of the schedule.

Central charging comes with the advantage that the routes would not need to be adapted provided that the bus system in question has a central hub already used by most bus routes, which would then be selected as the charging location. This would also allow for the charging stations to be used at maximum capacity. However, it is questionable whether this concept could provide an acceptable level of service: On some of the routes, central charging would mean longer travel times for passengers as it would require a longer dwell time at an intermediate stop. Travel time is an important criterion for the choice of transport mode (Balcombe et al., 2004; Bhat, 1997; Van de Walle and Steen-berghen, 2006). Especially in public transport, a longer travel time results in a decrease of usage (Vasconcellos, 2005). This would create tension between the required charging time and the available charging time. In addition, a solution would need to be found for those lines for which the central hub is not en route.

For decentralized charging, the charging infrastructure would be located at the ends of the routes. Positioning the charging stations there would not require a change of route planning either. It might, however, cause problems with the schedule as the vehicles need enough time to charge their battery before continuing their route. This, too, would create tension between the required and the available charging time. For this concept, the available charging time would hinge on the respective turning time..

4 METHOD

Using the example of Aachen, we have answered the questions of how different charging locations for electric buses affects route planning and travel time for public transport and how these concepts can be integrated into existing public transport structures from the point of view of transportation companies by analyzing two scenarios. The scenarios contain concepts that differ in where the charging infrastructure is located and offer possible visions of the future. In addition we analyzed whether there are differences in, for example, turning times or the length of routes to determine which types of routes are more suitable for the use of electric buses than others.

The two scenarios' impact on the demand is studied using the cross-border transport model of the Aachen region. The transport model simulates a weekday outside of school holidays in October and is based on the four-step algorithm. In addition to the StädteRegion Aachen, the transport model includes the surrounding communities as well as parts of the Dutch province of Limburg and parts of the German-speaking community in Belgium. The planning area for our analysis is the city of Aachen. It is divided into 178 zones. Demand is calculated based on structural data of the planning area from 2010, which is available for the zones. The impact on the operation is studied by means of an analysis of the vehicle scheduling of the urban transport company ASEAG..

4.1 Development of the scenarios

In order to come to a substantiated conclusion about how charging an electric bus affects public transport demand for each of the concepts, we first studied factors that influence the choice of transport mode. This choice is determined by numerous factors. The criteria come from different are-as such as economics, transport geography, and social psychology, and can be divided into socio-demographic, journey characteristic, and space-related indicators (De Witte et al., 2013).

Depending on how well the charging process is integrated into the schedule, charging electric buses may affect travel time and interchange. For example, charging infrastructure located centrally may extend travel time when charging would require a longer dwell time at an intermediate stop. Alternatively, passengers could change to another bus that has already been charged, immediately continuing their journey.

Interchange as a determinant is rarely studied in papers and infrequently found significant for the choice of transport mode (De Witte et al., 2013). The criterion interchange is a journey characteristic indicator. Interchange depends on how the public transport networks are scheduled (Litman, 2008; Wardman and Hine, 2000). Ideally, passengers should not have to change vehicles between their origin and destination.

The determinant travel time has been studied in a number of papers and labeled as a significant contributor (De Witte et al., 2013). In our analysis we therefore focus on the influence of an extended travel time on the demand for public transport. Travel time is a journey characteristic indicator and can be described as the time a person needs from door to door (De Witte et al., 2008). In this paper, we define travel time by public transport with the "door-to-door approach" as follows (Fig. 1): (1) walking from origin to the appropriate stop; (2) waiting for the bus; (3) sitting on the bus; and (4) walking from the final stop to the destination

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(Wardman, 2004; Salonen and Toivonen, 2013). Furthermore, the trav-el time by public transport could include transfers from one route to another including walking and waiting times (Benenson et al., 2011).

Exactly how much demand will decrease when the travel time in public transport is extended by 15 min to charge the electric buses central is examined in Scenario I (cf. chapter 3.1.1). Central charging of electric buses means that the vehicles would be charged at one central station. The buses on routes starting or ending at this station could charge during their turning times. On routes for which this station is not on the way, electric buses could not be used in our example. The buses stopping at the charging station as part of their route would then wait there until their battery is charged. The charging process would extend passengers' travel time. Alternatively, passengers could change to another bus that has already been charged. However, this means that transport companies would have to adapt their timetable and vehicle scheduling and would likely have to deploy additional vehicles. Central charging comes with the advantage that infrastructure costs would be low and the charging stations could be used at maximum capacity. It is, however, questionable whether an appropriate level of service can be achieved using this concept.

In contrast to Scenario I, we study the effects of decentralized charging in Scenario II (cf. chapter 3.1.2), which means that the buses would be charged at the terminal stops of their respective routes using their turning times. If the turning time is sufficient, this would be unproblematic. Turning times exists because buses on the same route that are compatible in terms of location and time are scheduled to form a consecutive cycle (Scholz, 2012). One cycle thus covers the use of a vehicle from when it is deployed to the finish of its shift. Aside from allowing for turning, turning times are meant to make up for delays and to allow drivers to take the breaks required by law. For an optimal schedule, turning times should be minimal since they mean a pause in transport service (Köhler, 2001). However, when the turning time can be used to recharge an electric bus, a long turning time already existing for operational reasons is particularly convenient.

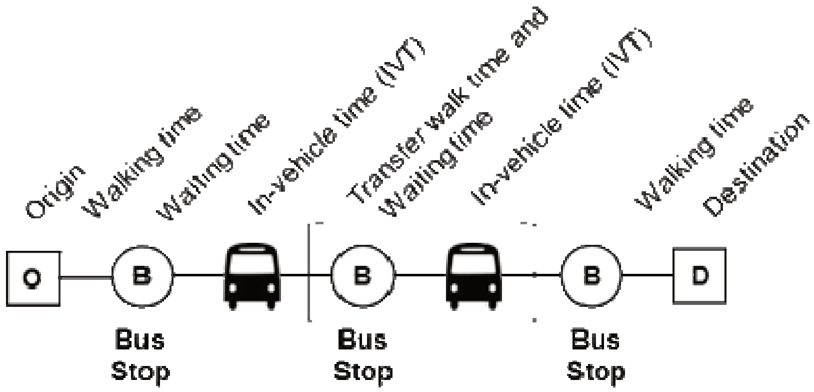

Fig. 1: Example of the door-to-door approach in public transport journeys. (Own depiction according to Salonen and Toivonen, 2013)

4.1.1 Method Scenario I: Central charging infrastructure

Scenario I explores the effects of central charging infrastructure for electric buses using the example of Aachen. The charging infrastructure is located at the central bus station Bushof in Aachen. This stop and the main inner-city bus station Elisenbrunnen constitute a central transport hub in the Aachen bus network. At a total of 65,000 passengers a day, these two stops are the most frequently used ones in Aachen (Planungskooperation "Busnetz 2015+", 2013). As Bushof is located on the standard route of the Aachen bus network, the charging infrastructure will be installed at this stop by way of example in scenario I.

In the analysis of the schedules, the journeys there and back of each route are examined, totaling 138 trips. Of these 138 trips, 18% (25 trips) already start or end at Bushof. Charging electric buses on these routes with otherwise unchanged conditions would not affect the passengers at all. Therefore, demand would not change. The transport company would, however, need to check whether charging the buses is possible without changes in the current cycle plan, i.e. whether or not the turning time is sufficient or whether the plan would need to be adapted and more vehicles used.

Bushof station is not on the way of 32% of the trips (44 trips). In this scenario, electric buses could not be used on these routes as they would require a large-scale adaption of the schedule and the business plan. For

50% of the trips (69 trips), Bushof is an intermediate stop. In order to study the impact of charging on the demand on these routes, we adapted their schedules in the transport model accordingly. In order to simulate the charging process, the dwell time of the buses at Bushof was extended by 15 minutes based on the assumption that at worst, an electric bus needs 15 min charging time per hour of operation (Falzeder, 2013) (Sinhuber, Rohlfs, Sauer, 2010).

Adapting the schedule results in a change of passengers' travel time. The impact of the longer travel time on demand is explored using the cross-border transport model of the Aachen region. The changed schedule is an input variable of the model. Longer travel times change the resistance on the routes of public transport, which directly leads to a changed relation of the resistance between public transport and motor-driven private transport on origin-destination routes. This in turn influences the choice of transportation mode on these routes and therefore the result of the modal split.

In addition, the changed route resistances also influence the result of the trip distribution. The new route resistances change the resistance relations in public transport between different relations. In the transport model, decision makers choose the fastest route. Changing the schedule extends travel time in public transport, causing a shift from public to private transport.

4.1.2 Method Scenario II: Charging at the end of the route

Scenario II explores the effects of a decentralized charging infrastructure for electric buses using the example of Aachen. Decentralized means that the charging stations are installed at the end of a scheduled route or in the bus depot. This comes with the advantage that the buses' turning time could be used for charging.

In order to answer to what extent this concept can be integrated into existing structures, we studied the timetable and vehicle scheduling in Aachen. One bus is rarely used on only one route, which means that buses change between routes and have different terminal stops. For charging buses at the end of their route, this means that the length of the cycle is relevant rather than the length of the route. One cycle covers the use of a vehicle from when it is deployed to the finish of its shift, during which one bus may be used on several routes. On single-route cycles, a vehicle stays on one route for the entire shift. The advantage of single-route cycles is that they have fixed terminal stops that could be used to charge electric buses. However, changing the cycle plan and introducing single-route cycles may make the schedule less efficient. Currently only 31% (162) of the cycles in the Aachen network are single-route cycles.

4.2 Analysis of the types of routes in public transport

We analyzed whether the types of routes of the public transport network in Aachen differ in their turning times, length, and duration in order to come to a conclusion regarding whether there is a route type which is more suitable for the use of electric buses and should be favored accordingly in future network planning.

There are four basic types of routes (Steierwald, Künne and Vogt, 2005): Radial routes, cross-city routes, tangential routes, and circle routes (cf. figure 3). For our case study in Aachen, we analyzed 74 bus routes operated by the urban transport company ASEAG on a workday Tuesday. The bus routes were allocated to the respective route types based on ASEAG's network plan. The results of the analysis can be found in chapter 4.3.

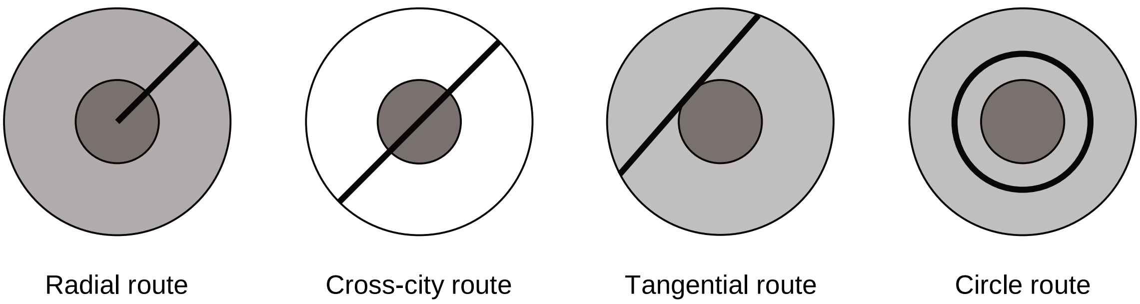

Fig. 2: Basic patterns of the route types (Source: Steierwald, Künne and Vogt, 2005)

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5 RESULTS

This chapter presents the results of the analyses of the two scenarios and the types of routes. Scenario I describes the installation of a central charging station. In contrast, Scenario II describes the effects of a decentralized charging station for the transport company.

5.1 Scenario I: Central charging infrastructure

Table 1 shows the change of the modal split due to the charging time at Bushof station in Aachen. Extending the dwell time at Bushof negatively affects public transport use: Use declines from 9.2% to 2.3% and is mainly shifted to private transport. The increase of private transport from 56.0% to 62.7% will lead to a higher load on roads, which will also come with economic effects.

To summarize, the charging infrastructure cannot be located centrally without changing the cycle plan because of the impact on demand alone. In order to avoid longer travel times, passengers could change to a fully charged electric bus at the central charging station. The effects of additional changing would therefore not have as negative an impact as longer travel times (De Witte et al., 2013), but would come with a significant need for additional vehicles at the transport company. Furthermore, the charging infrastructure requirements and the space needed for both charging and changing would be immense. Adapting the cycle plan would be out of all proportion to the resulting costs and benefits and is therefore no viable solution for Aachen.

Purpose of the journey	Analysis			Scenario I "Bushof"			Difference	
	non-MIT	MIT	PT	non-MIT	MIT	PT	MIT	PT
1 Home - Work	17,6%	69,1%	13,4%	17,9%	80,6%	1,6%	11,5%	-11,8%
2 Home - Primary school	59,6%	26,8%	13,5%	58,0%	34,9%	7,1%	8,1%	-6,4%
3 Home - Secondary school	43,6%	18,9%	37,6%	42,9%	24,1%	33,1%	5,2%	-4,5%
4 Home - Higher education	40,6%	23,3%	36,1%	40,1%	29,8%	30,2%	6,5%	-5,9%
5 Home - Shopping	30,5%	63,3%	6,2%	30,8%	68,4%	0,8%	5,1%	-5,3%
6 Home - Recreation	32,1%	59,8%	8,1%	32,4%	66,8%	0,8%	7,0%	-7,3%
7 Recreation - Recreation	25,8%	67,3%	6,9%	25,9%	73,9%	0,2%	6,5%	-6,7%
8 Work - Work	4,6%	83,3%	12,2%	4,9%	93,9%	1,3%	10,6%	-10,9%
9 Shopping - Shopping	34,0%	62,1%	3,9%	34,5%	65,5%	0,1%	3,4%	-3,8%
Total	34,9%	56,0%	9,2%	35,1%	62,7%	2,3%	6,7%	-6,9%

non-MIT: non-motorized individual transport
MIT: motorized individual transport
PT: public transport

Table 1: Modal split in the planning area (Own calculation, data source: transport model AC region)

5.2 Scenario II: Charging at the end of the route

Decentralized charging does not necessarily cause changes for the passengers. Therefore, charging the vehicles with otherwise unchanged conditions would not affect demand. If the turning times are too short, however, the charging could necessitate adapting the vehicle scheduling and would therefore affect the transport companies' planning.

Table 2 shows the cycle lengths in Aachen according to the current cycle plan. Assuming that a typical inner city electric bus has a range of 150 km (e.g. Rampini), cycles shorter than 150 km could be covered by electric buses without intermittent charging. On these cycles, the buses could be charged at the depot provided that they, once returned, have a long enough layover to fully charge their battery before the next cycle begins. In order to do so, another study would need to explore the vehicle deployment. 72% (378 cycles) of the cycles in Aachen are shorter than 150 km and could therefore already be covered by electric buses with no intermittent charging

En-route charging needs to be made possible for the cycles longer than 150 km. This could happen at the terminal stops using the turning time. Table 3 shows the distribution of turning times on the long cycles (<150 km). However, the turning times are average times scheduled by the cycle plan. The actual turning times may differ, e.g. because of the traffic situation. Only 11% of the cycles have a scheduled turning time of less than 5 minutes.

Cycle length	Cycles	
km	%	n
200 +	19	100
150 to < 200	10	53
100 to < 150	12	63
50 to < 100	21	110
< 50	39	205

Table 2: Cycle lengths in Aachen (Own calculation, data source: ASEAG)

The charging duration of electric buses using fast charging systems depends on the boundary condition (weight, fuel economy) and the charging capacity. It is, for example, possible to charge a 12 m bus (avg. load) consuming 30 kW on average in 5 minutes for an hour's journey at a charging capacity of 350 kW (Sinhuber, Rohlfs, Sauer, 2010) (Rohlfs, Mareev, Rogge, 2015). Even a charging capacity of 500 kW is possible for the electric bus system (Sinhuber, Rohlfs, Sauer, 2010) (Rohlfs, Mareev, Rogge, 2015). This means that at a required charging time of 5 minutes, 89% of the cycles (turning time > 5 minutes) could currently be charged using the turning time at the terminal stops.

Turning time accoding to schedule	Cycles (> 150 km)	
min	%	n
00:15:00 +	3	4
00:10:00 to < 00:15:00	29	43
00:05:00 to < 00:10:00	57	86
< 00:05:00	11	17

Table 3: Average turning time of cycles longer than 150 km according to schedule (Own calculation, data source: ASEAG)

The compromise between the required and the available charging time is an operational and technological challenge. The available charging time is restricted by the public transport schedule. The required charging time can be adapted by increasing the charging speed. In Aachen, all bus routes have a turning time of at least 3 minutes (cf. Figure 3, Table 4). However, we must consider that the turning time cannot be used for charging in its entirety. There must still be padding to make up for delays and to allow the vehicle to turn. Depending on the charging technology, the driver could take their break during the charging process. Therefore, a high charging speed and an optimized queuing policy are necessary for decentralized charging in Aachen to keep the charging time as low as possible

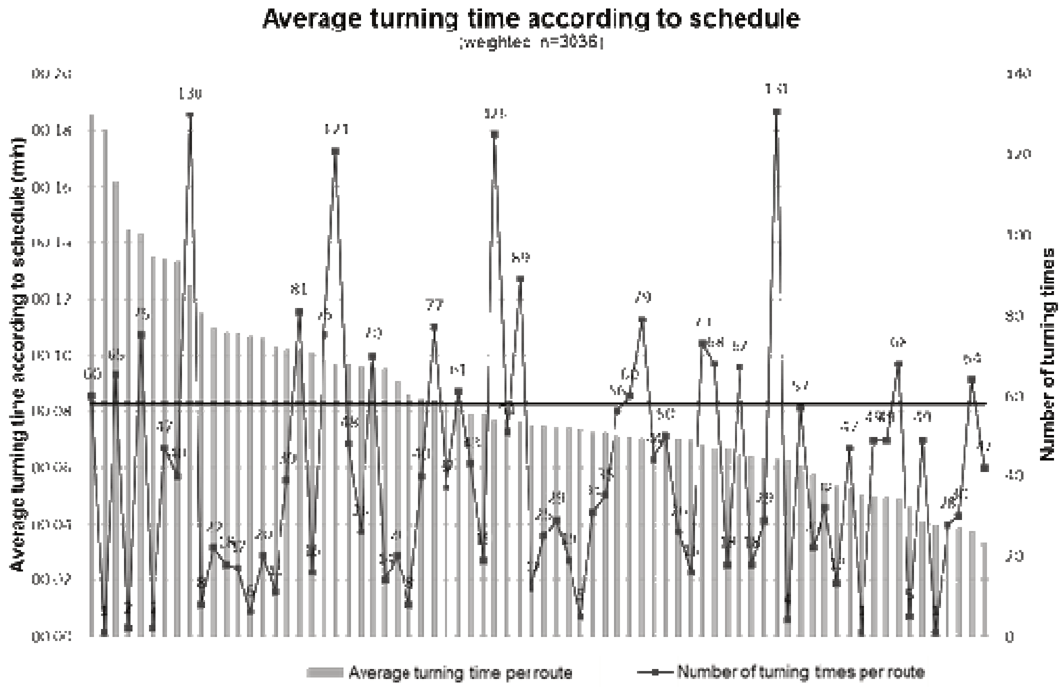

Fig. 3: Average turning times in public transport in Aachen (Own calculation, data source: ASEAG)

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In order to operate the charging stations at maximum capacity, the terminal stops of routes could be combined. Additionally, we should consider an interdisciplinary cooperation of different stakeholders: The charging infrastructure might also be used by urban electric vehicles.

Average turning time* (min)	Number of routes	
> 3	74	100%
> 4	69	93 %
> 5	63	85 %
> 6	59	80 %
> 7	49	66 %
> 8	31	42 %
> 9	26	35 %
> 10	19	26 %
> 15	3	4 %

Table 4: Distribution of the turning times(Own calculation, data source: ASEAG)

5.3 Results of the analysis of the types of routes in public transport

The distribution of the analyzed routes by route type is illustrated in Figure 4. In addition to route types such as cross-city, radial, circle, and tangential routes, Figure 4 distinguishes between routes outside of Aachen, school routes, and extra buses deployed during rush hour. School routes are buses used during the peak times of student traffic. Routes outside of Aachen have no connective function within the city. Extra buses are deployed during rush hour on partial routes and only stop at select stations. Bus transport in Aachen consists primarily of cross-city and radial routes. However, circle and tangential routes are used as well. Especially the five circle routes are scheduled tightly so that the overall network shape of the city of Aachen is a radial circle network.

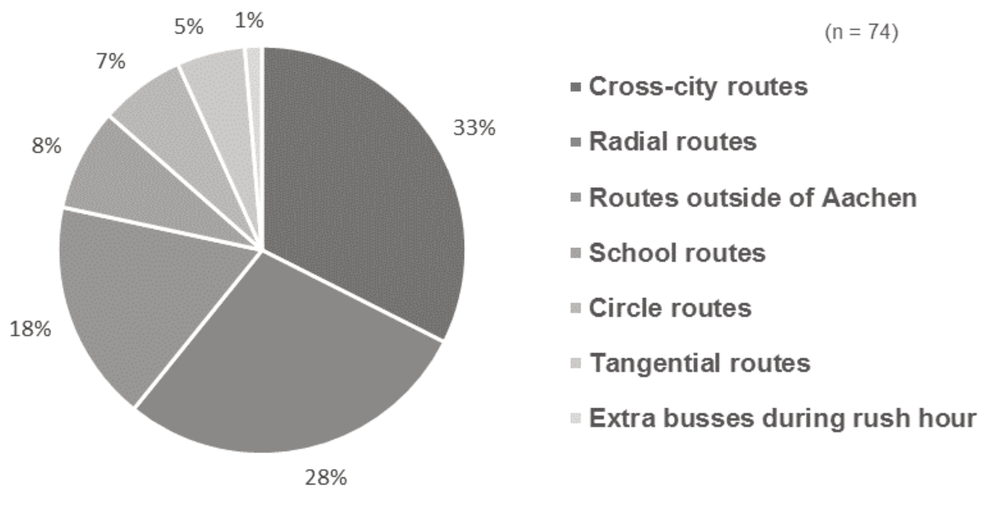

Fig. 4: Distribution of the bus routes in Aachen by type of route (Own calculation, data source: ASEAG)

The average route length, duration, and turning time are summarized in table 5 by type of route. The route length describes the distance between the terminal stops of a route. Turning time is the vehicle's scheduled dwell time at the first or last stop of a route before the next route begins. The turning time is necessary padding to make up for delays. The route duration is the time span between the terminal stops.

At 13.75 km the cross-city routes are the longest average routes. The circle and tangential routes are also longer than 12 km on average. The routes outside of Aachen, school routes, and radial routes are 8 to 10 km long. At 3.92 km, extra buses partially supporting busy routes during rush hour have the lowest average route length. The average length of all bus routes is 10.91 km.

The route duration and the route length correspond since the average speed of public buses in urban areas is virtually constant regardless of the type of route. Extra bus routes are the shortest both in length and duration. Cross-city routes are the longest at an average duration of 48:18 mm:ss. Circle routes are unique in that their first and last stop are identical. Cross-city routes also have the highest average turning time as they are the longest and are at a higher risk of delays.

In Aachen, radial routes are particularly suited to electric buses: At an average 8.66 km, radial routes are short and at the same time exhibit the second longest turning times in Aachen at 09:03 mm:ss on average.

	Number of routes	ø Length of route* [km]	ø Duration of route* [mm:ss]	ø Turning time* [mm:ss]
Cross-city route	24	13.75	48:18	09:11
Radial route	21	8.66	34:34	09:03
Routes outside of Aachen	13	9.48	29:42	06:13
School routes	6	8.93	24:50	09:03
Circle routes	5	12.96	32:07	05:31
Tangential routes	4	12.42	32:56	08:49
Extra buses	1	3.92	13:26	07:54
Total	74	10.91	36:50	08:20

Table 5: Summary of the types of routes (Own calculation, data source: ASEAG)

6 CONCLUSION

This paper explores the effects of the location of charging infrastructure for electric buses on route planning and travel time in public transport using the example of Aachen, distinguishing between central and decentral charging locations. For this purpose, the timetable and vehicle scheduling of local public transport in Aachen were analyzed. The aim was to study the impact of the two charging concepts on public transport demand and to analyze the possibilities of integrating these concepts into the existing public transport structures and the current vehicle scheduling. Additionally, the study analyzed if the types of routes in the public transport network in Aachen differ in e.g. turning times or length of routes, so that some types are better suited to the use of electric buses than others.

The analysis of the scenarios has shown that charging time is critical. Charging electric buses must not affect the passengers. A longer travel time significantly impacts demand. In order to keep up the current level of quality, the transport companies would have to adapt their planning. That way, passengers could, for example, change from an empty electric bus to a charged one. Waiting for the buses to charge has proved to have a much stronger negative impact on demand than having to change to another bus.

Aside from affecting demand, central charging would require an adaption of the schedules and would thus also impact the timetable and vehicle scheduling of transport companies. In addition, central charging would pose a logistic challenge and would require an improvement of the queuing policies (De Filippo et al., 2014).

The analysis of the timetable and vehicle scheduling has shown that decentralized charging is easier to integrate into the existing structures of local public transport. Decentralized charging using the buses' turning time comes with the advantage that the charging process does not affect the travel time provided the cycle plan is adapted accordingly and a sufficiently high charging speed is achieved. For example, the minimum turning time in Aachen is 3 minutes on average. In order to operate the charging infrastructure at maximum capacity, the ends of routes could be combined. In Aachen, radial routes are especially suited to the use of electric buses and to combining the terminal stops. When it comes to network planning in Aachen, this type of route, at an average 8.66 km, a duration of 34:34 mm:ss, and a turning time of 09:03 mm:ss, should be preferred to the other types. In addition, radial routes often have a common origin so that some of the routes already share a terminal stop.

The concepts need to be adapted and reviewed individually for each city. Especially the necessary network infrastructure should already exist in order to install a charging station. Whether the infrastructure can be integrated into each urban design needs to be verified as well. In order to come to a general conclusion regarding which type of route is particularly suited to electric buses, an analysis of the routes in other cities' public transport networks is necessary. We may conclude that successfully integrating the charging process

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into the existing structures of public transport requires a complex and holistic concept that takes numerous aspects into account. Finally, it is important to note that electrifying public transport significantly contributes to the solution of future challenges and to the improvement of quality of life.

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8 REFERENCES

Balcombe R, Mackett R, Paulley N, Preston J, Shires J, Titheridge H, Wardman M, White P.: The Demand for Public Transport: A Practical Guide. TRL Report 593. Available online: http://www.demandforpublictransport.co.uk/TRL593.pdf. Last accessed: 07/17/2015. 2004.

Benenson, Itzhak, Martens, Karel, Rofé, Yodan, Kwartler, Ariela: Public transport versus private car GIS-based estimation of accessibility applied to the Tel Aviv metropolitan area. Annals of Regional Science 47, 499-515. 2011.

Bhat, Chandra R.: Work travel mode choice and number of non-work commute stops. Transpor-tation Research Part B: Methodological 31 (1), 41-54. 1997.

Boulanger, Albert G., Chu, Andrew C., Maxx, Suzanne, Waltz, David L.: Vehicle electrification: Status and issues. P. IEEE, 99(6), 1116-1138. 2011.

Brouwer, Anne Sjoerd, Kuramochi, Takeshi, van den Broek, Machteld, Faaij, André: Fulfilling the electricity demand of electric vehicles in the long term future: an evaluation of centralized and de-centralized power supply systems. Applied Energy 107, 33-51. 2013.

Chao, Zhu, Xiaohong, Chen: Optimizing Battery Electric Bus Transit Vehicle Scheduling with Battery Exchanging: Model and Case Study. Procedia – Social and Behavioral Sciences 96, 2725-2736. 2013.

De Filippo, Giovanni, Marano, Vincenzo, Sioshansi, Ramteen: Simulation of an electric trans-portation system at The Ohio State University. Applied Energy 113, 1686-1691. 2014.

De Witte, Astrid; Macharis, Cathy; Mairesse, Olivier: How persuasive is ‘free’ public transport? A survey among commuters in the Brussels Capital Region. Transport Policy 15, 216-224. 2008.

De Witte, Astrid; Hollevoet, Joachim; Dobruszkes, Fréderic; Hubert, Michel; Macharis, Cathy: Linking modal choice to motility: A comprehensive review. Transportation Research Part A 49, 329-341. 2013.

Ding, Huajie; Hu, Zechun; Song Yonghua: Value of the energy storage system in an electric bus fast charging station. Applied Energy (2015), http://dx.doi.org/10.1016/j.apenergy.2015.01.058 (in press). 2015.

Doucette, Reed T., McCulloch, Malcolm D.: Modeling the prospects of plug-in hybrid electric vehicles to reduce CO2 emissions. Applied Energy 88, 2315-2323. 2011.

Electric Power Research Institute: Environmental Assessment of Plug-In Hybrid Electric Vehi-cles, Volume 1: Nationwide Greenhouse gas Emissions. Tech. rep. 1015325, Palo Alto, CA, USA. 2007a.

Electric Power Research Institute: Environmental Assessment of Plug-In Hybrid Electric Vehi-cles, Volume 2: United States air quality analysis based on aeo-2006 assumptions for 2030. Tech. rep. 1015325, Palo Alto, CA, USA. 2007b.

Falzeder, Florian: Charging into the Future. Pictures of the Future | Spring 2013, 106-107.

Folkesson, Anders, Andersson, Christian, Alvfors, Per, Alaküla, Mats, Overgaard, Lars, 2003, Real life testing of a Hybrid PEM Fuel Cell Bus. Journal of Power Sources 118, 349-357. 2013.

Hatton, C., S. K. Beella, J. C. Brezet and Y. Wijnia: Charging stations for urban settings: the design of a Productplatform for electric vehicle infrastructure in Dutch cities. World Electric Vehi-cle J., 3, http://repository.tudelft.nl/view/ir/uuid%3A6e209248-7741-4743-bf7c-b59d1e1323d8/ (ac-cessed July 23, 2015). 2009.

Imaseki, Takashi: Japanese automotive transportation sector’s impact upon Global warming. Applied Energy 59, 175-185. 1998.

Köhler, Uwe: Verkehr. Straße, Schiene, Luft. Kap. A-8, A-9, Abschn. B-3.1, B-5.2, C-2.5, Kap. F-3, Berlin: Ernst & Sohn Verlag. 2001.

Liu, Wen, Hu, Weihao, Lund, Henrik, Chen, Zhe: Electric vehicles and large-scale integration of wind power—the case of Inner Mongolia in China. Applied Energy 104, 445-456. 2013.

Litman, Todd: Valuing transit service quality improvements. Journal of Public Transportation 11 (2), 43-63. 2008.

Paulley, Neil, Balcombe, Richard, Mackett, Roger, Titheridge, Helena, Preston, John, Wardman, Mark, Shires, Jeremy, White, Peter: The Demand for Public Transport: A Practical Guide. TRL Re-port 593. Available online: http://www.demandforpublictransport.co.uk/TRL593.pdf. Last ac-cessed: 07/17/2015. 2004.

Rohlfs, Werner, Mareev, Ivan, Rogge, Matthias: Innovative Schnellladung von E-Bussen im Pro-jekt SEB e-ÖPNV. In: Der Nahverkehr, Heft 5. S. 11-16. 2015.

Salonen, Maria, Toivonen, Tuuli: Modelling travel time in urban networks: comparable measures for private car and public transport. Journal of transport Geography 31, 143-153. 2013.

Schmechtig, Mathias, NahverkehrsConsult; plan:mobil Frank Büsch; Ingenieurbüro Helmert (Planungs-kooperation „Busnetz 2015+“): Projekt „Busnetz 2015+“. Überarbeitung des Busliniennetzes in Aachen. Ergebnisbericht. Aachen. 2013.

Scholz, Gero: IT-Systeme für Verkehrsunternehmen. Informationstechnik im öffentlichen Perso-nennahverkehr. Heidelberg, dpunkt.verlag GmbH. 2012.

Silvester, Sacha, Beella, Satish, Quist, Jaco: Advent of electric vehicle: A research agenda, in Joint Actions on Climate Change (eds. A. Remmen and H. Riisgaard). University of Aalborg, Aal-borg. 2009.

Sinhuber, Philipp, Rohlfs, Werner, Sauer, Uwe: Conceptional considerations for electrification of public city buses. Emobility - Electrical Power Train. IEEE. 2010.

Sioshansi, Ramteen, Denholm, Paul: Emissions impacts and benefits of plug-in hybrid electric vehicles and vehicle to grid services. Environ Sci Technol 43, 1199–204. 2009.
Sioshansi, Ramteen, Fagiani, Riccardo, Marano, Vincenzo: Cost and emissions impacts of plug-in hybrid vehicles on the Ohio power system. Energy Policy 38, 6703-6712. 2010.
Sioshansi, Ramteen, Miller, Jacob: Plug-in hybrid electric vehicles can be clean and economical in dirty power systems. Energy Policy 39, 6151-6161. 2011.
Steierwald, Gerd, Künne, Hans D., Vogt, Walter: Stadtverkehrsplanung – Grundlagen, Methoden, Ziele. Springer-Verlag, Berlin, Heidelberg. 2005.
Van de Walle, Stefaan, Steenberghen, Therese: Space and time related determinants of public transport use in trip chains. Transportation Research Part A 40, 151-162. 2006.
Vasconcellos, Eduardo Alcantara de: Urban change, mobility and transport in São Paulo: three decades, three cities. Transport Policy 12, 91-104. 2005.
Wardman, Mark, Hine, Julian: Costs of Interchange: A Review of the Literature. University of Leeds, Institute of Transport Studies, Leeds. 2000.
Wardman, Mark: Public transport values of time. Transport Policy 11, 363-377. 2004.

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Escaping the Summer Heat – Revival Potential and Challenge of Near-Metropolitan Tourism Areas

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1 ABSTRACT

To be economically successful in the future, alpine tourism in Austria must develop appropriate strategies to adapt to changing climate conditions. The revitalisation of the historic "Sommerfrische" represents one potential strategy for low-lying mountain destination close to urban agglomeration to benefit by the increase in urban heat days. Whether this potential exists on the demand side and how it can be tapped by the respective destinations on the supply side will be investigated throughout this project. For this purpose, a large scale survey will be conducted in Vienna. This paper focuses on the development process, which is informed by a range of quantitative and qualitative methods at the pre-survey stage. First results indicate that the potential exists, yet mainly for shorter, spontaneous trips, not necessarily labelled as "Sommerfrische".

Keywords: destination management, sustainable travel, tourism demand, heat waves, climate change adaptation

2 INTRODUCTION

Tourism is one of the most important sectors of the Austrian economy; it accounted to 5.6 % of the Austrian GDP in 2015 (Statistik Austria 2016). However, given the nature of tourism, this sector is highly vulnerable to the effects of climate change (APCC 2014). Climate change has manifold effects on the tourism sector, mainly as a result of current temperature rise which is expected to increase further in future. In the city of Vienna, days with temperatures above 30 degrees have increased from 9,6 days per year (1957-1976) to 11,25 days per year (1977 – 1996) to 19,45 days per year (1997 – 2016) (Stadt Wien 2016), and is assumed to increase further to one in four summer days until 2040 (Kromp-Kolb et al. 2007). Similar numbers can be found for other Central European metropolitan areas. From a tourism perspective, these circumstances may create new potential for rural mountain destinations located close to agglomerations, such as the „Wiener Voralpen" and the „Mürzer Oberland". They might turn more attractive for the Viennese population due to their refreshing character away from the urban heat, in higher elevations.

So far, most research in the area of climate change adaptation in mountain tourism deals with the effects of temperature and precipitation changes on winter tourism. However, not much research exists around the potentials for alpine summer tourism arising from climate change; with no empirical studies estimating the specific quantitative potentials for the affected destinations. It has not yet been investigated whether an escape from the heat is a significant motive for leaving the city and, if so, which destinations would be preferred for what reasons and what the preferences and requirements regarding the accessibility and the transport offers are. While this paper does not yet outlay the quantitative results of these potential estimations, it aims at sketching the different scientific methods that have informed the actual survey design process and have helped to scrutinize existing and generate new working hypotheses. Aiming to present the findings from these different pre-survey methods, this paper is structured along the following two main research questions:

(1) Can "Sommerfrische" represent climate change adaptation option for citizens of large urban agglomerations characterized by increasing occurrences of heat days and nights? What transport-related demand, especially by car-free urban households, can be expected?

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(2) From the perspective of citizens and tourism and transport experts: How could a modern “Sommerfrische” look like in order to be considered an attractive travel option by Viennese citizens (with a special focus on car-free tourism options)?

3 LITERATURE

3.1 From Past to Present: summer tourism in the Alps & the definition of Sommerfrische

The original concept of “Sommerfrische” (summer retreat) evolved in Austria around the year 1800, driven by an increasing accessibility of mountainous areas by railway (Haas 1992). These journeys developed as trips of several months, undertaken by aristocrats and other upper social classes with affluent financial means. Schmidt-Lauber (2014) defined “Sommerfrische” as a “longer, stationary stay of a well-known, often family-related group of people during the summer months in a mostly repeatedly visited place and no trip with changing locations”. At the end of the 19th century, a catalogue of criteria for “Sommerfrische” destinations was developed stating the subsequent characteristics (Schmidt-Lauber 2014). Accordingly, “Sommerfrische” destinations:

(1) were mostly reachable by railways,

(2) were characterized by neither too flat nor too mountainous environments,

(3) found in environments with access to forests and water in order to be able to go for walks and swimming,

(4) provide cultural activities that could be enjoyed together with other families of a similar social standing.

As opposed to other trips made by these social classes (like Italy in late winter, educational trips to France or swimming holidays at the Baltic Sea), the traditional “Sommerfrische” was a retreat from the stress of other travels or the all-day life in cities. It was a conscious downtime in times of increasing mobility (Kos 1995). In terms of activities, “Sommerfrische” travels were hence characterized by nature-related relaxation and an avoidance of any type of exhaustion, meaning that days were filled with good food, short walks, swimming and concerts. With the increasing financial and physical accessibility of international tourism evolving in the 1950s, the historical “Sommerfrische” and the respective tourism destinations lost much of their attraction.

By now, the term as such has widely changed its meaning, also due to the fact that societal changes and current working patterns have made the classical “Sommerfrische” of several months impossible for most people (Weigel 2014). For this reason, it is now mostly understood as a synonym for shorter travels to these former “Sommerfrische” destinations or regions with similar characteristics that are – by now – accessible either by car or railway. As a touristic concept, it is still associated with relaxation, nature and an active “slowing down” (Schmidt-Lauber 2014). Yet, beyond the scope of tourism, the term has also found entrance into other product spheres, such as food and cosmetics where it connects the products with being “fresh”, “natural”, “regional” and, as a consequence, good for one’s well-being. Whether or not the focus of tourism destinations on offering “refreshing” vacations can meet the ever-changing demands of nowadays’ tourist and therewith represent a true potential remains unclear so far. For this reason, the subsequent sub-chapters aim at briefly outlining the different factors that could harm or support a positive development of current “Sommerfrische” destinations from a supply-side (destinations) and a demand-side perspective (tourists).

3.2 Climate Change Adaptation in Tourism – Demand-side perspective

There is strong indication from several studies that climate and weather conditions affect people’s leisure behaviour and in particular their tourism travel behaviour in many ways. Whereas these effects are well-researched for winter tourism (Smith 1993; Aaheim & Hauge 2005; Koetse & Rietveld 2009), there is a strong lack of empirical evidence dealing with summer tourism. Nevertheless, it is assumed by several researchers that an increasing number of heat days and tropical nights in urban areas is creating an increasing demand, for new multi- seasonal tourism developments. In particular with regard to urban source markets, the effects of heat days (days with temperatures greater than 30°C) are expected to lead to an increasing demand for short-term trips to more refreshing near-urban areas (Serquet & Rebetez 2011; Lieb et al. 2010; Fleischhacker et al. 2015).

Besides climate change, changes in lifestyle, consumption and mobility patterns are affecting the demand for tourism products and tourism travel behaviour (Sirakaya & Woodside 2005). The travel behaviour is also being influenced by developments in the societal, technological, social, economic, political and ecological areas. According to Held (2013), the expected travel behaviour in the future can be described with the attributes of individual, spontaneous, frequent, shorter, cheaper, more comfortable, safer, more exotic, more relaxing and more experienceful. Nature, the environment and the landscape form the basis for tourism and are often referred to as the most important travel motives (Arnberger et al. 2002). This significance could grow even further in the future and the need for unspoiled nature will become even more important (Held, 2013). Furthermore, technological progress, particularly in the area of mobility, information and communication technologies, will continue to challenge tourism. The digitization and the enormous changes in communication and information exchange offer new possibilities, which are to be used optimally in tourism (Held 2013). When addressed appropriately by the respective tourism destinations, these trends or aspects could favour a revitalisation or rather re-invention of the historic "Sommerfrische" destinations given their suitability for short, spontaneous trips to nature while also allowing for a high level of comfort.

3.3 Climate Change Adaptation in Tourism – Supply-side perspective

On the supply side, climate change effects both the (foremost low-laying) winter sport destinations as well as summer destinations. Whereas in winter, these regions are facing challenges due to a decreasing reliability of snow conditions (APCC 2014, Steiger and Abegg 2013), there are chances in summer due to the potential to reactivate the traditionally known "Sommerfrische" (Abegg and Steiger 2011, Fleischhacker et al. 2012).

At the beginning of the 21st century, old Viennese touristic resorts were rediscovered due to new offers in the fields of health, leisure and culture with the flair of past and present times (such as Semmering, Reichenau or Kamptal). According to Grün and Benesch (2005), today's tourism combines phenomena of different origins: "natural enjoyment of the Biedermeier period, day and excursion tourism, "second-home tourism", the contemplative "Sommerfrische" as well as the organized mass tourism" (Grün & Benesch 2005).

In the field of mountain tourism development, various initiatives can already be observed that lead towards the direction of a new modern form of "Sommerfrische". The tourism region surrounding Salzburg for example has branded itself as "Sommerfrischeland", offering a range of modern services and activities around the topics of relaxation, time with friends and family, beautiful landscapes as well as cultural and culinary experiences. Other regions focus strongly on the overall development of year-round tourism strategies. One common strategy, adapted for example by the tourism destination Schladming-Dachstein and the Austrian region Styria is the staging of the destinations as refreshing and relaxing places, allowing tourists to find a relief from the stress as well as the heat of the cities.

The aspect of car-free accessibility of tourism regions holds a special role in many tourism development strategies. Within the frame of a climate change adaptation (and mitigation) strategy, such options represent a crucial requirement in order to avoid maladaptation by encouraging increased individual travels by car. As examples from Switzerland (i.e. Saas-Fee, car-free tourism destination) indicate, such a regulation can actually enhance a destination's identity and therefore foster its economic development. This requires, however, the sufficient provision of alternative mobility options, a factor that often poses problems due to financial and other structural constraints. Especially in more rural, loosely populated areas, the commonly-promoted implementation of better public transport schemes is often very cost and energy-ineffective. For this reason, it does not always constitute a viable solution to the problem, requiring research to identify and develop alternative solutions suitable specifically for rural tourism destinations. In this respect, it is important to consider current visitor motives and planned activities and travel patterns (at the destination) to improve the suitability and therewith acceptability of imposed measures.

4 METHODOLOGY

4.1 The project's approach

A research project funded by the Klima- und Energiefonds under the „8th Call Austrian Climate Research Programme – ACRP" intends to evaluate the strength of intentions of urban residents to seek for refreshment in nearby mountainous regions and how the latter can respond to this demand by creating sustainable tourism offers and travel options to and in the destinations in order to avoid climate-unfriendly maladaptation as prioritized by the Austrian Tourism Strategy (BMWFJ 2010). These overall questions will be answered based on (1) a large-scale quantitative survey (n=800) to be conducted in Vienna in summer 2017 and (2)

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future workshops to be conducted in two case study regions in two rural tourism destinations in the Austrian Voralpen (Mürzer Oberland and Ötscher-Tormäuer).

4.2 The Theory of Planned Behaviour (TPB) underlying the survey design

It is increasingly recognized by researchers from various different fields including economics, psychology and transport studies that the reasons for people's consumption (and also travel) choices are much less rational than often assumed. While commonly named arguments such as price, product or service characteristics, time and flexibility are surely influential aspects, they can not account for the complexity of human decisions, which are also influenced by habit, spontaneous feelings and one's social environment (Lois & López-Sáez, 2009; Rise, Thompson, & Verplanken, 2003; Steg, 2005). This applies particularly to travel decisions, which are very much a representation of personal desires, societal trends and lifestyles as well as changing personal preferences and interests. For this reason, the survey will make use of Ajzen's (1991) Theory of Planned Behaviour (TPB) to analyse the intentions and the predictors influencing them.

The TPB is a psychological theory of attitude-behaviour relations (Anable, 2005), which states that a defined behaviour (such as traveling to "Sommerfrische" destinations) is a reasoned process that is determined by an intention to perform it (Conner & Armitage 1998). This intention in turn is measured based on (1) attitudes towards the specific behaviour, (2) subjective norms or social expectations and (3) the perceived behaviour control (PBC), which also has a direct impact on the intention as such. While the original model only includes the three predictors mentioned above, the literature analysis provides evidence that an inclusion of further predictors may increase the model's explanatory power. In order to determine the most relevant predictors into the survey design, scrutinize the main hypotheses of the project and explore first tendencies with respect to the project's research questions, a range of qualitative and quantitative research methods have been conducted in the initial phase of the project. This paper focusses on the methods applied within this pre-survey stage and the retrieved results. The chosen approach will be outlined subsequently.

4.3 Qualitative & Quantitative Methods Applied within Pre-Survey Stage

(a) Literature Review

First, a systematic literature review on the historical roots and developments of the concept "Sommerfrische" was undertaken. More precisely, the aspects covered in this first literature review include the following topics, respectively keywords: (1) the influence of climate change on urban agglomerations including national and international climate change adaptation strategies, (2) climate change adaptation in tourism – approaches and best practice cases, (3) structural changes in tourism and related transport demand over time, including changing travel motives and the trend of sustainable tourism, (4) the development of the historical "Sommerfrische" from the past till the present.

(b) Telephonic Pre-Screening

In a second step, a telephonic pre-screening with a net sample of 100 people was conducted aiming to investigate the overall interest and intention of Viennese citizens in visiting such destinations. For this purpose, a gross sample of 450 people living in Vienna were randomly selected from the Austrian 2015 telephone directory CD "Herold". The entries were first filtered by location (Vienna) and then selected based on a randomization algorithm, whereby all entries clearly belonging to corporate entities were manually excluded. Each person of the gross sample was contacted, with one of three possible outcomes:

Gross sample	N= 450
Participation refused or not possible (active refusal, language/communication problems, number inexistent)	n = 293
Unsuccessful call attempts on three different weekdays and times of the day	n = 57
Successful participation = net sample	n = 100 (average age: 59,2) Female: 55 (average age: 66,2) Male: 45 (average age: 56,6) Households with car availability: 72% Households with children at home: 24%

Table 1: Description of the sample of the telephonic pre-screening

The pre-screening mainly consisted of three question blocks: (1) their previous travels to “Sommerfrische” destinations (places, activities etc.); (2) intention to visit similar destinations in the future – in general and in case of increasing urban heat, and (3) sociodemographics (age, gender, household size, car ownership).

(c) Focus Groups

In a third step, stakeholders were invited to join two semi-guided focus groups, one with tourism and climate experts (partly from “Sommerfrische” regions) and one with Viennese citizens of different age groups and residence areas across the city. The two focus groups have been conducted in the beginning of February 2017; the citizens group containing seven participants; the expert group containing eight participants. Both focus groups took place at premises of BOKU Vienna and were guided by a professional moderator.

Within the citizen focus group, the following topics were covered as part of the interview guideline: (1) response to heat waves with a special focus on leisure time behaviour, (2) the relevance of different factors for taking travel decisions, (3) summer travel preferences and the current image and future potential of “Sommerfrische” destinations. The overall ambiance during this focus group was very positive and especially optimistic towards the prospects of “Sommerfrische” destinations. The group seemed rather nature and mountain oriented in their leisure activities, which surely influenced the discussion.

Within the expert focus group, the following topics were covered as part of the interview guideline: (1) current trends and developments in Austrian alpine tourism, (2) chances for the tourism sector to benefit from climate change including best practice examples, (3) development potentials for “Sommerfrische” destinations with a focus on communication to tourists and necessary transport offers. The overall discussion during this focus group was more discordant and more sceptical towards the concept of “Sommerfrische”.

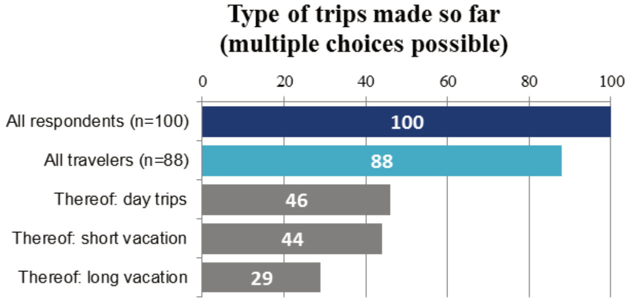
The analysis of both focus groups was conducted as a content analysis according to Mayring. For this purpose, an iterative coding process was followed, which allowed to continuously expand the original coding scheme which was based on the interview guideline and an initial analysis of randomly chosen subset of the focus group transcript. The final coding scheme was then applied to the entire transcript again. In a second stage, the quotes within the different sub-codes (i.e. A.1-A.8 in Table 2) were subsumed to more abstract yet distinct “theses”, which were, in a last step, each assigned one “key representative quote”. For the results section of this paper, direct quotes were translated from German to represent its meaning (not word-by-word) and marked the following way: > “quotation text” <.

(d) Picture Analysis as thought experiment

In a fourth and last step, a picture analysis was conducted that aimed at exploring the associations people have with the term “Sommerfrische”. For this purpose, 34 pictures were collected within the following five categories: (1) landscapes, (2) activities, (3) accommodation, (4) mobility, (5) random associations. The pictures within each category were selected with the aim of illustrating as much as possible a large variation of themes in order to account for different conceptualisations. The analysis was conducted subsequent to the focus group with the participants and was analysed descriptively using Excel.

5 RESULTS

5.1 Pre-Screening



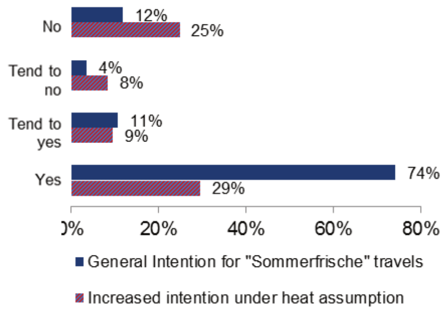


Figure 1: Type of trips in “Sommerfrische” destinations made so far (multiple answers possible). Figure 2: Intention for future "Sommerfrische" visits – in general and assuming increased occurrence of heat

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The first results (see figure 1) of the pre-screening indicate that there is a strong overall interest from the part of the population in these regions, with 88% of respondents having visited such a region (for day trips, short or long vacations) in the past years. As shown in the figure, day trips without accommodation were most frequently mentioned with 46%. 44% of all respondents said they were making shorter trips (2 to 4 days) and 29% mentioned they were making long vacations of 5 or more days in recent years. Similarly positive, 72% of respondents indicated that they are likely to visit such regions again in the future. For 33% of the respondents, increasing urban heat may favour their decision to do so (see figure 2)

5.2 Focus Groups with Experts and Citizens

The subsequent tables illustrate the coding scheme for both focus groups, which were developed throughout the qualitative analysis.

A - Development trends in tourism	B.4: legal conditions	E - Mobility & offers
A.1: influence of weather on holiday behavior	B.5: existing structures and patterns of thought	E.1: requirements for public transport services
A.2: trend: active holiday	B.6: market dominance of large providers	E.2: challenges for proposal development
A.3: trend: craft and culinary	B.7: focus on good weather offerings	E.3: lack of availability of offers and services
A.4: trend: pure nature	B.8: influence of heat	F - Tourism-based strategies
A.5: trend: spontaneous holiday decisions	C - Picture of Sommerfrische	F.1: staging
A.6: trend: classic second-travel destination	C.1: duration	F.2: characteristics of a successful offer
A.7: differentiation of tourism offers	C.2: market potential	F.3: simple bundled offers
A.8: shift of the main season to the rear	C.3: other associations	G - Information for the customer survey
B - Obstacles and challenges	D - Staging a new "Sommerfrische"	G.1: attractiveness factors for a short vacation
B.1: flexible financing of (mobility) offers	D.1: redefinition Sommerfrische	H - Good practice examples
B.2: communication with (potential) guests	D.2: advertising	H.1: mobility
B.3: day visitors	D.3: combination with main travel motive	H.2: strategies
	D.4: staging cool places	

Table 2: Coding Scheme for expert focus group

A - Dealing with heat	C - Picture of Sommerfrische	D.6: local leisure activities
A.1: burden of heat	C.1: historical/nostalgic	D.7: touristic information online
A.2: restructuring everyday and work	C.2: to take a breath	D.8: bad weather options
A.3: apartment accommodation	C.3: childhood experiences	D.9: marketing: stronger focus on short trips
A.4: choice of district/flat	C.4: duration	E - Mobility & offers
A.5: leisure	C.5: uncomplicated	E.1: public transport accessibility
A.6: perception of climate change	C.6: potential for revival	E.2: preference car use
B - Influence on holiday decision-making	C.7: recreation	E.3: comfort needs
B.1: family/friends	C.8: other	E.4: car-free tourism
B.2: climatic conditions/weather	D - Requirement to SF-regions	F - Barriers SF-vacation
B.3: advertising/catalogues	D.1: more attractive accommodation	F.1: globalization of travel
B.4: affordability	D.2: more options for short trips	F.2: lack of time
B.5: diversity/new	D.3: rejection packages	G - The "Sommerfrischler"
B.6: tourist information online	D.4: individuality & solitude	G.1: mountain affinity
B.7: hobby-specific	D.5: spontaneity	G.2: closeness to nature
		G.3: city-dweller

Table 3: Coding Scheme for citizen focus group

Tourism development trends and the potential of a new Sommerfrische

The development trends in tourism can be viewed as diverse and active vacations as well as the interest in culinary and crafts are particularly popular themes for short vacations: >*”These short vacations should always be relatively dense…Not from the effort, but from the experience intensity.”*<. On the other hand, people on holiday are also looking for unspoiled and natural places: >*”There is the trend of deceleration, not to consume, just searching for regions which are still unaffected.”*<. The booking of short breaks and weekend trips is increasingly occurring at short notice. A further opinion of the experts was that the holidays at classic second-travel destinations can take place in the main season, but it can be recognized as a trend that the main season shifts backwards into the late autumn. As can be seen the opposites between strongly staged, infrastructure-based and near-natural tourism offers become greater. By and large, available tourism options are increasingly differentiated.

The citizens agreed with each other in their perception that heat represents a burden, especially at night: >*”But if it does not cool down in the night, then it can be quite exhausting.”*<. Therefore, the escape from the city represents a possible adaptation at extreme heat, because excursions to these “Sommerfrische”-

regions are associated with cooler air: >”*...we wanted to get away, get out of the town”*<. However, local refreshment options are a vivid and attractive alternative to these short trips in the specific case of Vienna: >*”In Vienna you can go swimming everywhere.”*<.

With respect to the resulting market potential of a new Sommerfrische, the opinions diverged considerably between the two focus groups. While the experts stated that there is not enough demand for a new “Sommerfrische”, the citizens perceived the potential to be very positive. Despite their general scepticism towards the concept of Sommerfrische, the experts emphasized that there will certainly be an increasing potential for short vacations in general: >*”The market for “Sommerfrische” is available, at least for a short trip.”*< Similarly, the demand for cool places and freshness is definitely also present.

General requirements for a new “Sommerfrische”

For the experts, a successful re-invention of a new “Sommerfrische” requires the definition of freshness as counterpart to the heat in the city. The establishment of a new “Sommerfrische” could be successful if the offer is combined with common main trip motives such as culinary or crafts for short breaks: >*..the motive for travelling can be a culinary pleasure or for example hiking...”*<. It is also important to ensure that advertising for this new concept is made consciously and with a view of the right timing, because “Sommerfrische” can be a solution for people who suffer from the heat in the city. An essential touristic strategy is to stage such excursion destinations and activities: > *“Natural staging with benches and “power stations” is a huge theme in tourism.”*<.

The citizens were in agreement that there are many different requirements for these “Sommerfrische”-regions. In addition to a close connection to nature and simplicity, a certain comfort level is expected, especially with respect to accommodation offers. Experts and citizens shared the opinion that short trips are a great opportunity for these rural regions and that these should be advertised more strongly. Furthermore, the experts pointed out that tourists like to use uncomplicated vacation offers, where they do not have to worry about anything, providing them with a sense of “security” away from home. In contrast to this view, most of the citizens did not want to book “prefabricated” packages for their vacation due to the lack of flexibility and individuality. They want to have the free choice at any time: >*”It should be spontaneous; we want to design it ourselves.”*<. For the participants, attractive “Sommerfrische”-offers allow for the possibility for individuality and loneliness as well as the spontaneity and accessibility. These points represent a central potential for these “Sommerfrische”-destinations.

According to the citizens, a certain degree of infrastructure and leisure activities will further enhance the attractiveness of a rural destination. Not only that, the travellers also have a great interest in regional products and activities, yet these leisure offers should be authentic for the each individual region: >*”A small museum in each village is unnecessary...forcing that is difficult.”*<. In association with the weather conditions, the availability of offers, which can also be used even by bad weather, increases the attractiveness of the destinations enormously: >*”In the regions where there is a thermal bath, you can pay a visit, if the weather is really bad.”*<. This goes in line with some of the experts stating that attractive and popular tourism offers provide the guest a personal connection to the region. With regard to tourism advertising, it was stated by the citizens that it should focus more on possibilities for short trips, as opposed to presenting Austrian regions as longer holiday destinations exclusively. Moreover, it was mentioned by both groups that the availability of information and the communication with the guests are important features of a functioning offering.

Mobility needs

With regard to mobility and associated offers, the citizens perceive public accessibility is an important feature for destinations, which requires improvements in many areas: >*”For me, public accessibility is the most important thing.”*<. The journey by train is perceived to be pleasant, as transport and leisure time can be combined: > *“If we travel by train, we can both read the newspaper.”*< On the other hand, the car offers greater comfort and can be associated with more spontaneity, which is very important to many travellers: >*”By car it is definitely more comfortable.”*< In the area of public transport, the number of changeovers has a major impact on the willingness to use it: >*”If you have to change trains often, I understand that the car is more comfortable and so the train can be exhausting.”*< Also the amount of luggage represents a big hurdle for the journey by public transport. The planning of car-free travel can prove difficult and understanding respective timetables is perceived to be complicated in new and especially some rural areas. Despite this

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criticism, some of the citizens also highlight their satisfaction with the public transport services in Vienna and the surrounding area: >*”One comes comfortably from A to B. No matter whether you want to go up the mountain or stay in the city.”*<

The experts agreed that public transport services must be practical and uncomplicated to be used by the (potential) guests: >*”...also in the mobility area, whatever is simple will work.”*<. The guests also have certain demands with regards to public mobility, which are difficult to implement in rural areas. In this sense, the lack of access to public transport means that tourism companies are severely restricted in these rural areas. Information about mobility offers are often only insufficiently accessible and often obsolete, which also makes access to tourism enterprises more difficult.

5.3 A short excursus: picture analysis

The findings of the picture analysis were very revealing and varied. First, it can be said that the image of “Sommerfrische” is strongly focussed on landscapes and activities. This means that all images displaying landscapes (be it with waterfalls, forests, meadows, lakes or mountains) were strongly associated with “Sommerfrische”, without a difference between the different aspects. The activity-centred pictures illustrated a range of different activities including hiking, rafting, culinaric activities, swimming and relaxing among others. The degree to which these were associated with Sommerfrische or not, may be age-dependent. Besides those two categories most strongly associated with Sommerfrische, images with family members and friends were also often associated with “Sommerfrische”. The conceptualisation of “Sommerfrische, however, seems to be relatively independent of different types of accommodation and mobility tools. Within these categories, only cable cars and mountain huts were positively related to the image of “Sommerfrische”. Other forms of mobility towards or within the tourism destinations, whether by public transport or by car, are less associated with the concept of “Sommerfrische”. In addition to the categories of places, activities, mobility and accommodation, there were also pictures with different associations, for example the traditional “Sommerfrische” image with a family on a small boat, some women with a traditional costume or children on a playground. Even those pictures of people in rural regions were rather less or not connected with the concept of “Sommerfrische”. Overall, the conclusion is that the image of “Sommerfrische” can be regarded as surprisingly homogeneous and rather simple.

6 DISCUSSION AND CONCLUSION

6.1 The Potentials and Development Paths of a New Sommerfrische

The first quantitative results contradict the statements of the interviewed tourism experts who perceive the market for “Sommerfrische” regions to be rather unimportant due to the outdatedness of the concept. The citizens’ perception of the “Sommerfrische” concept diverged from the experts’ one: they perceive it as highly attractive and interesting for a range of reasons as soon as the destinations invest in providing easy access to destinations and to relevant tourism- and travel-related information (especially online) with a focus on spontaneous short trips. By the citizens, the varied travel possibilities are sensed as very positive, the interest in “Sommerfrische” destinations is definitely present, but it varies strongly between different groups of people (active vs. relaxed, longer vs. short etc.). This chapter discusses some observations or trends with respect to changes in tourism demand and the consequences for the destinations’ potential with respect to a “Sommerfrische” revival (PSF) and possible development paths (DP).

Observation 1: Changes in tourism behaviour have taken place; spontaneous, flexible short travels within Austria have increased in popularity, whereas longer holidays tend to be made abroad. “Sommerfrische” is hitherto rather perceived as an “Add on” to the otherwise often internationally oriented main vacation. For many respondents, short trips in Austria would be a lot more interesting if they had more free time or vacation time to enjoy the nature extensively. Given the time constraints though, they prefer to combine different types of travelling in order to see and experience as much as possible.

- PSF: It’s rather relevant for short weekend and multi-day trips, not necessarily conventional 2-week holidays. Also in terms of available offers (in terms of available activities, diversity…), “Sommerfrische”-destinations might be particularly interesting for short, more spontaneous travels.
- DP: The experts had the opinion that with respect to the marketing of “Sommerfrische”-regions, destinations should focus more on spontaneous offers for weekend and multi-day trips.

Observation 2: There is a strong indication from both the telephonic pre-screening and the focus groups that increasing amount of urban heat days is perceived as a burden and that travelling to nearby mountain regions is an attractive adaptation strategy.

- PSF: This seems to apply mainly for spontaneous short trips which are planned in accordance with weather forecasts (but not necessarily long-term changes in the overall climate).
- DP: "Sommerfrische"-places shall be staged with focus on fresh air, cool surroundings, waterfalls and ravines. For the staging of a new "Sommerfrische", it might therefore be helpful to design a concept which emphasizes freshness and refreshment in the foreground.

Observation 3.1: An increasing need for comfort and at the same time, the desire for simplicity or "switching off from a stressful all-day life" are differentiated developments which can be observed. The conceptual definition of "Sommerfrische" has at least partly lost its historic meaning and may therefore gain new importance and attractiveness for travellers. Different holiday concepts are associated with the term "Sommerfrische", above all, the connection with relaxation and simplicity. Especially for the elderly, the need for relaxation also goes together with the desire for familiarity in terms of acquaintances, places and available activities and a certain sense of home at the holiday destination.

- PSF: This favours a revival of "Sommerfrische" destinations because they are very suitable for providing relaxation, simplicity and an escape from the stressful city life.
- DP: It is important to combine offers for travel motives such as crafts and culinary delights with the exploration of unspoiled places close to or within nature, but without having to forego some comfort in the accommodation. This shall also integrate region-specific products and activities in order to allow for an authentic, natural yet exciting rural experience. The main focus here should be to follow the trend of deceleration and emphasize regions or places where people can actively and consciously recover themselves.

Alternative observation 3.2: As illustrated both in the literature and the focus groups, in addition to the growing need for relaxation, there is also an increasing trend towards active travels. The attractiveness of such places lies in the possibility of exercising versatile leisure activities, for which, however, a certain degree of infrastructure must be present. Individual offers and the opportunity to freely design the short holidays are important criteria for "Sommerfrische" resorts.

- PSF: This aspect can represent an obstacle for small rural tourism destinations, which do not necessarily have the financial and organisational resources to provide staged infrastructure of different types.
- DP: Depending on the respective type of travellers, destinations have two possible strategy options: either they provide pre-defined activity packages that are fully planned (incl. transport etc.) or they provide options for modularly combinable activity packages. For the smaller regions mentioned above, it may be necessary to specialize on few, very specific and authentic tourism products and services.

Observation 4: There are also two opposites in terms of mobility behaviour: on the one hand the growing comfort needs and on the other the general interest in car-free travel options.

- PSF: This point of view can express a development obstacle for those rural areas with no access to more comfortable public transport options (mainly rail) instead of buses. On the other hand, a well-developed mobility concept can also function as a unique selling proposition for a tourism destination.
- DP: Flexible, on-demand mobility options could be a possible approach for rural tourism destinations in order to facilitate the journey towards and within the destination and make it as comfortable as possible. For many travellers easily-accessible information (mainly online) is essential on their journeys.

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6.2 Relevance of results for survey development

The main purpose of these method mix applied within the pre-survey stage was to inform the actual survey development and develop more precise and valid working hypotheses. Below, an overview is listed of the gained insights that affected the overall survey structure and design.

Literature analysis: The literature analysis has provided indications that current travel patterns can lead to potentials especially for short-term travels into "Sommerfrische" destinations. Therefore, the options of day trips and shorter trips will be considered in the questions for tourism behaviour and intentions. Furthermore, a range of potential TPB predictors (role of media, habit, social norm, emotions) were pre-selected based on existing literature for further pre-studies.

Pre-screening: The results of the telephonic screening indicate that no screening-out or filter questions (based on former visits of such regions or not) will be needed for the main survey structure as there were enough people in the pre-screening who had already visited these rural destinations. Hence, we now assume that a sufficiently large interest in these regions exists. Furthermore, the feedback showed that a short explanation is needed for the transition from general tourism questions towards the relationship with heat and climate change, since the context was not immediately apparent to everyone.

Focus groups: The image of "Sommerfrische" differed strongly between experts and citizens. To account for this wide range of understandings, an explorative question on "free associations with this Sommerfrische" will be added to the survey in order to gain a clear understanding of the respondent's conceptualisation. As also depicted in the focus group results, the undertaken activities illustrate the strong diversity in people's understanding of "Sommerfrische". There were two main perspectives; the focus on relaxation vs. the focus on active holidays and sports. For this reason, the survey needs to allow the differentiation between different customer segments, requiring questions on general tourism behaviours, demands and attitudes. Furthermore, the results show that advertising and certain media play an essential role in people's tourism decisions, so this aspect will be integrated as a TPB-predictor into the survey.

Picture analysis: In the case of landscape and mobility images, there were only minor deviations in the answers. One could see that the shown landscapes were all very positively associated with "Sommerfrische". In contrast, the mobility pictures were very negatively connected with the term of "Sommerfrische". Given the lack of internal variation in responses, these two groups of pictures were omitted from the survey.

Besides generating new methodological insights into how the TPB can serve as a valuable theoretical underpinning of projects in social adaptation research, the findings of both the pre-survey stages as well as the survey results will also feed into the future workshops to be conducted with stakeholders in the two Austrian case study regions to ultimately inform their strategic planning decisions.

7 REFERENCES

Aaheim, H.A. & Hauge, K.E., 2005. Impacts of climate change on travel habits: A national assessment based on individual choices.

Ajzen, I., 1991. The theory of planned behaviour. Organisational Behaviour and Human Decision Processes, 50, pp.179–211.

APCC, 2014. Österreichischer Sachstandsbericht Klimawandel 2014 (AAR14), Wien: Verlag der Österreichischen Akademie der Wissenschaften.

Arnberger, A., Brandenburg, C. & Muhar, A., 2002. Monitoring and management of visitor flows in recreational and protected areas. In 1st International Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas. p. 495.

BMWFJ, 2010. Neue Wege im Tourismus: Die neue österreichische Tourismusstrategie. , p.44.

Conner, M. & Armitage, C.J., 1998. Extending the Theory of Planned Behavior: A Review and Avenues for Further Research. Journal of Applied Social Psychology, 28, pp.1429–1464.

Fleischhacker, V. et al., 2015. Klimawandel und Tourismus in Österreich 2030. Auswirkungen, Chancen & Risiken, Optionen und Strategien. Studien-Langfassung BMWFW, ed.,

Grün, S. & Benesch, A., 2005. Der Blick hinaus: Touristische Wege aus der Stadt ins Land. In K. Brunner & P. Schneider, eds. Umwelt Stadt: Geschichte des Natur- und Lebensraumes Wien. Wien: Böhlau Verlag, pp. 544–555.

Haas, H., 1992. Die Sommerfrische - Ort der Bürgerlichkeit. In H. Stekl et al., eds. „Durch Arbeit, Besitz, Wissen und Gerechtigkeit". Bürgertum in der Habsburgermonarchie. Band 2. Wien: Böhlau Verlag Gesellschaft m.b.H. und Co.KG

Held, N., 2013. Entwicklung und Bedeutung des Schweizer Sommertourismus. , pp.8–11.

Koetse, M.J. & Rietveld, P., 2009. The impact of climate change and weather on transport: An overview of empirical findings. Transportation Research Part D: Transport and Environment, 14(3), pp.205–221. Available at: http://dx.doi.org/10.1016/j.trd.2008.12.004.

Kos, W., 1995. Lesen mit Aussicht: Zur Einleitung. In W. Kos & E. Krasny, eds. Schreibtisch mit Aussicht: österreichische Schriftsteller auf Sommerfrische. Wien: Ueberreuter, pp. 7–16.

Kromp-Kolb, P.H., Formayer, H. & Clementschitsch, M.L., 2007. Auswirkungen des Klimawandels auf Wien unter besonderer Berücksichtigung von Klimaszenarien.

Lieb, K. et al., 2010. StartClim2009.F. Anpassung an den Klimawandel - Gletscherrückgang und Permafrostveränderung in hochalpinen Tourismusdestinationen F. und W. (BMWFW) Bundesministerium für Wissenschaft, ed., Graz.

Schmidt-Lauber, B. ed., 2014. Sommer_frische: Bilder. Orte. Praktiken, Wien: Institut für Europäische Ethnologie.

Serquet, G. & Rebetez, M., 2011. Relationship between tourism demand in the Swiss Alps and hot summer air temperatures associated with climate change. Climatic Change, 108(1), pp.291–300.

Sirakaya, E. & Woodside, A.G., 2005. Building and testing theories of decision making by travellers. Tourism Management, 26(6), pp.815–832.

Smith, K., 1993. The influence of weather and climate on recreation and tourism. Weather, 48(12), pp.398–404.

Stadt Wien, 2016. Klimatologische Kenntage in Wien 1954 bis 2016. Available at: https://www.wien.gv.at/statistik/lebensraum/tabellen/eis-hitze-tage-zr.html [Accessed May 2, 2017].

Statistik Austria, 2014. Environmental Conditions and Behaviour. , 18 SRC-. Available at: http://www.statistik.at/web%7B_%7Den/statistics/energy%7B_%7Denvironment/environment/environmental%7B_%7Dconditions%7B_%7Dand%7B_%7Dbehaviour/index.html.

Weigel, A., 2014. Die Sommerfrische im Wandel der Zeiten. In B. Marchart & M. Holzweber, eds. Garser Geschichten: Gars am Kamp, tausende Jahre Kulturlandschaft. Krems-Stein: Druckwerk Krems, pp. 521–588.

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Examining the Applicability of Location Based Services to Determine the Movement Patterns of Commuters between Sandton and Park Station in Johannesburg City

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1 ABSTRACT

The movement of people within cities forms patterns and changes the development of transport systems as well as innovations within the Information and Communication Technologies (ICT) sector. The City of Johannesburg has been witnessing massive transformations in urban public transport systems in the past decade and very little is currently known about the movement patterns of commuters between major centres of the city. Investigating and illuminating novel insights on the movement patterns of commuters is very imperative and essential given the multiplicity of modes and centres in increasing decentralized cities such as the Johannesburg Metropolitan City. This work therefore examine the applicability of location based services to determine the movement patterns of Gautrain and Rea Vaya commuters between Sandton and Park station centres, using a case study research design and mixed methods approaches consisting of qualitative, quantitative and spatial data. This research presents novel data analysed into empirical results suggesting that location based services plays a pivotal influence in determining movement of urban public transport commuters in Johannesburg city. The findings also reveal the complexity of spatial and communicative platforms in multiplicity of urban public modes resulting in complex models of movement patterns. These empirical results require further research on the applicability of location based services in determining movement patterns of commuters, with the aim of corroborating the prospects of agglomerating an urban mobility model at a city wide scale.

Keywords: micro city centres, movement patterns, Johannesburg metropoitan city, urban public transport, South Africa

2 INTRODUCTION

Urban public transport is one of the most important factors for the functionality of any city. It is a socio-economic need pivotal for humans’ every day sustenance. Furthermore, urban public transport systems have evolved over the years from being just mere transportation to vehicles that improve people’s lives through Transit Oriented Development (TOD). Moreover, the focus on providing sustainable transport is at the fore front of development currently consisting of multiplicity of modes that ensure integration. Beyond the provision of urban public transport as a socio-economic necessity lies the interest to investigate urban public transport commuter mobility patterns. It is identified that human mobility patterns in urban public transport have been researched, focusing on but not limited to health aspects, human needs and geo-simulation of urban mobility. Some studies include past and present travel patterns in cities while others focus on transportation analyses in general (Zia et al., 2013; Fang et al., 2012; Gao et al., 2013; Li et al., 2011).

Movement of people within a city changes with time as a result of developing transportation systems in addition to innovations within the Information and Communication Technologies (ICT) sector (Mitchell and Casalegno, 2005). Cities across the world have come of age and are moving towards the smart city concept inclusive of the smart mobility component. According to Siemens (2015), smart mobility “is a paradigm shift to a more flexible and multi-modal transport system that allows seamless, efficient and flexible travel across various modes”, as a way of addressing transportation challenges such as traffic congestion, green-house emissions, longer commuting and many more. Although some countries have championed this concept through innovative Intelligent Transport Systems (ITS), in others it is still a new concept that needs to be adopted as a way of redressing urban public transport challenges, particularly connectivity among different micro city centres (Cardinale et al., 2014; Chen et al., 2014; City of Johannesburg, 2009; Deloitte, 2014; Dreskovic & Nurkovic, 2014; Ferris et al., 2010; Franz et al., 2014).

While identifying key issues to address in this endeavour, it is important to understand movement patterns of commuters between different micro city centres (Allbach et al., 2014; Ambrosino et al., 2014; Amegui, 2014; Bajracharya et al., 2014; Bululukova et al., 2014). Decentralized major cities brewing locations with

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high level concentration of economic activities and complex spatial structures supported by urban public transport systems are becoming more complex as more micro city centres emerge (Seimens, 2015). Therefore there is need to understand how commuters move between these micro city centres. Getting to know how spaces are connected between micro city centres can inform planning and provision of adequate and responsive public transport systems.

Generally, movement in the Johannesburg Metropolitan City has been an overarching issue for many years, owing its faults to the historic spatial fragmentation and rapid urban population growth (City of Johannesburg, 2013). Over the years, studies have focused more on how urban planning has sought to redress the implications of spatial structure in some instances lacking to fully understanding the needs of commuters. Consequently, efforts by government (local, provincial, national) in the city have not fully aided the situation. They have rather battled to make urban public transport systems accessible, affordable and safer for commuters. Although the main concern has been central to integration of urban public transport systems in the city, there is vast need in focusing on movement patterns of commuters using urban public transport as a mission for improvement (Wilkinson, 2009; Williams, 2011).

Urban public transportation is at the heart of the Johannesburg Metropolitan City's development agenda. The city has been making efforts to create Transit Oriented Development (TOD) and urban renewal as a way of building 'corridors of freedom' (Gauteng Department of Roads and Transport, 2013; Steer, 2012; Transportation Research Board, 2009). There have been massive innovative urban public transport systems developments in the City of Johannesburg since 2010 that among others include the Gautrain and Rea Vaya bus services as a way of improving the already existing Metrobus, Taxis and Metro rail services (The Gautrain Management Agency, 2013; City of Johannesburg, 2013; Gauteng Department of Roads and Transport, 2013).

Of late, Sandton and Park station have been receiving massive flow of movement; this is evident through the daily amounts of traffic between the two centres often causing traffic congestions. Moreover, there has also been an introduction of other modes and how they move people between these two centres has become a focus (Rudd, 2007-11; City of Johannesburg, 2013). Recently, the city has been making concerted efforts to improve the movements of commuters between Sandton and Park station by the use of Location Based Services (LBS). However, little has been known about the movement patterns of commuters between these two centres. In the midst of multiplicity of modes, this study seeks to examine the applicability of Location Based Services (LBS) to determine the movement patterns of commuters between Sandton and Park station. Furthermore, this research seeks to make inquiries on the efficacy of connectivity between multiple micro city centres. Beyond micro city centres, there is need to research bigger areas of interest such as the Johannesburg metropolitan city as a whole.

2.1 Study Area

City of Johannesburg is a well-established economic hub and the fastest growing city in terms of the economy, development and population in South Africa. It is located in the Gauteng Province and has a population of 4 434 827 people as of 2011 census (City of Johannesburg, 2013; Gauteng Department of Roads and Transport, 2013). This metropolitan city is divided into 7 regions that is Region A, B, C, D, E, F and G. Besides it being the over populated economic hub of South Africa, City of Johannesburg as well as its neighbouring metropolitan cities share the most innovative transportation mode (Gautrain) in South Africa linking these three functional cities into one economic region, consequently movement patterns and accessibility becomes a central issue in the City of Johannesburg perpetuated by demand (see Figure 1). However, for the purpose of this study the focus is on Regions E and F comparing Sandton and Park station centres depicted above in Figure 1.

The Gautrain and Rea Vaya are located in the Johannesburg Metropolitan City of Gauteng province, South Africa (Figure 1). The Gautrain alone operates in three metropolitan cities in Gauteng province namely City of Johannesburg, City of Pretoria and East Rand (Ekurhuleni metropolitan municipality). These three areas form a city region which is the economic heartland of South Africa and are the only cities in South Africa having a rapid transit train. The Rea Vaya only operate under the jurisdiction of the Johannesburg Metropolitan City across many communities and micro city centres. These two modes started operating during 2010 when the FIFA World Cup was hosted in South Africa. They also operate along mixed land used as well as major economic, institutional and social nodes such as the FNB stadium, Ellis park stadium, Wits University, University of Johannesburg, FNB bank city, Nedbank bank city, Carlton centre, Rosebank mall, Sandton convention centre.

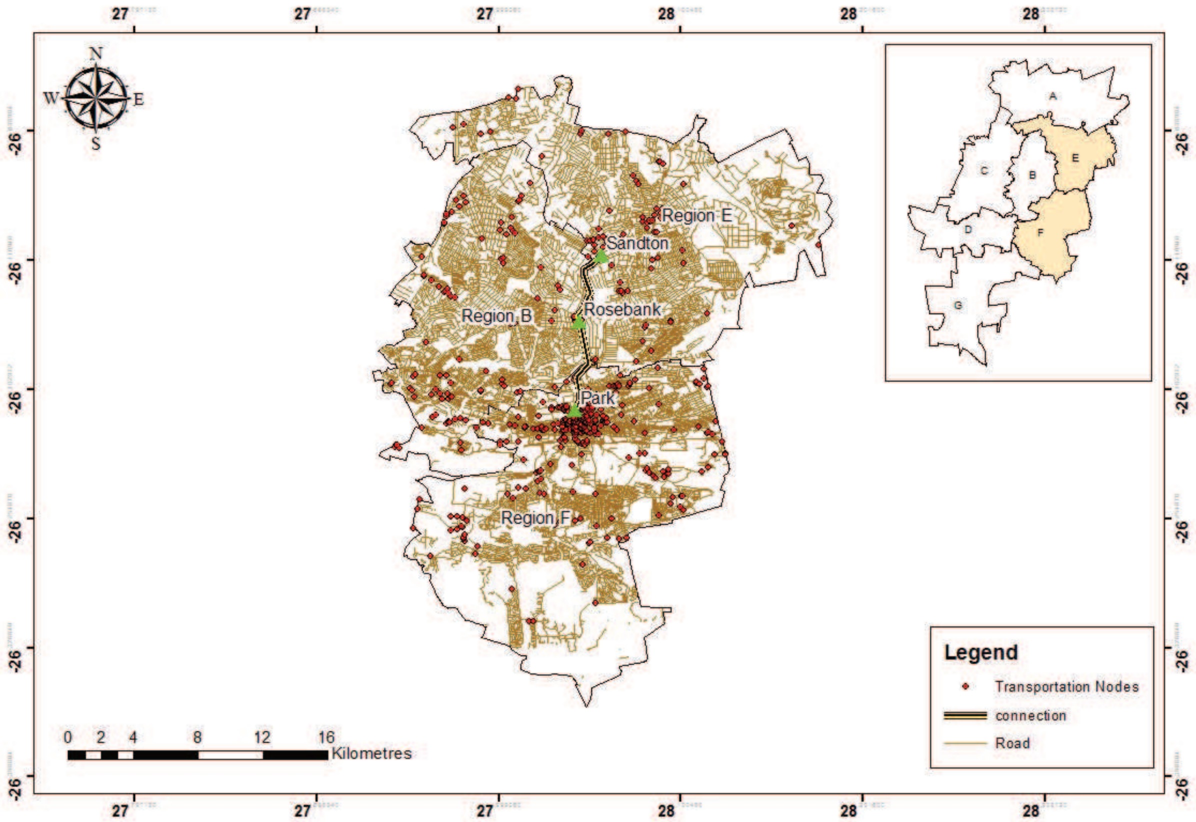

Fig 1: Region E and F, City of Johannesburg, South Africa (Source: Researcher)

City of Johannesburg caters for both motorized and non-motorized urban public transport. These are Metrobus, Metrorail, Rea Vaya bus, Gautrain, Putco, Tuk-Tuk, Uber, Maxi taxis, Minibus taxis and dedicated bicycles lanes for private bicycle cyclists. Urban public transport in the City of Johannesburg is used by the youth to commute to school, to get to service centres and recreational areas; adults to commute to work and recreational areas and by old aged citizens to commute for leisure and to get to basic services. However, for the purpose of this study these two modes of public transport are examined on their commuter movement patterns in Region E and F of Johannesburg particularly regulating focus between Sandton and Park micro city centres.

Park station micro city centre is a major public transport interchange were passengers from all over Africa, South Africa and Johannesburg transfer from trains and buses, buses to minibus taxis and more (SITPF, 2013). Park station situated in Braamfontein bordered by Rissik, Wolmarans, Wanderers and Noord streets is the largest public transport station in Africa. Sandton micro city centre is Johannesburg Central Financial and Business District and it is also regarded as the ‘richest square mile in Africa’ (SITPF, 2013). Over the years, financial focus shifted from the Johannesburg CBD to Sandton City due to over population and urban decay in Johannesburg downtown. However, this has caused vast movements of people moving in and out of Sandton therefore creating traffic congestion. As a result, traffic volumes have increased between Park station and Sandton City and has caused a continuous overarching traffic congestion problem.

2.2 Study methods

This exploratory study adopted a case study survey research design. A mixed-methods research approach was applied where quantitative, qualitative and spatial data was collected and analysed. The study examined the applicability of geo-location based services in determining the movement patterns of commuters particularly with the intention to compare Sandton and Park station centres. Questionnaires were administered with Gautrain, Rea Vaya, Metrobus and Taxis commuters. Key informant interviews were also conducted with key informant personnel from Gautrain Management Agency (GMA), Johannesburg Roads Agency (JRA) and Gauteng Department of Roads and Transport to give information on movement patterns of commuters in the Johannesburg Metropolitan City. Data from Echo-Echo software was used to gather social media comments on the urban public transport modes and locations co-ordinates of where the comments were made. The data in this study was analysed statistically, thematically, semantically, spatially and through time series. The study period is from January to June 2016. The quantitative, qualitative and spatial analysis was triangulated to yield viable results.

3 MODES AND HOW THEY ARE CONNECTED/MOVEMENT PATTERNS OF COMMUTERS

Over the years, urban public transport companies have become more innovative. The internet of things has made it better for urban public transport users to communicate with their service providers. The use of social media has strengthened involvement and communication in society about current affairs, business, politics, brand awareness and most importantly the role of organisations in people's lives. The mosaic of communication threads has allowed different stakeholders in urban public transport such as the Gautrain, Rea Vaya and Metrobus to thrive as smart urban public transport options that are reliable, efficient and safe for commuters in the Johannesburg Metropolitan city. Social media platforms such as Twitter and Facebook have also allowed urban public transport commuters to directly confront challenges faced with urban public transport service providers in real time hence changing their perceptions towards urban public transport and allowing the amount of urban public transport users to grow and thrive.

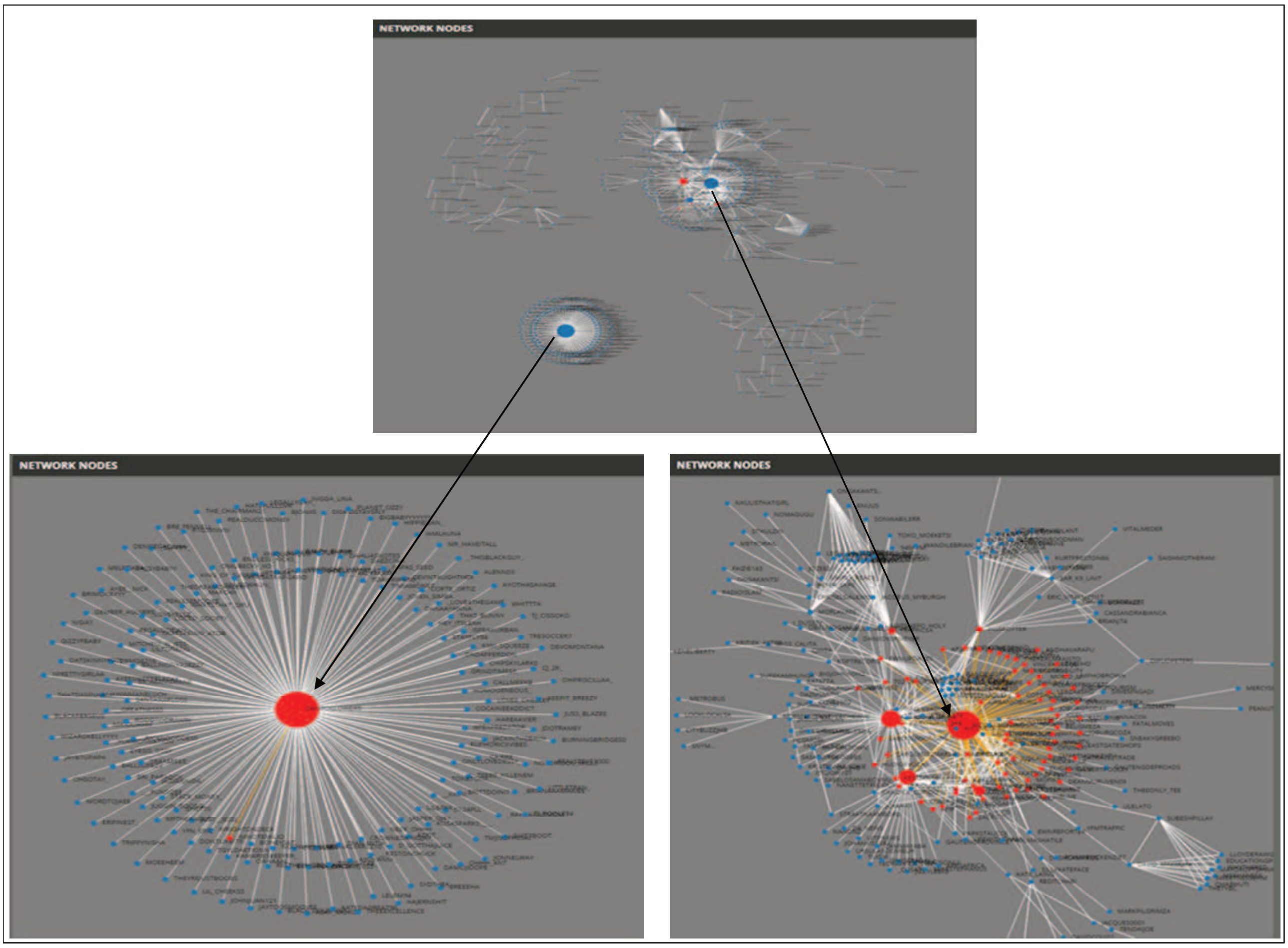

Fig 2: Network Nodes 2016 (Source: Echo-Echo, 2016)

Figure 3 below is a location map of the City of Johannesburg with an indication of the number of tweets and Facebook posts which have been made by commuters using the Gautrain and Rea Vaya bus. The different coloured circles represent different number of tweets and Facebook posts and they are as follows:

- Blue icon = 1 tweet or Facebook post.
- Blue = less than 10 tweets and Facebook posts.
- Yellow = less than 100 tweets and Facebook posts.

- Red = less than 1000 tweets and Facebook posts.
- Pink = less than 10 000 tweets and Facebook posts.
- Purple = less than 100 000 tweets and Facebook posts.

From Figure 3 below, it can be deduced that there is a lot of social media activity taking place in the Gauteng province, specifically between the Johannesburg and Pretoria region. The map indicates that in Johannesburg there is an accumulated 14 104 tweets and Facebook posts which have been made on the basis of trending topics centred on the Gautrain and Rea Vaya. This could be a result of the integration of public transport in the Central Business District (CBD).

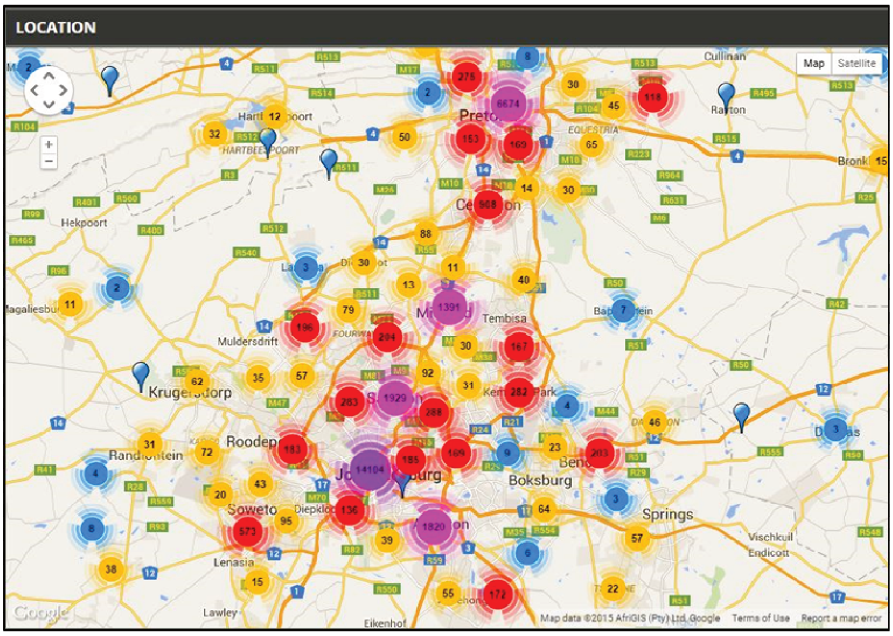

Fig 3: City of Johannesburg Twitter and Facebook posts (Source: Echo-Echo, 2016)

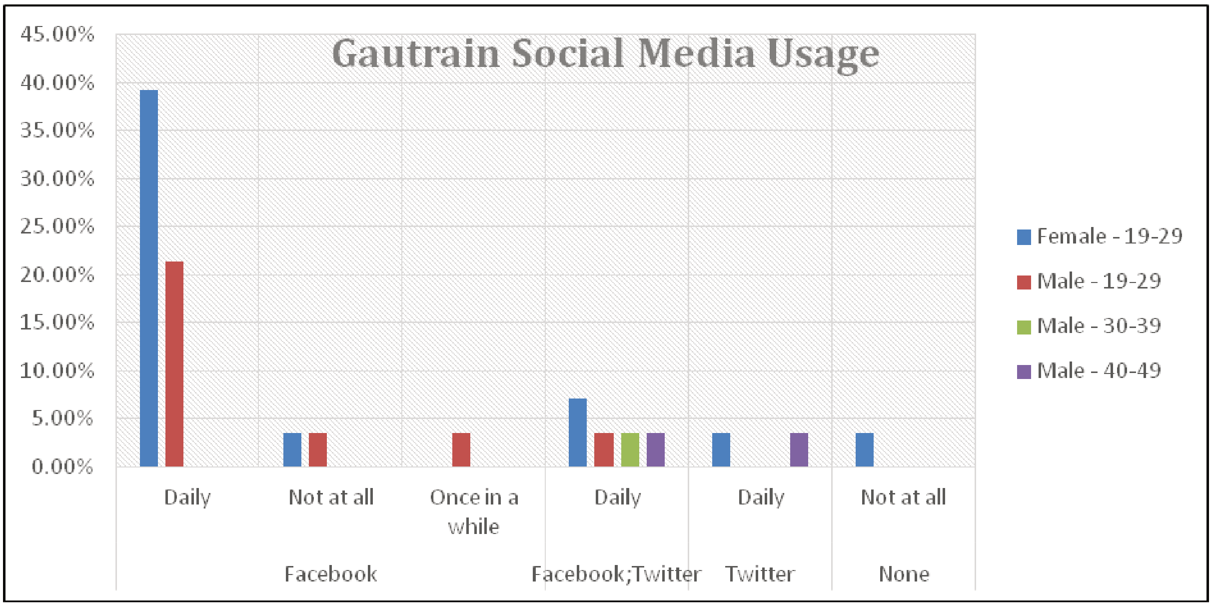

Fig 4: Gautrain Social Media Usage graph (Source: Own Source)

Therefore, more of the tweets regarding the topics on the Gautrain and Rea Vaya are from their commuters and some from residents. Alberton (1820), Sandton (1929), and Midrand (1391) also had the highest tweets and Facebook posts suggesting that commuters, businesses and residents in and around the Gautrain and Rea Vaya stations have been posting topics about marketing, complaints and compliments. These posts also show huge numbers made in locations were Gautrain does operate such as Soweto, suggesting that there are potential clients and need for expansion and integration with Rea Vaya that is currently operating in that area. In addition to feasibility studies and origin and destination surveys, location based services can be

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effectively used to track movement patterns of commuters of urban public transport systems for the effective use of urban public transport provision. Figure 4 below shows social media usage of Gautrain commuters who took part in the study. The graph shows that there were 60.72% commuters who used Facebook daily of which 39.29% were females between the ages of 19-29 years and 21.43% were males between the ages of 19-29.

3.57% of females between the ages of 19-29 years and 3.57% of males between the ages of 40-49 years used twitter daily. 7.14% of females between the ages of 19-29 years used both Facebook and Twitter Daily as compared to 3.57% males between the ages of 19-29 years, 30-39 years and 40-49 years who used both Facebook and Twitter daily. The total number of Gautrain social media users who took part in the study were 89.28%.

Figure 5 below also show social media usage of Rea Vaya commuters who took part in the study. The graph shows that there was a total of 100% Rea Vaya commuters who used social media. A total of 57.69% females and 42.31% were males used Facebook and twitter. 11.54% females between the ages of 19-29 years used Facebook daily and 7.69% females between the ages of 30-39 years used Facebook once in a while. 19.23% females between the ages of 30-39 years; 7.69% females between the ages of 19-29 and 7.69% females between the ages of 18 and less used both Facebook and Twitter daily. 3.85% females between the ages of 40-49 years used both Facebook and Twitter once in a while. 7.69% males between the ages of 19-29 years aswell as 3.85% males between the ages of 30-39 years used both Facebook and Twitter daily.3.85% males between the ages of 19-29 years used both Facebook and Twitter once in a while. 3.85% males between the ages of 30-39 years used twitter once in a while. 11.54% males between the ages of 30-39 years; 3.85% males between the ages of 40-49 years; 3.85% males between the ages of 50-59 years aswell as 3.85% males between the ages of 60 years and more used both Facebook once in a while.3.85% males between the ages of 19-29 years used both Facebook and Twitter once in a while.

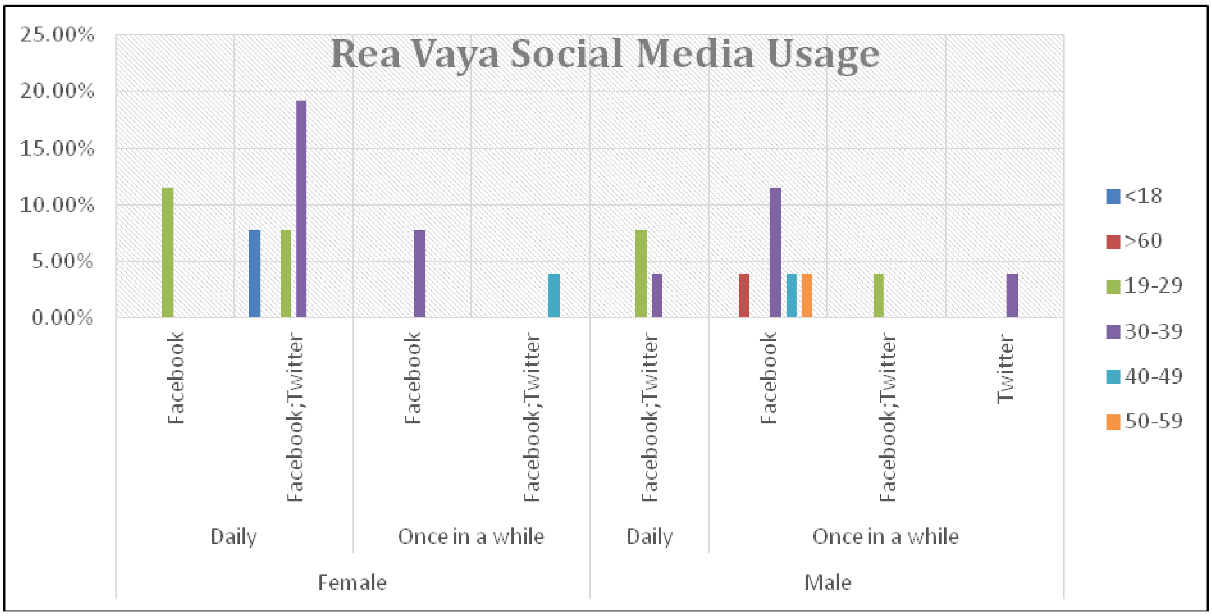

Fig 5: Rea Vaya Social Media Usage graph (Source: Own Source)

These statistics reaveal that most of Gautrain commuters use social media as compared to Rea Vaya commuters and have contributed vastly to the posts obtained from the Echo-Echo software aswell as Co-ordinates. The co-ordinates were converted into shape files that were in turn used to create the focal statistics and krigging maps. These maps show hot and cold spots and help to track movement patterns of commuters using urban public transport and from the survey questions about origin and desination were included to validate locations and create a map with possible routes eminating from different locations to Sandton, Park station and nodes in between.

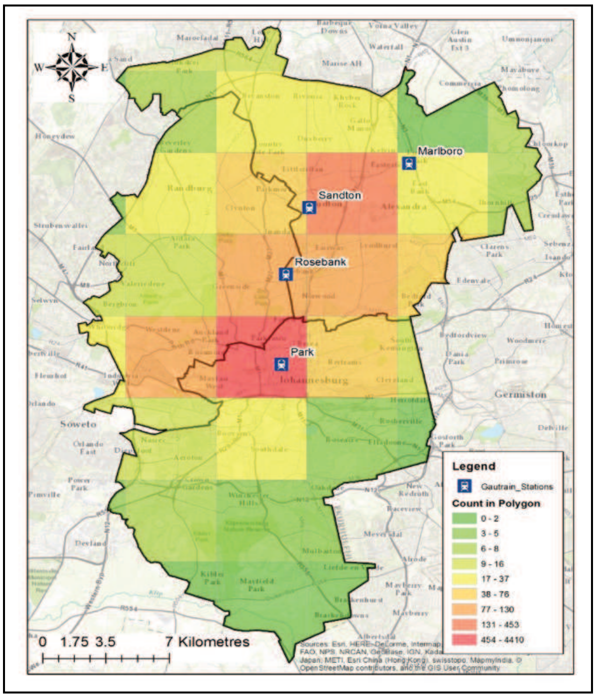

Figure 4: Gautrain Count in polygon for wards (Source: Own source)

Figure 4 above shows hot spots extending from Eastern Johannesburg towards Park station and from Park station through Rosebank and into Sandton. These hot spots are a result of the high frequency of posts made on the Gautrain stations namely Park station, Rosebank station and Sandton station. Furthermore, there are hot spots on the Eastern and Western parts of Park station, Rosebank and Sandton indicating high concentration of posts possibly by commuters of the Gautrain. This is an indication that people move from the East and West parts of Park station, Rosebank and Sandton station to commute on Gautrain for different purposes hence the need for Gautrain expansion to these areas is important. Although the wards vividly represent the hot and cold spots, they visually do not represent real world settings as the shape of the ward is challenging to match in density per square Kilometre.

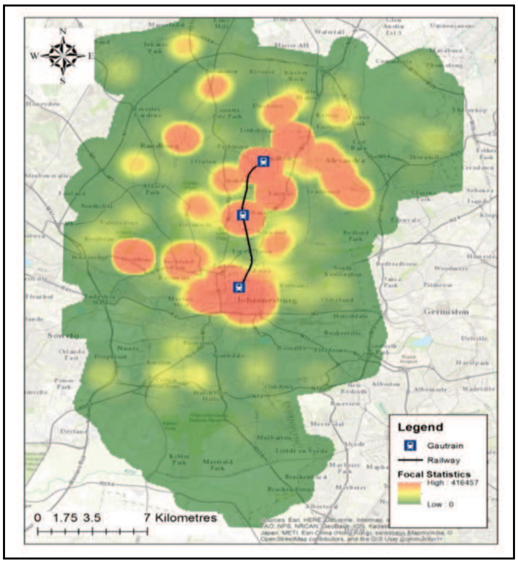

Fig 5: Gautrain focal statistics 6 months (Source: Own source)

However, this challenge is corrected by overlaying a fishnet that analyses the wards in the Johannesburg metropolitan city per 500 metres squared. Figure 5 above shows the time series analysis over 6 months from January to June 2016 respectively. Hot spots are identified mainly in Johannesburg, Rosebank and Sandton. However, there are also hot spots identified in areas not serviced by Gautrain such as Randburg, Westdene, Auckland Park, Mayfair west, Norwood, Fairway, Bryanston and Greenside. The identified hot spots are areas of interest showing high concentrations of commuters even though Gautrain does not provide service

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for some of these locations, therefore suggesting that people move from these locations to Park station, Rosebank station and Sandton station.

Figure 6 below shows hot spots scattered from North West of Sandton, South East and central Johannesburg towards Park station. These hot spots do not cover a wider area, this may be caused by the minimal frequency of posts made on the Rea Vaya bus stations namely Park station, Rosebank station and Sandton station. Furthermore, there are hot spots on the Eastern parts of Park station indicating high concentration of posts made by commuters of the Rea Vaya. The Western parts of Sandton such as Alexandra township hot spots, this reveals the great need for Phase 1C of the Rea Vaya to start operating so that locals can use it to travel from Sandton to Park. There is an indication that people from the East and West of Sandton city are in need of Rea Vaya to commute to various places of interest hence the need for Rea Vaya expansion to the Jukskei Park and Bryanston areas is important. Figure 6 further shows cold spots in most of Johannesburg city, the low concentrations reveals less activity on Rea Vaya in most areas in Johannesburg, although there are Phases of expansion to be developed and completed in the future, the current need for Rea Vaya is prominent.

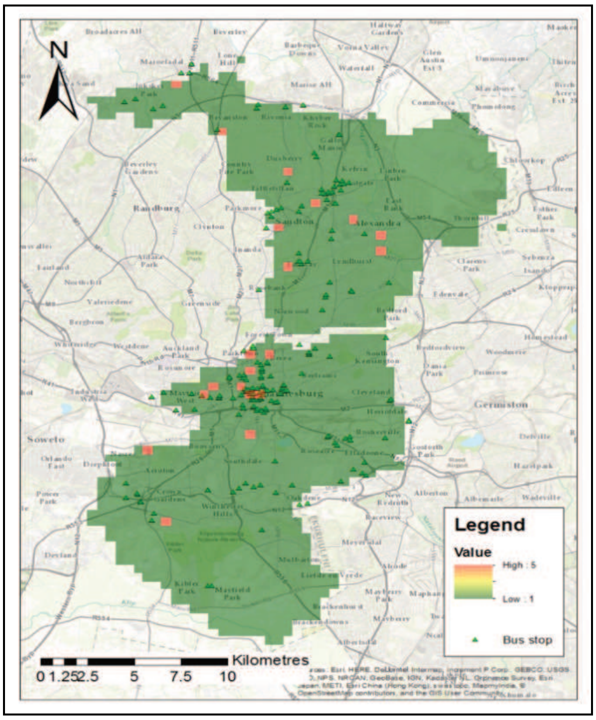


Fig 6: Rea Vaya focal statistics 6 months (Source: Own source)

Figure 6 shows the time series analysis over 6 months from January to June 2016 respectively. The most prominent hot spots are identified mainly in Johannesburg, Nasrec, Jukskei Park, Dusberry, Mayfair West, Berea, Southdale area, Littlefillan, Sandton, Alexandra, Lyndhurst, Crown Gardens, Bryanston, Parktown, Fairway. The identified hot spots are areas of interest showing high concentrations of commuters even though Rea Vaya does not provide services for some these locations, therefore suggesting that people move from their locations using other modes of transport to get to Rea Vaya to travel only in the Johannesurg CBD and areas such as Soweto, Auckland Park, Park town, Cresta and areas in between them. Although there is a Rea Vaya route nearly reaching its final stage of construction linking Park station and Sandton through Louis Botha Avenue, it is not yet operatinal.

Figure 7 shows hot spots concentrated in the Johannesburg inner city as well as some parts of the Eastern, Western and Southern Johannesburg area. However, there are cold spots of low concentrations as the hot spots stretch outwards towards far North and South of Johannesburg. The time series analysis from January to June 2016 shows an uneven but consistent distribution were cold spots are mainly in the Sandton region while hot spots are concentrated in the East, West and central Johannesburg (see Figure 7). The East, West and central Sandton had even distribution of cold spots from January to June 2016. More hot spots are in Park station, Johannesburg CBD, Johannesburg East, West and South as compared to more cold spots in Sandton area from January to June 2016 (see Figure 7).

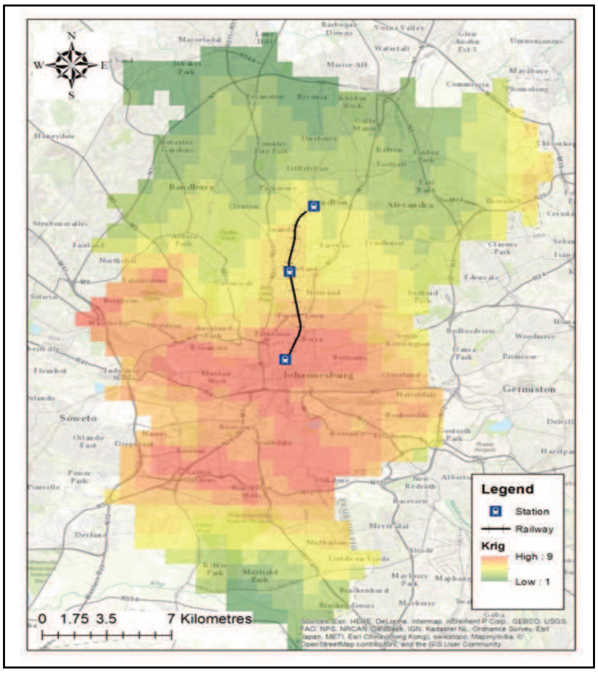


Fig 7: Gautrain Krig 6 month (Source: Own source)

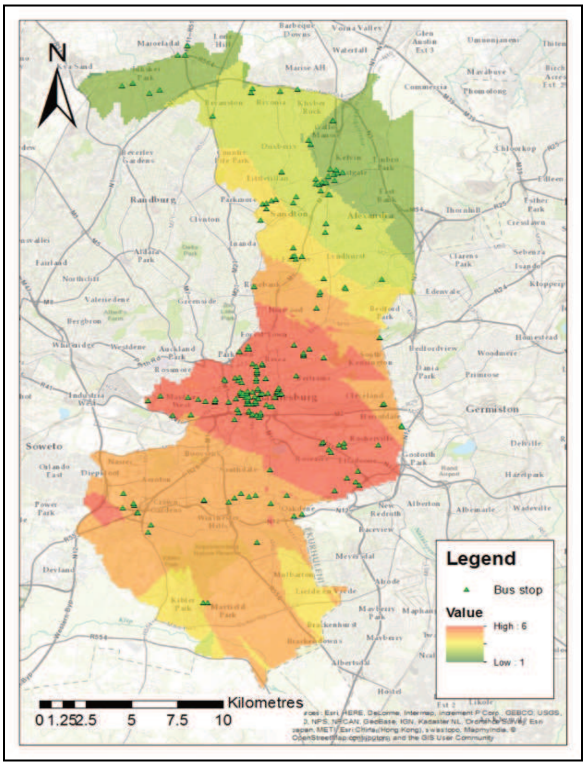


Fig 8: Rea Vaya Krig 6 months (Source: Own source)

Figure 8 above shows uneven depictions of cold and hot spots on geo-statistical analysis conducted on the Rea Vaya. This is due to the small amount of tweets and Fascebook posts obtained from the Echo-Echo software made on the Rea Vaya. The map show analysis based on geo-locational coordinates of posts made from January to June 2016 respectively. Hot spots are visible only in the inner city and Eastern parts of Johannesburg; cold spots were more prominent in the Sandton area. Hot spots were more noticeble in Park station, Parktown, Booysens, Mayfair west, Auckland park, Greenside and Rossmore. Most of the cold spots were in Randburg, Alexandra, Rosebank, Sandton area, and areas in the North of Sandton. this may be due to

Fig 9: Origin and destination Gautrain commuters (Source: Own source)

Origin	Percentage
Johannesburg CBD	8%
Alberton	8%
Doornfontein	15%
Braamfontein	8%
Germiston	15%
Yeoville	8%
Westdene	8%
Pretoria Silverton	7%
Thembisa	8%
Danville	7%
Randburg	8%

Table 1: Origin of Gautrain commuters (Source: Own source)

Fig 10: Origin and destination Rea Vaya commuters (Source: Own source)

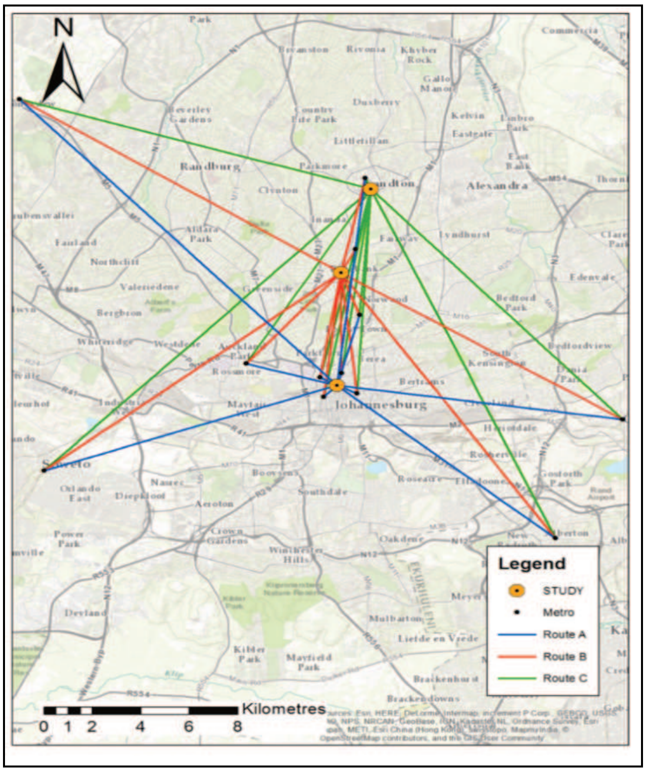
Origin	Percentage
Windsor East	7%
Johannesburg CBD	4%
Soweto	13%
Doornfontein	7%
Alberton	3%
Germiston	3%
Rosebank	7%
Auckland park	7%
Hillbrow	8%
Apel	3%
Hyde Park	3%
Sunninghill	3%
Brixton	3%
Norwood	4%
Melville	3%
Kew	3%
Harare	3%
Westdene	3%
Zimbabwe	3%
Joe Slovo	3%

Table 2: Origin of Rea Vaya commuters (Source: Own source)

Table 1 shows the origin of Gautrain commuters who took part in the study. Their destinations were mainly Park, Rosebank and Sandton stations in order to know where they are going when travelling between

Sandton and Park station. The percentages in table 1 were then used to digitize the map (see figure 11) that shows 3 possible routes originating from points of origins of Gautrain commuters forming catchment areas for possible expansions and developments. Table 2 shows the origin of Rea vaya commuters who took part in the study, their destinations varied. A major issue was that Rea Vaya has not started operating between Park station and Sandton through a direct link, however posts about Rea Vaya have been made in areas not serviced by Rea Vaya hence this shows that people move from these areas use Rea Vaya when travelling in the Johanneburg CBD, Soweto area, Doornfontein, Hillbrow, Auckland Park, Parktown, Cresta areas and there is need for expansion of Rea Vaya to these catchment areas in Table 2 (see figure 11).

Figure 11 and figure 12 is a representation of possible origin and destination areas of Gautrain and Rea Vaya commuters who took part in the study. From the map we can deduce that from each location, a commuter has two or three possible routes that they can take when travelling between Sandton and Park station. These routes may be direct links from their origin to their destinations on may be interconnected through other stations as possible routes to reach the destinations of choice conviniently. These two modes of urban public transport constantly need to track their commuter movement due to change in origin and destinations over time hence the idea of location based services is applicable in tracking commuter movement patterns through geo-locational patterns that show hot and cold spots. The idea is for the service provider to reach out to commuters wether in the form of expanding services or contracting emergency and temporary urban public transport in times when needed most such as traffic jams aswell as tracking social media feeds using location based services analysis software such as Echo-Echo to manage their social media platforms effectively which inturn renders real time and effective service to many of its commuters and the public at large.



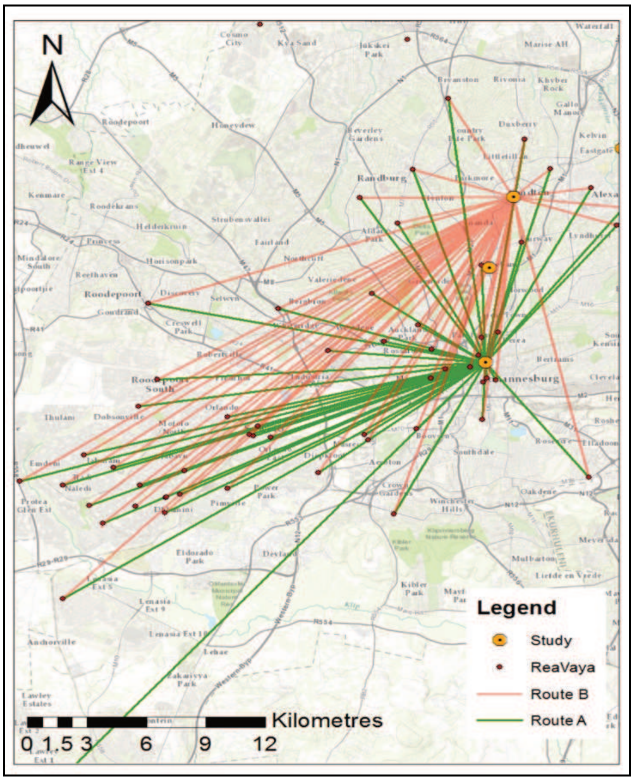


Fig 11: Gautrain Movement of commuters (Source: Own source). Fig 12: Rea Vaya Movement of commuters (Source: Own source)

4 CONCLUSION

Access to the world is at our finger tips. Development is at our disposal, through innovative gadgets such as cellphones, laptops and tablets, anywere in the world anyone can communicate, share information and make the world a better place. Transport development has improved over the years to more sustainable and intelligent systems. To achieve sustainable transport systems, there is need to continously improve transportation and transport systems, hence finding convinient and efficient means of acquiring information through big data has become pivotal in improving transportation, transport systems and other areas of development in general. This study has presented how location based data obtained from social media platforms such as facebook and twitter can be used to model the points of origin as well as movement

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patterns of Gautrain and Rea vaya commuters in the Johannesburg Metropolitan city particurly between Sandton and Park station. Moreover, this study has revealed that beyond the study area, a lot needs still needs to be done in developing urban public transport especially in the outskirts of Johannesburg inner city and Sandton CBD.

Hot spots are identified mainly in Johannesburg, Rosebank and Sandton area. However, there are also hot spots identified in areas not serviced by Gautrain such as Randburg, Westdene, Auckland Park, Mayfair west, Norwood, Fairway, Bryanston and Greenside. The identified hot spots are areas of interest showing high concentrations of commuters even though Gautrain does not provide service for these locations, therefore suggesting that people move from these locations to Park station, Rosebank station and Sandton station. Furthermore, hot spots are identified in some parts of Johannesburg CBD, Mayfair West, Parktown, Alexandra, Sandton, Fairway, lastly between Dusberry and Littlefillan. However, there are also hot spots identified in areas not serviced by Rea Vaya such as Dusberry, Sandton, Jukskei Park, Littlefillan, Alexandra, Fairway, Bryanston and Lyndhurst. The identified hot spots are areas of interest showing high concentrations of commuters even though Rea Vaya does not provide services for some these locations, therefore suggesting that people move from their locations using Rea Vaya to travel betweem Park station and Sandton. There are many areas that are marginalized from Gautrain and Rea vaya bus development in the Johannesburg Metropolitan city, reasons may be that there is no market for these services to sustain operational costs. On the contrary the model shows hot spots for locations that need services from Gautrain and Rea vaya and are currently not serviced. As a result, Location Based Data (LBS) is applicable in determining movement of commuters and may assists interested professionals and stakeholders when making informed decision in development.

The data used in this study was conducted for a time period of 6 months from January 2016 to June 2016. Moreover, there is need to increase the time period for further studies especially for all Regions of the City of Johannesburg to increase accuracy and validity of results and to track variations between time periods in different locations. Although the model has proved that LBS are applicable in determining the movement patterns of Gautrain and Rea vaya commuters between Sandton and Park station, it has also revealed that LBS provided is highly dependent on geo-locational coordinates which needed to be accurate. In this study, gaps were identified from the data collected from LBS. The LBS data had some unidentified variables that caused errors when processed, as a result the data needed to be cleaned and only data that had geo-location co-ordinates was used to create the maps. In addition, the posts from social media posts are not stating wether people who post are actual Gautrain and Rea Vaya commuters or are possible commuters. In summation, this study discussed and examined the applicability of location based services in determining movement patterns of commuters in Johannesburg Metropolitan city.

5 REFERENCES

Allbach, B., Henninger, S. and Deitche, E: An Urban Sensing System as Backbone of Smart Cities. In: Journal of Real Corp, pp 55-64, Vienna, 2014.

Ambrosino, G., Guerra, S., Pettinelli, I. & Sousa, C: The role of Logistics in Smart Cities: the experience of ENCLOSE project. In: Journal of Real Corp, pp 1029-1034, Vienna, 2014.

Amegui, A.G: Digging into the smartness: A short Techno-political (Pre) History of Vienna‘s Urban Lakeside. In: Journal of Real Corp, pp 845-849, Vienna, 2014.

Bajracharya, B., Cattell, D. and Khanjanasthiti, I: Challenges and opportunities to develop a Smart City: A case study of Gold Coast, Australia. In: Journal of Real Corp, pp 119-129, Vienna, 2014.

Bululukova, D., Wahl, H. and Ballner, M: European Academic Smart Cities Network Renewable Urban Energy Systems, Sustainable mobility and ICT Technology Nexus for Smart Cities studies. In: Journal of Real Corp, pp 207-215, Vienna, 2014.

Cardinale, T., Paula, L. & Zucchi, G: The city of Matera and the Sass: Smart places with a Dantean Attraction. In: Journal of Real Corp, pp 665-674, Vienna, 2014.

Chen, C., Bian, L., Ma, J: From traces to trajectories: How well can we guess activity locations from mobile phone traces?. In: Transport Research Part C: Emer. 46, 326-337, 2014.

City of Johannesburg: GDS 2040 Outreach Programme, 2009.

City of Johannesburg: Integrated Development Plan 2013/16. In: www.joburg.org.za, 2013.

City of Johannesburg: Strategic Integrated Transport Plan Framework. In: www.joburg.org.za, 2013.

Dachs, W: Gautrain: A case study. In: www.gautrain.co.za, 2011.

Deloitte: Africa is ready to leapfrog the competition through Smart Cities Technology. In: www.deloitte.com, 2014.

Dreskovic, N. and Nurkovic, R: Influence of Transport on Urban and Rural development in Bosnia and Herzegovina. In: Journal of Real Corp, pp 287-293, Vienna, 2014.

Fang, Z., Shaw, S.L., Tu, W., Li, Q., and Li, Y: Spatiotemporal analysis of critical transportation links based on time geographic concepts: a case study of critical bridges in Wuhan, China. In: Journal of Transport Geography. 23, 44-59, 2012.

Franz, S., Reutter, U., Haslauer, E., Schnurch, D. and Prinz, T: Assessing smart Locations – The MORECO project. In: Journal of Real Corp, pp 83-90, Vienna, 2014.
Gao, S., Wang, Y., Gao, Y., and Liu, Y: Understanding urban traffic flow characteristics: a rethinking of betweenness centrality. In: Environ. Plan. B: Plan. Des 40, 135-153, 2013.
Gauteng Department of Roads and Transport: Gauteng 25 year Integrated Transport Master Plan. In: www.gautengonline.gov.za, 2013.
Li, Q., Zhang, T., Wang, H., and Zeng, Z: Dynamic accessibility mapping using floating car data: a network constrained density estimation approach. In: Journal of Transport Geography. 19, 379-393, 2011.
Musakwa, W: The use of Social Media in Public Transit Systems: The Case of the Gautrain, Gauteng Province, South Africa: Analysis and Lessons Learnt. In: Journal of Real Corp, pp 721-727, Vienna, 2014.
Rudd, M: A New era for South Africa rail transport. In: www.Gautrain.co.za, 2011.
The Gautrain Management Agency: Socio-Economic Development Progress. In: www.gautrain.co.za, 2013.
Wilkinson, P. C: Transit Oriented Development: A strategic Instrument for Spatial Restructuring and Public Transport System Enhancement in South African Cities?. In: School of Architecture, Planning and Geomatics, University of Cape Town, 2009.
Williams, D: Gautrain: a case study. In: www.alive2green.com, 2011.

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reviewed paper

From Migration to Urban Sprawl in Flanders (Belgium)

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1 ABSTRACT

Belgium, and especially Flanders, is recently developping new policy plans for the future spatial development. Within this context a discussion is going on about the strategies to deal with the ungoing urban sprawl.

In this paper we will first focus on migration figures, and draw up a map with current migration patterns in Belgium. This map faces the residential pressure level of the municipalities and the regional housing market areas. This housing pressure is the result of depositing the growth in households relative to the available building possibilities.

Secondly we will analyse the forecasted population growth in Flanders. Immigration to Belgium comes mainly from the rest of Europe, primarily from the group of 20-50 year olds. From 2040 on growth will only be due to external immigration. This external immigration arrives on the one hand basically in the larger cities. The internal migration, on the other hand, shows a pattern away from these larger cities. Especially the cities outlying edges and the rural areas have a growth at the expense of city centers. Accordingly the current population is changing. Within Belgium and Flanders, as in most other Western European countries, we are confronted with the ageing of the population and with a limited growth of the number of households mainly because of smaller households.

Finally we confront the migration patterns, the population forecasts and the disponsibility of building plots. The large surplus of building opportunities, especially in rural areas, drives along the suburbanization. This urban sprawl in turn leads to the known dispersed settlement pattern in Flanders, the northern part of Belgium.

In this context and in relation to European trends, we examine how the government can steer upon spatial planning and in particular on the available building possibilities.

Keywords: housing pressure, urban sprawl, migration patterns, Flanders, spatial planning

2 INTRODUCTION

2.1 Urban sprawl in Belgium

Belgium, and especially Flanders, is recently developping new policy plans for the future spatial development. Within this context a discussion is going on about the strategies to deal with the ungoing urban sprawl (Ruimte Vlaanderen, 2017). It can be assumed that sprawl is perceived, and dealt with, in different ways according to the spatial planning culture and to the institutional and political context of the country involved (Territorial Cohesion and Urban Matters Workgroup, 2010). Planning systems, legislative stipulations, subsidies and taxes play a role in driving or moderating urban sprawl (European Environment Agency and Federal Office for the Environment, 2016). However, the spatial zoning plans and rules allow and even shape sprawl, they don't require it. Thompson (2013) stresses the demand for sprawl by people and firms who keep choosing the suburbs mainly for financial reasons (more than for personal preference). Property prices and personal preferences are key drivers of sprawl.

Within the European Union there is an ungoing debate about urban sprawl. Several documents present urban sprawl as an important challenge (European Commission, 1990; CEMAT, 2003; European Commission - Inter-services Group on Urban Development, 2007; European Parliament - Committee on Regional Development, 2007; Ministers in charge of spatial development in the EU, 2007). Urban sprawl is not a new problem. In 2006 already, the European Environment Agency (EEA) reported on the scattered expansion of urban areas into the part of Europe's countryside (European Environment Agency, 2006). More recently the degree of urban sprawl in 32 countries in Europe is investigated (European Environment Agency and Federal Office for the Environment, 2016). The level of sprawl increased in all European countries between 2006 and 2009. The increasing urban sprawl in Europe is causing land use conflicts and is posing a major threat to sustainable land use. The two largest clusters of high-sprawl values in Europe are located in north-eastern

France, Belgium, the Netherlands and part of Western Germany; and in the United Kingdom between London and the Midlands (Fig.1).The urban sprawl leads to the known dispersed settlement pattern in Flanders, the northern part of Belgium(De Decker, 2011; Verbeeck, Boussauw, & Pisman, 2014).

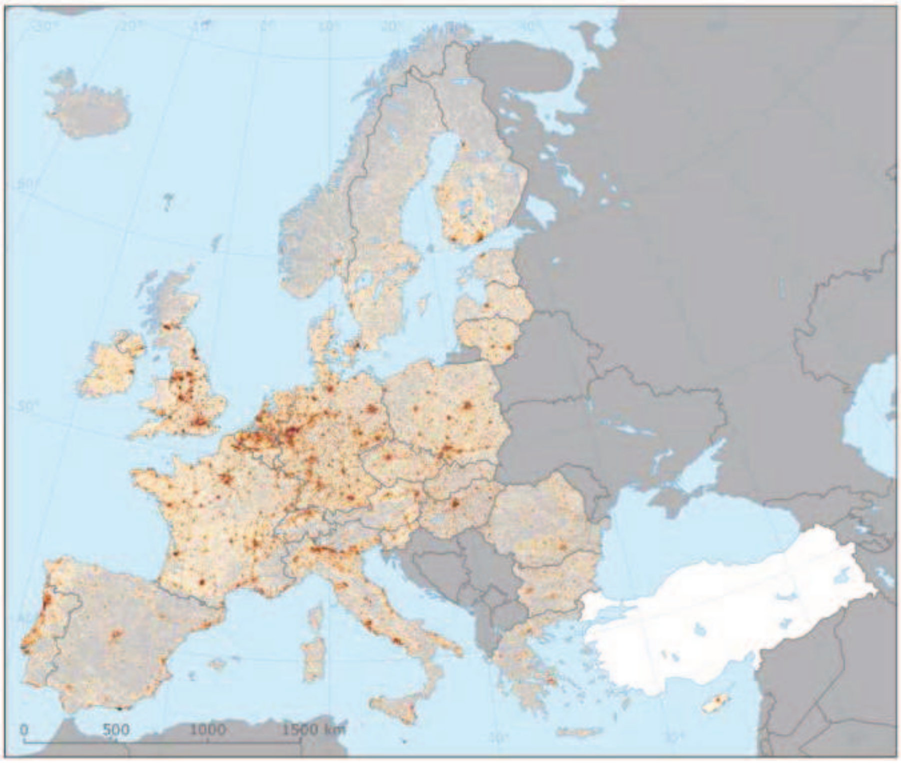

Fig. 1: Sprawl in Belgium in European context (2009). Source: EEA (2016).

2.2 Data and methodology

In the scientific and policy literature concerning the issue of sprawl, the residential function generally takes the largest place (Territorial Cohesion and Urban Matters Workgroup, 2010). Therefore, in this paper we focus on the household evolutions and migrations of people and households.

Different types of data are used to sketch the process from migration to sprawl in Belgium and Flanders. First, data on external migration is used to position the net migration flows to and from Belgiums main regions (Flanders, Brussels Capital Region, and Wallonia). Second, internal migration patterns are mapped schematic, based upon internal migration figures from 2015, the latest available data. Both maps help to outline the migration analysis in Belgium. The next section describes the population forecasts for Flanders, the northern region of Belgium. Data reveal expected demographic growth and shrinkage on the local scale (municipalities). These forescast are made by the Flemish Government in 2015. In section 5, we confront the demographic forecasts with the available building possibilities at the local level. The available building opportunities drive urban sprawl in Flanders. The same confrontation on the upper scale of housing market areas reveals that local shortages of building opportunities are limited to a few housing market areas.

The analysis of the different maps lead finally to conclusions about a business as usual scenario or a scenario that steers upon the available building plots and counters ongoing sprawl in Flanders.

3 MIGRATION ANALYSIS FOR BELGIUM

3.1 External migration

Despite the major migration flows worldwide from east to west and from south to north, the situationin Belgium is somewhat different, since almost 70% of the migration comes from within Europe. The major flows are between Western European countries (Netherlands, France). Net seen, the influx from Eastern Europe is most significant. These figures take no account of the accelerated migration from Syria in 2014-2017. But despite the visibility of it, this share is relatively limited in the migration to our country. 10% of the population in Belgium is migrant. The largest influx of migrants goes to the Brussels Capital Region, followed by Flanders and Wallonia (Fig. 2). There is also a flow between these regions, whereby the suburbanization from the Brussels Capital Region towards Flanders and in minor order towards Wallonia is significant.

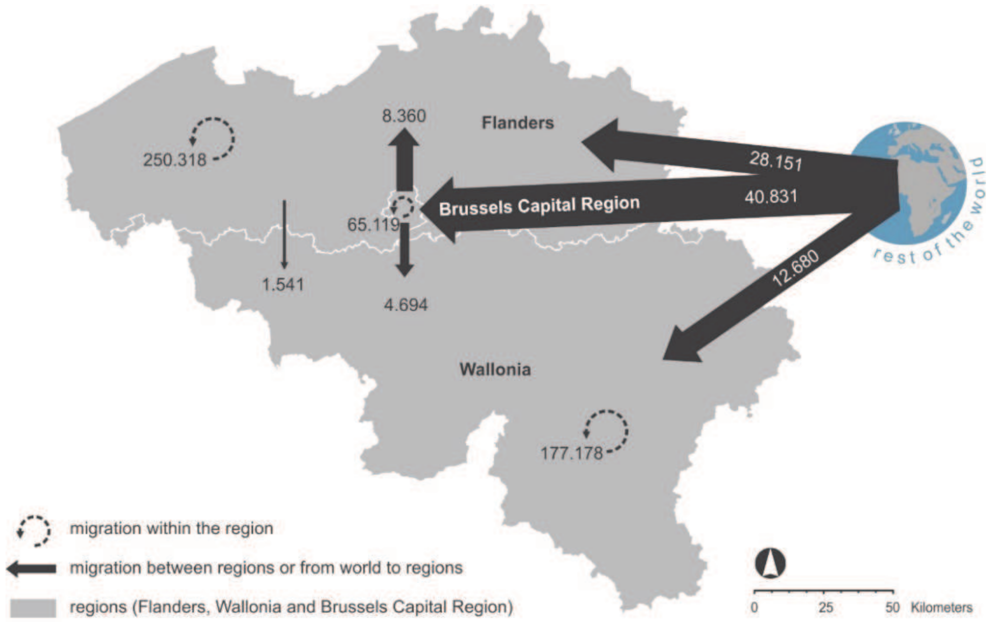

Fig. 2: Net migration flows to and from Belgiums main regions (Flanders, Brussels Capital Region, and Wallonia), average number per year over the period 2010-2013. Source: Processed data from the Flemish Government – Research Centre Flanders (2014).

3.2 Internal migration patterns

The strongest flows of migration, however, are within the regions. The internal migration is four times as strong as the external immigration (Fig. 2). The internal migration flows are steered from suburbanization processes. Fig. 3 illustrates the flows to and from the major cities and regional towns.

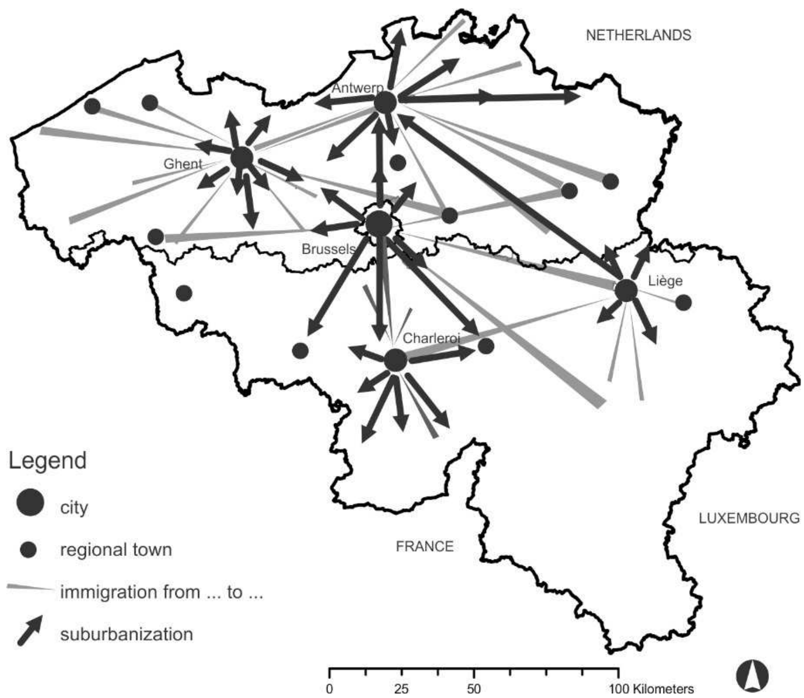

Fig. 3: Migration patterns in Belgium based on internal migration figures from 2015. Source: Processed data from the Flemish Government – Research Centre Flanders (2017).

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4 POPULATION FORECASTS FOR FLANDERS

4.1 Population and household growth

Population growth in Flanders, predicted by the Federal Planning Bureau (FPB, 2015), is approximately 370,000 additional inhabitants in the period 2015-2030. By 2050 it is about almost 744,000 inhabitants. Figure 4 gives the population forecast for Flanders in the period 2015-2030, per municipality. Although Flanders is characterized by continuous growth, on the local level there will be some municipalities which will shrink.

Household growth in Flanders predicted by the Federal Planning Bureau (FPB, 2015) is approximately 230,000 additional households in the period 2015-2030. In Flanders, the number of households increase each year with some 20,000 which are almost entirely attributable to single-person households and single-parent families (Statistics Belgium, 2016a). By 2050, Flanders will count about 418,000 households.The proportion of singles will rise spectacularly from one-third in 2015 to 40% in 2050. The proportion of couples with children decreases (from 29% to 22%). These smaller families conceal several trends. The classic family with children is increasingly a smaller share of households. Aging causes an increase in the number of elderly.

This outlook would lead to increased housing demand and necessitate an ambitious building program (Vlaamse Regering (2014), Vlaamse Overheid (2012), Vlaamse Confederatie Bouw (2015), Ryckewaert (2014)).

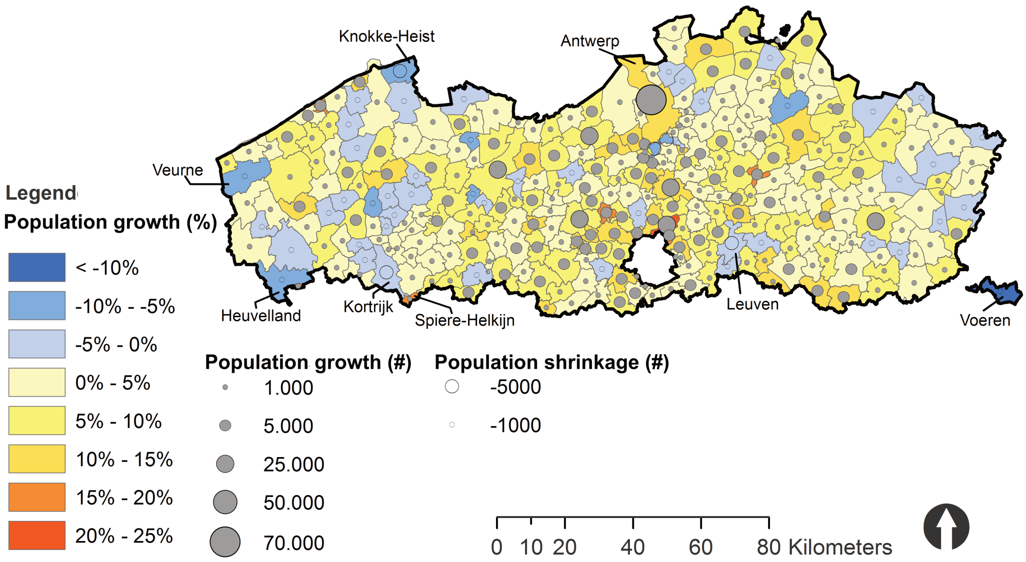

Fig. 4: Population forecasts in Flanders (Belgium) for the period 2015-20130. Source: Processed data from the Flemish Government – Research Centre Flanders (2015).

4.2 Ageing and rejuvenation

The aging population will increase rapidly by 2050, with an increase of 60% in the age group 67 years and older. At the same time there occurs a ‘greening’ (rejuvenation), albeit much less pronounced. However, this group of young people percentage-wise remains stable. In percentage terms, the active group will fall sharply (from 64% in 2015 to 56% in 2050). This decrease coincides with the increase in the proportion of older people (from 17% to 24% in 2050). That is double compared to 1991. Within the elderly population there occurs another ageing: the 80+ persons rose from 3% in 1991 and 6% in 2015 and will further increase to 11% in 2050.[1] Especially on the coast, the proportion and numbers increase significantly, partly due to internal immigration (Vandekerckhove, De Luyck, Volckaert, De Witte, & De Decker, 2014). That rapidly growing group will also make different demands to the houses and the environment depending on their housing preferences (aging-in-place versus moving-in-time). Given the Flemings are sedentary, homes are

[1] Calculation based upon population forecasts of the Federal Planning Bureau. Database accessed on 5/1/2016. http://www.plan.be/databases/database_det.php?lang=nl&TM=46&ID=35

aging along with their inhabitants. It also shows that most of those homes are not adapted to physical limitations (Myncke & Vandekerckove, 2007; De Witte et al., 2012).

5 HOUSING MARKET AREAS AND HOUSING PRESSURE

5.1 The role of housing market areas

The concept of housing market areas was widely introduced for the first time in Flanders by Van Nuffel (2005), based on earlier work by Thissen (1995). It defines a 'regional housing market', or even the 'regionalization of the housing market' as "a concept that shows the intertwining of urban and rural areas in the network society and draws attention to the structure behind the distribution pattern of land prices. (...) A regional housing market consists of the area around an employment center and is considered as a residence by families whose members work in the employment center (Van Nuffel & Saey, 2006). Not so much the price level, but the price gradient around larger cities is important. Its definition was based on land prices, commuting and migration. Housing markets may partly overlap. More recent updates within the Flemish context we find in van Meeteren et al. (2015), and under more limited form in Soresma (2009); Arts et al. (2011); Arts, Boussauw, and Loris (2014) and SUMResearch, Sint-Lucas Architectuur Brussel-Gent, and KULeuven (2012), which are limited to processing commuting and/or migration data. In a sense, connect the latter to the approach of the 'migration basins' of Willaert (1999) and Willaert, Surkyn, and Lesthaeghe (2002).

The use of migration is one of the favored practical approaches. Flows of migrants are indeed the outcome of a search process within a defined market area. One of the main concepts thereby is that of 'spatial containment'. As household migration is not a part of a daily urban system like commuting, the measure of containment can be lower than by travel-to-work areas (Jones, 2002). Nevertheless, a high degree of closure is needed in the sense that low proportions of movers into and out of the area are observed. Besides the fact that in-migration from a surrounding area should be of minor significance, a housing market area should be at least a settlement or groups of settlements according to Jones (2002). He defines a housing market area as "a contiguous area comprising a settlement or group of settlements with a high degree of housing market self-containment, and where in-migration from outside the immediate housing market are is of only minor significance" (Jones, 2002: 557).

Housing market areas reflect, according to Hincks and Baker (2012), the outcome of internal spatial arbitrage, market search, the relationship between home and work and the issue of scale and submarkets reflect the outcome of constraints placed on the arbitrage process. Sub-markets are considered to exist because of market imperfections such as transactions costs and inelastic supply e.g. caused by planning constraints or construction lags (Jones, 2002; Jones, Leishman, & Watkins, 2003; Brown & Hincks, 2008). This leads to different prices of a standardized house in each sub-market. These price differentials could lead to temporary sub-markets. The existence of 'the' housing market is also contested by Vastmans, Helgers, Damen, Goeyvaerts, and Buyst (2016), who speak rather of a patchwork of regional housing markets (p. 98). For example, sharply increasing the price in a particular region can cause households to move to neighboring regions in which prices may increase. In any case, prices in a given region may temporarily deviate from neighboring regions, but in the longer term they will always return to an equilibrium (Vastmans et al., 2016).

Another important social factor is demographics. The term demographic refers to all non-price and non-income terms (e.g. household size, marital status, population size, fertility, …). Demographic developments (family formation and growth) largely determine the need for housing. Headship influences the housing market through the demand for separate units. It also has spatial consequences if new dwellings must be built to accommodate the increase in number of households, e.g. by migration to the suburbs (Muth & Goodman, 1989).

The issue of size brings us to the existence of sub-markets. The existence of sub-regional housing market areas has been debated vividly in literature (Watkins, 2001; Bourassa, Hoesli, & Peng, 2002; Jones et al., 2003; Brown & Hincks, 2008; Islam & Asami, 2009; Wu & Sharma, 2012). UK-literature stresses the importance of policies managed and implemented at the sub-regional level, either than at regional or local levels (Roberts & Baker, 2004). This in contrary to the tradition in the UK of local authorities coordinating local housing provision and establishing the amount of land required to accommodate new housing (Brown

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& Hincks, 2008). In Belgium, Flanders, this is also the case with this difference that the local plans must abide by sub-regional structure plans of provinces and by the regional Spatial Structure Plan of Flanders.

Defining and delineation of regional housing (sub-)markets are important issues addressed in literature. An agreed definition is still the most arduous part. Islam and Asami (2009) give an overview of the main streams in defining and delineating housing submarkets, making a difference between major perspectives such as topographic or geographic boundary, quality of the houses, hedonic and equilibrium models.

Altough there is no conscensus in literature about the delineation of housing market areas, we use the concept of housing market areas, as defined by Arts, Boussauw and Loris (2014), to analyze demand and supply on a more regional level.

5.2 Supply versus demand: housing pressure

Demographic trends lead to changes in demand in housing. The household evolution, both in size and age, provides an increase in the proportion of apartments in the permits and a decline in the proportion of permits for new construction in detached dwellings. Also migration flows play an important role in the demand for housing. The number of refugees currently residing in shelters will have to be housed eventually in a more sustainable manner. This is likely to put pressure on the underside of the housing market (cheap rent) (Vastmans et al., 2016).

It is important to attune supply with this demand. The question arises whether the housing market will provide this supply, or whether steering (from a planners perspective) is necessary. Planning, as well as the building process are slow processes. Anticipating these future developments is important.

Attuning demand and supply is not easy, as demography, lifestyles and working careers change rapidly. The problem with tuning demand and supply is the relative immutability of the built environment opposite to a high degree of variability of society (Musterd, 1996). Per phase of life differs the need for housing. A single young person will have different housing needs than an older single. Moreover, young people move more often because they experience many changes in working conditions and household conditions. Population and economic growth require land. Taking Flanders alone, 6ha per day are needed for urban use (Loris I. & Van Daele W., 2012). Thus, policy-makers are asking questions such as: Will there be enough land to support urban development? Are there alternatives that require less land?

Hereby development sites play an important role. Because the supply of building land, by definition, is limited, it responds only to a limited extent to an increase in the demand. The value of land is determined residual. The price of land has increased significantly in recent years (Statistics Belgium, 2016b). Many will insist to extend the supply to reduce the price. But calculations have shown that there is still ample supply to accommodate the needs of the coming years (Loris I., 2009, 2011). It is not easy to determine whether all of these places are also the places where the need is urgent. To the extent that prices reflect the residential preferences, the demand for living areas is greatest in urban and peri-urban areas. Nonetheless, the work hypothesis is that demand can be absorbed within the existing building stock and supply of land despite regional differences in demand and supply.

Figure 5 illustrates the housing pressure in Flanders per municipality in 2015. This pressure is calculated by the percentage of building opportunities necessary to fill in the housing needs for the period 2015-2030. An overall pattern of oversupply is visible with even municipalities which will shrink in the future. Nontheless, there are a few municipalities -mostly larger cities- that will know a shortage of supply. Most prominent are the major cities of Antwerp, Ghent and the fringe of the Brussels Capital Region.

However, when we look at the same phenomenon on the scale of a housing market area, than only the coastal area will face a shortage (Fig. 6). As for the city of Antwerp again, there may be a shortage in the city centre but there is an oversupply in the fringes, leveling out the shortage. The same occurs in the housing market of Ghent.

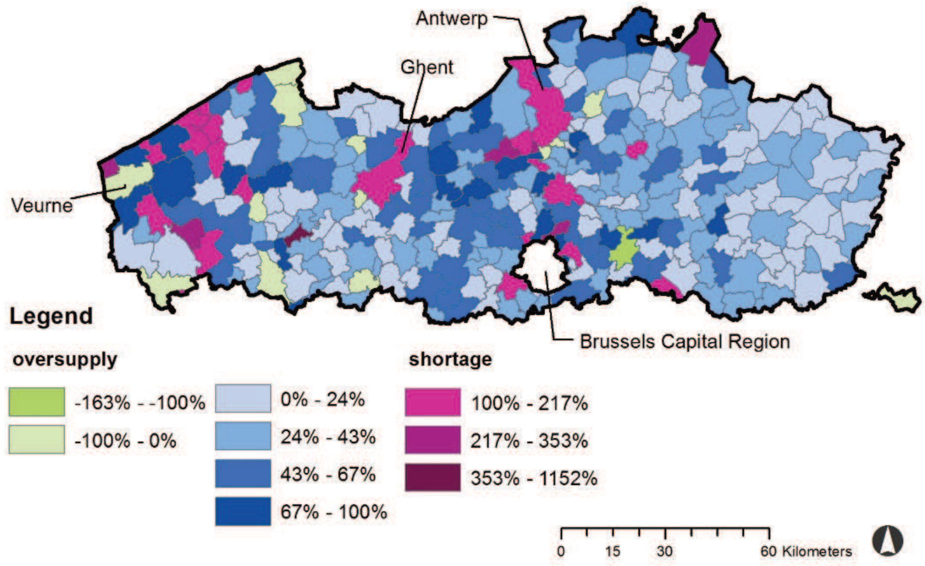

Fig. 5: Percentage of building opportunities necessary to fill in the housing needs in the period 2015-2030. Source: Population forecasts: Processed data from the Flemish Government – Research Centre Flanders (2015); building supply: Processed data from the Flemish Government - Environment Department.

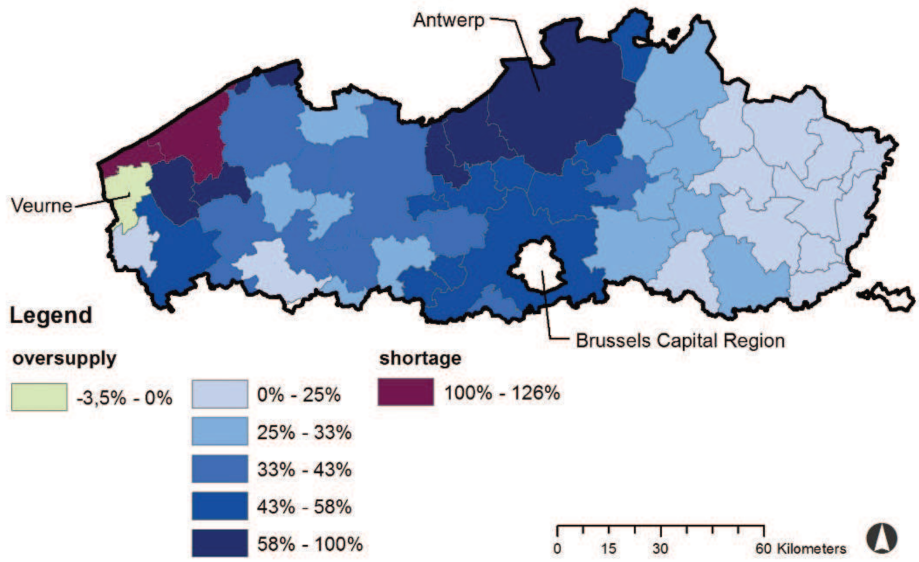

Fig. 6: Percentage of building opportunities necessary to fill in the housing needs in the period 2015-2030. Source: Population forecasts: Processed data from the Flemish Government – Research Centre Flanders (2015); building supply: Processed data from the Flemish Government - Environment Department.

6 CONCLUSION

In Flanders, there are still 41,000ha of building plots, representing 570,000 building opportunities, anchored in the existing Spatial Structure Plan of Flanders. Approximately half of these are situated in urban areas and half in rural areas. As stated earlier, housing needs will be about 230,000 units for the next 15 years (2015-2030). These building opportunities are calculated based on densities of 15 units per hectare in rural areas and 25 units per hectare in urban areas. Altough these densities are relative low compared to other countries, there is still more than dubble of the amount on building opportunities than the need for it. There can be differences on the local level. But still, this oversupply on buiding plots steers suburbanisation in Flanders.

For the moment, the public sector in Flanders is developing new policy plans to deal with the ungoing urban sprawl. In her White Paper of the Policy Plan(Ruimte Vlaanderen, 2017), Flanders states two major objectives that are of direct importance to counter sprawl. First, spatial development is restricted to the existing builtfabric. That means that the foremensioned 41,000 hectare of building plots can't be build upon. Of course in practice, land can be switched so naturally valuable areas can be saved and better located areas, e.g. near towns, can be developed. This is a strategy of spatial efficiency. It comes preferebly with the

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deletion of badly located areas of the oversupply on land. The only solution in this context is to shift the supply in the rural areas toward the urban areas. The fact that the majority of the buiding plots are in hand of individuals makes this future policy action all the more difficult. So a renewed vision on the urban structure of Flanders is needed to counter ongoing spawl.

Second, the plan states what 'better located areas' mean. The goal is to develop further the surrounding of railway stations or other nodes of public transport. This is the strategy of transit oriented development. Densification, reuse, interweaving are means to achieve this strategy. Local and regional spatial strategies have to be implemented by the public sector. The conceptualization and measurement of demand, supply and market equilibrium have had important impacts in the formulation of housing policies at both the national and local levels (Muth & Goodman, 1989).

However, the issue of sprawl can not only be tackled by public authorities. In particular, sprawl is an issue where the private citizen is particularly active and must thus be involved in order to come to efficient solutions. Property prices and personal housing preferences (detached housing with gardens in rural areas) still drive sprawl in Flanders.

The private economic sector (developers, real estate managers, …) has also an important role to play, and organisations of the third sector (e.g. environmental associations) are often involved (Territorial Cohesion and Urban Matters Workgroup, 2010). Specific subsidies and taxes can steer the location of real estate; a territorial policy is needed to differentiate spatial policy between rural and urban areas.

7 REFERENCES

ARTS, P., BOUSSAUW, K., & LORIS, I.: Scenario's voor woonlocatiebeleid in Vlaanderen: criteria en doorrekening, [Scenarios for residential location policy in Flanders: criteria and projections]. In: Ruimte & Maatschappij, Vol. 5, Issue 4, pp. 8-31. 2014.

ARTS, P., DUGERNIER, M., MULKENS, E., WITLOX, F., BOUSSAUW, K., & VAN ACKER, V.: Sturingsmodellen voor het wonen. Ontwerprapport, Brussel: anteagroup - Universiteit Gent, vakgroep Geografie. 2011.

BOURASSA, S. C., HOESLI, M., & PENG, V. S.: Do housing submarkets really matter?, Genève: Université de Genève. 2002.

BROWN, P. J. B., & HINCKS, S.: A framework for housing market area delinearion: principles and application. In: Urban Studies, Vol. 45, Issue 11, pp. 2225-2247. 2008.

CEMAT. Ljubljana declaration on the territorial dimension of sustainable development, adopted at the 12th session of the European Conference of Ministers responsible for Regional Planning, September 7-8 Hannover. 2003.

DE DECKER, P.: Understanding urban sprawl: the case of Flanders, Belgium. In: Environment and Planning A, Vol. 43, Issue 2011, pp. 1634-1654. 2011.

DE WITTE, N., SMETCOREN, A.-S., DE DONDER, L., DURY, S., BUFFEL, T., KARDOL, T., & VERTÉ, D.: Een huis? Een thuis! over ouderen en wonen. Brugge: Vanden Broele, 2012.

EUROPEAN COMMISSION - INTER-SERVICES GROUP ON URBAN DEVELOPMENT. Guide - The urban dimension in Community policies for the period 2007-2013. 2007.

EUROPEAN COMMISSION. Green paper on the Urban Environment - Communication from the Commission to the Council and the Parliament - COM(90) final. 1990.

EUROPEAN ENVIRONMENT AGENCY. Urban sprawl in Europe. The ignored challenge. EEA Report N°10/2006. 2006.

EUROPEAN ENVIRONMENT AGENCY AND FEDERAL OFFICE FOR THE ENVIRONMENT. Urban sprawl in Europe. joint EEA-FOEN report. Luxemburg: Publications Office for the European Union, 2016.

EUROPEAN PARLIAMENT - COMMITTEE ON REGIONAL DEVELOPMENT. Draft report on the Follow-up of the Territorial Agenda and the Leipzig Charter: Towards a European Action Programme for Spatial Development and Territorial Cohesion - 2007/2190(INI). 2007.

FPB. (2015) Bevolkingsvooruitzichten 2014-2060. In F. Planbureau (Ed.), (17/3/2015 ed.). http://www.plan.be/databases/database_det.php?lang=nl&ID=35: Federaal Planbureau.

HINCKS, S., & BAKER, M.: A critical reflection on housing market area definition in England. In: Housing Studies, Vol. 12, Issue 7, pp. 873-897. 2012.

ISLAM, K. S., & ASAMI, Y.: Housing market segmentation: a review. In: Reviiew of urban & regional development studies, Vol. 21, Issue 2/3, pp. 93-109. 2009.

JONES, C.: The definition of housing market areas and strategic planning. In: Urban Studies, Vol. 39, Issue 3, pp. 549-564. 2002.

JONES, C., LEISHMAN, C., & WATKINS, C.: Structural change in a local urban housing market. In: Environment and Planning A, Vol. 35, Issue 2003, pp. 1315-1326. 2003.

LORIS I.: Er is voldoende bouwgrond. In: Ruimte, Vol. 1, Issue 3, pp. 38-43. 2009.

LORIS I.: Woonaanbod in Vlaanderen: analyse van het register van onbebouwde percelen en gemeentelijke woningprogammaties. In: Ruimte & Maatschappij, Vol. 2, Issue 4, pp. 2011.

LORIS I., & VAN DAELE W.: Twaalf voetbalvelden per dag. In: Ruimte, Vol. 4, Issue 15, pp. 2012.

MINISTERS IN CHARGE OF SPATIAL DEVELOPMENT IN THE EU. Territorial Agenda of the EU, adopted in Leipzig, May 25, 2007. 2007.

MUSTERD, S.: Vraag en aanbod op de woningmarkt: een onvoorspelbare verhouding. In: Nieuw tijdschrift voor de volkshuisvesting, Vol. 1996, pp. 14-19. 1996.

MUTH, R. F., & GOODMAN, A. C.: The economics of housing markets (Vol. 31). Chur: Harwood academic publishers GmbH, 1989.

MYNCKE, R., & VANDEKERCKOVE, B.: Toekomstige ruimtebehoefte voor ouderen in Vlaanderen, Brussel: Departement Ruimtelijke Ordening, Woonbeleid en Onroerend Erfgoed, Woonbeleid. 2007.
ROBERTS, P., & BAKER, M.: Sub-regional planning in England: neglected opportunity or unwanted complexity. In: Town Planning Review, Vol. 75, Issue 2004, pp. 265-286. 2004.
RUIMTE VLAANDEREN. Witboek Beleidsplan Ruimte Vlaanderen. Brussel, 2017.
RYCKEWAERT, M.: Van demografische uitdaging naar doemscenario? Speculaties over wijzigende woonvoorkeuren, de onmogelijkheid van betaalbaar stedelijk wonen o pmaat van gezinnen en samenwonen-uit-noodzaak., [From demographic challenge to doom scenario?]. In: Ruimte & Maatschappij, Vol. 6, Issue 1, pp. 1-13. 2014.
SORESMA. Onderzoek naar woontendensen en -behoeften binnen de provincie Antwerpen., Antwerpen: provincie Antwerpen. 2009.
STATISTICS BELGIUM. (2016a) Aantal huishoudens volgens type. In S. Belgium (Ed.). Brussels: Statistics Belgium.
STATISTICS BELGIUM. (2016b) Gemiddelde prijs van de verkopen van bouwgronden. In S. Belgium (Ed.). Brussels: Statistics Belgium.
SUMRESEARCH, SINT-LUCAS ARCHITECTUUR BRUSSEL-GENT, & KULEUVEN, G. I.: Regionale woningmarkten West-Vlaanderen-Eindrapport. 2012.
TERRITORIAL COHESION AND URBAN MATTERS WORKGROUP. Urban and development sprawl. Final report prepared for and presented to the TCUM Workgroup, Brussels. 2010.
THISSEN, F.: Bewoners en nederzettingen in Zeeland: op weg naar een nieuwe verscheidenheid. In: Nederlandse Geografische Studies, Vol. 191, pp. 1995.
THOMPSON, D.: Suburban Sprawl: exposing hidden costs, identifying innovations, Ottawa: University of Ottawa, Canada. 2013.
VAN MEETEREN, M., BOUSSAUW, K., SANSEN, J., STORME, T., LOUW, E., MEIJERS, E., DE VOS, J., DERUDDER, B., & WITLOX, F.: Kritische massa. Verdiepingsrapport., Brussel. 2015.
VAN NUFFEL, N.: Regionalisering van de woonmarkt. Een onderzoek naar de ruimtelijke structurering van het nederzettingspatroon in Noord-België, 1990/91-1995/96. Proefschrift aangeboden tot het behalen van de graad van doctor in de wetenschappen: geografie. Universiteit Gent, Gent. 2005.
VAN NUFFEL, N., & SAEY, P.: Geografen gaan vreemd. Regionale woonmarkten en ruimtelijke planning. In: Ruimte en Planning, Vol. 26, Issue 1, pp. 9-21. 2006.
VANDEKERCKHOVE, B., DE LUYCK, N., VOLCKAERT, E., DE WITTE, N., & DE DECKER, P.: Ook de aangespoelden blijven. Woon- en zorgperspectieven van pensioenmigranten aan de kust.: Garant, 2014.
VASTMANS, F., HELGERS, R., DAMEN, S., GOEYVAERTS, G., & BUYST, E.: De economie van de woningmarkt. Antwerpen: Garant, 2016.
VERBEECK, T., BOUSSAUW, K., & PISMAN, A.: Presence and trends of linear sprawl: Explaining ribbon development in the north of Belgium. In: Landscape and Urban Planning, Vol. 128, pp. 48-59. 2014.
VLAAMSE CONFEDERATIE BOUW. Doorbraken. Scenario's voor de technologische (r)evolutie. Visierapport 2015.: VCB. 2015.
VLAAMSE OVERHEID. Groenboek. Vlaanderen in 2050: mensenmaat in een metropool? Beleidsplan Ruimte Vlaanderen. Brussel: Departement Ruimtelijke Ordening, Woonbeleid en Onroerend Erfgoed, 2012.
VLAAMSE REGERING. (2014). Regeerakkoord Vlaamse regering 2014-2019. Vertrouwen, verbinden, vooruitgang. Brussel: Diensten voor het Algemeen Regeringsbeleid Retrieved from http://www4wvg.vlaanderen.be/wvg/armoede/publicaties/Documents/regeerakkoord_Vlaamse_Regering_2014-19.pdf.
WATKINS, C. A.: The definition and identification of housing submarkets. In: Environment and Planning A, Vol. 33, pp. 2235-2253. 2001.
WILLAERT, D.: Migratieprofielen naar leeftijd voor de migratiebekkens en zones in de nieuwe ruimtelijke indeling. In: Working paper 1999-6, Vol., pp. 1999.
WILLAERT, D., SURKYN, J., & LESTHAEGHE, R.: Bevolkingsprojecties voor de Belgische migratiebekkens en hun zones, en voor de grote en regionale steden van België, 2000-2020. In: Working paper 2002-1, Vol., pp. 2002.
WU, C., & SHARMA, R.: Housing submarket classification: the role of spatial contiguity. In: Applied Geography, Vol. 32, Issue 2012, pp. 746-756. 2012.

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🏆 *reviewed paper*

GoGreen, der Einfluss von Begrünung auf eine aktive Mobilität

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1 ABSTRACT

Das Straßengrün erfüllt im öffentlichen Raum zahreiche Funktionen, die die aktive Mobilität fördert: Identität und Raumgliederung, Beschattung und Kühlung bei sommerlicher Hitze, ästhetisches Erleben und freudvollen Genuss. Zudem begünstigt Begrünung soziale Inklusion und bietet Raum für Kontakte. Aktuell steigt der Trend zur Begrünung von Stadträumen, nicht nur in Wien sondern weltweit, da Grün vielseitige Funktionen erfüllt und die Lebensqualität erhöht. Auf diesen Bewusstseinswandel reagieren bereits Bewohnerinnen, Bewohner und die Stadtverwaltung; Beide induzieren einen Wandel des MIV geprägten Stadtbildes zu mehr Vielfalt, Abwechslung und Auflockerung der verbauten Stadt.

Zu den Anreizen, häufiger und längere Wege zu Fuß zurückzulegen, zählt die fußgängerinnen- und fußgängerfreundliche Gestaltung von Straßen, Wegen, Plätzen und auch das Straßengrün, die Begrünung in den Straßen. In GoGreen, einem vom bmvit (Bundesministerium für Verkehr, Innovation und Technologie) geförderten Forschungsprojekt, wurde der Zusammenhang von aktiver Mobilität und Begrünung für die Förderung des Fuß- und Radverkehrs näher untersucht. Das Hauptziel des Forschungsprojekts war, Policy-Kriterien zum Straßengrün zu erarbeiten, die in der Planung und Umsetzung berücksichtigt werden sollten, um für die Bewegung anregende öffentliche Räume zu schaffen.

In einer Literatur- und Internetrecherche wurden nationale und internationale Good Practice Beispiele zusammengestellt und Potentiale zum Straßengrün analysiert. Mittels qualitativer Methoden (Expertinnen- und Experteninterviews, Fokusgruppen, Beobachtungen) und quantitativer Methoden (Straßenbefragungen) wurden die Bedürfnisse und Wünsche der Stadtbewohnerinnen und Stadtbewohner zum Straßengrün erhoben. In internen und externen Workshops wie auch in Raumanalysen wurden Evaluationskriterien und Empfehlungen für Begrünungsmaßnahmen zur Förderung der aktiven Mobilität erarbeitet.
Zentrales, allgemeines Ergebnis der Studie ist, dass ein enger Zusammenhang zwischen Straßengrün und aktiver Mobilität besteht. So kann die aktive Mobilität in Zukunft verstärkt werden, wenn die Qualität und Quantität der Begrünung sowie Ausstattung in Straßenräumen gehoben wird. Darüber hinaus gilt es, ein Bewusstsein zu schärfen, dass Stadtgrün ein wesentlicher Bestandteil der Belebung von Stadträumen, der Lebensqualität und daher ein zentrales Element der nachhaltigen Stadtentwicklung ist. Dabei sind die vielfältigen Leistungen und Vorteile von Stadtgrün zu erkennen, um eine breite Wertschätzung zu erzielen.

Keywords: Bedürfnisse von Fußgängern, Policykriterien, Potenziale zur Begrünung, Prozessinnovation, Straßengrün

2 EINLEITUNG

2.1 Ausgangslage und Ziel der Studie

Der Anteil von aktiver Mobilität am Verkehrsgeschehen in Wien betrug im Jahre 2015 laut Wiener Linien 34 % (Fußweganteil 27 %, Radweganteil 7 %; Daten Wiener Linien 2015). Das Hauptziel des Projekts GoGreen ist, Kriterien für eine qualitative hochwertige urbane Infrastruktur mit Begrünungselementen zu erarbeiten, damit der Anteil an Fußgängerinnen, Fußgängern, Radfahrerinnen und Radfahrern erhöht werden kann. Ein ausgeprägtes und ausdifferenziertes Stadtgrün mit vegetativen Qualitäten ermöglicht im Sinne der Stadt der kurzen und begrünten Wege einen leichteren Umstieg von MIV auf ÖV und eine aktive Mobilität.

Folgende Themenfelder standen im Fokus der Bearbeitung:

Erforschen der Wechselwirkung zwischen aktiver Mobilität und Begrünung: Formen, Funktionen und der Bedeutung der Begrünung; Vor- Nachteile von Begrünungsmaßnahmen aus Sicht der Expertinnen und Experten und der Bürgerinnen und Bürger; Potenzialanayse und Übersicht über nationale und internationale Good-Practice-Beispiele attraktiver öffentliche Räume mit Grünelementen.

Raumanalysen für die Erarbeitung der Bedürfnisse von Fußgängerinnen und Fußgängern; Barrieren/Hindernisse in Bezug auf Begrünungsmaßnahmen;

Sponsoring- bzw. Fundingmöglichkeiten von Straßengrün;

Empfehlungen und Kriterien für die Förderung aktiver Mobilität durch Begrünung.

2.2 Methoden

Um diese Forschungsthemen zu bearbeiten, wurden mehrere Methoden in Kombination verwendet:

Literaturanalyse: Für die Literaturanlayse wurde sowohl im Internet recherchiert als auch Gespräche mit Kolleginnen und Kollegen geführt, um internationale Good-practice-Beispiele in Bezug auf unterschiedliche Formen der Begrünung zu sammeln.

Expertinnen- und Experteninterviews: Es wurden 13 Expertinnen und Experten aus den Bereichen Wissenschaft, Politik, Landschaftsplanung und Landschaftsarchitektur zu ihren Erfahrungen und Wissen über Begrünung im öffentlichen Raum befragt. Die Interviews fanden im August, September und Oktober 2015 statt. Beim Expertinnen- und Experteninterview handelt es sich um eine qualitative Befragungsmethode, bei der der Untersuchungsgegenstand in einer ganzheitlichen Form erfasst wird. Dabei geht es um das Beschreiben, Interpretieren und Verstehen von Tatbeständen und Zusammenhängen. Qualitative Interviews eignen sich sehr gut als Vorbereitung von quantitativen Befragungen. Die Interviews wurden zum Teil mit Tonband aufgezeichnet und transkribiert zum Teil handschriftlich mitprotokolliert. Die Antworten der Expertinnen und Experten wurden anonym und fragenspezifische zusammengefasst und mittels Themenanalyse (Froschauer & Lueger 2003) ausgewertet.

Fokusgruppeninterviews: In drei Fokusgruppeninterviews mit Fußgängerinnen, Fußgängern, Radfahrerinnen, Radfahrern, Autofahrerinnen und Autofahrern und sechs Tiefeninterviews mit Kindern und gehbeeinträchtigten Personen wurden die Bedürfnisse und Wünsche unterschiedlicher Verkehrsteilnehmerinnen und Verkehrsteilnehmerin Bezug auf Begrünung erforscht.

Ein Fokusgruppeninterview ist eine Form der Gruppendiskussion, bei der in einem strukturierten Prozess vorgegebene Inhalte unter der Leitung geschulter wissenschaftlicher Mitarbeiterinnen und Mitarbeiter diskutiert werden. Insgesamt nahmen 20 Personen an den Fokusgruppen teil, 10 Frauen und 10 Männer. In einer Fokusgruppe diskutierten ausschließlich Jugendliche zwischen 14 und 17 Jahren. Bei den anderen Fokusgruppeninterviews waren die Gruppenteilnehmerinnen und Gruppenteilnehmer im Alter von 20 bis 75 Jahren. Die Interviews wurden mit Tonband aufgezeichnet und transkribiert. Die Fokusgruppen wurden anhand eines Leitfadens durchgeführt, der auf Basis der Literaturstudie und der Expertinnen- und Experteninterviews ausgearbeitet worden war.

Befragung: Eine standardisierte Straßenbefragung in Wien gibt Aufschluss über die Bedeutung von Begrünung beim Zufußgehen, über die Bereitschaft der Bevölkerung selbst aktiv an der Begrünung der Stadt mitzuwirken und ob Grün zur Attraktivierung des öffentlichen Raums und zu mehr Sicherheit beitragen kann. Der Fragebogen wurde in einem iterativen Prozess im Rahmen interner GoGreen-Workshops auf Basis der Ergebnisse der Expertinnen- und Experteninterviews und FokusgruppenDiskussionen entwickelt. Zehn Interviewerinnen und Interviewer wurden hinsichtlich des Fragebogens und Vorgehens bei der Befragung eingeschult und führten die Befragung in allen 23 Bezirken Wiens durch. Dabei erhielten sie Vorgaben bezüglich der demographischen Verteilung der zu befragenden Personen. Ziel war es, eine Verteilung an Teilnehmerinnen und Teilnehmern zu erreichen, die auch die tatsächliche Verteilung der Population spiegelt. Die Straßenbefragungen wurden im November 2015 bei gutem Wetter im öffentlichen Raum in unterschiedlichen Bezirken Wiens durchgeführt. Insgesamt nahmen 414 Personen (212♀, 202♂) im Alter zwischen 14 und 92 Jahren (Mittelwert = 41,19 Jahre, Standardabweichung = 19,15 Jahre) an der Befragung teil. In der Stichprobe waren alle Verkehrsteilnehmerinnengruppen und Verkehrsteilnehmergruppen vertreten (39 % regelmäßige Fußgängerinnen und Fußgänger, 33 % regelmäßige ÖV-Nutzerinnen und ÖV-Nutzer, 10 % regelmäßige Radfahrerinnen und Radfahrer, 17 % regelmäßige Autofahrerinnen und Autofahrer).

Workshops: In mehreren internen und drei externen Workshops mit Expertinnen und Experten aus der Wissenschaft und Politik wurden Evaluationskriterien und Maßnahmen erarbeitet. Die Maßnahmen wurden analysiert und strukturiert zusammengefasst.

2.3 Ergebnisse (Auszug)

Aus dem Blick der Pflanzenverwendung steht im Stadtraum eine Vielfalt von Begrünungsmöglichkeiten zur Verfügung. Durch verschiedene Bepflanzungstypen können unterschiedliche Raumqualitäten in der Stadt erzeugt werden und zur Einprägsamkeit und zum Charakter des Stadtbildes als das „Gesicht der Stadt" beitragen. Begrünte Flanierwege mit passender Erdgeschoßnutzung verstärken Geh- und Verweilaktivitäten. Es werden drei Kategorien nach den Raumqualitäten des Straßengrüns unterschieden:

- Straßenbäume in vegetationslosen Baumscheiben oder in Grünstreifen
- Unterpflanzungen
- Bauwerks- und Infrastukturbegrünung mit Gehölzen und Stauden.

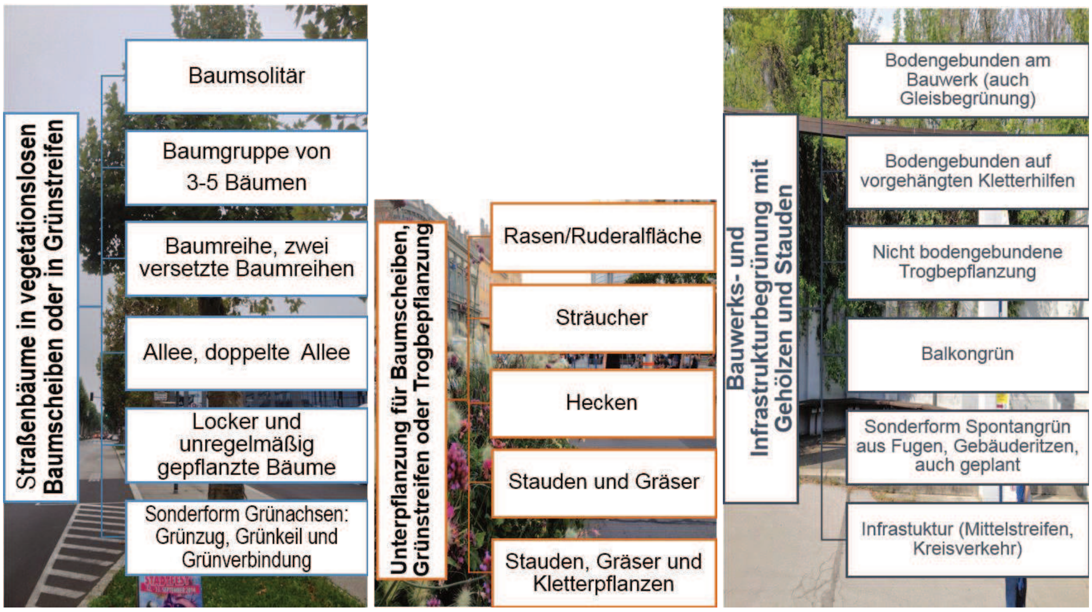

Abb.1. Die drei Begrünungsformen (©MK Landschaftsarchitektur)

Der Idealfall von urbaner Begrünung besteht aus einer Kombination von Vegetationsformen aus den vorgestellten drei Begrüngsformen, der Baumallee, der Fassaden- und Dachbegrünung und der Unterpflanzung. Dadurch wird im Weiteren ein hoher Beschattungsgrad in Verbindung mit Wasserelementen angestrebt, um urbane Hitzeinseln zu reduzieren. Optimal ist ebenfalls eine Trennung der Fahrbahn von Gehwegen.

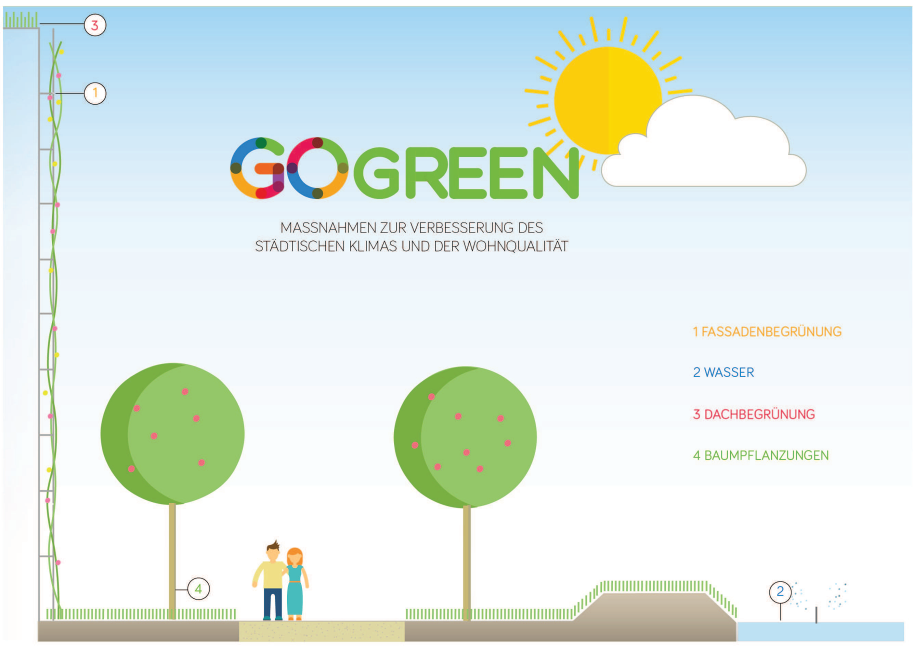

Abb.2: der Idealtyp der Begrünung entlang von Gehwegen (©MK Landschaftsarchitektur)

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2.4 Meinungen von Expertinnen und Experten zum Zusammenhang zwischen aktiver Mobilität und Begrünung

Alle Expertinnen und Experten sind sich einig, dass es einen Zusammenhang zwischen Straßengestaltung und erhöhter aktiver Mobilität gibt. Das Straßengrün spielt dabei eine wesentliche Rolle. Grünräume regen laut Expertinnen und Experten Menschen zum Hinausgehen an, zum Stehenbleiben, zum Schauen und Betrachten. Grün mache eine Stadt lebendig, auch wenn man alleine auf der Straße unterwegs sei. Es wird als angenehm bewertet, wenn Stadtgrün in den Alltagswegen integriert werden kann, damit nicht auf zusätzlichen Wegen Parks und Grünräume aufgesucht werden müssen, um Grün erleben zu können, wie es auch die Abbildung 1 zeigt.

Die Bedeutung von Straßengrün beim Gehen und Radfahren

In den Befragungen wird der Begrünung eine hohe Priorität eingeräumt: für drei Viertel der Befragten ist Grün gemeinsam mit Verkehrsberuhigung wichtig auf ihren alltäglichen Wegen. Insbesondere ältere Personen, und jene, die bereits viel zu Fuß unterwegs sind, schätzen Straßengrün. Umwege, um auf grünen Wegen zu gehen, werden nur bedingt gemacht. Ältere Personen, Frauen, sowie Personen, die öfter zu Fuß oder mit dem Rad unterwegs sind, nehmen am ehesten einen Umweg in Kauf. Etwas weniger als die Hälfte der Befragten hätte nichts dagegen, Parkplätze in Grünflächen umzugestalten. Hier gab es keine signifikanten Unterschiede zwischen regelmäßigen Fußgängerinnen, Fußgängern, Autofahrerinnen und Autofahrern. Änliche Ergebnisse in Bezug auf die Umgestaltung von Parkplätzen lieferten bereits frühere Studien in Wien (siehe z. B. Ausserer et al 2009, Ausserer et al. 2013).

Mehr Grün in der Stadt wäre für rund die Hälfte der Befragten ein Anreiz mehr Wege zu Fuß zurückzulegen. Den größten Vorteil der Begrünung sehen die Befragten in der Verbesserung der Luftqualität und in der Erhöhung der Aufenthaltsqualität des öffentlichen Raums. Ein Fünftel der Befragten (20 %) ist bereit, an der Begrünung der Stadt mit Baumscheiben- und Restflächenbepflanzung mitzuwirken und für die Pflege aufzukommen. Hier besteht großes Potenzial, die Bürgerinnen und Bürger aktiv an der Lebensqualität in der Stadt mitwirken zu lassen. Mehr als 60 % wissen jedoch nicht, an wen sie sich wenden sollen, wenn sie sich aktiv an der Gestaltung des öffentlichen Raumes beteiligen wollen. Hier besteht Kommunikationsbedarf.

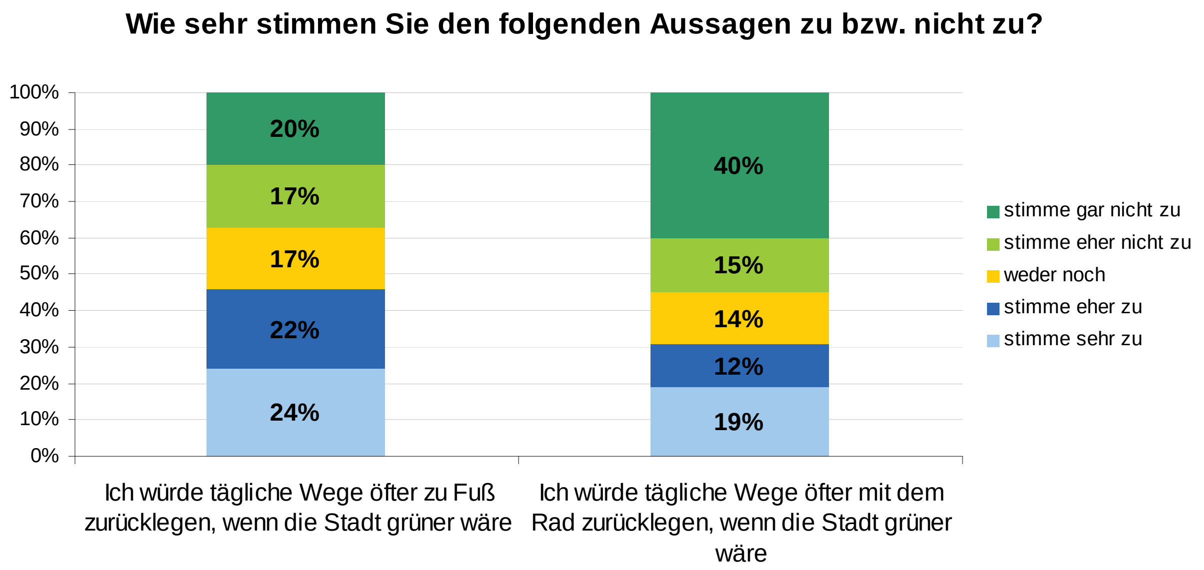

Abb. 3: Bereitschaft zu aktiver Mobilität bei höherem Grünanteil in der Stadt (n=414) (© Factum OG)

Vorteile und Nachteile von Begrünung

Begrünung ist laut Meinung der Expertinnen und Experten mit einer Vielzahl von **Vorteilen** verbunden. Die von den Expertinnen und Experten erwähnten Vorteile entsprechen den Funktionen von Begrünung. Folgende Aspekte wurden von den Expertinnen und Experten genannt, die auch in der Literaturanalyse bestätigt wurden.

Begrünung ist raumbildend: Bei breiteren Straßen wird laut Meinung der Expertinnen und Experten durch Begrünung als Abstandhalter zum Autoverkehr wieder ein menschlicher Maßstab hergestellt. „In einem 30-

40m Straßenquerschnitt fühlt sich ein Mensch ohne Baum verloren.“ (Verkehrsplaner). Durch Begrünung würden Teilräume im Gesamtstraßenraum geschaffen, sodass sich der Mensch auch wohl fühlen könne (siehe auch Gehl et al. 2013, Hancrenci 2013).

Schallschutz: Rein technisch zeige Grün aus Expertinnensicht und Expertensicht zwar eine geringe Schallreduktion von 5 bis 10 dB, könne aber subjektiv das Gefühl einer Lärmreduktion positiv beeinflussen.

Beschattung: Begrünung biete einen Schutz vor Sonne und spendet Fußgängerinnen, Fußgängern, Radfahrerinnen und Radfahrern Schatten (siehe auch Bowler et al. 2010, Zheng et al. 2014).

Wahrnehmung des Jahreskreislaufes: Bergrünung ermögliche die Jahreszeiten bewusster zu erleben und den Kontakt zur Natur nicht zu verlieren. Es biete auch einen Lebensraum für Insekten und Kriechtiere (siehe auch Ausserer et al. 2012).

Physisches und psychisches Wohlbefinden: Laut Expertinnensicht und Expertensicht wirkt Grün entspannend, belebt den öffentlichen Raum und hat einen positiven Einfluss auf das Wohlbefinden. Gleichzeitig rege es an sich draußen aufzuhalten (siehe auch De Vries et al. 2013, Krekel et al. 2015).

Die Expertinnen und Experten sahen mit einer Begrünung des öffentlichen Raumes primär Vorteile verbunden. **Nachteile** der Begrünung kämen laut Expertinnensicht und Expertensicht nur dann zu Tage, wenn die Begrünung nicht fachgerecht erfolge und die Pflege vernachlässigt werde. Durch eine unpassende Pflanzenwahl und durch fehlenden jährlichen Rückschnitt können Sichtverhältnisse eingeschränkt werden und dies könne sich negativ auf die Verkehrssicherheit auswirken. Zusätzlich bestehe die Gefahr, dass durch eine nicht fachgerecht ausgeführte Begrünung, z. B. durch eine falsche Baumwahl und ohne Baumscheibe die Infrastruktur zerstören werden könne, in dem zum Beispiel Wurzeln großer Bäume den Asphalt wölben. Dies berge eine potenzielle Sturzgefahr für Fußgängerinnen, Fußgänger, Radfahrerinnen und Radfahrer.

Kriterien für Begrünungsmaßnahmen

Die Qualitätskriterien für die Förderung der aktiven Mobilität in begrünten Straßenräumen, werden anhand eines Kriterienbaums dargestellt. Der Baum besteht aus drei „Kriterien-Astpaaren“, die unterschiedliche Aspekte beleuchten. Die Grundvoraussetzung für alle Maßnahmen bilden die räumlichen, personellen und wirtschaftlichen Ressourcen – sie stellen die Wurzeln des Baumes dar. Die unteren beiden Äste beziehen sich auf den Stellenwert von Straßengrün in der Gesellschaft in Bezug auf grüne Alltagswege. Die mittleren auf das emotionale und individuelle Erleben. Die obersten Äste sind den grundlegenden Bedürfnissen der Nutzerinnen und Nutzer zugeordnet (Nutzungskomfort, Sicherheit).

Abb.4: Der Kriterienbaum (©MK Landschaftsarchitektur)

Dieser Kriterienbaum zeigt, dass Staßengrün als Raumveränderung gesellschaftlich getragen werden muss. Verhaltensveränderungen sind mit Raumveränderungen eng miteinander verknüpft. Die nachhaltige Erhöhung des Anteils der aktiven Mobilität am Gesamtmodalsplit durch urbane Begrünung setzt räumliche, personelle und wirtschaftliche Ressourcen voraus. Diese Ressourcen sind die Wurzeln im Kriterienbaum und die Basis für erfolgreiche Maßnahmen. Vorhandene, begrenzte Raumpotenziale müssen kreativ genutzt werden. Dieses „Substrat", nährt, und schafft Raum für Veränderungen.

Bedürfnisse und Erfahrungen mit Straßengrün

Die Mehrheit (64 %) der befragten Wienerinnen und Wiener wünschten sich mehr Bäume und Grünflächen in Wien, wobei von einem Großteil der Befragten (65 %) auch im Sommer viel Grün auf den Alltagswegen bereits wahrgenommen wird. Nur 21 % der befragten Wienerinnen und Wiener gehen jedoch davon aus, dass für die Politikerinnen und Politiker Straßengrün ein wichtiges Thema darstellt.

Zu den Bedürfnissen zählen prioritär Komfort, Sicherheit und Wohlbefinden bei der Nutzung von Straßenräumen. Im Weiteren sind

- Schutz vor schlechter Witterung (Sonnen-, Regen- und Windschutz)
- Schutz vor Lärm und Schadstoffen,
- Lenkung des Blicks,
- ein ästhetisches Erleben,
- Natur- und Raumerleben,
- das Empfinden des menschlichen Maßstabs als relevante Bedürfnisse.

Wünsche in Bezug auf grüne Gestaltungselemente

Die befragten Wienerinnen und Wiener wurden gebeten maximal vier der genannten Gestaltungselemente zu benennen, die wichtig sind, damit sie gerne aktiv unterwegs sind. Außerdem hatten sie die Möglichkeit, sonstige Wünsche anzugeben (siehe Abb.5).

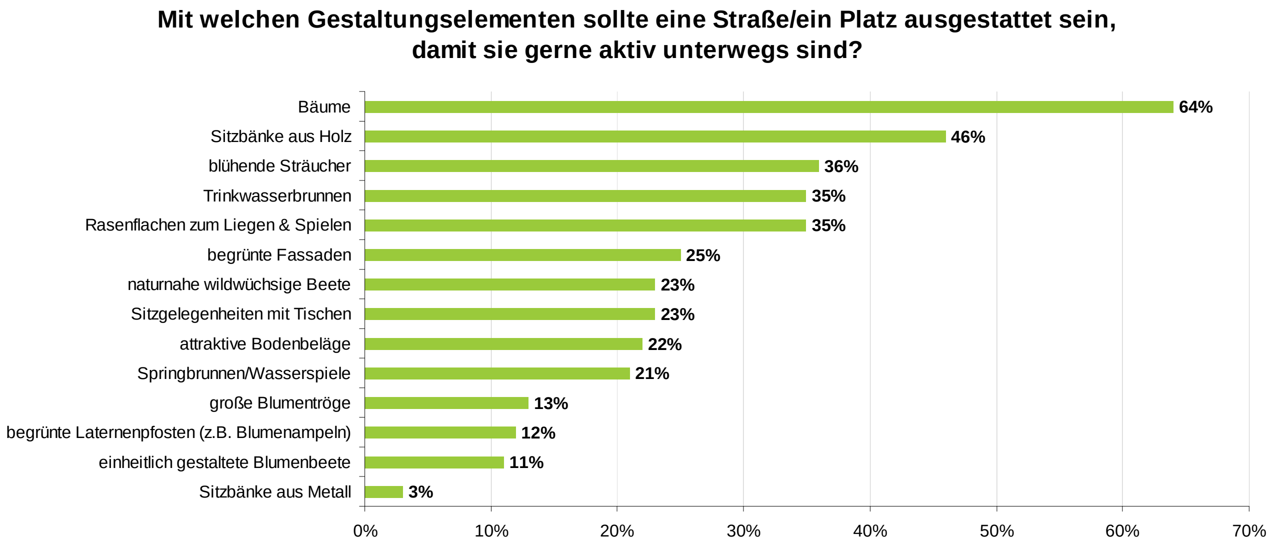

Abb. 5: Bevorzugte Gestaltungselemente (n=400) (© Factum OG)

Das beliebteste Gestaltungselement sind Bäume (64 %), gefolgt von Sitzbänken aus Holz (46 %) und blühenden Sträuchern (36 %). Trinkwasserbrunnen und Rasenflächen zum Liegen und Spielen wurde von mehr als einem Drittel der Befragten gewünscht. Begrünte Fassaden, naturnahe wildwüchsige Beete, attraktive Bodenbeläge und Springbrunnen nannten etwas mehr als ein Viertel der Befragten. Rund jeder Achte findet Blumentröge und begrünte Laternenpfosten attraktiv. Sitzbänke aus Metall werden von den wenigsten Befragten als den öffentlichen Raum belebendes Gestaltungselement empfunden. Unter Sonstiges wurden Wünsche geäußert, die indirekt mit Begrünung zusammenhängen. So wurden mehr Aschenbecher und Mistkübel gewünscht, mehr Fußballspielflächen, mehr Radwege und mehr autofreie Straßen (nicht in der Abbildung dargestellt).

Hemmnisse und Barrieren

Um die Identifikation mit Grün zu stärken, wird in Wien, aber auch in vielen andern Städten, den Bürgerinnen und Bürgern die Möglichkeit geboten, sich aktiv in die Gestaltung des öffentlichen Raumes einzubringen. Die Pflegeübernahme von Pflanzbeeten durch Bürgerinnen und Bürger bringt Vorteile für die urbane Bevölkerung. In der GoGreen-Umfrage begrüßten 90 % der Wienerinnen und Wiener Partizipationsmöglichkeiten in Bezug auf eine aktive Mitgestaltung des öffentlichen Raums. Die Bereitschaft, aktiv mitzuwirken, war jedoch bedeutend geringer. So würden rund 20 % der Befragten selbst aktiv werden. Die Gründe, warum Bürgerinnen und Bürger nicht selbst zum „Garteln" anfangen sind vielfältig. In Gruppendiskussionen und Expertinnen- und Experteninterviews wurden unter anderem folgende Hemmnisse und Barrieren bei der Bürgerbeteiligung konstatiert:

Persönliche Einstellungen: Desinteresse an der Gestaltung, Angst vor Vandalismus, vor ungewollter Rauminanspruchnahme vor starkem Nutzungsdruck, vor Konflikten (z. B. Beschattung, Geruchsbelästigung), ...

Grenze der persönlichen Ressourcen: Zeit, Geld, Geduld, Kenntnisse, fehlende zusätzliche Informationen z. B. Pflanzenkenntnisse, Kenntnisse der Genehmigungsprozesse

Rechtliche Erschwernisse: Eigentumsverhältnisse, Haftungsfragen (eine nachträgliche „Legalisierung" von nicht genehmigten Begrünungsmaßnahmen ist kaum realisierbar).

Räumliche Einschränkungen: fehlende Aufstellmöglichkeit wegen Raumknappheit (enge Straßenräume), Einbauten, fehlende Besonnung

Sponsoring

Unterstützungen in Form von Sach-, Dienst- oder Geldleistungen tragen erheblich zur Umsetzung und somit zum Gesamterfolg von Projekten, Veranstaltungen und Aktionen bei. Dazu ist eine gezielte Suche nach potenziellen Sponsorinnen und Sponsoren sinnvoll.

Neben den alternativen Finanzierungsmodellen gibt es die herkömmliche Methode, Sponsoren für ein Einzelprojekt durch gezielte Ansprache zu finden. Im Rahmen des Projektes wurde bei den Unternehmen generell die Bereitschaft abgefragt, „Grünprojekte" zu unterstützen. Insgesamt wurden 50 kleinere und größere Unternehmen aus unterschiedlichen Bereichen (Blumenhandel, Baumärkte, Lebensmittelketten, Elektronikunternehmen etc.) kontaktiert. Da sich bereits nach den ersten Telefongesprächen gezeigt hat, dass eine allgemeine Anfrage nicht zielführend ist, wurde bei den weiteren Anfragen von einem fiktiven Begrünungsprojekt in der Mechitaristengasse (1070 Wien) ausgegangen. Dabei wurde von einer realisierbaren und wirkungsvollen Begrünungsmaßnahme ausgegangen. Die visionäre Umgestaltung wurde visualisiert (siehe Abb.5).

Abb. 6: Visualisierung des Straßenraums in 1070, Mechitaristengasse, Status quo, Wunsch und Vision © MK Landschaftsarchitektur

Die Bereitschaft, Grünprojekte zu finanzieren war sehr niedrig. Als Hauptablehnungsgrund wurde erwähnt, dass das Unternehmen bereits gezielte Projekte fördere oder sich auf ganz bestimmte Bereiche z. B. Gesundheit, Bildung, Sport, humanitäre Projekte (SOS-Kinderdörfer, Licht ins Dunkel, Sozialverein Concordia, etc.) konzentriere, die gesponsert würden. Einige Baumärkte und Supermärkte konnten sich vorstellen, Sachspenden zu leisten. Es wurde jedoch generell von den Unternehmen betont, dass für die Anfrage zum Sponsoring eines Projektes eine Vorlaufzeit von einem Jahr einberechnet werden sollte.

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Sponsoring stellt keine einseitige Leistung dar, sondern beruht immer auf einer Gegenleistung, d. h. auch der/die Sponsor-Suchende muss einen Kundinnen- und Kunden-Nutzen anbieten können. In Bezug auf Sponsoring kann festgehalten werden, dass es Kooperationsmodelle gibt, die auch für Begrünungsprojekte zur Förderung der aktiven Mobilität angedacht werden können. Empfehlenswert ist, wenn die Sponsoringprojekte sehr lokal organisiert sind, und auch von lokalen Politikern unterstützt werden. Der gemeinschaftliche Gedanke muss dabei herausgearbeitet werden, z. B. Fassadenbegrünung für eine Schule. Geduld, Hartnäckigkeit und Ausdauer sind wesentliche Kriterien, um bei einer Sponsorensuche erfolgreich zu sein. Ein gut durchdachtes Sponsoringkonzept erleichtert die Akquise, ermöglicht eine gezielt Vorgehensweise und erhöht die Erfolgschancen.

3 CONCLUSION

Ins Tun kommen ist hier der Schlüsselsatz. Dabei ist eine Vorgangsweise über die Einzellösung weiter zu denken: Im Wesentlichen ist auf die Kombination und Variation der drei vorgestellten Begrünungsformen zu achten. Dabei ist auch das Augenmerk auf Prozesse zu legen, die vom Großen, Übergeordneten ins Kleine, ins Detail reichen. Das Empowerment gelingt, wenn eine Unterstützung der Initiativträgerinnen und Initiativträger erfolgt und der gemeinschaftliche Nutzen für alle sichtbar ist. Die Vernetzung der Bezirke und eine überparteiliche Kooperation sind sinnvoll, aber auch individuelle, wenig planbare Raumaneignungsprozesse müssen zugelassen werden.

Die Belebung der Stadtviertel kann gesteigert werden, wo urbaner Raum für Lebendigkeit und Veränderungen zur Verfügung steht und, wo unterschiedliche, gemeinschaftliche Nutzungsaktivitäten gezielt unterstützt werden. So können etwa eine Agentur für Begrünung und Bewusstseinsbildung sowie die Leerstands- und die Mobilitätsagentur der Realisierungsmüdigkeit Abhilfe schaffen und den vielfachen Wert von Grün in unterschiedlichen Prozessen und Verfahren vermitteln. Eine wichtige Voraussetzung ist Fachwissen in Umsetzungsprozesse einzubringen. Eine Weitere ist die Anerkennung der Arbeit, die für Grün geleistet wird, ein Fakt, der zugleich aber auch Grenzen des Handelns definieren kann.

Der Beitrag endet mit einem offenen Ausblick und mit der Frage, wie viel Urbanität benötigt eine Stadt, wenn alle Raumpotenziale ausgenutzt werden? Wird in Zukunft ein Begrünungsfaktor auch für öffentliche Räume festgelegt, an dem sich bindend gehalten werden muss?

Hinweis: Weitere Ergebnisse zu ***GoGreen*** werden auch in Form einer Broschüre, die bei den Autorinnen und Autoren angefordert werden kann, sowie als Endbericht zum Download zur Verfügung gestellt.

4 REFERENCES

Ausserer, K., Sumper E., Reindl I., Röhsner R., Risser R (2012) GEMMA WEITER: Auswirkungen von Mobilitätsmanagement im Kindergarten auf das Mobilitätsverhalten von Eltern und Kleinkindern, Endbericht; Projekt im Rahmen der 3. Ausschr. ways2go des Forschungs- und Technologieprogramms iv2splus, Wien

Ausserer K., Braguti I., Füssl E., Höfferer G., Risser A., Risser R.: Bef(w)usst unterwegs: Fußgängerstudie in Wien. In: Forschungsarbeiten aus dem Verkehrswesen, Band 191, BMVIT, Wien, 2009

Ausserer K. Füssl E. Risser R.: Nutzerinnen- und Nutzerbefragung: Was gefällt am Gehen und was hält davon ab. Studie im Auftrag der MA 18 Stadtentwicklung und Stadtplanung, Endbericht, Wien, 2009

Bowler, D.E. ; Buyung-Ali, L. ; Knight, T.M. ; Pullin, A.S. (2010): Urban greening to cool towns and cities: A systematic review of the empirical evidence. Landscape and Urban Planning, 97(3), S. 147-155

De Vries, S. ; van Dillen, S.M.E. ; Groenewegen, P.P. ; Spreeuwenberg, P. (2013): Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. Social Science and Medicine, 94, S. 26-33

Gehl, J. and Svarre, B. (2013): How to Study Public Life, Island Press, Washington DC

Gehl, J. and Svarre, B.: How to Study Public Life, Island Press, Washington DC, 2012

Gehl, J.: Leben zwischen den Häusern, Jovis Verlag, Berlin, 2012

Gehl, J.:Städte für Menschen, Jovis Verlag, Berlin, 2010

Hancrencl G. (2013) Fassadengebundene Veritkalbegrünung. Untersuchung des Mikroklimas fassadengebundener Begrünungs-systeme, Masterarbeit an der BOKU, Wien

Krekel Ch. Kolbe J., Wüstemann H. (2015): The Greener, the happier? The effects of Urban Green and Abandoned Areas on Residential Well-Being, SOEP-Paper 728, Berlin

Stiles, R. et al. (2014): Urban Fabrik and Microclimate Response – Assessment and Design Improvement, TU Wien, Institut für Städtebau, Landschaftsarchitektur und Entwerfen, Austrian Institute of Technology/ Energy Departement, TU München, Lehrstuhl für Strategie und Management in der Landschaftsentwicklung, Wien

Zheng T., Ng E. (2014): Influence of Greenery in cooling the Urban Athmosphere and Surfaces in Compact Old Residential Building Blocks: A building morphology approach, 30th International PLEA Conference 16-18 Dec. 2014, Ahmedabad

Growth of Population Pressure Resulting Migration: Its Issues and Perspectives for India

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1 ABSTRACT

India is a developing country and has second largest population in the world after China. As per 2011 census data shows around 41 percent of India's is below the age of 20 years, 50 percent of the population are in the age group of 20 to 59 and only 9 percent of the population are above the age group of 60 years. Every third person in an Indian city today is a youth. The median individual in India will be 29 years, very likely a city-dweller, making it the youngest country in the world by 2020. An increasing proportion of India's youth are unemployed. A look at the World Development Indicators data of the World Bank shows that only one in three people in the 15 to 24 years was employed in 2014. That is a 13 percentage point drop from the 45 percent employment rate in 1991 when economic reforms were initiated.

To be sure, the population in the 15 to 24 age group has increased by 45.3 percent in India between 1990 and 2015, according to data from UN World Population Prospects. So, jobs for this segment have failed to keep pace with the rise in population. That said, the proportion of this age group in the overall population has marginally declined. It was 19 percent in 1990 and came down to 18.4 percent in 2015.India's youth employment is also far lower than the 41 percent global average.

To be sure, another reason for the fall in youth employment is that a greater proportion is seeking higher education. Data from the ministry of human resource development show that enrolment in higher education among 18 to 23 year olds has increased from 8.1 percent in 2001-02 to 21.1 percent in 2012-13. Simply put, a lower percentage of India's youth is now seeking jobs. National Sample Survey Office (NSSO) data show a sharp fall in the proportion of youth in both rural and urban areas due to migration to other countries as a form of brain drain for better opportunity as well as to increase income.

India has been a major source of human resource for many countries of the world. Substantial migration of people from the India started in the 1830s and led thousands of Indians to colonial destinations, still continues. However, the later migrants differ markedly, particularly from the earlier migrants of the 19th century, in terms of venous socio-economic attributes, intentions to migrate, and the diversity in destinations as well. Now-a-days, because of the euphoria about high rates of growth in India as well as insulation from the economic crisis, as compared to many other countries of the world, people from developed countries are also pouring in India to look for profitable business prospects, employment in the multinational companies and for education. But, despite having experienced major migratory flows, India's involvement in international migration lacks a well structured policy framework. Also, there are no relevant data sets on the out flows, inflows and stocks of migrants belongingto various categories and countries.

Assuming that migration is a process and requires a multi-level planning not only by the individual migrants but also by the family, the community, and the government, the paper discusses several important areas of migration cycle. This paper attempts to put together issues related to international migration in a global perspective and covers wide range of issues crucial for migration policy in India. The paper argues that migration policy cannot be formulated in isolation room the changes and developments taking place across the global socio-political spectrum and need to be in harmony withinternational law while acknowledging the rights of every stakeholder, i.e., the receiving country, thesending country, local communities in both the countries, and the migrants themselves.

Keywords: Migrants, brain Drain, Migration Policy, International Migration, Receiving and destination countries

2 INTRODUCTION

India is not only seen as an emigration country today, rather it also attracts a large number of people from across the nations in Africa, Asia and even in the West. However, the immigrants are quite different from Indian emigrants particularly in terms of their education, socio-economic composition and motivation. There have been large inflows of people from neighboring countries like Bangladesh, Nepal, Tibet, etc., which has even made significant changes in the demographic profile of some states in India. India is also fast emerging as a destination for many multinational companies (MNCs) to outsource some of their operations. Looking at the history of migration from Indian in the last two centuries four waves of substantial emigration are quite distinguishable:

1st Phase of migration: Started from the year 1830s and spanned a little over a century, dominated by Indian labour imported to fill the supply gaps in the plantations in British and other colonies, viz., Mauritius, South Africa, Malaya, Fiji, and other Caribbean countries.

2nd Phase of migration: took place especially after World War II, majority of Indian migrants headed towards the industrial nations of Europe and North America. Emigration of Indians to the Gulf in the 1970s, particularly in the wake of massive extraction of petroleum products and the subsequent construction booming constitutes.

3rd Phase of migration: beginning in the 1990 when Indian market opened up; and

4th Phase of migration: picking up in the early 21's century, from India consists of software professionals, management professionals and highly educated professionals who have migrated to the European countries, US and to South West Asian countries in particular.

Unlike 1st and 2nd phase, migration patterns from India today show a paradigm shift. Not only the UK, the US, Australia, Canada and the Gulf but a large number of countries in the European Union, countries in Africa and Asia are emerging major destinations for Indian emigrants. A foreign degree also opens gateways to enter in the international labour market.

Migration of Indians during 4th phases has been triggered and managed not by any considerate policy framework by the Indian state rather by the push factors at home on the one hand and the unstable demand supply gaps in the receiving countries on the other. Towards the end of the first phase the Emigration Act, 1922 was enacted to regulate the recruitment and emigration of low-skilled agricultural workers, but the Act remained silent on the issues of exploitation of emigrants and the emigration of people with technical qualification or professional expertise.

Even in the post-independence period international migration has not been paid considerable attention in the policy perspectives and the same old legislation kept in vogue until the enactment of the Emigration Act 1983. The Act, which made it mandatory for certain workers or prospective migrants put under a category called Emigration Check Required (ECR) to obtain clearances form the office of the Protectorate of Emigrants, under the Ministry of Labour, was put in place to protect the emigrant workers from abuses in the labour market.

Medical tourism is the new addition in the list of immigration to India. People not only from the developing countries but from the developed world too have now been heading to India. The immigration policies of the destination countries are being reshaped and remodeled by three important factors as under:

(a) Demographic imbalances and consequent labour shortages,

(b) Increasing pressure on internationalization and competition for superiority in the global market, and

(c) Security concerns to safeguard the interests of their local citizens from undesirable immigrants and terrorist activities.

Focusing on emigration, the questions facing India's policy stance are:

(a) Whether more out migration is good and should be encouraged, or is bad and therefore should be discouraged?

(b) Good for whom, bad for whom - for the country as a whole, for the migrants, for the family accompanying them, for those left behind?

(c) Is there an optimum rate of out migration?

(d) Whose emigration should be supported and whose to be restricted?

These are tough and serious questions which have no unique answers for all times to come. The migration policy addressing them must therefore have flexibility for incorporating amendments according to the changing circumstances and paradigms.

3 MAJOR MIGRANT CATEGORIES

Economic migrants: An economic migrant generally refers to a person who leaves his/her home country to work in some other country. Migrants belonging to all occupational or professional categories who primarily earn their livelihood by contributing in some economic activity are economic migrants and include all high-skilled, semi-skilled, and low-skilled people. Their entry into the destination country is facilitated by visa extending them legal right to stay there up to a certain period of time. There are specific statues/laws laid down by nation-states to regulate the entry, working conditions, wages/remuneration, integration, etc., for foreign country nationals in their territories. Majority of economic migrants choose legal channels but there are large number of economic migrants too who seek entry through illegal channels and therefore have to bear the wrath of the state for they are not allowed to engage in any economic activity.

Generally, people tend to improve their economic status through migrating; sometimes they are forced to migrate due to extreme poverty or unemployment as is the case in many countries of South Asia. Economic migrants flock in the places where employment opportunities are abundant and flee from those places where economic opportunities are shrinking. Silicon Valley in the US, for example, has become a hub for IT professionals in the late 20th century for it provided immense opportunities for the people. Economic migrants are not always pushed by the opportunity-deficient home economies; many times they are pulled by the receiving countries to avert the negative impact of labour or skill shortages arising due to reasons such as demographic imbalance or massive expansion of economic activities.

Majority of migrants in the world today are economic migrants. On an average, labour migration accounts for about 25 percent to 30 percent of permanent migration (Khadria, 2002; OECD, 2007). According to the Ministry of Overseas Indian Affairs "there are about five million overseas Indian workers all over the world. More than 90 percent of these workers are in the Gulf countries and Southeast Asia" (MOIA, 2008). Who are mainly unskilled or semi-skilled workers; and most of them too come back to India after the expiry of their contract. Majority of economic migrants who go to the developed countries, US, UK, Canada, Australia, etc., are better educated and skilled than their counterparts going to the Gulf.

Significant proportions of them intend to migrate for permanent residency in the countries of their destination. However, due to the better economic performance of their own countries in the last few decades and the stricter immigration policies of the destination countries in extending citizenship rights to migrants, increasing number of migrants going to the developed countries too also prefer to return to their own country or to some other country.

Family migrants: is one of the most important categories of permanent immigration that accounts for almost 45 to 60 percent of total flows (OECD, 2007). Economic migrants, who primarily move in order to better their employment and earning prospects, do keep in mind their long term interests too. They also want their family members (spouse, parents, siblings, etc.) to accompany them or to join them later, depending upon the laws of the destination country about family reunification. Migration, therefore, induces further migration.

Laws for family reunification are not universal in every country (IOM, 2000) and do vary in accordance with inter alia labour requirements of the receiving countries and their attitude in granting permanent or long-term residency rights to the immigrants. For example, developed countries that have traditional ties with countries in Asia and Africa such as the UK, and countries where the contribution of migrants, specially the skilled migrants, such as the US and Canada receive large number of migrants induced under the family reunification clause of their migration policy. On the contrary, family migration in the receiving countries where granting of permanent or long-term visa is almost prohibited, most of the economic migrants in these countries go on short-term labour contract and inevitably have to return to their home country after the expiry of the contract.

Family migration has important bearings for host country as well as for the home country. While it is presumed that family migration helps in better integration of the migrants in the host society as it provides emotional support to the primary migrants to adapt to the new society (IOM, 2000) there are also evidences that it may affect the integration adversely if immigrants form old different clusters and kept on following their original norms and traditions. Further, it may also induce other family members to engage in economic activities in the host society creating ripple effects on the local labour markets. Family migration also decreases the flow of remittances to the countries of origin because migrants have to spend more in the host country and save less. This can be seen from changes in the pattern of remittances India receives every year from developed countries and Gulf countries.

Political migrants: is a person who leaves his/her home country and tend to migrate to another country not because of an apparent economic motive but because of the fear of persecution in the homeland. Frequent occurrences of political, ethnic, religious and regional turbulences in some parts of the world, coupled with natural environmental disasters, have led to the affected people to leave their homes and seek asylum elsewhere. History is replete with the instances of people fleeing their homeland and seeking refuge elsewhere in the times of political turmoil. 20th century, perhaps, has witnessed unprecedented human sufferings because of the warring nation-states on the one hand and quest for political identity among various groups of people formed on geographical, religious, ethnic or ideological basis. People were forced to flee their homes and had to stay in refugee camps for many years. Estimates show that in 2000 there were 17 million refugees in the world constituting 9.7 percent of all international migrants up from 4.5 million or 5.5 percent in 1970 (IOM, 2005).

India has witnessed one of the most severe crises arising out of political instability during the time of partition. Millions of people became refugees overnight in their own homeland. They were brutally forced to flee to the other sides of the newly drawn border. Their properties were ransacked and their belongings were looted by the miscreant mobs of religious fundamentalists. In 2003, for example, India ranked among the top ten countries with 13,553 claims lodged for asylum in developed countries (UNHCR, 2004).

There is a great need for improving refugee protection and assistance in the regions of origin. The nation-states and other international regulators should now realise that patchy efforts are unlikely to prevent the movements of refugees and asylum seekers. Rather, a comprehensive regularisation policy needs to be devised taking into account the factors that generate human sufferings and force the people to flee and not just monetary compensation. The principle enunciated in the 'Agenda for Protection' established by the Office of the United Nations High Commissioner for Refugees (UNHCR), is that the institution of asylum should not be undermined by the efforts of states to stem irregular migration. As specified in Article 31 of the 1951 UN Refugee Convention, refugees must not be penalized on account of their illegal entry or presence in a country.

Students: Cross-border mobility of students for higher education has undergone remarkable increase during the last four decades. There has been a trend of internationalisation of higher education in many countries. The number of international university rose from about 238,000 in 1960s to 2.5 million in 2004 (Chen and Barnett, 2000; UNESCO Institute of Statistics Online). Majority of international students come from developing countries such as China, Korea and India, and prefer to go to the developed countries such as the US, the UK, Germany, France, Australia and Japan (Teichler, 1999). Students from India also have been heading offshore to pursue higher studies or to do research, particularly to the developed countries of the West. For example, over 150,000 tertiary level students leave India to study overseas every year (Financial Express, March 17, 2008). The U.S. has emerged as the most favored destination among Indian students. However, the mobility of Indian students today is not limited to the traditional destinations of US or UK; rather increasing number of Indian students have been moving to other countries like Australia, Germany, France, Canada, New Zealand and Singapore.

For many universities of the developed countries who recruit international students higher education has become an export good. The international representatives or education agents provide services like counseling, expert guidance on choosing courses and universities, ticketing, foreign exchange, orientation programmes, etc. Education Fairs are organised where representatives of different universities meet students and provide information regarding the courses offered and the kind of opportunities that the students might get if they decide to take admission.

However, the picture painted by the representatives of foreign universities may not be as rosy as it appears to be. Some of these universities may be ranked quite low in their own countries but might be able to lure students from countries like India where, prima facie, a foreign degree is considered better than the native degree on the pretext of quality education and post-degree placements. In these kinds of scenarios it is a genuine requirement from the state regulatory authorities to prepare the list of foreign universities and educational institutions who are accredited to recruit students from India with their international rankings and publish it from time to time. The Indian High Commission in the destination countries can be asked to keep track of Indian students and collect feedback from them regarding the universities and education agents. The Indian High Commission should also try to build networks with student bodies in the respective host country as it would help them address student issues better.

Illegal Migrants: is increasingly taking centre stage in most migration debates:

(1) Many countries across the world, developed as well as developing, are facing large influx of illegal migrants. Most often, they come from the neighbouring countries. For example, Bangladesh and Nepal, countries that share physical borders with India, are prominent source of illegal migrants to India. Illegal migration causes several kinds of problems in the local community and sometimes may bring far reaching impact on the socio-demographic profile of the receiving region/state,

(2) They also affect employment opportunities for locals in the region, by taking up jobs, sometimes even at wage rates much below the prevalent wages. Illegal migrants can broadly be put in the following categories:

- Legal (skilled/semi-skilled/low-skilled) migrants who lost their legal status due to overstay in the destination country.
- Illegal migrants (skilled/semi-skilled/low-skilled) infiltrated voluntarily.
- Forced illegal migrants brought through hazardous routes such as trafficking.

(3) Illegal migrants belonging to these categories differ in terms of their socio-economic profile, education,

employment and inclination. Therefore, migration law should take into account certain issues such as: who are the illegal migrants and where they have come from; what are their motives; what are the areas of their operation; when did they arrive and who helped them reach the destination; how do/can they affect the interests of the local population? But whatever may be the causes and nature of illegal migration, migration policy should aim at curbing illegal migration in all forms.

Nation-states employ various mechanisms to deal with illegal migration. Deportation of illegal migrants to their own countries is one such method. Deportation, which might appear quite the simplest, however, is difficult to implement. For example India has been following the policy of deportation since long but it has not brought enthusiastic results. UK and France are also encouraging illegal immigrants to return home voluntarily by offering them lump-sums and benefits to restart their livelihood. In 2006, Britain returned 6,000 illegal immigrants. However, this policy may also result in increasing the flow of illegal immigration in order to get good money and then come back.

4 AREAS OF KEY CONCERN IN MIGRATION CYCLE

Job and education search: It is a fact that majority of people who intend to move overseas do so for better employment prospects and therefore gather information regarding the job opportunities in the labour markets of their preferred destination countries from various sources, e.g., newspapers and employment news, online advertisements, companies' bulletins, personal contact of the people in the host country, and from recruitment agents. However, no systematic mechanism has been put in place for collecting, compiling and disseminating information about overseas job opportunities and educational avenues in India so far. Given the massive outflow of people from India in search of employment and for education as well systematic information related to different aspects of migration decision is imperative. This enunciates the need to develop an index for major destination countries based on certain variables such as access to labour market, prospects for family reunion, education, transportation, residential rights, political participation, political stability, migration governance, social security, climate and others.

Recruitment: Migrants are employed either directly by the employer or through some outsourcing agency or an agent. In India there are a large number of agents. As on 31st December 2007 there were 1835 recruiting agents in the country (MOIA, 2008). The task of these recruiting agents is to facilitate the process of emigration, particularly in case of low-skilled and semi-skilled people, and help them coordinate with their overseas employers. The recruitment agents could be asked keep informing the concerned state authorities from time-to-time about their clients in foreign countries and about the credibility of employers. Registered recruiting agents can be extended logistic support based on public-private-partnership model for keeping and maintaining the database, like working in collaboration with employment exchanges in India. But it is to be noted at the same time that everything is not topsy-turvy with migration agents. Many of them would be doing commendable jobs. But there is no system to recognize them and reward them accordingly.

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Passport: A passport is a document that recognises the individual as a citizen of the country granting it. It is a right of every individual in India to obtain a passport within prescribed timeframe after the payment of certain fee. Under the Passport Act 1967, three kinds of passports may be issued:

(a) Ordinary passport - to the citizens of India,

(b) Official passport - to the specified government officials of different categories, and

(c) Diplomatic passport - to the officials of the Indian Foreign Services and some other specifically identity. Mainly three kinds of documents are required for getting the passport (i) age related (ii) residential address related, and (iii) Educational certificates.

Due to the lack of a centralised network connecting all the 28 passport offices across the Country, quite a few times an individual has been issued more than one passport. This can have serious consequences for national security as by this way erroneous people can get into India using fake passports. At present, passports are either delivered by post or can be obtained by the person from the counter at the passport office. Both these modes of passport delivery are continuing for several years and have been good enough. But certain problems have been creeping up regarding the efficacy of these mechanisms.

Modem technology in data handling combined with systemic reforms can make the system quick and efficient. A national database of citizenship can be prepared. This database can be linked up with crime records (reports of the violation of law, misconduct, or criminal offence) available with police departments and investigation agencies across the states, and the judiciary.

Visa: A visa is an endorsement on the passport. It allows the holder to enter in the territory of the issuing country. Visas are generally of three types:

(a) Immigrant or permanent resident visa, issued to the persons who intend to immigrate or settle permanently in destination/receiving country;

(b) Non-immigrant or temporary visa, issued for a temporary period after which the holder of the visa will have to leave the country, visitor's visa, tourist visa, student visa, business, visa, work visa; and

(c) Transit visa, required when somebody passes through a foreign country which comes in the way to reach another foreign country as the destination. For getting transit visa, to and fro tickets are necessary to be produced along with the destination country visa.

Besides these common forms, several other forms of visa have been introduced in the last few years, e.g., airport visa, working holiday maker's visa. Airport visa is issued to those who tend to change a flight at the airport en-route to some other country. Working holiday maker's visa is issued to those who are allowed to work in the country for a limited time to satisfy primarily non-economic objectives. Coordination with foreign missions and consulates might help save the emigrants from being exploited at the hands of touts.

Travel and foreign exchange: Travel involves several decisions such as the air route, the cost of travel, check-in, arrangements of foreign exchange, etc. Due to the lack of specified and categorical mechanism of providing information on such issues many people have to bank upon the services of middlemen and agents, There is a need to develop some mechanism of collecting up-to-date information about it.

Settlement: Set dement in the host country involves many decisions starting from the choice of locality for accommodation, proximity from the site of employment, means of transportation, living conditions in the surroundings, and most important the cost of living. Also, one has to think about the medical facilities and security, especially in the countries where people are showing an increasing distrust and hatred towards the immigrants. There is a need for government intervention assuring people about their safety and security.

The growing scale of international migration is a response to the demand for workers in receiving countries. But, despite greater demand, the opportunities for legal entry and set dement of immigrant population are still limited. Along with the countries of origin, the destination countries should also work in harmony to promote the safety and protection of migrants. Also, nation-states are required to ensure that migrants are granted secure legal status to enhance the possibility of free movement between countries of origin and destination. This is likely to protect the migrants from falling into the clandestine ways and protect them from exploitation. A number of migrants resort to fake marriages with the citizens of the destination countries in order to become eligible for citizenship. However, laws have been amended in this concern in countries like the UK, but the resultant impact on the families is to be looked into as this causes unnecessary stress and troubles for honest migrants also.

Return and re-integration: Indians who went abroad in search of better educational and professional opportunities are returning home. Source countries like India, which once viewed the migration of their educated individuals as brain drain for they had an inclination for permanent set dement in the destination countries, are no more worried about the current scale of migration, including those of highly skilled individuals, for they are witnessing now that a large number of people tend to return home after having some foreign exposure. Their return is being seen as beneficial for the source country, as return migrants come back with improved levels of knowledge and technical skills, i.e., human capital.

However, the impact of return migration in the domestic economy depends to a large extent on the kind of migrants, that is, with which skill category the migrants belong to. It should inspire their confidence in their own country and 'homecoming' should no longer be felt a nightmare for potential returnees. It is very important to gain trust and confidence of the Indian overseas diaspora. As long as they do not perceive it worth while to return to the home country they will be hesitant.

5 OVERARCHING DOMAINS

Gender and international migration: At present, the number of people living outside their own country of birth is larger than at any time in history. Among the huge migrant population, nearly 50 percent are women. Unlike in the past, when women migrated mostly due to marriage, a large number of them are now migrating for work. In Asia, the number of women migrating from some countries has surpassed males. Migration can provide new opportunities for women to improve their lives, escape oppressive social relations, and support those who are left behind. But at the same time it can also expose them to new vulnerabilities as the result of their precarious legal status, abusive working conditions, exposure to certain health risks, and most importantly being perceived as weaker sex. Instances are abounding regarding the trafficking and exploitation of women by touts and agents, who sometimes force them into flesh trade. Due to the pitiable state of women migrants many source countries have started putting age restrictions, insisted on male guardian's consent and put temporary blanket bans. In the early 1990s, Bangladesh, India and Indonesia imposed minimum age restriction. Currently, the minimum age requirement for women to be eligible to migrate overseas in Indonesia and Pakistan is 22 years and 35 years, respectively.

Despite being a major source country India still does not have enough information on women migrants. There have been many studies from gender perspective in the field of international migration but significant work on the gender dimensions in international migration from India is not available. Khadria (2003, 2007) conducted studies in India but they were on migration of nurses. This gap needs to be bridged. Empirical studies on women migrants are required in region/state specific contexts capturing the condition of Indian women who have migrated either as immediate relatives and later on took jobs or directly migrating as economic migrants. The problems faced by them due to the triple effect of (i) being an immigrant, (ii) being a women, and (iii) profession specific as in the case of housemaids, etc., need in-depth investigation and fair treatment.

International migration and remittances: Increased labour mobility has led to an upsurge in the magnitude of money transfers across international borders as migrant workers send a large proportion of their earnings home to help families left behind. Remittances constitute a vast sub-economy upon which many nations depend to sustain their gross domestic product. Remittances have more than doubled in the past six years to $318 billion in 2008, of which $240 billion came from migrants from developing countries. Countries receiving the largest amount of money from their nationals working abroad were India ($27 billion), China ($25.7 billion), Mexico ($25 billion) and the Philippines ($17 billion). The main sources of remittances were the US ($42 billion) and Saudi Arabia ($15.6 billion) (World Bank, 2008). A major chunk of the remittances, comprising as much as 80-90 percent, is spent on consumption worldwide (Migration News, 2008), reflecting that the breadwinner is often abroad and that remittances substitute for local earnings.

Brady (2008) points out that migrants probably spend as much as $400 billion to their home countries each year, i.e., four times the West gives in aid. But the cost of transferring remittances can be extremely high. The Government of India has taken this issue with banks like the AXIS Bank and the State Bank of India and persuaded them to bring down the transfer cost reasonably low. In this regard some exclusive rights can be given to the banks to lower the transfer charges. Also, the migrants should be informed about the transfer rates charged by different banks.

Climate change and international migration: According to Dr. Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, current research in Asia indicate that South, Southeast, and East Asia will face risks of reduced agricultural productivity as large parts of the region face increased risk of floods and droughts. By 2025, cereal crop yields will decrease 2.5 to 10 percent. Economic refugees will perceive additional reasons to flee their homes because of harsher climatic conditions. Besides the movement within countries, especially to urban areas, many displaced persons will move into neighbouring developing countries, sometimes as a staging ground for subsequent movement onward to more developed and richer countries with greater economic opportunities. Many likely receiving nations will have neither the resources nor interest to host the climate induced migration. The consequences of global warming are expected to include faster rising sea levels (seas rose six to nine inches in the 20th century) and more precipitation at higher latitudes and less in semi-arid subtropical regions, many of which already suffer droughts. The US National Intelligence Council released a report in June 2008 that predicted destabilizing events around the world in the wake of climate change, including ethnic violence and illegal immigration (NIC, 2008). Climate change, according to the NIC, "will worsen existing problems such as poverty, social tensions, environmental degradation, ineffectual leadership and weak political institutions." The NIC predicted that the effects of global warming are likely to be most severe in sub-Saharan Africa, the Middle East and Central and Southeast Asia, where farm output may drop and encourage rural-urban migration (Migration News, 2008).

As India has also been experiencing climatic changes we need to explore the impact that climate change and the consequent movements of people could have on migration. India should analyse the possibilities and the risks involved and also how to deal with such a situation of climate induced migration.

Terrorism and international migration: The separatist movements in different countries and the increasing extremism related to some religions and sects have arisen as a serious threat to the very existence of a peaceful coexistence of distinct human identities across nations. This phenomenon has serious implications for international migration also and has been occupying significant space in migration debates particularly after the 9/11 incident. The key factors that spawned international terrorism show no signs of abating over the next some years.

Moreover, they harm the prospects of cross-border movement of people like international tourists by creating panic which affects the livelihood of the local populace quite adversely. On the linkages of migration and terrorism State for External Affairs, Government of India, once told the United Nations General Assembly that many a times, illegal migrants have been found involved in terrorist activities in India (Indian Express, 2006). Besides tackling the issue on its own India has raised this issue time and again at bilateral and multilateral platforms, but the fact remains that no comprehensive mechanism to deal with this threat has yet evolved. There is an urgent need for India to win the confidence of the global community in its anti-terror mechanisms.

International migration law: Putting the international refugee regime aside, there is little internationacooperation on migration at the global level and no truly international migration regime exists to date. There are the longstanding but under-subscribed conventions of the International Labour Organization (ILO), limited cooperation in practice on high-skilled migration under the General Agreement on Trade in Services (GATS) and increasing cooperation on illegal migration, human smuggling and trafficking within the context of the United Nations Convention on Transnational Organized Crime.

The fundamental obstacle to international cooperation on labour migration, as Ari Zolberg (1991;1992) and James Hollifield (1992) have pointed out, is that migrant destination countries have little incentive to join such a regime because foreign labour, especially low skilled labour, is in abundant supply. A global migration regime may make sense for reasons such as increasing economic efficiency worldwide, ensuring poor migrant source countries' access to the wealthier migrant destination markets, and for the sake of international development and reducing global inequalities.

Future of migration: Due to shortage of labour in many of the developed countries, there has been an increasing competition among them to attract skilled labour from developing countries. This tendency of fulfilling labour shortage in the developed countries by imported manpower is perceived to pose certain challenges as well as provide opportunities for source countries. India being a leading labour export country has to ponder over the future impacts that this may have on the Indian economy as well as the Indian Diaspora. Considering the demographic shifts and India's own position in producing human capital two possible scenarios emerge for India:

6 FINDINGS

In order to maximize the positive impacts of cross-border migration and minimize the negative consequences veritable statistics is fundamental requirement. Data related to various aspects of migration such as flow/stock of migrants, destination countries, countries of origin, profile of migrants, their intentions, mode of crossing borders, legal status, remittances, etc., for all migrants should be collected. However, the fact is that despite growing scale of international migratory flows necessary statistics in India is not easily available simply because it is neither collected properly nor maintained. At present, statistics relevant to migration is being collected in India for different purposes by different government departments and other organisations, namely, Bureau of Immigration, Protectorate of Emigrants, Ministry of External Affairs, Office of the Registrar General and Census Commissioner and National Sample Survey Organization (NSSO). Since migration statistics is collected by different agencies to meet their own individual requirements and differs in coverage, it purportedly lacks uniformity and comparability. Some academic institutions such as Centre for Development Studies, Kerala, are also engaged in collecting and analysing migration data with focus on unskilled migration. However, it would really be very ambitious to expect from individual institutions to provide a comprehensive coverage of migration form a country like India. This situation warrants sequential coordination between various government departments, universities and institutions involved in study and monitoring of migration.

India losing out: According to the World Population Council the productive population of India, i.e., people belonging to the age group 15 to 60, will stop increasing in the coming years and it will stabilise at 64 percent of the total population from 2025 to 2050 and will decrease thereafter to 62 percent of the total population in 2050 Gain, 2008). It may lead to shortage of skilled labour in India too, if the present rate of migration from the country continues unabated. The government is right now focusing on the immediate benefits associated with emigration. But the pattern of emigration shows that the migrants belong to the high-skilled categories such as the scientists, engineers, doctors, management and IT professionals, academicians, who are already in short supply, may lead to decline in productivity. Also, the education system shall face severe shortage of teachers and researchers resulting in poor quality students passing out from educational institutions.

India gains: The second scenario postulates that India along with China would emerge as a major global player having an immense impact on the geo-political landscape. India is well positioned to become a technology leader in the coming decades. Sustainable high economic growth, expanding military capabilities and large demographic dividend will be the contributing factors to the expected elevation of the country. Knowledge and technology involving the convergence of nano, bio, information and material technology could further its prospects in the forthcoming global economy. Substantial enhancement of financial recourses in social sector, especially on education and research, would help India to become the largest source of knowledge professionals in the world.

The two scenarios just described are based on the recent indicators of economic performance and potential for future growth. Nothing is sure to happen. Nevertheless, projections provide food for intellectual engagement and help moving ahead with certain degree of expected outcomes. Projections, therefore should be given due importance in policy perspectives if they are based on solid empirical indicators. Migration policy of India should, therefore, be based upon vital datasets of social and economic importance.

7 CONCLUSIONS

This paper has tried to cover a wide range of issues concerning the subject of international migration in India. It presumes that migration decision-making and processes are overarching fields which requires a well structured policy framework taking care of the concerns of both countries, i.e., the host country and the country of origin. Migration affects and gets affected too by a large number of issues and developments taking place in the larger socio-political context and cannot be governed or managed by unilateral laws. In order to create a win-win situation for all the stakeholders, viz., the destination country and the host society, the country of origin, the local community and the migrants, developing a national migration regime necessitates working in tandem with other participating nation-states as well as the related international organizations through bilateral and multilateral dialogues. Various concerned departments such as education, labour, home, and foreign affairs need to work out a comprehensive long-term plan to reap the advantages of India's large quantum of un-nurtured or under-nurtured human resources.

8 REFERENCES

A Report, The Ministry of Statistics and Programme Implementatio, National Sample Survey Office: http://mospi.nic.in/

Brady, Hugo (2008), "EU Migration Policy: An A-Z", Centre for European Reform, February.

Indian Express (2006), "India Links Illegal Immigrants to Terrorism", September 15, http://www.expressindia. com/news/fullstory.php?newsid=73906.

India Together (2007), "Grounded till Thirty", August 21, 2007 http://www.indiatogether.org/2007/aug/wom-migrant.htm.

IOM (2000), World Migration Report 2000, International Organization for Migration & United Nations (2005), World Migration 2005: Costs and Benefits of International Migration, International Organization for Migration, Geneva.

Khadria, B. (2002), "Skilled Labour Migration from Developing Countries: Study on India", International Migration Papers 49, International Labour Office, Geneva.

MOIA (2008), Annual Report: 2007-08, Ministry of Overseas Indian Affairs, New Delhi: Government of India.

Murphy, Kara (2006), "France's New Law: Control Immigration Flows, Court the Highly Skilled", Migration Policy Institute. November. available online: http://www.migrationinformation.org/Fearure/display.cfin?id=486.

NIC (2004), Mapping the Global Future, Report of National Intelligence Council's 2020 Project, National Intelligence Council, Pittsburg, PA.

NIC & NIA (2008), National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030, National Intelligence Council and National Intelligence for Analysis, Pittsburg, PA.

OECD (2007), "On the Move: International Migration", DELSA Newsletter, Issue 5, OECD Directorate for Employment, Labour and Social Affairs, www.oecd.org.

STI Working Papers (2004), Migration of Highly Skilled Indians: Case Studies of IT and Health Professionals, 2004/6, April, OECD, Paris.

Straubhaar, Thomas (2000) "Why do we Need a General Agreement on Movements of People (GAMP)?", in Bimal GHOSH (ed.), Managing Migration. Time for a New International Regime?, Oxford: Oxford University Press, pp. 110-136.

Teichler, U. (1999), "Internationalisation as a Challenge for Higher Education in Europe", Tertiary Education and Management, 5: 5-23.

UNHCR (2004), "Afghan Refugees to Resolve Disputes before Leaving Iran", United Nations High Commissioner for Refugees, 21 May.

UNFPA (2006), "State of the World Population". United Nations Population Fund. Wickramasekara, P. (2002), "Asian Labour Migration: Issues and Challenges in an Era of Globalization", International Migration Papers, 57, International Labour office, Geneva.

World Bank (2008), "India Top Receiver of Migrant Remittances in 2007, Followed by China and Mexico", http://web.woridbank.org/WBSITE/EXTERNAL/NEWS/0"contentMDK:2I692926-pagePK:34370-piPK:34424-the SitePK:4607,00.html &"Global Remittances", (2008), 14(1), January.{2008), "Climate Change and Migration", 14(3), July.

Zolberg, Aristide (1991), "Bounded States in a Global Market: The Uses of International Migration Regimes", In P.B. and J.S. Coleman, eds., Social Theory for a Changing Society, Boulder, Colorado: West view Press.

Zolberg, Aristide (1992), "Labour Migration and International Economic Regimes: Bretton Woods and After", In International Migration Systems: A Global Approach, eds., M.M. Kritz, L. Lean Lim, H. Zlotnik. Oxford: Clarendon Press.

reviewed paper

How to Strengthen Non-Motorised Mobility of Elderly People? An Evidence-based Manual for the Set-up of Fall Prevention Programmes in Communities

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1 ABSTRACT

In the course of life, mobility behaviour and needs change and have to be adapted. With growing age, muscle mass reduces continuously. If this natural degradation process is not countered, the risk of falls and getting injured increases. Once a person has experienced a fall, the fear of falling again is likely to evolve. As a consequence, physical activity is associated with feelings of insecurity and is therefore avoided (post-fall-syndrome). Within the age group 55 years and older, almost a quarter of occurring falls in Austria happen in traffic (KFV, 2016). Thus, motivity and health are key prerequisites for a safe, independent and injury-free mobility. In order to tackle this topic, the Austrian Road Safety Board (KFV) developed the project "Pimp your Skills"[1] (Eichhorn et al., 2016), which focused on strengthening non-motorised mobility of elderly people and, particularly, on fall prevention. As a result, a manual on setting up an effective fall prevention programme for adults is now available.#

Keywords: balance and strength, fall prevention, non-motorised mobility, elderly, effective intervention

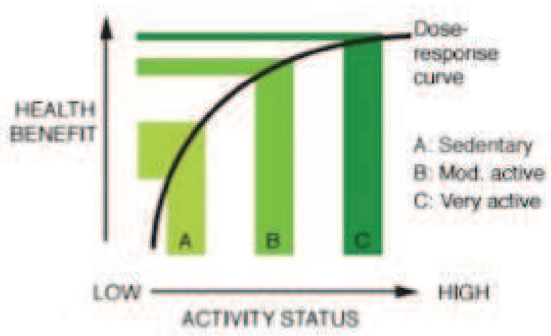
2 INTRODUCTION

In Austria, the demographic trend shows a growing, yet also ageing population. With increasing life expectancy and the baby boomer generations of the early 1960s now reaching retirement age, the number of people over the age of 65 will grow most in the future. Over 18% of the Austrian population are now in the age of retirement: a steadily growing trend that results in an ageing population. This unfolding demographic trend in Austria also has a strong impact on the mobility of older people.

As people get older, they are more and more faced with health-related and/or physical restrictions that also affect their choice of mode of transport. The available modes of transport, technological developments and personal attitudes likewise play a key role. While the car remains an important mode of transport for younger senior citizens, walking increases among the age group 75+.

However, the importance of walking in daily life is currently underestimated in mobility studies. Each individual route, no matter what primary means of transport is used, also includes a more or less longer walking distance. Consequently, walking is an essential part of everyday mobility. Experts agree that mobility and health are crucial prerequisites for being able to travel safely, independently and without injury, especially with growing age. Regular walking has a positive effect on one's own fitness[2] and on the other hand fitness itself is an important basis to choose walking as a mode of transport at all.

According to Pate et al. (1995) the dose-response curve represents a good estimate of the relationship between physical activity (dose) and health status/benefit (response). The lower the baseline physical activity level, the greater the health benefit associated with increased physical activities.



[1] Funded by the Austrian Road Safety Funds.

[2] According to the WHO (2010) older adults who are physically active exhibit higher levels of functional health, a lower risk of falling, and better cognitive function.

Fig. 1: Relationship between physical activity and health. Source: Pate et al. (1995).

Though, as accident figures in Austria show, the risk of falling increases disproportionally with growing age. In order to address the importance of active mobility with growing age adequately, the Austrian Road Safety Board (KFV) carried out the project “Pimp your Skills” (Eichhorn et al., 2016[3]). As it is essential to take note of both social and individual factors of influence the project considered trends in society (demographics, megatrends, future scenarios and mobility parameters) and analysed individual circumstances (lifestyles, motives, impairments and mobility behaviour). The results and insights obtained through the project with regard to independent non-motorised mobility formed the basis for a manual on setting up an effective fall prevention programme for adults. The paper presents the theoretical background and the manual itself.

3 CHANGES IN DAILY LIFE AND THEIR IMPACT ON THE RISK OF FALLING

Among other things, biological degradation processes in old age affect mobility, strength and stamina.

With reference to the sensorium, the visual perception and thus the recording and processing of visual information are reducing; e.g. especially in the case of changing or deteriorating light conditions level differences are seen less well. With increasing age in addition acoustic signals are perceived delayed or not at all.

Motor skills (stamina, strength, speed, motility and coordination) are also subject to a change in advanced years. Most notably a reduction in muscular strength and mobility is observable; e.g. a mobility loss of the cervical vertebra impedes looking to the left and right when crossing the road. Longer standing and longer walking routes as well as overcoming stairs and unevenness can also be experienced as very exhausting.

In addition, many older people suffer from disturbances of balance that can cause dizziness. It should also be noted that the use of medication can lead to side effects that affect balance as well.

These physical changes and uncertainties also affect psychological, social and emotional areas. Stress and anxiety, e.g. of crowds or falls, can lead to the fact that trips outside the home are avoided.

3.1 Balance and stability

Balance, on the one hand, is important in order to coordinate movements and, on the other hand, to react quickly and appropriately in the event of a fall. As well as muscle strength, the balance ability decreases by degrees with growing age. These processes start already at the age of 40. Furthermore, a reduced reaction time in older age leads to a greater vulnerability in case of a fall.

Several perception systems are responsible for the maintenance of the balance:

(1) The vestibular system, which forms a part of the inner ear, perceives the position of the head and the body, and senses any body movement. This allows for controlling the reflexes in case of a fall.

(2) The visual system (eyes, optic nerve) informs about the position of the body in the room.

(3) The so-called sensory receptors (e.g. muscle receptors, mechanoreceptors, or free nerve endings) are located in muscles, joints, tendons, fascia and skin and control the body.

The information from these three systems is processed by the central nervous system. When it comes to balance fluctuations, it reacts to these irregularities and triggers corresponding reflexes (positional changes, muscle tension). Thus, in the case of a fall we are able to support ourselves in time with our hands. Through a balance training this "reaction process" can be improved.

In summary, balance for older ones is important for

- walking on uneven or sloping surfaces
- carrying trays, glasses/cups etc.
- an appropriate response to changes in position (interception of a fall)
- a safe and anxiety-free mobility in everyday life

[3] The final report can be downloaded at: https://www.bmvit.gv.at/verkehr/strasse/sicherheit/fonds/vsf/55_pimp.html

3.2 Muscular strength

Already from an age of 30 years a continuous reduction of muscle mass occurs, if you don't do something about it. Muscle reduction in lower extremities can gradually lead to an increased risk of falling. Lest this loss affects everyday activities, muscularity should be strengthened at an early stage. Muscular strength can be trained at any age.

Exercises that strengthen the following muscle groups are recommended:

(1) Leg muscles (e.g. quadriceps, biceps femoris, foot muscles)

(2) Arm and shoulder muscles

(3) Back and abdominal muscles

Especially strengthening the front of the upper thigh muscles is crucial for fall prevention. It should be remembered that strength training alone is not sufficient to avoid falls. According to Becker and Blessing-Kapelke (2011), a combination with exercises for balance is a prerequisite for a successful fall prophylaxis. According to Lacroix et al. (2014) a ratio of 2/3 balance training and 1/3 strength training has proven to be most effective.

In summary, sufficient muscle strength for the older ones is important to:

- support a straight position
- prevent muscle mass from degradation
- reduce the risk of falling
- protect the joints from pain
- be able to get up again in case of a fall and to
- enable independent mobility.

4 FALL AND FALL PREVENTION

Studies show that about a third of people over 65 years fall at least once a year (Sattin, 1992; Fall Prevention Center of Excellence, 2016). The older a person is, the more likely an injury arises from a fall.

The accident figures in Austria provide a clear picture as well: over 231,200 persons aged 55 or older annualy are treated in the hospital because of a fall, of which almost a quarter occurs on traffic areas (KFV, 2016).

Age	Number of hosiptal-treated falls	Proportion of falls in the age group
55-64 years	50,900	5%
65-74 years	60,900	7.3%
75+ years	119,400	17.2%

Table 1: Proportion of hospital-treated falls aged 55+, Austria (extrapolation average of the years 2011-2015). Source: IDB Austria.

4.1 Main risk factors of falls

Most falls are caused by a combination of several risk factors. The more risk factors a person is exposed to, or the more pronounced a risk factor is, the greater the probability of falling.

It can be differentiated between intrinsic (personal) and extrinsic (environmental) factors causing falls (Gschwind et al., 2013; Todd et al., 2004; O'Loughlin et al., 1993).

Intrisic factors are:

- advanced age
- previous falls
- fear of falling
- muscle weakness
- medication
- mobility and balance disorders

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- visual and hearing disorders
- dizziness
- chronic diseases, e.g. incontinence, diabetes mellitus, metabolic syndrome

Extrinsic factors are:

- tripping hazards like cords and wires or carpets
- poor light conditions (unlit paths)
- unsuitable stairs (missing railings)
- slippery floor
- unsuitable shoes
- poorly adapted or misused vision aids
- poorly adapted walking aids

However, external factors play a minor role as about 90% of falls are attributed to intrinsic risk factors. In the majority of cases, diminishing or lacking muscular strength and a deterioration of balance are crucial factors.

4.2 Consequences of falls

With growing age, the severity of injuries caused by a fall increases and as a consequence, more severe physical and psychological changes are observed. Approximately 10% of falls lead to serious injuries (Eichhorn & Aigner-Breuss, 2016).

In many cases, a fall leads to a trauma that may change the usual way of life: if elderly have suffered a severe fall; e.g. fracture of femur, and had an inpatient treatment, severe consequences for their independent living are likely. Whereas three quarters of older people were still able to walk independently and without aids before a fracture this was the case for only 15% after a severe fall (LZG, 2010).

Such falls can set up a negative cycle called post-fall syndrome. Once an elderly person suffered a severe fall, the fear of falling anew is rising and self-confidence in their own physical abilities is reduced. Walking and cycling is then associated with anxiety and insecurity. Thus, all situations that appear risky or uncomfortable are avoided. If a person is untrained this leads to less activity and as a consequence to a deplation of the interaction between muscles and nerve system. This is manifested in angular, tense, and insecure movements. Subsequently, less movement leads to a further decrease of muscle strength and balance which in return results in even more uncertainties. At the end of this negative cycle stands the loss of daily living skills and social isolation.

Fig. 1: Post-fall-syndrome. Source: bfu (2015). Editing: KFV

5 BE FIT – STAY MOBILE MANUAL

In most cases, the causes of a fall are a diminished or a lack of muscular strength and a deterioration of balance. However, muscularity and balance can be trained and improved at any age. This means that every person can minimize his or her risk of falling due to muscle and balance training and the maintenance of fitness.

5.1 Impacts of fall prevention programmes

Fall prevention programmes usually include a combination of strength and balance exercises, a training of one's own body awareness and an improvement of posture.

An additional benefit of a group training is gaining new social contacts, which in turn can contribute to a positive reinforcement and subsequently to more walking and cycling in daily life. An attractive and theory-based fall prevention programme thus cannot only significantly improve independence but also quality of life.

Fall prevention programmes have different approaches, with a strong variation of the achieved impacts. The following elements proved to be most effective (Sherrington et al. (2008), Todd et al., 2004; Becker et al., 2009; Lacroix et al., 2014):

- Balance exercises have the greatest impact on reducing the risk of falling. Strength exercises alone do not seem to have a positive effect. Stamina and stretching exercises alone are not suitable for fall prevention either.
- The training should be carried out at least 2 hours a week and as long as possible (at least six months), but most preferably permanently.
- Two exercise units per week show better effects than one exercise unit per week.
- The programmes can be done as a group activity as well as at home alone. However, group exercises seem to have greater training effects. Study results recommend a combination of group activity and self-activity at home.
- The programmes should be tailored to the needs of the target group to ensure that they are both challenging and safe at the same time.
- An effective programme should enhance performance by 20%.
- Before the start of a programme, a motor function test should be mandatory to assess the individual fall risk.

Among others, the Otago Exercise Programme (Campbell, J. & Robertson, C. (2003) as well as the Swiss Fall prevention training (Lacroix et al., 2014) were able to show positive effects.

5.2 Content and structur of the manual

Based on the results described above, the “be fit – stay mobile” fall prevention manual was developed by KFV experts in the field of mobilty, supported by an external sport scientist (Eichhorn & Aigner-Breuss, 2016).

The manual is aimed at professional trainers and provides guidance on setting up a tailored fall prevention programme for adults, in particular for the age group 50+[4], which can be carried out in different settings.

The manunal is divided into three blocks. The first one points out the importance of activity to maintain independence in old age. The second section specifies the design of an effective training programme and the last chapter additionally gives activity tips for everyday life. Subsequently, section 2 of the manual, is described in more detail:

At the beginning of every training programme it is recommended to carry out a set of motor function tests to determine the risk of falling. At the end of the programme (ideally after 6 months), these risk assessment tests should be repeated in order to give feedback on possible improvements. All 5 tests described in the manual correspond to the quality criteria of practicability, validity and reliability.

[4] Experts agree that fall prevention has to be initiated before the risk of falling is raising. Thus, the “be fit – stay mobile” manual suggests to start with fall prevention as early as possible, but at least at 50 years.

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Selected balance and strength exercises within the manual include various levels of difficulty in order to address persons with already slightly reduced mobility as well as those who are still active. In accordance with evaluated fall prevention programmes (e.g. Lacroix, 2014) 2/3 of the “be fit – stay mobile” training exercises addresses balance and 1/3 muscular strenght.

Besides physical exercises the manual suggests to include information sequences in the training units. These provide background to the exercises in particular and to the topic fall prevention in general.

Experience shows that older people are difficult to reach and to motivate for preventive measures. Therefore, the manual further provides suggestions on how to address different target groups and gives examples on how to implement a fall prevention programme in varied settings. Within the project “Pimp your Skills” four different types of active mobility could be derived in that respect.

- People of the “adventurous” type are very mobile and a lot of them are still working. They can be characterised as open-minded, flexible and easily to be enthused by new ideas or options (particularly, there is a keen interest in technological innovations). They don’t exercise for the sake of their health, they do so for fun. Health in itself is not an important issue for this group.
- People of the “responsible” type are very mobile as well. They can be described as conscientious and ecologically sensitive. This is expressed in a conscientious lifestyle. Health is more important to this group than fitness, which is also reflected in a very high proportion of every day cyclists.
- People of the “wait-and-see” type are partially retired. Physical activities are especially done when external stimuli are offered, e.g. get-togethers with friends or family. They often play an important role in the family and take on care tasks. This group could be motivated by health and environmental issues.
- People of the “comfortable” type are mainly retired. They can be characterised above all as comfortable and safety-driven, e.g. cycling is experienced as rather unsafe. Health and fitness issues do not have any priority, and this group shows only limited willingness to try something new. If at all, they could be addressed with environmental issues.

Aditional information on these types of mobility (training contents, examples for different settings and a listing of possible and appropriate strategic partners) in the manual enables the trainer to motivate different participants in a respective way.

Printed versions of the manual are distributed on congresses or in interested communities. The online version (German language with English abstract) is available at the KFV website.[5]

6 CONCLUSION

Walking is a fundamental part of daily mobility in growing age. However, the age group 65+ shows an increased risk of falling and changes of physical conditions due to ageing. This has consequences on mobility behaviour. Nonetheless, effective fall prevention programmes prove that these changes are reversible to a considerable extent. Therefore, fall prevention programmes are effective to maintain independent mobility as long as possible. The manual “be fit – stay mobile” addresses persons with a professional background in the field of physical activity or therapy. Furthermore, it is aimed at multipliers who want to develop and promote exercise programmes in municipalities or institutions.

In a next step, a fall prevention pilot training on the basic suggestions of the manual will be developed including an evaluation of the effectiveness comparing a test and control group. Additional to physical changes raising knowledge on the correct performance of strength and balance exercises as well as enhancing self-efficacy should be initiated.

7 REFERENCES

BECKER, C. & Blessing-Kapelke, U. Empfehlungspapier für das körperliche Training zur Sturzprävention bei älteren, zu Hause lebenden Menschen. In: Zeitschrift für Gerontologie und Geriatrie, Vol. 2/2011, pp. 121-128, 2009.
BFU – Beratungsstelle für Unfallverhütung. Sturzprävention in der Physiotherapie. Fachbroschüre. Bern, 2015.
CAMPELL, J. & Robertson, C. Otago Exercise Programme to prevent falls in older adults. Otago Medical School. 2003

[5] https://www.kfv.at/fileadmin/user_upload/Handbuch_Skills.pdf

EICHHORN, A., Aigner-Breuss, E., Kaiser, S., Strohmeier, F., Pröstl, S. & Braun, E. Pimp your Skills. Verkehrssicherheitsmaßnahmen für „Best Ager“ von heute und morgen. Forschungsarbeiten des Österreichischen Verkehrssicherheitsfonds. Band 055. Wien, 2016.

EICHHORN, A. & Aigner-Breuss, E. Fit sein – mobil bleiben. Anleitung für den Aufbau eines Sturzpräventionsprogramms für Erwachsene. KFV, 2016.

FALL PREVENTION CENTER OF EXCELLENCE, 2016. Last access on 2017/06/02 at http://stopfalls.org/what-is-fall-prevention/fp-basics/

GSCHWIND, Y.J. & Pfenninger, B. Training zur Sturzprävention – Manual für Kraft- und Gleichgewichtstraining zur Sturzprävention im Alter. bfu – Beratungsstelle für Unfallverhütung. bfu-Fachdokumentation, 2.104. Bern, 2013.

KFV, Injury Data Base Austria extrapolation, 2011-2015, mean-values of falls due to walking or cycling: Interviews with injured persons with principal residence in Austria, who get after-treatment in an emergency department. Vienna, 2016.

LACROIX, A., Kressig, R.W., Mühlbauer, T., Brügger, O. & Granacher, U. Effekte eines Sturzpräventionstrainings. bfu - Beratungsstelle für Unfallverhütung. bfu-Grundlagen. Bern, 2014.

LANDESZENTRALE FÜR GESUNDHEITSFÖRDERUNG IN RHEINLAND-PFALZ E.V. (LZG). Sturzprophylaxe durch Bewegung. Materialien zur Gesundheitsförderung, LZG-Schriftenreihe Nr. 121, 2010.

O’LOUGHLIN, J., Robitaille, Y., Boivin, J.F. & Suissa, S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. In: American Journal of Epidemiology, Vol. 137, Issues 3, pp. 342-54, 1993

PATE, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., Buchner, D., Ettinger, W., Heath, G. W., King, A. C., Kriska, A., Leon, A. S., Marcus, B. H., Morris, J., Paffenbarger, R. S., Patrick, K., Pollock, M. L., Rippe, J. M., Sallis, J. and Wilmore, J. H. Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. Journal of the American Medical Association, Vol. 273: pp. 402–407, 1995.

SATTIN, R.W. Falls Among Older Persons: A Public Health Perspective. In: Annual Review of Public Health, Vol. 13, pp. 489-508, 1992.

SHERRINGTON, C., Whitney, J., Lord, S.R., Herbert, R.D., Cumming, R.G. & Close, J. Effective exercise for the prevention of falls: A systematic review and meta-analysis. In: Journal of the American Geriatrics Society, Vol. 56, Issues 12, pp. 2234–2243, 2008.

TODD, C., Skelton, D. What are the main risk factors for falls among older people and what are the most effective interventions to prevent these falls? Copenhagen, 2004.

WHO. Global recommendations on physical activity for health, 2010. Last access on 2017/07/20 at http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979_eng.pdf

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Human's Digital Space – What about the Metrics?

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1 ABSTRACT

At the recent conference, CORP 2016, the idea about free space around a human has been discussed. In GIS systems, there are 1D, 2D, 3D, 3D+t representations of geographical elements and others features. According to GIS applications, a human also can be regarded as an object of GIS presentation and investigation for end users, software agents etc.

In this paper, we would like to continue our research regarding human's digital space (HDS). A very important object of our discussion is a metric for HDS properties. However, if we are speaking about metrics, we should take a look at classical mathematics. A short review of mathematical definitions of space and their metrics is also discussed. Our preliminary research has shown that Hausdorff measure (a special mathematical measure used to calculate length, area and volume of non-specific figures) discovers new opportunities for realisation of different kinds of business logics in complex multidimensional and implicitly specified spaces. In HDS, investigation the Hausdorff measure could be used as an approach for numerical interpretation of HDS properties.

Keywords: Human's Digital Space, Hausdorff measure, GIS, 3D, Space definition

2 INTRODUCTION

In philosophy and some classical mathematics sources, we can find that the metaphysician Immanuel Kant said that the concepts of space and time are not empirical ones derived from experiences of the outside world—they are elements of an already given systematic framework that humans possess and use to structure all experiences. Kant referred to the experience of "space" in his Critique of Pure Reason [5] as being a subjective "pure a priori form of intuition". According to Kant, knowledge about space is synthetic, in that statements about space are not simply true by virtue of the meaning of the words in the statement. According to this, Kant rejected the view that space must be either a substance or relation. Instead, he came to the conclusion that space and time are not discovered by humans to be objective features of the world, but imposed by us as part of a framework for organizing experience.

Modern scientists usually fall under two opposing groups: overt opponents and adherers of Kant's idea. While not being experts in a field of philosophical inquiry, we, however, can note that we are closer to Kant's idea, since in computer science, and especially in geoinformatics, this idea becomes a very good ideological basis for designing of actual technology and applications [8].

For a common case, space exists independently of events and experiments. Taking in mind philosophical aspects of space, we should also note that the GIS has strong applied sense. According to this, two ideas should be investigated together: absolute space and relative space [2].

Considering such complex history of this term and its current ambiguity, we should address its mathematical definition. All the more so because in our field of study, in geoinformatic field, anthropological nuances do not aid, but, in fact, obscure this truly important matter. In [1] and other mathematical sources, the mathematical term of "space" can be defined as [1] "mathematical set that possesses structure defined by axiomatic properties of its elements (e.g. points in geometry, vectors in linear algebra, events in probability theory and etc.). Subset of space is called "subspace" if space structure initialises the structure of same type on this subset (the exact definition depends on space type)".

The term "space" for mathematics turned out to be extremely useful. Let us give a partial list of various types of space in mathematics:

- Affine space is a space that generalizes the properties of Euclidean spaces. It is mostly similar to vector space, however, affine space is distinctive by the fact that all its points are equal (in particular, the concept of zero point is not defined in it).
- Banach space is a complete normed vector space.

- Probability space is a concept, introduced by A.N. Kolmogorov in 1930s in order to formalise the concept of probability that originated the rapid development of probability theory as a strict mathematical discipline.
- Hilbert space is a generalisation of Euclidean space that allows infinite number of dimensions.
- Euclidean space, in initial terms, is a space which properties are described by Euclidean geometry axioms. In this case, it is assumed that the space is three-dimensional. In modern understanding, in more general sense, it can denote one of closely related objects: finite-dimensional real vector space with positively defined scalar product, or metric space corresponding to such vector space.
- Normed space is a vector space on which a norm is defined.
- Vector space is a mathematical structure that represents a set of elements (points) called vectors, for which operations of addition and multiplication by number (scalar). These operations are defined by eight axioms.
- Metric space is a set for which distance with certain properties (metric) between any pair of elements is defined.
- Minkowski space is a four dimensional pseudo-Euclidean space with signature, suggested as an interpretation of space-time in the special theory of relativity. For every event there is a corresponding point in Minkowski space in Galilean coordinates.
- Topological space is a set with additional structure of certain type (so called topology). It is one of objects of study for one of branches of mathematics also called topology. Historically, the term "topological space" originated as generalisation of metric space.

The classification of mathematical term "space" given above has formed historically and it reflects the level of generalisation of fundamental concepts of "point", "measure" and some other qualities. A question emerges: can HDS belongs to one of the listed types or to a number of them? Of course, it can. For example, common for ordinary person Euclidean space, topological space (navigational format C57) and some others.

At the same time, we should note that at present time such traditional notions like "space", "set", "point" are failing to satisfy not only theorists but practitioners as well. These contradictions can be clearly represented for HDS. The notion of "point" is so abstract that it becomes more and more difficult to create applicable along with theoretical interpretation and to refer it to one of the types of mathematical spaces, described above. The case is that it is physically impossible to denote the term "point" in traditional sense (some abstraction indicating coordinates). We always deal with a certain multidimensional, at least with dimension of three, neighbourhood of some point that cannot always be denoted as a centre of some local coordinate system. In addition, even if we do so, there is no positive gain from this abstraction. An attempt to solve practical tasks for HDS as a GIS object leads to piling of large abstractions and relations between them. It is no coincidence that in Java programming language there are no simple abstract data types like point, line etc., as there were in preceding languages. They used to be practically identical to notion of "point" in Euclidean space. In Java we initially have a notion of "object" and it is very right. In other words, we have a defined set with given structure. Term "object" cannot be referred to the term "set" in algebra. This is a new concept more closely related to the concept of "category" [7]. Therefore, the term "point" cannot be constricted to just some coordinate vector. Moreover, consequently, the term cannot be referred to any of the known abstract data types apart from "object". In this context, we have no simple analogue for known mathematical definitions of space.

At this rate, the question arises: what is space for HDS in GIS? If it is a point, the basis of practically any space, then, after generalisation of "point" concept, we have to define what space for GIS denotes. Complexity of analysis of this concept also arises from the fact that GIS is at the same time a theory, a technology and a practice. At that, theory, technology and practical application are very closely connected and often change places in time in unnatural order (compared to traditional concept of fundamental science, application-oriented technologies and practice). In computer sciences, it has been long noted that application-oriented researches and technologies frequently outpace theoretical, fundamental. We can assume that HDS is defined by such formats or sets of numbers that are needed for business analytics realisation (for user's convenience). Alternatively, this space is defined by such space (usually a mathematical concept) that represents GIS business analytics. In scientific work [3] it is shown that GIS is specified on multidimensional space. At that, all mathematical space paradigms turn out to be either trivial or useless due to interpretation complexity. However, we should clearly understand what we are dealing with, what interpretation capabilities we possess. Without formal definition of HDS for GIS it is unlikely to succeed in designing and application. Space is a foundation of all model system, specified on this space. Models are building blocks for application tasks and business logic that created for simplified representation, study and analysis of objective and/or abstract reality.

3 SPACE DEFINITION

Having determined that such categories as “time” and “space” are key concepts for HDS, we still have to give them a definition. Concept of time is universal nearly for all fields of study and is unlikely to have any particularities. Exclusively, we can note that there can be several relative time scales. For example, while modelling, we can artificially slow down or speed up time, do time jumps forwards or backwards along the time line. Space is different story. Considering the fact that, as stated above, we have at least six types of major spaces (scientific fields) but, in truth, there are much more of them, we needed to regard them separately.

As was noted in introduction, any recent graduate and even user understands that most simple and at the same time the most general abstraction is a point. On its own, a point is a primitive concept with sufficiently vast set of properties. Yet, the concept of point is not independent. Without definition of space, the concept of point is meaningless and vice versa. Considering the specificity of our field of study: HDS, the point is not simply a mathematical notion but, firstly, it is a coordinate and not only a coordinate. Depending on context, the point has a whole set of properties and sometimes methods (functions).

Let us regard the concept of point for various situations form the point of view of mundane consciousness:

(1) One-dimensional case (point). The point has one coordinate and a number of other parameters.

(2) Two-dimensional case (Euclidean space). The point has two coordinates and a number of other parameters.

(3) Three-dimensional case. The point has tree coordinates and a number of other parameters.

(4) Multidimensional case. The point has a number of coordinates plus a number of other parameters.

(5) All cases above plus time. The point has time parameter added.

The point is an initial concept from which all other abstracts found for HDS can be formed, e.i. they are derivative. On the other hand, abstract concept of point should differ. Regardless of the fact that we apply HDS for specific purposes and for one, in particular case, subject area, these spaces should not overlap, else we will obtain whole system of contradictions.

Let us make one small remark. We cannot build HDS for GIS space system using axiomatic approach [3]. It means that we cannot formulate universal set of constraints and assumptions for all HDS systems. It is more than likely that we should use evolutionary approach and, perhaps, in the future it will be possible to design an axiomatic system (theory).

We have a very complex combination of spaces, rather closely interrelated, that, however, have a principal difference in fundamental concept of “space point”. Shortly, these abstract points can be defined as measurement (signal, connection, etc.), object (physical or abstract), tactical situation, threat, resource and solution. For every space measure should be defined as a mean of specifying analytics on space in favour of practical and/or abstract task solving.

4 MEASURE DEFINITION FOR SPACE

In philosophical sense, measure is a philosophical category denoting unity of qualitative and quantitative qualities of some object. According to A.P. Ogurtsov [10], this category generalises means and results of measuring objects. Measure analysis derives from importance of variation intervals of quantitative values, in terms of which we can talk of object’s quality preservation. Measure category is closely related to a number of philosophic notions along with those falling into fields of ethics and aesthetics. In mathematics, measure is a common name for different types of generalisation of notions of Euclidean length, area and n-dimensional volume. There are various specifications to the notion of measure:

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- Jordan measure is an example of finitely additive measure or one or the ways of formalising notions of length, area and n-dimensional volume in Euclidean space.
- Lebesgue measure is an example of denumerable additive measure, is a continuation of Jordan measure on more vast class of sets.
- Riemann measure (Riemann integral) is an area of region under a curve (a figure between graph of function and abscissa).
- Hausdorff measure is a special mathematical measure. Necessity of introduction of such measure derived from the need to calculate length, area and volume of nonspecific figures that can be not specified analytically. Application of such generalisation for HDS discovers new opportunities for realisation of different kinds of business logics in complex multidimensional and implicitly specified spaces. It is nearly impossible to do analytically, or, at least, very difficult. Level of difficulty is common for the task of calculating the volume of available networks [3G, 4G, Wi-Fi and etc.] outdoors for particular user, or for given type of users, taking into account complex surrounding space (buildings, metal fences and etc.). Numerical values of such space can be calculated directly in the process of field task solving (by specifying Hausdorff measure and step-by-step calculation), or using imitation modelling method when field is already given.

5 HAUSDORFF MEASURE FOR HDS ESTIMATION

In ordinary life, many things are suitable for our comprehension. Very typical parameters like length, area, volume etc. require no additional study for an individual. What parameter can be used as an analog of typical parameters in HDW? Are there similar analogs for HDS?

In the previous paper [10] we have noted that the stated similarity of the mathematical form of individual profile and track representation as a vector of values of a certain set of characteristics allows us to combine the methods of individual "track" identification and individual "profile" identification.

In other words, if we have definitions of "track" and "profile" of individual, they are subjects of estimation for HDS. However, there are no typical abstractions like those that we have in IGIS subject domain. One way to approach such atypical abstractions is to apply the Hasdorff measure.

For example, let us regard an Euclidean plane with Cartesian coordinates. We shall divide it into small squares of side ε > 0 using lines, parallel to coordinate axes. Let us establish a bounded set S on this plane. N(ε) is a minimal number of squares that cover S. If S is some known figure, e.g. a sphere, then its area is given by:

$$S = \lim_{\varepsilon \to 0} \varepsilon^2 N(\varepsilon)$$

It can be said that when ε→0 the number of covered squares N(ε) grows like S/ε2 . The denominator of this fraction indicates dimensionality (it equals 2), and the numerator indicates area's size, or, figuratively speaking, size of 2-measure.

In a common case, we will assume that the set S has dimension d = dimS, 0 <= d <= 2, if, while ε →0, the number of cells N(ε) grows like C/εd , where C is some positive constant called d-measure of the set S. It means that:

$$C = \lim_{\varepsilon \to 0} \varepsilon^d N(\varepsilon)$$

One of the simplest examples is for the plane. In case of 3-dimensional physical representation, e.g. radiation fields, we are given a set of spheres with a radius ε. This case is common for estimation of availability of various kinds networks for an individual in different geographical coordinates and conditions: apartment, office, cafeterias, street, subway, car, plane, yacht etc. All this is normally conceived by human consciousness. However, if we begin to contemplate the topology of computer networks while trying to analyze tracks of data transmission to or from us from one or many sources, situation goes beyond our traditional comprehension. In this case we can derive Hausdorff measure with fractal dimension, e.g. d can have various values, which can be difficult to imagine or decipher. This poses the question: can HDW be interpreted as an element of global network, of global DW, with help of one or several measures? Can we correctly create a business logic for estimation of vulnerability and protection of HDW that is an element of global network (DW)? These are only a couple of questions that arise as we delve into the subject of HDW. If we cannot imagine spaces like DW, HDW as measurable, then there is no sense in speaking about the degree of protection of modern individual, of his rights and freedoms.

6 CONCLUSION

Definition of the term “space” as an independent object of study in IGIS opens vast perspectives for study of nonspecific objects that can not be represented in the familiar for a human form: in form of a point, line, sphere, polyline or their combinations. Practically all geographical formats were developed with purpose of creating the simplest set of abstractions, from which all other object in GIS are derived. In mathematical terms, these are understandable metrical spaces and functions, defined on them.

Similar situation was in mathematics until Hausdorff noted the narrowness of such representation. Many mathematicians have noticed before those natural phenomena like shoreline, snow, clouds etc. can not be represented as some aggregate of traditional notions like a point, line etc. and can not be analytically described.

Same situation we now have in IGIS, when efforts are taken to integrate IGIS into complex information systems and all more so when global information systems are based on IGIS technologies.

The more complex structure have objects that are connected to modern human activities. This problem was discussed on the previous CORP conference. Understanding the fact that any modern human resides in global informational space, the question has risen: what belongs solely to him and how can he estimate, control and protect this “property”? Personal space can not be labeled as simple “property” category given that it integrates such notions like freedom, independence, personal life etc.

Estimation of individual’s personal space is not a banal thing and should have a clear and comprehensible for each individual. Application of Hausdorff measure and its further development will allow to approach the estimation and understanding of place an role of “personal” HDS in the hierarchy of complex subspaces of DW. Each human has the right to understand their rights, freedoms and responsibilities in the global DW.

7 REFERENCES

[1] Shraer O., Shperner G. Introduction to Linear Algebra in Geometrical Interpretation (Einfuhrung in die analytische Geometrie und Algebra)/ Olshansky G. (translation from Germany to Russian). — M.–L.: ОНТИ, 1934. — 210 pp.

[2] Jean-Claude Thill. Is Spatial Really That Special? A tale of Spaces\\ Information Fusion and Geographic Information Systems: Towards the Digital Ocean, Lecture Notes in Geoinformation and Cartography 5, DOI 10.1007/978-3-642-19766-6_1, Springer-Verlag Berlin Heidelberg 2011, pp.3-12.

[3] Iintelligent GIS. Edited by V. Popovich. M.: Nauka, 2013, 324pp, in Russian.

[4] Blasch E. Fundamentals of Information Fusion and Applications / Blasch E. // Tutorial, TD2, Fusion, 2002.

[5] Immanuel Kant, Critique of Pure Reason (Kritik der reinen Vernunft) [1781], trans. Norman Kemp Smith (N.Y.: St. Martins, 1965), A 51/B 75.

[6] Eilenberg S., MacLane S. A general theory of natural equivalences // Trans. Amer. Math. Soc., 58: 231-294, 1945.

[7] MacLane S. Categories for the Working Mathematician. Springer, 1971.

[8] Popovich V. Space Theory for IGIS \\ Information Fusion and Geographic Information Systems. Springer-Verlag Berlin Heidelberg 2017, pp.3-14.

[9] Ogurtsov A.P. Disciplinary Structure of Science. Genesis and Argumentation. M., 1988, in Russian.

[10] Popovich V., Borodkin L., Shrenk M. Human’s Digital Space in a Digital City. Real Corp 2016, 22-24 June 2016.

Identifizierung von Steigungen als Barrieren für mobilitätseingeschränkte Personen

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1 ABSTRACT

Nicht erst durch den demographischen Wandel verändern sich die Anforderungen an den öffentlichen Straßenraum. Die Forderung und Nachfrage nach barrierefreier Mobilität, besonders für Menschen mit körperlichen Einschränkungen, bilden die Grundlage für viele Planungen. Der öffentliche Straßenraum weist neben Behinderungen durch Verkehrsinfrastrukturen, wie Schilder und Treppen, auch grundlegende Hindernisse auf. Gerade Steigungen sind insbesondere für ältere und mobilitätseingeschränkte Menschen sowie Rollstuhlfahrer eine enorme Erschwernis. Ein realistisches Bild von der Barrierefreiheit des Straßenraumes stellt daher eine wichtige Grundlage für eine effektive Verkehrsplanung dar. Barrieren im Straßenraum werden allerdings aktuell aufgrund des hohen Erfassungsaufwands nur für ausgewählte Gebiete erfasst, Steigungen lassen sich dabei in der Örtlichkeit nur mit einem speziellen Neigungsmesser aufwändig ermitteln.

In dieser Studie sollten speziell Steigungen in einer flächendeckenden Karte für die Stadt Wetter in Nordrhein-Westfalen (NRW) dargestellt werden. Das Ziel war es, ein Werkzeug zu erstellen, welches es ermöglicht, Straßen anhand ihrer Steigungen zu klassifizieren und diese dementsprechend auf einer Karte darzustellen. Voraussetzung war, dass die Analyse in einem freien Geoinformationssystem durchgeführt wird und ausschließlich amtliche Geodaten verwendet werden.

Durch das vorgestellte Werkzeug, welches in einer Kombination aus QGIS und R umgesetzt wurde, kann die Analyse von Steigungen im Straßenraum mit Geobasisdaten für gesamte Städte und Kreise flächendeckend durchgeführt werden. Anschließend ist eine zielgruppenspezifische Einteilung in Klassen möglich, um die Daten der Öffentlichkeit als Karte oder Dienst bereitzustellen. Im Hinblick auf den demographischen Wandel und die Veränderung des Bevölkerungsalters bietet dieses Werkzeug großes Potenzial, als direkte Hilfestellung für Menschen mit körperlichen Einschränkungen zur Sicherung der barrierefreien Mobilität zu dienen und eröffnet gleichzeitig für die nachhaltige Mobilitätsplanung eine Methodik zur Visualisierung der Potentiale für einen ausgewogenen Modal Split.

Keywords: Barrieren, Steigungen, Demographie, Mobilität, Kartographie

2 MOTIVATION

Der demographische Wandel hat in der heutigen Gesellschaft große Auswirkungen. Durch die Verlagerung der Altersstruktur in der Gesellschaft verändert sich das Grundbedürfnis der Mobilität. Die Nachfrage an barrierefreien Straßenraum steigt gerade für ältere und mobilitätseingeschränkte Menschen immer weiter an. Der öffentliche Straßenraum weist vielseitige Hindernisse auf. Diese reichen von einem unebenen und unbefestigten Untergrund bis hin zu Behinderungen durch Verkehrsinfrastrukturen, wie schlecht platzierte Schilder, Durchgangssperren oder Treppen ohne Rampe. Neben den baulichen Einschränkungen lassen sich grundlegende Hindernisse oder Gegebenheiten auf Basis der Topographie feststellen, die eine Passierbarkeit unmöglich machen. In dieser Studie soll auf die vorhandenen Steigungen eingegangen werden, welche eine enorme Erschwernis darstellen. Bereits Steigungsveränderungen von über 3 % machen eine Route nur eingeschränkt oder gar nicht mehr nutzbar (DIN 18040-3). Bisher werden Barrieren im Straßenraum manuell und nur für ausgewählte Gebiete erfasst. Um Steigungen für die Verkehrsplanung effektiv nutzen zu können, müssen diese flächendeckend vorliegen. Aufbauend auf Arbeiten im Hochsauerlandkreis, NRW, (Götte, R, o.J.) wurde zu diesem Zweck ein Werkzeug entwickelt, mit dem eine flächendeckende Klassifizierung der Straßen anhand ihrer Steigungen vorgenommen werden kann. Die Ergebnisse werden im Anschluss in Form einer Karte oder Web-Anwendung Planern sowie Bürgern zur Verfügung gestellt.

3 DATENGRUNDLAGE

Um die Anwendung frei verfügbar und ausführbar zu gestalten, wurden als Datengrundlage die seit dem 01. Januar 2017 durch die „Open.NRW Strategie" des Landes Nordrhein-Westfalen bereitgestellten Geobasisdaten eingesetzt (Bezirksregierung Köln, 2017a). Zum einen wurde das Digitale Basis-Landschaftsmodell (Basis-DLM) genutzt, welches u.a. die Straßen sowie Brücken und Tunnel in topographischer Form beschreibt. Das Basis-DLM ist lagetreu und für eine Anwendung im Maßstab 1:10.000 erfasst (AdV, 2016). Als weiterer Eingangsdatensatz diente das Digitale Geländemodell mit einer räumlichen Auflösung von 1 m (DGM 1). Beide Datensätze sind flächendeckend frei über das Geoportal Open.NRW verfügbar (Bezirksregierung Köln, 2017a, 2017b). Für einen Praxistest der implementierten Anwendung wurde das Gebiet der Stadt Wetter (NRW) als Untersuchungsgebiet definiert.

4 AUFBEREITUNG DER AUSGANGSDATEN

Zur Nutzung der Ausgangsdaten mussten diese entsprechend aufbereitet werden. Die Geodaten des Basis-DLM liegen in einem Datensatz für das gesamte Bundesland vor. Dieser Datensatz besteht aus diversen Layern, in welchen einzelne oder mehrere Objektarten, wie z.B. Straßenachsen, mit ihren zugehörigen Attributen enthalten sind (vgl. Tabelle 1). Zur Reduzierung der Berechnungszeit wurde dieser Datensatz auf das zu untersuchende Gebiet zugeschnitten. Zum Verschneiden des Datensatzes wurden die Verwaltungsgebiete im Maßstab 1:250.000 verwendet. Diese werden von dem Dienstleistungszentrum des Bundes für Geoinformation und Geodäsie des Bundesamtes für Kartographie und Geodäsie (BKG) bereitgestellt. Der Datensatz umfasst die Geometrien der Umringe der Verwaltungseinheiten (Kreise, Städte und Gemeinden) und ist ebenfalls über das Geoportal abrufbar (Ministerium für Inneres und Kommunales des Landes Nordrhein-Westfalen, 2017).

Im zweiten Schritt wurden die in dem Datensatz enthaltenen Straßen, welche nicht für Fußgänger nutzbar sind, entfernt. Dazu wurde anhand des ATKIS-Objektartenkataloges (AdV, 2008) eine Aufteilung durchgeführt. Der Objektartenkatalog enthält Beschreibungen für alle in den Geodaten enthaltenen Objektarten. Anhand der Attributbezeichnung und der zugehörigen Werteschlüssel wurden Autobahnen sowie Wirtschaftswege (leicht- oder unbefestigte Wege) entfernt. Dadurch verblieben für die Analyse ausschließlich Straßen, die tendenziell für eine Nutzung durch Fußgänger und Rollstuhlfahrer vorgesehen sind (Tabelle 1). Anschließend wurden die beiden zu verwendenden Layer ver_01l und ver_02l zu einem Datensatz zusammengefasst.

Layer	Objektart	Kennung	Attributbezeichnung	Bezeichner	Wert
ver_01l	AX_Strassenachse, AX_Fahrbahnachse	42003 42005	Widmung (WDM)	Bundesstraße	1303
				Landesstraße, Staatsstraße	1305
				Kreisstraße	1306
				Gemeindestraße	1307
ver_02l	AX_Fahrwegachse, AX_WegPfadSteig	42008 53003	Funktion (FKT)	Hauptwirtschaftsweg	5211

Tabelle 1: Attributselektion des Basis-DLM Datensatzes

Eines der größten Probleme bei der Analyse von Steigungen bereiten Tunnel und Brücken. Diese sind nicht Teil des Digitalen Geländemodells, da dieses nur die Geländeoberfläche ohne bauliche Einrichtungen abbildet (Bezirksregierung Köln, 2017). Durch Vertiefungen, die durch Verkehrsbauwerke entstehen, werden hohe Gefälle, gefolgt von großen Steigungen berechnet. Aufgrund der Tatsache, dass diese Objekte ebenfalls im Basis-DLM im Layer ver06_l flächendeckend erfasst sind, können sie automatisiert bei der Ermittlung der Steigungen berücksichtigt werden (vgl. Abbildung 2). Dazu wurden alle Elemente (Features) der Objektart AX_BauwerkImVerkehrsbereich genutzt. Die Anzahl wurde erneut durch den Zuschnitt auf das Untersuchungsgebiet begrenzt.

Die Ausgangsdaten des Digitalen Geländemodells lagen im XYZ-Dateiformat vor. Die Geländehöhe wird dabei durch ein Koordinatentriplet aus X-, Y- und Z-Koordinate repräsentiert. Für die Analyse musste das Geländemodell jedoch als georeferenziertes Raster vorliegen. Dazu wurde ein zusätzliches Werkzeug entwickelt, welches die Daten direkt in ein Raster überführt. Die Ausdehnung des DGMs wurde dabei zur Optimierung der Prozesslaufzeit so klein wie möglich gewählt.

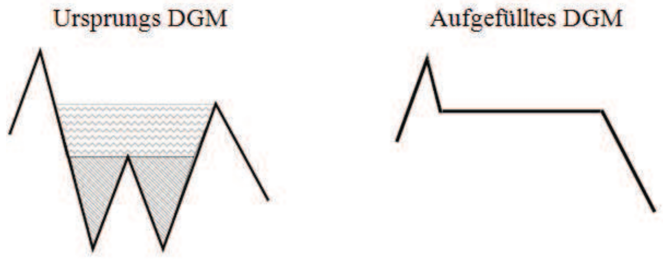

Abbildung 1: Schematische Darstellung zur Auffüllung von Artefakten in Digitalen Geländemodellen (Arge et al., 2003)

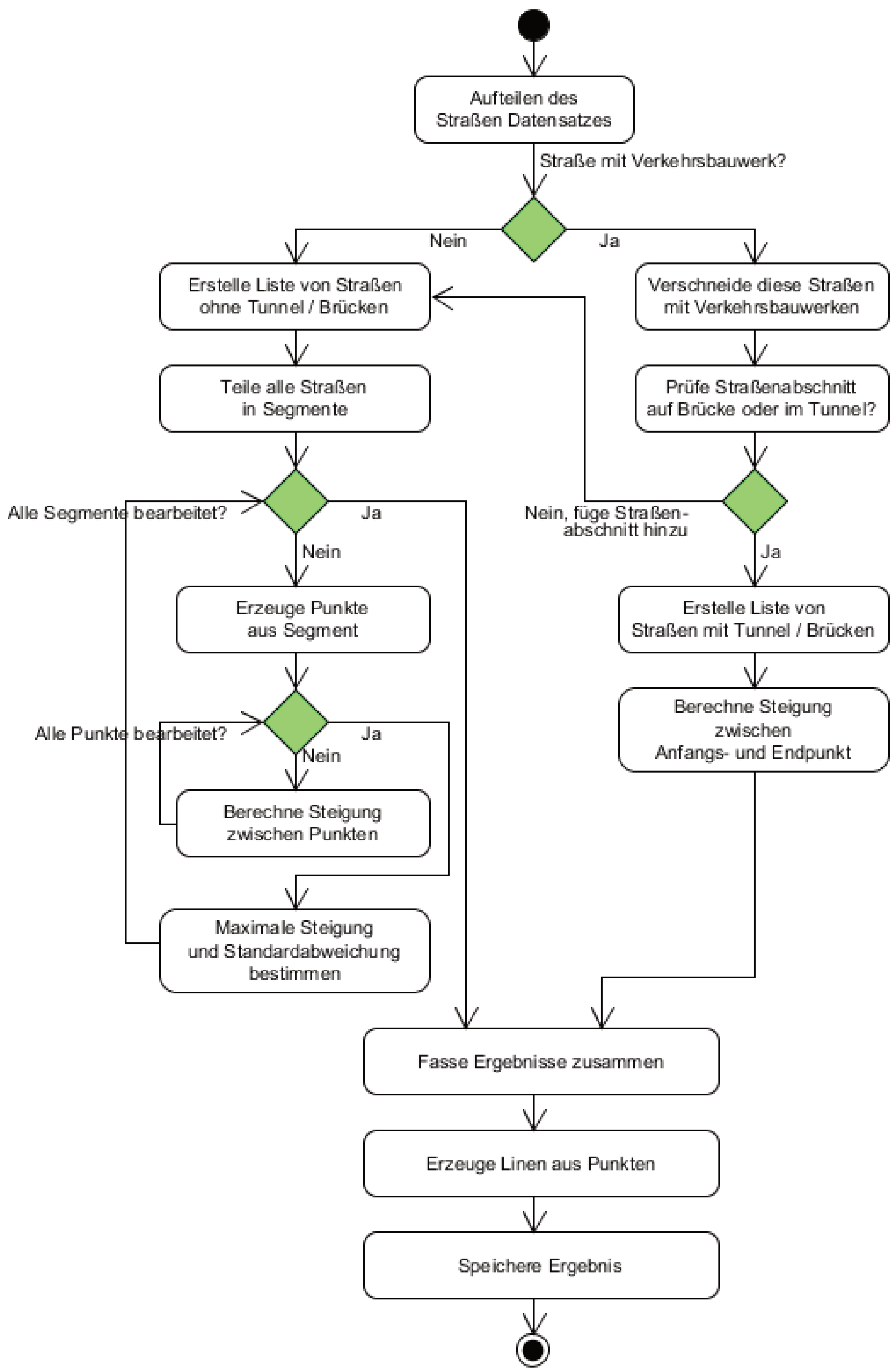

Abbildung 2: Aktivitätsdiagramm des Werkzeugs

Nachdem das DGM als Raster vorlag, konnte es von Datenartefakten, sogenannte Senken, bereinigt werden. Als Senken können Geländevertiefungen verstanden werden, die keinen dauerhaften oberirdischen Abfluss besitzen, da sie von höhergelegenen Gebieten umrundet sind. Sie sind oft bedingt durch Fehler im Geländemodell (Arge, 2003). Wie in Abbildung 1 dargestellt, wurden die vermeintlichen Senken bis zum Ausflusspunkt aufgefüllt. Dadurch ergaben sich bei der Berechnung der Steigungen keine Gegengefälle und somit keine Unstimmigkeiten bei der Richtung der Steigung.

5 TECHNISCHE UMSETZUNG

Entsprechend dem Ansatz der Nutzung öffentlich verfügbarer amtlicher Geodaten sowie der Umsetzung in freier Software, wurde die Implementierung in der Programmiersprache “R” durchgeführt. Mit R können Daten sowohl statistisch analysiert als auch graphisch dargestellt werden (Adler, 2010). Sie ist unter der General Public License (GPL) der Free Software Foundation veröffentlicht und daher frei verfügbar (R Foundation, o. J.). Außerdem bietet sie den Vorteil, dass die erstellten Skripte in verschiedene Geoinformationssysteme importiert werden können, wodurch eine hohe Flexibilität und ein großer Anwenderkreis erreicht wird.

Die Funktionsweise des entwickelten Werkzeugs lässt sich aus dem in Abbildung 2 dargestellten Aktivitätsdiagramm entnehmen. Dieses lässt sich funktional in sechs Arbeitsschritte unterteilen. Zunächst wird der Datensatz in Straßen mit und ohne Verkehrsbauwerke (Brücken, Tunnel) aufgeteilt (1). Anschließend werden die Straßen mit den Verkehrsbauwerken verschnitten und in zwei Datensätze aufgeteilt (2). Straßen, die keine Brücken und Tunnel kreuzen, werden in Segmente zerlegt (3). Zur Berechnung der Steigungen bzw. zur Ermittlung der maximalen Steigungen sowie der Standardabweichung werden entlang der Achse Punkte erzeugt, welche die Grundlage zur Berechnung darstellen (4). Schließlich werden die Steigungen der Straßen mit Verkehrsbauwerken aus den Start- und Endpunkten berechnet (5). Die Ergebnisse werden abschließend zusammengefasst und das Ergebnis gespeichert (6).

Das Ziel der Analyse ist die Darstellung der Steigungen in Prozent für kleinräumige Straßensegmente. Um dies zu erreichen werden die Straßen entlang ihrer Achse in einem definierten Abstand aufgeteilt. Diese Segmente bilden im Endergebnis die Darstellung der Straßen. Damit gibt der Abstand die räumliche Auflösung vor. Zur flexiblen Gestaltung der Analyse, kann die Länge der Segmente je nach Zielgruppe und -maßstab frei gewählt werden.

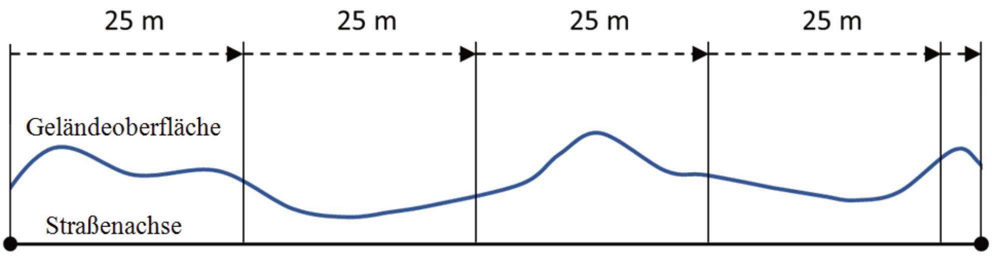

Abbildung 3: Schematische Darstellung der Segmenterstellung mit 25 m Schrittweite

Je nach Zielgruppe und Anwendungsfall ist es ebenfalls sinnvoll, neben der durchschnittlichen Steigung die maximale Steigung sowie die Standardabweichung des Segments zu berechnen. Insbesondere für mobilitätseingeschränkte Personen sind selbst kurze und große Steigungen kaum zu bewältigen. Aus diesem Grund wird bei der Berechnung eine weitere Unterteilung der Segmente vorgenommen. Wie in Abbildung 3 dargestellt, werden die erzeugten Segmente erneut aufgeteilt und zwar mit einer Kantenlänge, die der Auflösung des Digitalen Geländemodells entspricht. Bei großen Segmentlängen (z.B. 100 Meter) werden Höheninformationen wie z.B. bei Kuppen und Senken ggf. nicht detektiert. Zwar erhöht sich dadurch die Laufzeit, allerdings wird die Streuung der Steigungen anhand der Standardabweichung wiedergegeben. Gerade in Hinblick auf Steigungskarten für gesamte Kreise und Städte mit großen Maßstäben kann dadurch die Güte der bestimmten Steigungen angegeben werden. Damit ist ein Trade-Off zwischen sehr großen Segmenten und der resultierenden Genauigkeit der Steigungen möglich.

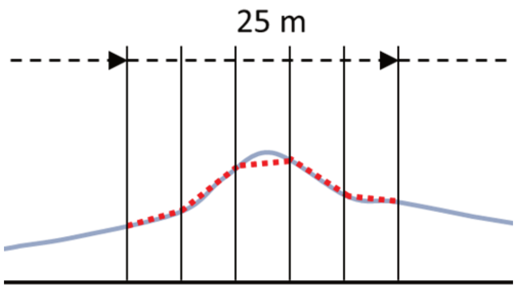

Abbildung 4: Schematische Darstellen zur Berechnung der maximalen Steigung sowie deren Standardabweichung

Wie bereits beschrieben, stellen Brücken und Tunnel ein besonderes Problem dar. Ein Digitales Geländemodell beinhaltet, wie bereits erwähnt, die Topographie ohne bauliche Anlagen, wodurch große Abweichungen entstehen. Das in Abbildung 4 gezeigte Beispiel stellt eine Straße dar, die oberhalb einer Geländevertiefung verläuft. Da Verkehrsbauwerke ebenfalls flächendeckend im Basis-DLM enthalten sind, lassen sich diese Fehler automatisiert bereinigen.

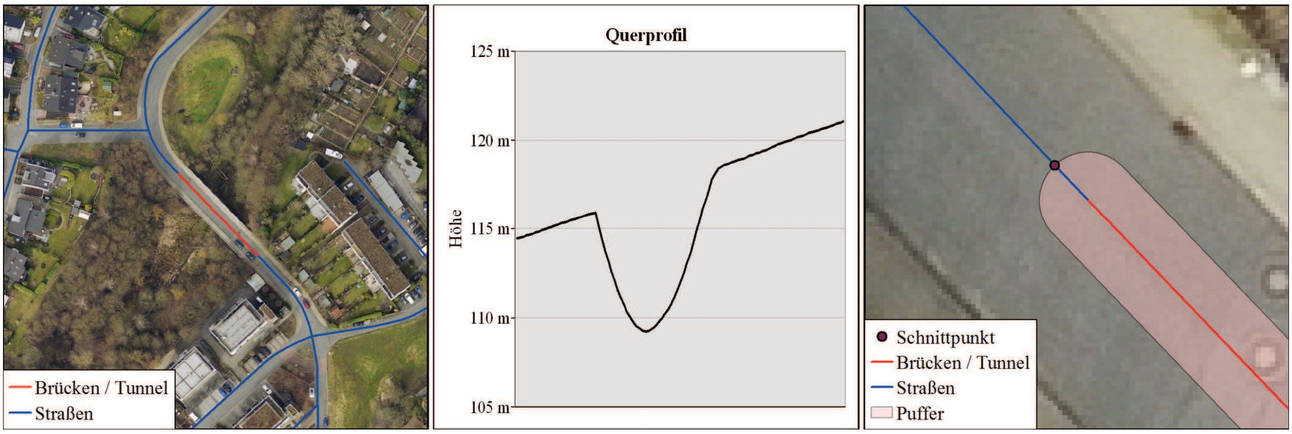

Abbildung 5: Brücken und Tunnel im Digitalen Geländemodell

Der Ausgangsdatensatz wird zuerst in Straßen ohne und mit Verkehrsbauwerke aufgeteilt (1). Im zweiten Schritt werden Brücken und Tunnel mit den jeweiligen Straßen verschnitten (2). Um sicherzustellen, dass keine kreuzenden Straßenabschnitte verschnitten werden, müssen diese die gleiche Liniengeometrie besitzen. Außerdem ist zu gewährleisten, dass die Höhen aus dem DGM zur Berechnung oberhalb der Vertiefung liegen (Abbildung 5, mitte). Es wird ein Sicherheitsbereich mithilfe eines Puffers mit einem Abstand von einem Meter um Brücken und Tunnel gebildet (Abbildung 5, rechts). Die Achse der Straße wird mit dem Puffer verschnitten, wodurch jeweils drei Teilstücke entstehen. Die vor und hinter dem Bauwerk liegenden Straßenachsen werden zum Datensatz der Straßen ohne Verkehrsbauwerke hinzugefügt. Im Anschluss (3) werden diese Straßen in Segmente aufgeteilt und die Steigungen sowie die Standardabweichung berechnet. Zum Segmentieren der Straßen werden entlang der Achse Punkte mit dem vorab definierten Abstand erzeugt (4). Beim Erzeugen der letzten Punkte pro Segment ergeben sich zwei mögliche Konstellationen, die es zu berücksichtigen gilt. Zum einen kann die Länge der gesamten Straße kleiner sein als der definierte Abstand. Dann wird ein Segment aus dem Start und Endpunkt erzeugt. Zum anderen, kann der Abstand zwischen dem letzten und vorletzten Punkt kleiner sein als die Kachelgröße des DGMs. In diesem Fall wird der vorletzte Punkt entfernt und das Segment vergrößert sich bis zur Länge der Rasterzelle.

Die Steigung in Prozent ergibt sich aus der horizontalen Entfernung zwischen zwei Punkten Pi und Pi-1 sowie deren Höhendifferenz.

$$Steigung = \frac{\sqrt{(X_{P_i} - X_{P_{i-1}})^2 + (Y_{P_i} - Y_{P_{i-1}})^2}}{Z_{P_i} - Z_{P_{i-1}}} * 100 = \frac{\Delta x}{\Delta z} * 100 \qquad \text{mit} \qquad i = 1, \dots, n$$

Die Parameter X und Y lassen sich aus den erstellten Punkten auslesen. Zur Bestimmung der Höheninformationen werden über die Koordinaten (X und Y) der Punkte die Zellwerte aus dem DGM automatisch abgegriffen. Dies wird für alle n Punkte auf einem Segment durchgeführt. Die Steigung pro Liniensegment ergibt sich schlussendlich aus dem arithmetischen Mittel der Teilsteigungen. Zusätzlich wird

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aus den Steigungen die Standardabweichung □ berechnet. Diese ergibt sich aus der Wurzel des gemittelten Fehlerquadrats.

$$\sigma = \sqrt{\frac{\sum_{i}^{n}(x_i - \bar{x})^2}{n-1}}$$

Außerdem wird die maximale Steigung gespeichert. Anschließend werden die Steigungen der Straßenabschnitte, die auf einer Brücke bzw. in einen Tunnel liegen, zwischen dem jeweiligen Anfangspunkt und Endpunkt berechnet (5). Eine Unterteilung in Segmente sowie die Berechnung der maximalen Steigung und Standardabweichung wird nicht vorgenommen.

Zusätzlich zum Steigungswert wird die Steigungsrichtung bestimmt. Diese lässt sich aus dem Vorzeichen der durchschnittlichen Steigung ableiten. Bei einer negativen Steigung liegt ein Gefälle vor. Zur Visualisierung der Richtungen wurden Richtungspfeile kleiner (<), größer (>) und Gleichheitszeichen (=) eingesetzt. Über die Linienbeschriftung im Geoinformationssystem lassen sich diese darstellen. Um einen Rückschluss der Liniensegmente auf die Ursprungslinie zu erhalten, wird eine fortlaufende "LineOID" vergeben.

Abschließend werden aus den erzeugten Punkten wieder Linien erzeugt und die durchschnittliche und maximale Steigung sowie die Standardabweichung und Steigungsrichtung zugewiesen. Dabei werden die beiden Datensätze zusammengefasst (6) und im Shape-Format gespeichert. Dieser Datensatz kann in einem Geoinformationssystem eingeladen, die Steigung in Klassen eingeteilt und die Richtungen als Linienbeschriftungen eingestellt werden.

In einer Fallstudie wurde das vorgestellte Werkzeug für den Innenstadtbereich der Stadt Wetter mit einer Segmentlänge von 10 Metern ausgeführt. Abbildung 6 stellt das Ergebnis dieser Berechnungen dar.

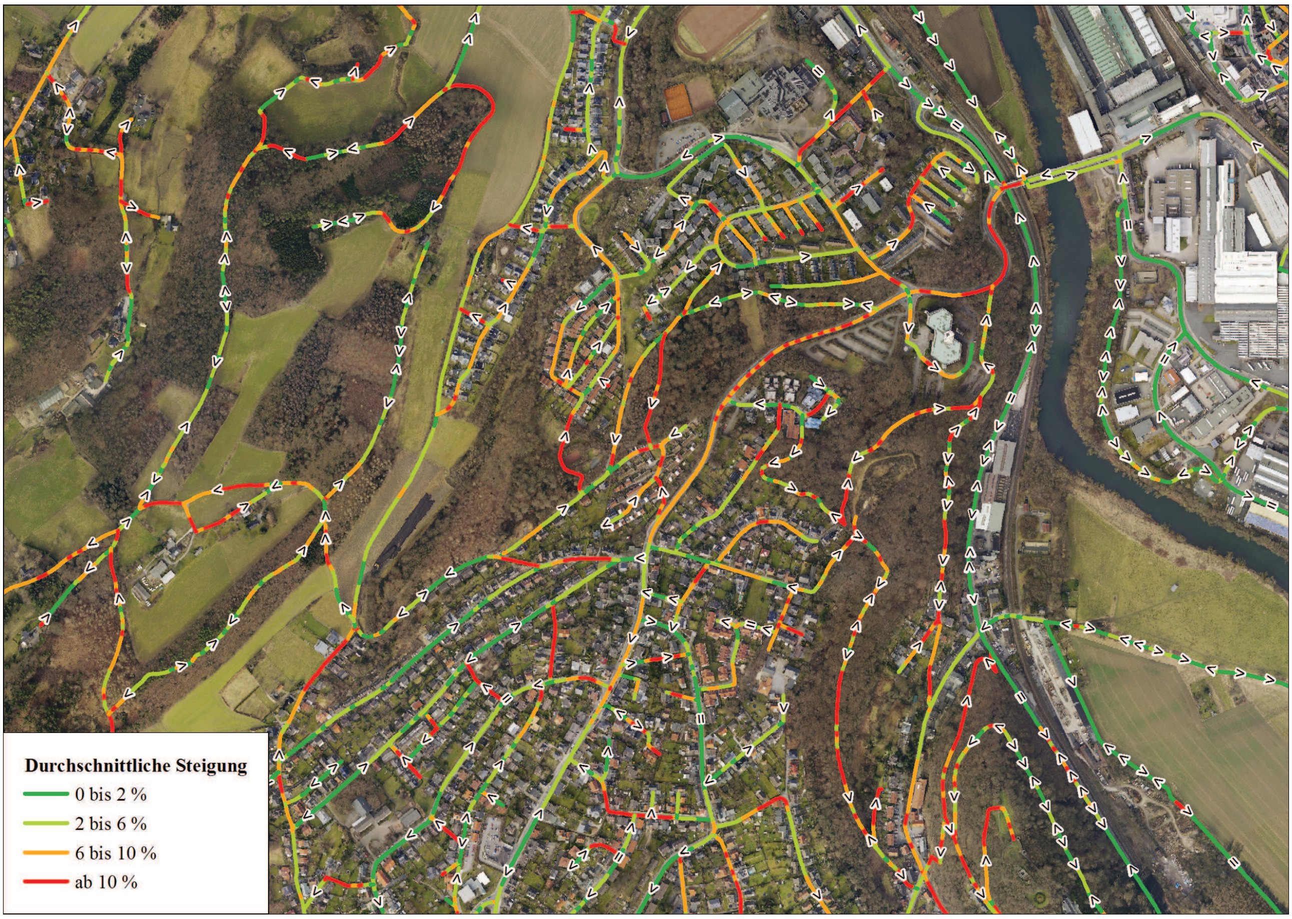

Abbildung 6: Ergebnis Steigungskarte mit einer Segmentlänge von 10 Metern

6 INTEGRATION IN QGIS

Nach der Implementierung wurde das R-Skript nach Vorgaben des freien Geoinformationssystems QGIS (2017) angepasst, damit es als Werkzeug namens GradientMap eingebunden werden konnte. Das Werkzeug lässt sich über eine benutzerfreundliche graphische Oberfläche aufrufen und nutzen. Zusätzlich bietet es die Möglichkeit, die in Kapitel 4 beschriebenen nötigen kartographischen Aufbereitungen mit der Software umzusetzen. Dadurch wird es zu einem vollständigen Werkzeug zur Erstellung einer Steigungskarte. In Abbildung 7 ist die Oberfläche der Anwendung GradientMap abgebildet. Als Eingangsparameter werden das Digitale Geländemodell, Straßen sowie Brücken und Tunnel erwartet. Als Segementlänge wird ein Standardwert von 25 Metern verwendet, der jedoch je nach Zielgruppe und Fragestellung beliebig verändert werden kann.

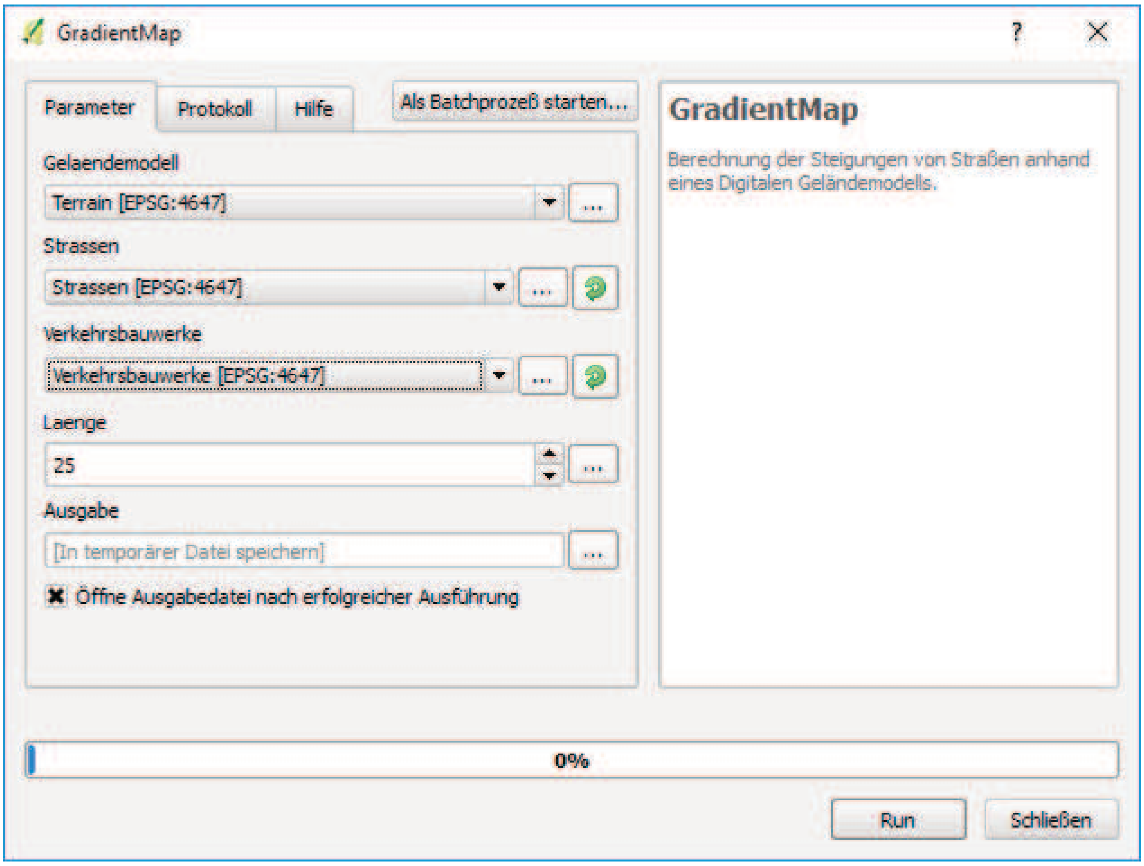

Abbildung 7: Benutzeroberfläche Tool GradientMap

7 ERGEBNIS

Wie in Abbildung 5 bereits dargestellt, lassen sich aus dem Ergebnis Karten erzeugen, mit dessen Hilfe mobilitätseingeschränkte Menschen einen guten Überblick über die Steigungen auf ihrer geplanten Route erhalten können. Es wird deutlich, dass selbst in dem kleinen Ausschnitt des Untersuchungsgebietes der Stadt Wetter sehr viele Straßen nicht passierbar sind. Betrachtet man das Digitale Geländemodell losgelöst von Straßen und Wegen, ergibt sich ein ähnliches Bild. In diesem Fall kann eine maximale Höhendifferenz zwischen dem höchsten und niedrigsten Punkt von 195 Meter abgeleitet werden. Somit stellt das Stadtgebiet von Wetter mit seiner ausgeprägten Topographie ein gutes Untersuchungsgebiet für eine Fallstudie des entwickelten Werkzeugs dar.

Die Klassifikation der Steigungen wurde in Anlehnung an die DIN 18040-3 für Rollstuhlfahrer (6 %) und die Schwierigkeitswerte des Allgemeinen Deutschen Fahrrad-Club eV (ADFC, o. J.) für Radfahrer (10 %) durchgeführt. Bei einer Segmentlänge von 10 m ergibt sich bspw., dass 235 der insgesamt 32.857 Straßensegmente eine Steigung von über 25 % aufweisen (Tabelle 2). Diese sollten im Nachgang einzeln kritisch geprüft werden. Insgesamt lässt sich aus den Ergebnissen in Tabelle 2 ableiten, dass plausible Steigungswerte zugewiesen wurden. Allerdings fallen bei der Standardabweichung große Abweichungen auf. Diese gibt die Güte der berechneten Steigung wieder. Hierbei wird deutlich, dass die Abweichungen innerhalb der Segmente schon bei einer Länge von zehn Metern sehr hoch sind. Mehr als ein Viertel der

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Segmente weisen eine Standardabweichung größer als 6 Prozent auf. Die entsprechenden Straßen sollten im Gelände überprüft und ggf. mit einer kleineren Segmentlänge durchgerechnet werden.

Klasse	Steigung		Standardabweichung	
	Anzahl	Anteil in Prozent	Anzahl	Anteil in Prozent
0 bis 2 %	10117	30,8 %	8597	26,2 %
2 bis 6 %	10926	33,3 %	14607	44,4 %
6 bis 10 %	6439	19,6 %	4270	13,0 %
10 bis 25 %	5140	15,6 %	4505	13,7 %
Ab 25 %	235	0,0 %	878	2,7 %
Summe	**32857**	**100,0 %**	**32857**	**100,0 %**

Tabelle 2: Elemente pro Klasse

Abschließend lässt sich sagen, dass das entwickelte Werkzeug mit frei verfügbaren und amtlichen Daten flächendeckende Ergebnisse liefert. Diese sollten hinsichtlich der Plausibilität geprüft werden. Eine Validierung im Feld hat für die Fallstudie in Wetter bisher nur für vereinzelte Straßenzüge stattgefunden. Durch die Angabe der Standardabweichung ist eine Aussage über die erreichte Genauigkeit möglich. Dies kann ebenfalls Hinweise darüber geben, ob die gewählte Auflösung der Eingangsdaten für das Untersuchungsgebiet ausreichend ist.

8 AUSBLICK

Aus Sicht der Bürger kann eine Steigungskarte zu einem hohen Maße zur Verbesserung der Mobilität beitragen. Bei der Weiterentwicklung und Verwendung des Werkzeugs sind aktuell einige Ansätze vorstellbar. Zum einen sollte über die Darstellung und Präsentation der Karte entweder als Print oder Web-Anwendung nachgedacht werden. Dazu sind verschiedene Detailierungsstufen mit entsprechenden Segmentlängen abzuwägen. Dabei gilt es auch für jeden Anwendungsfall zu prüfen, welche Steigung (durchschnittlich oder maximal) publiziert werden sollte.

Bisher erfolgt die Berechnung statisch, da nur eine Segmentlänge angegeben werden kann. Für eine Weiterentwicklung könnte es interessant sein, einen iterativen Ansatz zu wählen. Damit kann von einer sehr großen Segmentlänge bis hin zu einer sehr feinen Auflösung eine Karte erstellt werden, bei der die Standardabweichung als Kriterium für die Auflösung genutzt werden kann.

Die ermittelten Steigungen lassen sich auch im Hinblick auf eine nachhaltige Stadtplanung nutzen. So besteht die Möglichkeit hohe Steigungen für mobilitätseingeschränkte Personen als Hindernisse einzustufen und eine entsprechende Alternative anzubieten, wie z.B. den Ausbau des ÖPNVs an den betroffenen Stellen. Zusätzlich zu den objektiven Vorgaben durch einschlägige Normen, könnte das Ausmaß der Einschränkung durch Steigungen durch Emotionskartierungen abgeschätzt werden (vgl. Bergner et al., 2011). Außerdem kann eine Planung des Ausbaus der barrierefreien Straßenraumgestaltung, durch Fokussierung auf Wege mit geringen Steigungen, effizient gestaltet werden. Darüber hinaus kann die Steigungskarte zur barrierefreien Routenplanung, wie bspw. OpenRouteService (Müller et al., 2010) oder eNav (Džafić et al. 2016a, 2016b) genutzt werden. Letzteres berücksichtigt bereits Steigungsinformationen, zu denen der hier beschriebene Workflow eine präzisere Ergänzung darstellen kann. Eine kombinierte Nutzung mit Crowdsourcing-Daten von bspw. Wheelmap.org oder OpenStreetMap könnten weitere wichtige Erkenntnisse ermöglichen. Außerdem könnten die erzeugten Daten für weitere Gruppen (z.B. Radfahrer) von Interesse sein.

9 REFERENZEN

Adler, J. (2010). R in a Nutshell. Beijing: O'Reilly.

Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder der Bundesrepublik Deutschland (AdV) (2008): Dokumentation zur Modellierung der Geoinformationen des amtlichen Vermessungswesens (GeoInfoDok). http://www.geodatenzentrum.de/docpdf/ATKIS-OK%20Basis-DLM%206_0.pdf

Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder der Bundesrepublik Deutschland (AdV) (2016): Produktblatt Digitales Basis-Landschaftsmodell (Basis-DLM). http://www.adv-online.de/AdV-Produkte/Standards-und-Produktblaetter/Produktblaetter/

Arge, L., et al. (2003): Flow Computation and Massive Grids, Duke University, Durham https://www.cs.duke.edu/geo*/terraflow/papers/acmgis01_terraflow.pdf

Bergner, Benjamin; Zeile, Peter; Papastefanou, Georgios; Rech, Werner (2011): Emotionales Barriere-GIS als neues Instrument zur Identifikation und Optimierung stadträumlicher Barrieren. In Angewandte Geoinformatik, pp. 430–439.

Bezirksregierung Köln (2017): Basis-DLM. Abgerufen am: 09.06.2017 von http://www.bezreg-koeln.nrw.de/brk_internet/geobasis/landschaftsmodelle/basis_dlm/index.html

Bezirksregierung Köln (2017): Digitale Geländemodelle (DGM). Abgerufen am: 09.06.2017 von http://www.bezreg-koeln.nrw.de/brk_internet/geobasis/hoehenmodelle/gelaendemodelle/index.html

DIN 18040-3: 2014-12 Barrierefreies Bauen - Planungsgrundlagen - Teil 3: Öffentlicher Verkehrs- und Freiraum

Džafić, Dženan; Klein-Ridder, Daniel; Schoonbrood, Pierre; Franke, Dominik; Kowalewski, Stefan (2016a): Der Bodenbelag-Detektor des eNav-Systems. In AGIT – Journal für Angewandte Geoinformatik, 2-2016 2, pp. 318–327.

Džafić, Dženan; Lahr, Florian; Schoonbrood, Pierre; Franke, Dominik; Kowawelewski, Stefan (2016b): Das Barrierenerkennungssystem von eNav. In AGIT – Journal für Angewandte Geoinformatik, 2-2016 2, pp. 298–397.

Ministerium für Inneres und Kommunales des Landes Nordrhein-Westfalen (2017a): Open Data. https:/open.nrw

Ministerium für Inneres und Kommunales des Landes Nordrhein-Westfalen (2017b): Bund: Verwaltungsgebiete 1:250 000 - Stand 31.12. https://open.nrw/de/dataset/431406f6-1b31-48a9-b6db-dc4b38caf5eabkg

Götte, R. (o. J.) Steigungskarte für den Hochsauerlandkreis. Abgerufen am: 17.07.2017 von http://www.hochsauerlandkreis.de/buergerservice/bauen_wohnen_kataster/geo_service/open/117180100000068733.php

Müller, Astrid; Neis, Pascal; Zipf, A. (2010): Ein Routenplaner für Rollstuhlfahrer auf der Basis von OpenStreetMap-Daten. In Konzeption, Realisierung und Perspektive AGIT 2010

QGIS (2017): 17.31. Use R scripts in Processing. Abgerufen am 09.06.2017. http://docs.qgis.org/2.14/de/docs/training_manual/processing/r_intro.html

R Foundation. (o. J.). The R Project for Statistical Computing. Abgerufen am 10.06.2017 von https://www.r-project.org/

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Impacts of Sustainable Transportation on City Tourism: a case of Chatuchak Market in Thailand

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1 ABSTRACT

The paper describes the interdependences in transport between tourists, local customers and store owners in Chatuchak Market (Thailand). It is the most famous market in Thailand and is located in the center of Bangkok nearby the Northeastern Bus Terminal. A mass transit system was launched in Bangkok in late 1990s as Sky train (BTS) and Bangkok underground Mass Rapid Transit (MRT) was implemented in the beginning of the year 2000. These transport systems have played an important role for economic growth in Bangkok, particularly for shopping destinations that were promoted along the BTS and MRT lines and become good examples of environmentally friendly transport of densely populated city of Bangkok. The effective mass transport system is fundamental to destination development and generates visitors and business. Tourism is the key benefit on the economics of the Chatuchak weekend market and local customers. Mass transit systems and services are providing effective accessibility for this weekend market. The market area with more than 15,000 stores and more than 200,000 people is designed for Pedestrians.

Analysis of the transport behavior of the market visitors shows that 63% of the visitors respondents traveled to the market by public transport (Buses, BTS, MRT, public van). In addition, 24% of the respondents arrived by taxi and 2 % used the Tuk tuk (three wheels vehicle with roof). The other visitors walked or used their car, bicycle or motorcycle. 39 % used more than 15 minutes and 16% used less than 5 minutes to walk into the market. Furthermore, visitors were asked to assess the satisfaction of 12 principles and 12 important issues to engage the transport for accessing the market. The important variables were linked to the public transport intensity and existing infrastructure surrounding the market. The second target group of this study are store owners. The analysis shows that 60 % of the store owners traveled to the market by car, 12 % of the respondents used Tuk Tuk and taxi . The market is designed as a car free environment. During opening hours no car is allowed to enter. The paper shows these important preconditions for the high share of public transport and describes the quality of connecting infrastructure for a car free accessibility of Chatuchak market.

Acknowledgement

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Keywords: Mass transit, public transport, pedestrian, tourism, Thailand

2 INTRODUCTION

Chatuchak Weekend Market is the most famous market in Thailand which located in the center of Bangkok nearby the Northeastern Bus Terminal (Mo Chit 2) and it is on Kamphaeng Phet 2 Road, Chatuchak, Bangkok, which is the largest market in Thailand.Chatuchak is claimed as a world's largest market is commonly known among Thai's as JJ (jay jay). With more than 15,000 retailers in 27 sections, occupying some 27 acre space, what makes Chatuchak busy every weekend is not only the fun of bargaining prices but an incredible variety of merchandise it has to offer, from latest fashion items and vintage decor finds to Thai crafts and teak wood tables.Chatuchak market is held on the grounds of a park donated to the people of Thailand by the State Railway according to the wishes of His Majesty the King on the anniversary of HM's 4th Cycle birthday in 1976. Inside the park there are many gardens of various themes, an herb garden, and a garden devoted to flowers in literature. (tourismthailand.org,2016). More than 200,000 visitors come here to buy the goods on offer in every weekend.(Bangkok.com, 2017) As a center of the city of Bangkok, there was a study related to how Chatuchak is one of the important destination for shopping.

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3 LITERATURE REVIEW

Shopping tourism was identified as a fundamental element for city tourism. Through the development of retail services and offerings, shopping tourism can serve as a platform for urban regeneration by adding value to areas here to fore less visited by tourists. Cities utilize shopping and retail experiences to boost the appeal of the destination, supporting economic growth and income generation. Shopping tourism and cities form a symbiotic partnership (UNWTO,2014). In the last fifty years, land use and transportation have been closely connected; first in the dense, mixed use walking city, whose limited transportation options and travel speeds ensured that urban land use remainded closely integrated, and later in the transit city, with its fixed train and tram systems. The advent of the automobile, however, and to lesser extent the diesel bus that mean for the first time that transport could be used to join people from thier home to city. Therefore transportation land use connection was broken and automobile dependence became established. (P.Newman ,J.Kenwothy,1999) Traffic congestion is one of the most significant cumulative drawbacks of motorised mobility, generating negative externalities such as vehicle loss hours, restricted accessibility, wasted fuel and driver frustratin (Rodier, C.J., Johnston, R.A., Shabazian, D.R., 1998). In 2016 ,INRIX reported that Bangkok drivers spent average 64.1 hours in traffic jams become the 12th most congested city in world (Bangkok Post,2017). City transportation requirements cannot be satisfied exclusively by private cars. Public transportation has advantages over private one both in the city centre and along the main highways in dense urban areas. In order to deal with the increasing flow of passengers and cargo, new concepts in the city transportation area are requested. Therefore, the development of new transportation modes has a growing interest (Y. Lianga, J. Serranob, N. A. Pecorarib,V. Serranob, 2013). Traffic congestions, increasing time consuming travels in Bangkok due to inefficient transport system both directly and indirectly led Chatachak market to a declining stage of most popular place for tourists in late 1990s.

To establish a sustainable mobility system, transport modes should adhere to objectives that are socially acceptable (ensuring traffic safety and protecting health), ecologically justified (decreasing fuel consumption and greenhouse gas emissions) and economically feasible (accessible and efficient) in order to serve the societal needs of today and in the future (Vermote, L., Macharis, C., Putman, K., 2013).The concept of sustainable transportation is vital to ensure environment clean, healthy and high quality. The concept is also emphasis on the human life and the environment, to meet current and future needs (M. R. Mat Yazid, R. Ismail, R. Atiq, 2011).

An alternative transport mode had been introduced and create the contribution towards sustainable mobility (Vermote, L. et al.,2013). The launch and operations of mass public transit in Bangkok has significant influences to the convenient and ease of traveling in Bangkok. The study can be related on a more efficient public transport and mass public transit as well as sustainable urban planning in Bangkok as the part of city tourism and shopping tourism.

4 RESEARCH METHODOLOGY

Survey data and statistical analysis had been done by interviewing of local customers and tourists during weekend by using random sampling as a methodology. An interview of shop owners by random sampling of shops during opening time, asking for the development trend of customer before and after mass transit was developed. Study used a 5-point for rating scale (1–5) in most questions on the satisfaction and importance issues from both groups. The general information parts that collected in this survey had been adopted in the appropriate respondents.

The secondary data will be analysed from the collecting data that related in organizations and existing data.The data distribution and correlation analysis will be carried out to find out how causes and effects are related.

5 RESEARCH RESULT

There are two main groups for the survey, first is visitors both local visitors and foreigners and second is the shop owners in the market. The result of survey during July and August, 2016 found that 46.72 % of visitors who responded the survey have 16-30 years old and 42.34 % have 31-45 years old. In additional 1.70 % , 8.76 % and 0.79 % have age in range of under 15 , 46-60, and more than 60 years old. The majority of respondents are living in Bangkok and vicinity 40.15 %, 33.82 % is living outside Bangkok and 24.84 % come from oversea. The respondents are employed by 37.39 %, 24.09 % of the result is self -employed persons. The purposes of visitors are shopping and tourism 68.86%, additional 9.25% want to make recreation , picnic and do sport in the park nearby , visit friends and relatives is 10.71% and there is 11.19 % of respondents come for working. In order to travel accompany, 39.90 % of respondents come with friends, 29.68 % come with family and relatives , 25.06 % come alone and 5.35 % come with business partners or co-workers.

The result of survey can be explained by using public transport to the market was favored issue by 62.77 % of the visitors respondents said they traveled to market by public transport (Buses, MRT, BTS, public van) . In addition, 23.60 % of the respondents traveled with by taxi and 2.43 % traveled by Tuk tuk . There are small number of visitors traveled to market by private cars, bicycles, motorcycles and walk as 8.28 %, 0.49 %, 0.49 % and 1.95 % as show in figure 1. The connection between market and travel to the end points surrounding the market found that 61.54 % people walked from Phaholyothin Bus station and 10.61 % walked from MRT Chatuchak station. The rest of respondents walked form parking places surrounding the market. Result of walking time can be identified that 38.97 % used more than 15 minutes to walk into market, 28.92 % used 5-10 minutes, 11.18 % used 11-15 minutes and 15.93 % used less than 5 minutes to walk into the market.

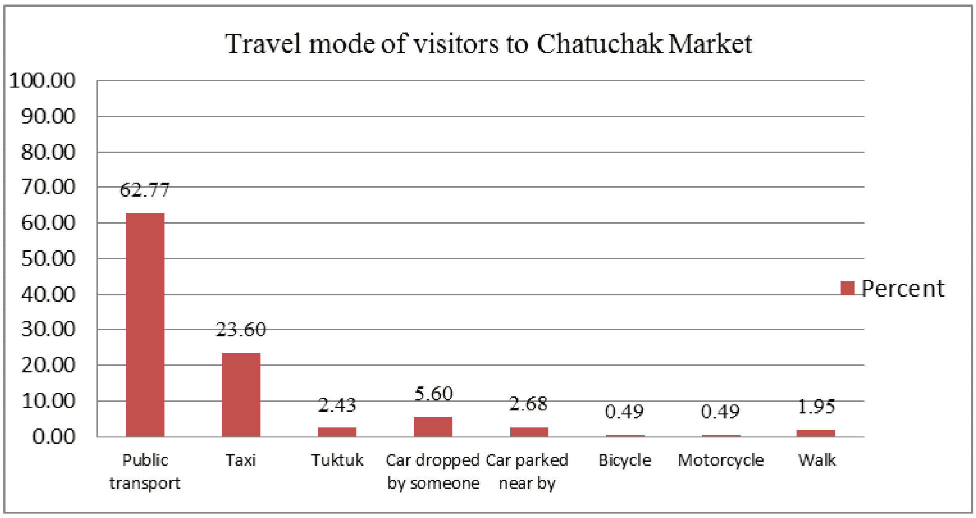

Figure 1 travel modes of visitors

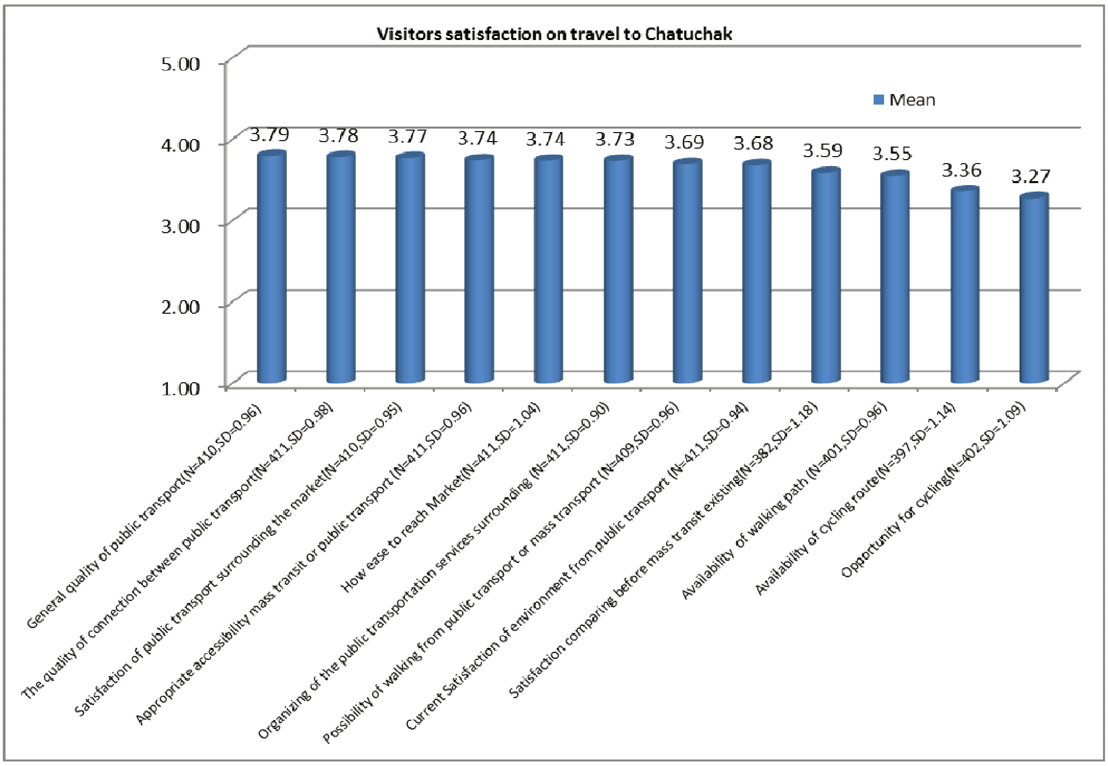

Figure 2 Visitors satisfaction on travel to Chatuchak

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The visitors were asked to assess the satisfaction of 12 principles and how they think about the importance issues that engage the transport for accessing the market in 12 principles. The importance variables were linked to the public transport intensity and existing infrastructure which related to transport surrounding the market.

The level of satisfaction in transport from visitors of market, The level of satisfaction are 1 to 5 , 1 is not satisfy , 2 is little satisfy, 3 is satisfy , 4 is very satisfy and 5 is absolutely satisfy, these factors can be ranked from the highest means score to the lowest means score show in figure 2 as followed:

(1) General quality of public transport with the means score of 3.79

(2) The quality of connection with the means score of 3.78

(3) The public transport surrounding the market with the means score 3.77

(4) Appropriate accessibility on mass transit or public transport with the means score of 3.74

(5) Destination can be reach with the means score of 3.74

(6) Organizing of public transport services with the means score of 3.73

(7) Possibility of walking from public transport or mass transit with the means score of 3.69

(8) Current public transport and environment with the means score of 3.68

(9) Existing walking path with the means score of 3.59

(10) Comparison before and after mass transit existing with the means score of 3.55

(11) Availability of cycling route with the means score of 3.36

(12) Opportunity to cycling with the means score of 3.27

The level of importance in transport from visitors of market, these factors can be ranked from the highest means score to the lowest means score show in figure 3 as followed:

(1) Organizing of public transport services with the means score of 3.93

(2) General quality of public transport with the means score of 3.88

(3) Destination can be reach with the means score of 3.84

(4) The quality of connection with the means score of 3.82

(5) Appropriate accessibility on mass transit or public transport with the means score of 3.82

(6) The public transport surrounding the market with the means score 3.81

(7) Current public transport environment with the means score of 3.78

(8) Existing walking path with the means score of 3.75

(9) Possibility of walking from public transport or mass transit with the means score of 3.72

(10) Comparison before and after mass transit existing with the means score of 3.65

(11) Availability of cycling route with the means score of 3.48

(12) Opportunity to cycling with the means score of 3.46

The second target group of survey in this study is shop owners, who have business into market. The result of this group can be identified by gender as 68.07 % are female and 31.93 % are male. Percentage of shop owners who responded the survey have 16-30 years old is 15.97% and 49.58 % have 31-45 years old. In additional 27.73 %, 6.72 % have age in range of, 46-60, and more than 60 years old.

The majority type of customers are both local and foreigners 54.62 %. The survey shows result that 26.89 % of the clients are and 18.49% of shops in market gave information as local clients. There are variety type of products are saling in the market , according the result of survey show that cloths and fashions is ranking number one as 42.02 %, handicraft is 10.08 % as same as souvenir. Other products ,such as food and beverage is 7.56 %, home and decoration is 9.24 %, jewelry is 5.04 %, plant is 4.02% , and mixed products (glasses, leather, pet) is 11.76 %. Up to 34.45 % of shops run business more than 15 years, 10.92 % open their business in the market for 11-15 years, the businesses are runing between 6-10 years is the third ranking as 28.57 %. The busineses are runnign between 1-5 years is 17.65 % and the new business that are open less than one year is 8.40 %.

The result of survey can be explained by 59.66 % of the shop owners who responded said they traveled to market by using private cars. In addition, using Tuk Tuk and taxi is 11.76 % of the respondents. Result from the shop owners survey can show 21.01 % of this group used public transport as a mode of traveled to market. There were small number of shop owners travel to market area by using motorcycle and walk as 4.02 %, and 3.36 % that show in figure 4.

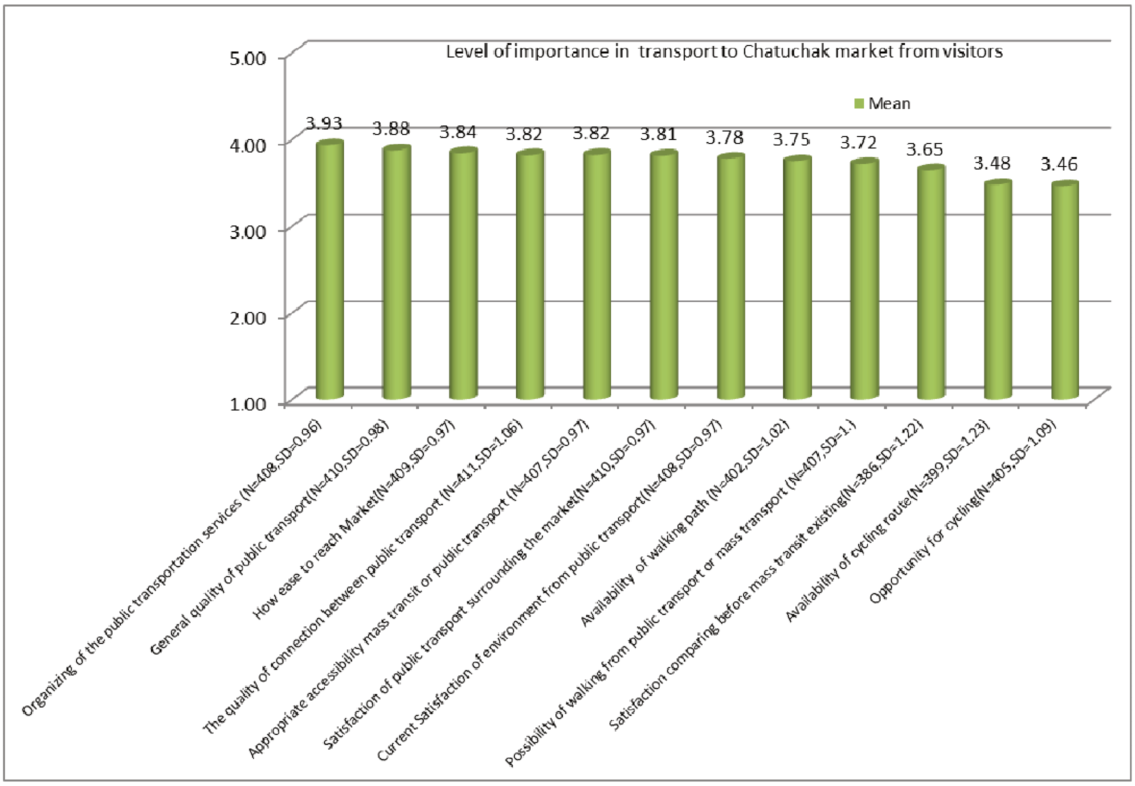

Figure 3 Level of importance in transport to Chatuchak market from visitors

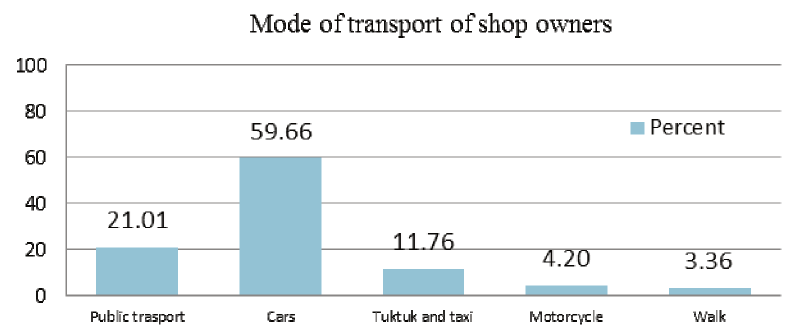

Figure 4 Mode of transport of shop owners

For 47.08 % of shop owners who responed in this survey used mass transit and public transport including public services for delivering or transferring their product. However, up to 52.92 % never used optional of transport modes to deliver their products. For the respondents who used optional transport modes to deliver their products can be defied as up to 60.71 % have been used mass transit (BTS, MRT) and 39.29 % have been used public transport including public services (busses, vans, Tuk Tuk) as show in figure 5.

Figure 6 can show the time comparison of shop owners by delivering goods as an optional delivery travel mode, the result could show that 74.29 % , the owners think using public transport faster than using car for their delivery.

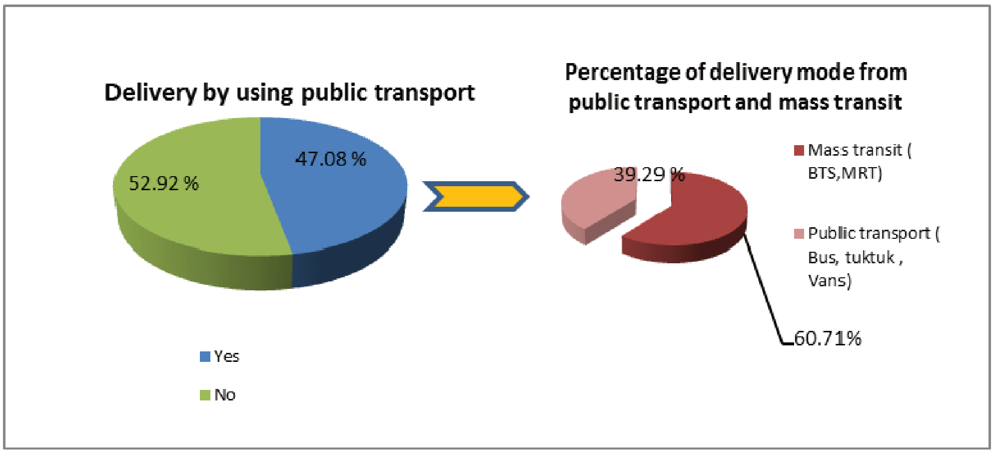

Figure 5 Delivery of shop owners by using public transport and mass transit

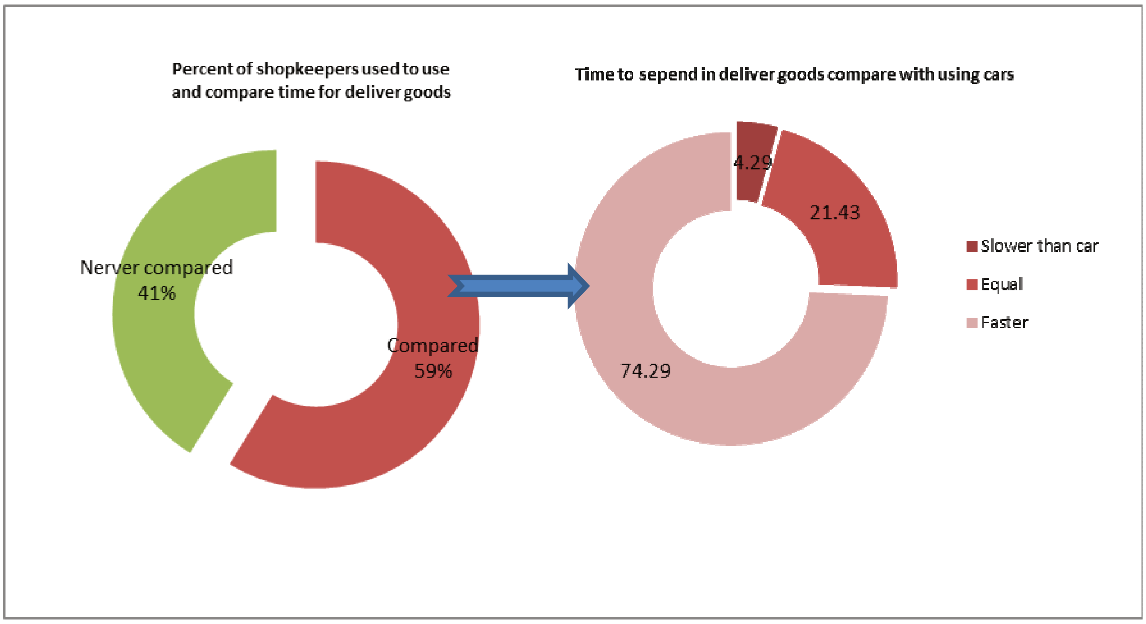

Figure 6 Shop owners compare time for optional delivery travel modes

The shop owners also were asked about the satisfaction of 9 principles and how they think about the importance issues that can be engaged the transport for accessing the market in 9 practical issues. The importance variables were linked to the public transport intensity and existing infrastructure which related to transport surrounding the market and the most favored mode of travel that they use for get into the market.

The level of satisfaction in transport from shop owners of market are 1 to 5 , 1 is not satisfy , 2 is little satisfy, 3 is satisfy , 4 is very satisfy and 5 is absolutely satisfy, these factors can be ranked from the highest means score to the lowest means score show in in figure 7 as followed:

(1) The quality of connection between public transport around the market with the means score of 3.66

(2) Current public transport and environment with the means score of 3.63

(3) Appropriate accessibility on mass transit or public transport with the means score of 3.61

(4) Satisfaction on goods deliver before and after mass transit exist with the means score of 3.55

(5) Possibility of walking from public transport or mass transit with the means score of 3.48

(6) Availability of walking path with the means score of 3.45

(7) Satisfaction on travel to market comparing before mass transit existing (in case had experience) with the means score 3.30

(8) Availability of cycling route with the means score of 3.14

(9) Opportunity to cycling with the means score of 3.08

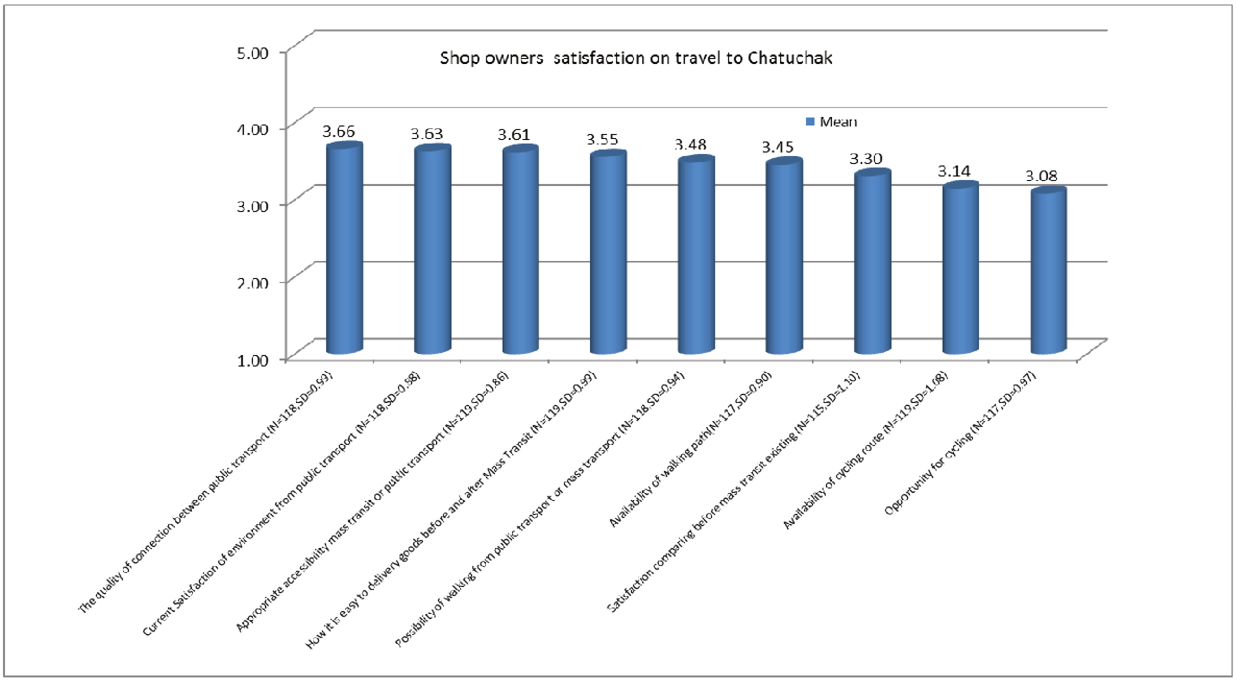

Figure 7 shop owners satisfaction on travel to Chatuchak

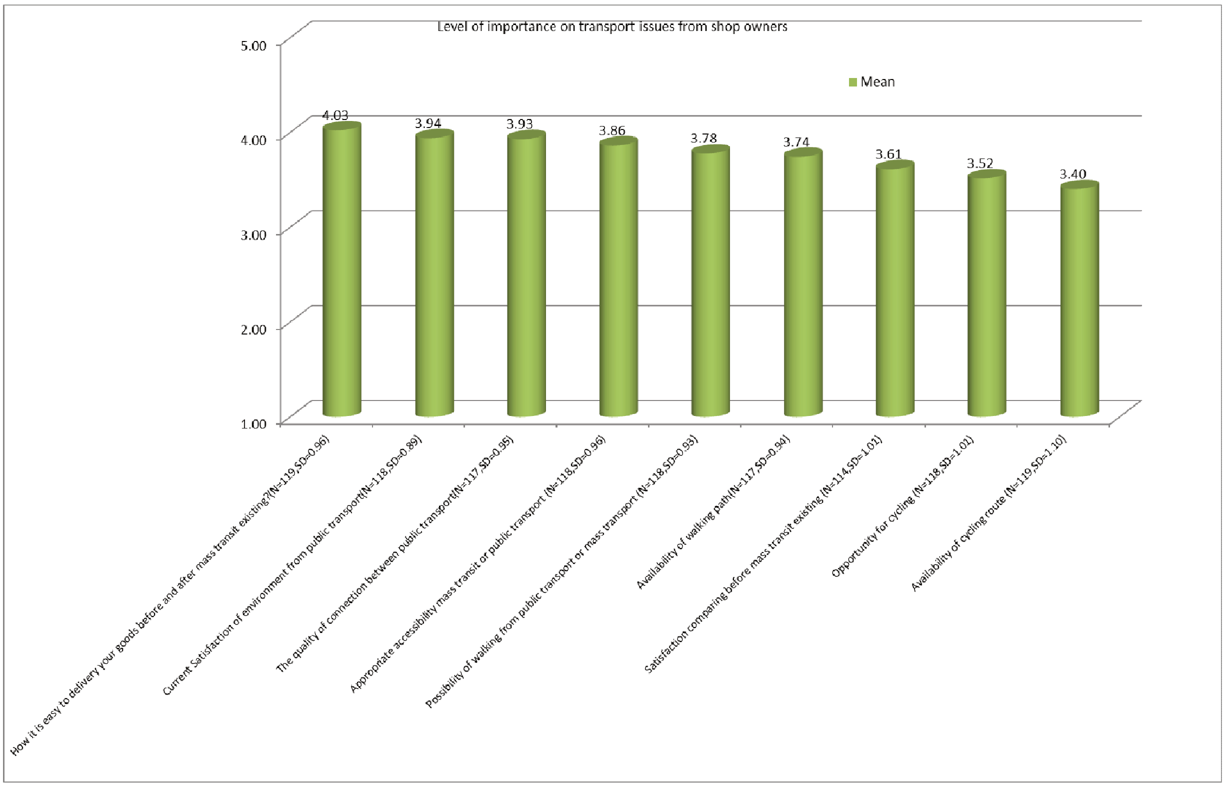

Figure 8 Level of importance on transport issues from shop owners

The level of importance in transport from visitors of market, these factors can be ranked from the highest means score to the lowest means score show in figure 8 as followed:

(1) Delivery systems before and after mass transit exist with the means score of 4.03

(2) General environment from public transport to the market with the means score of 3.94

(3) The quality of connection between public transport around the market with the means score of 3.93

(4) Appropriate accessibility mass transit or public transport to the market with the means score of 3.86

(5) Possibility of walking from public transport or mass transit with the means score of 3.78

(6) Availability of walking path with the means score of 3.74

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(7) The convenience compared before mass transit existing (in case had experience) with the means score 3.61

(8) Opportunity to cycling with the means score of 3.52

(9) Availability of cycling route with the means score of 3.40

6 DISCUSSION

The mobility of all types of vehicles use a lot of energy and burning fossil fuels which can be produced smoke and noise and created effect on local environment and quality of living of people who live in the mega city like Bangkok. In the tourism business, transportation has been playing an importance role for engaging business and impacts of pollution on the environment and visitor's decision making. The good public transport and connecting systems can be impacted to the tourism business, for saving time, reducing the pollution and convenient life. There are few general comments of visitors who visit to Chatuchak market that need to be discussed on the tourism promotion for this market. Taking taxi from home to destination can be convenient transport modes for people who not travel alone. And when make cost comparision with mass transit has no diferent. The weather conditions such as hot climate, raining days also are the factors of traveller's decision. For the visitors who travelled by public transport has common comment as they are prefer travel by free busses system. This free busese system had been promoted by government for their saling point during the election beriod particular in the Bangkok area.

The use of sustainable and non - motorized transport modes surrounding market area may elevate the environmental awareness and increase the tourism business surrounding and in the market. However is not easy to implement due to the car oriented business and the big city like Bangkok.Nevertheless, as the recent economic crises, sustainable transportation and car free environment seem to be meaning more and more particular for the urban area. That could be right time for the changing paradigm of transport planners or city planners.The implementation of non-motorized transportation can be integrated as a part of the sustainable urban planning shows in figure 9. Car free environment in the area could be the one of topic that can be making Chatuchak market much more attractive and unique.

Figure 9 bicycle path along Kamphaeng Phet 3 road

Figure 10 Shared space on Mariahilfer Strasse, Vienna, Austria

As some European cities have dedicated road to be shared space and focus on designing networks in neighborhood areas, focuses on linking with existing road infrastructures by improving non-motorized quality. These can be achieved by example of implementing European model as car free environment on the transportation design. Lesson learned from Mariahilfer Strasse, the famous shopping street in Vienna shows as the implemention of shared space concept in area has a positive feedback. (vienncouver.com, 09-07-2017)

The decision will be an opportunity for the designed stages and development of motorized as well as non-motorized facilities including the layout of buildings and infrastructures. Most European cities give priority on non-motorized on certain streets and intersections when designing green phases at traffic model. Some one-way streets have been transferred into two-way streets for non-motorized, moreover non-motorized modes are exempted from many turn restrictions for cars. (M. R. Mat Yazid, R. Ismail, R. Atiq, 2011).

7 CONCLUSION

Famous travel mode of Chatuchak market visitors is public transport up to 62 .77 % according survey result, for the shop owners, travel by car up to 59.66 % show in survey result. Both target groups are satisfied in the public transport and mass transit systems surrounding the market. Transportation systems around the market have been improving all the time by promoting the mass transit systems and public transports that can make Chatuchak market much more attractive as a hub of shopping area in Bangkok. The car free environment such as building the bicycle lanes is still want to make it better and runing in well function. Making more attractive for cyclist who want to use bicycle around the market and its connection points are also can be developed in the future.

8 REFERENCES

M. R. Mat Yazid, R. Ismail, R. Atiq:The 2nd International Building Control Conference (2011) The Use of Non-Motorized For Sustainable Transportation in Malaysia, Procedia Engineering 20 125 – 134), 2011.

Peter Newman ,Jeffrey Kenworthy: , Sustainability and cities: overcoming automobile dependence:Island Press,1999.

Raquel Camprubí ,University of Girona:Spain CAPITAL CITIES TOURISM IMAGE: IS IT FRAGMENTED?: European Journal of Tourism, Hospitality and Recreation Vol. 6, Issue 1, pp. 57-74. Polytechnic Institute of Leiria,2015 .

Rodier, C.J., Johnston, R.A., Shabazian, D.R.: Evaluation of advanced transit alternatives using consumer welfare, Transportation Research Part C 5, 141–156. 1998.

Vermote, L., Macharis, C., Putman, K.,: Sustainability assessment of 30-km/h policy measures: the Brussels' pentagon case, European Journal of Decision Processes ,2013a.

Vermote, L. et al., Participatory evaluation of regional light rail scenarios: A Flemish case on sustainable mobility and land-use, Environ. Sci. Policy (2013)

World Tourism Organization: Global Report on Shopping Tourism: AM Reports, Volume eight , UNWTO Madrid,2014.

Y. Lianga, J. Serranob, N. A. Pecorarib & V. Serranob: Simulation study towards a new sustainable transportation solution in urban areas, S.A.T. Project :Selection and/or peer-review under responsibility of Chinese Overseas Transportation Association, ,Procedia - Social and Behavioral Sciences 96 ,1712 – 1720), 13th COTA International Conference of Transportation Professionals (CICTP 2013).

http://www.bangkokpost.com/learning/advanced/1201724/bangkok-traffic-jams-among-worlds-worst (29-05-2017)

http://www.bangkok.com/shopping-market/popular-markets.htm (29-05-2017)

https://www.tourismthailand.org/Chatuchak-Weekend-Market (15-06-2016)

http://www.vienncouver.com/2015/01/viennas-begegnungszone-shared-space-program (09-07-2017)

🏆 *reviewed paper*

Influence of Air Traffic on Economic Development of Bosnia and Herzegovina and Business Environment of the European Air Traffic

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1 ABSTRACT

In the paper, influence of air traffic in Bosnia and Herzegovina on trends and business environment of the European air traffic is analysed. Observed globally and on a long-term basis, air traffic is one of branches of economy that has a high rapidity of technological development. Taking into consideration social and economic interest of the country in creating policy of air traffic development, it is necessary to take care of development of all factors in air traffic during making strategic decisions. In the past, air traffic developed by assistance of the state, particularly by subsidizing of the national air traffic. For political and social interest, the states subsidized also maintenance of non-profitable lines to national airlines, particularly in domestic traffic. The paper is based on a thorough theoretical and practical knowledge of air traffic and its emerging forms, not only in our country, but also in Europe. For such a complex development of air traffic in Bosnia and Herzegovina the elements of social, economic and physiognomic nature, which were special and significant for transformation, respectively for changes of the space with its orientation of spatial development of economic activities, as well as social and technical infrastructure, were considered.

Keywords: airports, economic development, air traffic, Bosnia and Hercegovina, infrastructure

2 INTRODUCTION

The influence of air traffic in Bosnia and Herzegovina's trends, and the business environment of the European air traffic, has been analysed in the paper. Globalization and integration processes are characteristics of new strategies of bigger number of industries, which directly affects economic development of the countries caught by it . Observed globally and on a long-term basis, air traffic is one of branches of economy that has a high rapidity of technological development. Elements that enhance such development are reflected primarily in development of computer science and telecommunication system and development of modern aircraft engines that reduce fuel consumption, and increase the landing and flight speed. Taking into consideration social and economic interest of the country in creating the air traffic policy for development, it is necessary to consider development of all factors in air traffic in making strategic decisions. In the past, air traffic developed by state aid, particularly by subsidizing of the national air traffic. Except for financing the purchase or renewal of aircraft fleet of airlines, with direct investing into capital investments, the states financed construction of airport infrastructure and facilities of air-traffic control. In new economic-political conditions that determine development of Bosnia and Herzegovina and with regard to tendencies of air traffic changes in our environment, deep changes in the structure and organization of our air traffic are needed, so that it can be successfully fitted into the international air traffic system with the most favourable effects on total social and economic development. It requires defining of objectives as part of state economic policy regarding the start of new cycle of development of airports and equipment in Bosnia and Herzegovina in all aeronautical domains, particularly in traffic, and also a very serious, expert approach in considering alternatives, in order to avoid mistakes that may mean missing important possibilities and a loss of previously acquired positions and potentials or, in other extreme, acceptance of non-realistic projects that would burden the national economy. For political and social interest, Germany, Turkey, Austria and Saudi Arabia have also financed maintenance of airports in Bosnia and Herzegovina. The paper is based on a thorough theoretical and practical knowledge of air traffic and its emerging forms, not only in our country, but also in Europe. For such a complex development of air traffic in Bosnia and Herzegovina the elements of social, economic and physiognomic nature, which were special and significant for transformation, respectively for changes of the space with its orientation of spatial development of economic activities, as well as social and technical infrastructure, were considered.

Traffic development in the function of international communicating is articulated with primary interest of connecting Croatia with its European environment, with a special emphasis to traffic connections that correspond with political and economic orientation of Croatia. In that sense, land traffic connections toward Central Europe and through it to Western Europe, and toward the Pannonian basin of the Central European region and, through it, toward Northern and Eastern Europe, are distinguished (Nurković, 2007). At the same time, directions of international air traffic of Bosnia and Herzegovina with its European environment are more broadly analysed, and the transit connections on air directions of West-East communication, respectively northeast – southwest. When it comes to international traffic routes in the air space of Bosnia and Herzegovina, importance of tourist traffic should be particularly valorised, with an interest of attracting the air corridors. As important issue the traffic connecting is distinguished, respectively transiting through Bosnia and Herzegovina, which represents geo traffic wholeness with the European Union in specific parts and with specific directions. Air cargo traffic achieves an extensive transportation work. (Cargo quantity multiplied by covered distance), particularly on long distances and its participation increases in total traffic owing to a large average distance. Around 40% of the world's industrial exports, according to value, are transported by airplane today. Air traffic is currently one of transportation sectors with the most rapid development in the world's economy. Most of estimates indicate that in the first decade of the 21st century the growth of air traffic will continue with annual rates of above 5%, (almost double faster than the rate of global growth of gross domestic product).

3 METHODS OF WORK AND DATA SOURCES

Methodological approach has been imperatively adjusted to purpose of the work, as air traffic in Bosnia and Herzegovina has a strong influence on economic–geographic local and regional development. The research has been performed through economic development, transportation of passengers and goods in Bosnia and Herzegovina. In estimation of economic contribution of economic activities quantitative methods are used almost exclusively, in the range from stochastic to deterministic. Of stochastic methods, econometric methods based on analysis of time periods and panel data are used most frequently. Deterministic methods include models of gravitation (which partly can be stochastic models as well), input-output analysis (Input-output, IO) and matrixes of national accounts, and computable general equilibrium model. Many theoretical models and techniques that can be used will often be adjusted from historical or comparative studies connecting the same areas (Hirst, 2008).. In order to determine influence of air traffic on economic development in Bosnia and Herzegovina, several methods have been used. First of all, gathering and processing the relevant scientific and expert, relatively modest domestic literature, and more considerably of the foreign literature should be mentioned. With regard to insufficient statistic data on air traffic from statistic publications the biggest challenge was gathering the original statistic data from all airports and air terminals. In the paper, statistic data related to traffic of passengers and goods and economic development of Bosnia and Herzegovina have also been used and analysed. Demand for air traffic (really all transportation means) originates from population, their distribution, and economic and other factors that affect significantly the tendency to travel within the population. Very simply, one day there will be no space for meeting higher demand without unacceptable influence on services, such as delays and safety of passengers, as sufficient capacities are the advantage. Instead of waiting for that time to come, it is important that the companies involved in traffic start thinking on innovative solutions for development of new airports and passengers. For additional practical understanding of the situation and complexity of solution, a very simple system that offer a starting point and is based on regular form and a homogenous community, will be analysed considering several possible ways of serving to travel demands. It has nine identical locations (Nurković, 2016). The empirical results of a model that is used for estimation of applicability of perfect competition on the international air traffic market have been shown in (Figure 1.)

Comparative data are the valuable source of comfort for forecasters. A data model can help researchers, if not exactly with what will happen, then at least with the possibilities that are likely to be noticeable in the future. In order to determine the influence of air traffic on economic development in Bosnia and Herzegovina, several methods have been used. First of all, gathering and processing the relevant scientific and expert, relatively modest domestic literature, and more considerably of the foreign literature should be mentioned. With regard to insufficient statistic data on air traffic in the statistic publications, the biggest challenge was gathering the original statistic data from all airports and air terminals. In the paper, statistic data related to traffic of passengers and goods and economic development of Bosnia and Herzegovina have also been used and analysed.

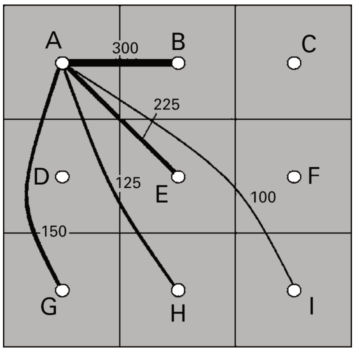

Fig. 1: Air transportation system for transportation (passengers/day) between nine evenly distributed communities of similar size.

- demand to B = 300
- demand to C = 150
- demand to D-300
- demand to E = 225
- demand to F = 125
- demand to G = 150
- demand to H = 125
- demand to I = 100 (and the total demand is 1475 passengers/day).

4 THE ECONOMIC EFFECTS OF AIRLINE INDUSTRY

Air traffic is a strong initiator of economic development, creating jobs, trade and mobility in Bosnia and Herzegovina and the European Union. It is crucial for economy of the European Union and strengthens its leading position in the world. The air traffic strategy is necessary in order to ensure competiveness of the European sector and to use rapid changes and development of the world's economy. In air traffic sector of the European Union around 1,4 milion and 2 million people are employed, which supports between 4,8 million and 5,5 million of jobs. A large contribution of air traffic contributes to GDP, in the European Union it amounts to 110 billion EUR and total effect, including tourism, reaches 510 million EUR when the multiplier effect is taken into consideration. In makings decisions on location of the headquarters in Europe, big companies are largely lead by availability of big international flights: increase in offer of intercontinental flights of 10 % causes the rise in number of headquarters of big companies of 4 %. Increase of number of departing passengers in broader urban area of 10 % causes increase of number of employed people in local sector of services of 1 %. (European Commission, 2015). In Bosnia and Herzegovina a new strategy of development of air traffic is necessary where in last 10 years, in 2014, total traffic of passengers and goods at the airports in Sarajevo was 79,0%, in Tuzla 4,2 %, in Mostar 0,1% and Banja Luka 16,7%. The European Union appropriates considerable funds for modernization of airports in Bosnia and Herzegovina. The European sector of in 2015, total traffic of passengers at the airports London 74. 954, Paris 65.698, Frankfurt 60.899 and Amsterdam 58.168. (Table 1 and Figure 2).

The European sector of air traffic has considerably developed over the past 20 years due to liberalization of the European Union's internal market of air traffic services and significant rise in demand for air transportation in the European Union and the world. The air traffic users have never had bigger and more favourable possibilities for air travel. Number and frequency of airlines within the European Union and the international lines and number of passengers have significantly inreased. The low-cost carriers from the European Union are among the most succesful according to number of passengers and market capitalization. The same is applicable for the European aeronautical industrial production. A noticable progress has also been recorded in the international air traffic sector outside of Europe, with a large growth in specific regions of the world. It is related to moving the world economic focus toward the East, particularly to Asia. For that reason, several air carriers and airports have appeared in Bosnia and Herzegovina, which are the serious new competitors to the European carriers and the biggest airports in Europe. In addition, the air traffic growth in Europe and the world should develop in accordance with keeping high standards of air traffic safety and reducing its ecological footprint, also making contribution to fight against climate change. In a few words, the air traffic growth in Bosnia and Herzegovina must be sustainable. The contribution of the air traffic sector to economy in Bosnia and Herzegovina and the European Union, as well as its presence in the world are very important, therefore, it is crucial to keep its competitiveness, leading position and the possibilities of growth. Europe must be a leader in the international air traffic and the world's example of the sustainable air traffic, with a high level of services and ambitious standards of the European Union. The objective of this paper is increasing the competitiveness of air traffic and sustainability of the entire valuable network of the European Union and Bosnia and Herzegovina.

Airport	Total air passenger transport	Growth 2015/2014
London/Heathrow	74 954	+2.2%
Paris/Charles de Gaulle	65 698	+3.2%
Frankfurt/Main	60 889	+2.5%
Amsterdam/Schiphol	58 168	+5.8%
Madrid/Barajas	46 297	+ 11.4%
Munchen	40 861	+3.3%
London/Gatwick	40 257	+5.7%
Roma/Fiumicino	40 231	+5.2%
Barcelona/El Prat	39 425	+5.4%
Paris/Orly	29 663	+2.8%
Kobenhavn/Kastrup	26 512	+3.8%
Dublin	24 924	+ 14.9%
Palma de Mallorca	23 717	+2.8%
Brussels/National	23 269	+7.0%
Stockholm/Arlanda	23 155	+3.2%
Manchester	23 093	+5.2%
Wien/Schwechat	22 740	+ 1.2%
London/Stansted	22 514	+ 12.9%
Dusseldorf	22 448	+2.9%
Berlin/Tegel	20 995	+ 1.6%
Lisboa	20 111	+ 10.8%
Milano/Malpensa	18 445	-1.2%
Athinai/Eleftherios Venizelos	18 090	+ 19.1%
Helsinki/Vantaa	16 418	+3.0%
Hamburg	15 581	+5.7%
Malaga/Cosat del Sol	14 360	+4.8%
London/Luton	12 263	+ 17.0%
Nice/Cote d'Azur	12 013	+3.1%
Praha/Ruzyne	11 868	+6.6%
Warszawa/Chopina	11 218	+5.8%

Table 1: Passenger traffic at the leading airports in the European Union.

Fig. 2: Major traffic flows

5 THE ECONOMIC EFFECTS OF AIR TRAFFIC IN BOSNIA AND HERZEGOVINA

The air traffic sector in Bosnia and Herzegovina must be enabled to use new, growing markets from the European Union and other countries of the world, as in the future decades large economic opportunities for air companies will be opened on these. Geography is not the only factor that determines selecting the location of sucessful international airports and air carriers. Availability of the adequate infrastructure, nature of economic, fiscal and regulatory system and historical, cultural and trade connections are also important. It is possible to manage these parameters, and the European Union has all instruments needed for that. Experience has shown that negotiations on universal air transport agreements with the third countries are at the European Union level. For example, number of passengers was almost trippled since signing the agreement on air traffic between countries of the Western Balkans and the European Union. When it comes to Bosnia and Herzegovina, that number has doubled. With formulating the ambitious foreign policy for the air traffic in Bosnia and Herzegovina that will be based on understanding on comprehensive agreements on the air traffic, with a clear orientation toward the growing markets, the European Union can make easier for the European air traffic sector to approach important overseas markets and to increase the possibilities for investing into them, thus increasing the international connections of Europe and ensuring fair and transparent market conditions for all air carriers from the European Union in Bosnia and Herzegovina. Experience with the air traffic in the European Union has shown that with opening the markets, which would be reached by these agreements, opportunities for entering the new subjects on the market and using new business models would also be created. The research results show the increased demand and connections of airports in Europe and the world. For example, the customer demand is less sensitive on the trend of prices at the biggest airport on local market. (European Commission, 2015)

Fig. 3: Trans-frontier air traffic in Bosnia and Herzegovina in 2017.

If we look at the trends in passengers traffic in the period from 2010 to 2016 at the airports of Bosnia and Herzegovina, we can notice the constant growth in passenger numbers by 2016. In the year that follws, there was a decline in the number of passengers by 3,5% compared to 2010 as a result of the global economic and financial crisis. The impact of the crisis was reflected primarily in the transport of passengers and cargo at the airports of Bosnia and Herzegovina. The year 2010 brought a recovery of the most important European and world economic powers and an increase in the number of passengers to 5.54% that stabilizes the total number of passengers to the size of the turnover in 2011. If we look at passenger traffic from 2012 at the

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airports of Bosnia and Herzegovina, we find that the Sarajevo Airport individually leads in the observed period with the average growth in passenger number of 533,915 passengers or 97.2%. The Tuzla Airport in the same period in 2009 transported 3.92823 passengers or 0.7% of total number of passengers of airports. The Mostar Airport transported 4,027 passengers or 0.7%, and the Banja Luka Airport transported 7,300 passengers or 1.3%. The Sarajevo Airport in the total number of passengers in 2014 transported 709,901 passengers or 74.2%, followed by the Tuzla Airport on the second place with 151,353 passengers or 15.8%, the Mostar Airport with 67,974 passengers or 7.1% and the Banja Luka Airport with 27,636 passengers, or 2.9%. The total number of passengers at all airports in Bosnia and Herzegovina was constantly growing from 2015 (1.130.042 passengers) to 2016 (1.225.676 passengers). (Table 2 and Figure 3) (State Agency for Statistics of Bosnia and Herzegovina, 2016).

Airport	2010	%	2012	%	2013	%	2014	%	2016	%
Sarajevo	563.266	95,3	580.058	86,7	665.638	82,7	709.901	74,2	838.966	68.4
Mostar	17.833	3,0	78.207	11,7	68.939	8,6	67.974	7,1	53.618	4.3
Tuzla	5.438	0,9	4.191	0,6	61.564	7,6	151.353	15,8	311.398	25.4
Banja Luka	4.798	0,8	6.420	1,0	8.837	1,1	27.636	2,9	31.499	2.5
Total	591.335	100	668.876	100	804.978	100	956.364	100	1.225.676	100

Table 2: Transport of passengers at airports in Bosnia and Herzegovina 2010-2016.

Unlike the trends in the number of passengers, the trends in the cargo and mail traffic is much more irregular and has significantly lower growth. In 2011, there were 1.518 tons of cargo and mail and in 2014 there was an increase of 2,607 tons of cargo and mail. Moreover, cargo and mail traffic is almost negligible in relation to the transport of passengers. In Bosnia and Herzegovina 1,609 tons of cargo and mail have been transported in the last ten years. It can be assumed that the average passenger weighs 80 kg and has at least 20 kg of luggage which means that cargo and mail traffic accounts for only 2.12% of the air transport of Bosnia and Herzegovina. (State Agency for Statistics of Bosnia and Herzegovina, 2016).

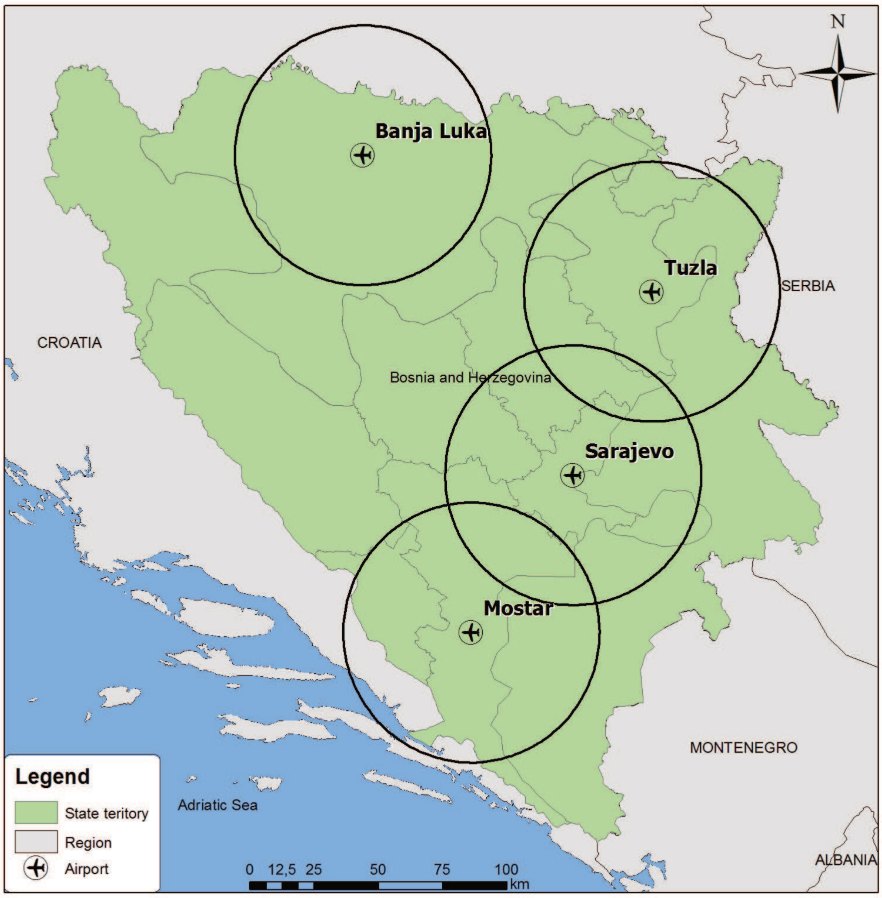

Fig. 4: Airports and airfields of Bosnia and Herzegovina, 2016.

The Sarajevo International Airport had the largest cargo and mail transport of 2,060 tons of cargo and mail or 79.0% on average in 2014, and the lowest was 1,366 or 90.0% of the total of cargo and mail transport in 2011. However, when we compare cargo transport in 2011 and 2014, there is an evident increase in traffic around 12, 7%. The share of other airports in the transport of cargo and mail halved in the period from 2011 to 2014. The exception is only the Banja Luka Airport which transported 436 tons of cargo and mail or 16.7% in 2014. The Tuzla Airport transported 109 tons of cargo and mail or 4.2% and the Mostar Airport transported 2 tons of cargo and mail, or 0.1%. (Table 3 and Figure 4) (State Agency for Statistics of Bosnia and Herzegovina, 2016).

Airport	2011	%	2012	%	2013	%	2014	%	2016	%
Sarajevo	1.366	90,0	1.526	94,0	1.603	99,6	2.060	79,0	4.238	43,5
Mostar	0	0,0	29	1,8	0	0,0	2	0,1	150	1,5
Tuzla	152	10,0	67	4,1	6	0,4	109	4,2	237	2,4
Banja Luka	0	0,0	0	0,0	0	0,0	436	16,7	5.109	52,5
Total	1.518	100,0	1.624	100,0	1.609	100,0	2.607	100,0	9.734	43,5

Table 3: Transport of cargo and mail at airports in Bosnia and Herzegovina 2010-2016.

6 GUIDELINES OF THE FUTURE BUSINESS OPERATIONS OF AIR TRAFFIC

With regard to long-term projection of development of passenger and cargo air traffic it is necessary to create a business model as a precondition for positioning of Bosnia and Herzegovina on the air market. The new business model should be perceived in the context of numerous factors. The basic precondition for construction and functioning of a new model of business operations is the competency of management system. In the nature of things, each management system is integrated to a larger or smaller extent, so we are speaking about competency of the integrated management system that is defined as a series of characteristics, which makes it able of achieving a complex mission of the integrated system, in continuity, on personnel, processing and business level. The air carriers, airports and air traffic controls in Europe have so far acted in a rather isolated and closed manner, everyone in its own yard (Conrath, et al., 2016). Therefore, the European Commission invited to a change of the management over extremely fragmented air space in order to enable the companies to lose less time, money and fuel, in the light of significant air traffic growth. The Commission adopted the second package of measures Single European Sky in 2012, aiming at the establishment of the single European airspace. The aims of proposals are further improvement of safety, reducing costs and delays, lower emissions of carbon dioxide, new jobs, and profit of the industry on global market, as the package includes also improvements in researches and technologies (Gillen et al., 2014).

The congestion of air traffic over Europe, particularly over southeast of Europe to which Bosnia and Herzegovina belongs as well, is getting bigger and bigger. Such density of air traffic considerably affects safety. For this reason, restrictions issued by air traffic controls to air carriers are getting more and more frequent, so that they are late even before flying, the passengers get nervous, particularly those who are supposed to continue their travel and to be on time for another flight. Due to delays, the carriers lose the place they had already reserved at some airport where they land or take off in the scheduled time, so it is quite understandable that new radical measures are necessary for salvation of the European air industry as a whole. The Sarajevo flight control is one of the most modern in Europe, as it possesses the supervisory airspace system like other countries in Europe. In new economic–political conditions that determine the development of Bosnia and Herzegovina, and with regard to tendencies of air traffic changes in our environment, Europe and the world, deep changes are needed in the structure and organization of our air traffic so that it can be successfully fitted into international air traffic system, with the most favourable effects on total social and economic progress. The traffic has had a very dynamical development in the European Union and has become a significant branch of mass transportation. Air traffic is one of transportation sectors with the fastest development in the world's economy today. Most of forecasts indicate that in the 21st century air traffic growth will continue at annual rate over 5%, (almost double faster than the global growth rate of social product.). This means that doubling of the air traffic volume is expected in the next 12 to 13 years.

With liberalization of the international exchange and development of regional co-operation and integration, it comes to strengthening of competition, to gradual liberalization of traffic rights and equalizing the air

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regulations, not only on bilateral but also on multi-lateral and regional basis (the example of the European Union). Privatization of the national airline companies in some countries has been implemented or is ongoing, (in dependence of how strong and consolidated national economy is and the air traffic within that), but in most of countries national capital makes majority and, all in all, the foreign carriers are only exceptionally allowed to acquire more significant share in their ownership structure. Due to increase of competition, many air companies in the European Union associate through the capital (to an extent allowed by the state airline policy) and even more through business co-operation and associated exploitation of the lines and the fleet, for the purpose of reducing costs and transportation of passengers and goods. Influence of globalization of the world's economy and trade indicate to need for gradual harmonization of national air policies and to perspective of global regulations of air traffic. Process of market liberalization is unstoppable, nevertheless it is developing unevenly (spatially and timely), because it depends of geopolitical circumstances, economic structure and extent of general economic development of single countries and larger areas in which they are located (Borel, 2012).

7 CONCLUSION

The paper has been largely focused on the segment that belongs to air traffic and economic development of Bosnia and Herzegovina, with a particular review to business environment of the European air traffic. It certainly deals with air traffic and air space, and multilateral agreement on the common European airspace, as well as its objectives and principles and on status in Bosnia and Herzegovina in the context of the European integrations. The objective of this paper was to determine which of the regulatory frames Bosnia and Herzegovina must satisfy for joining the European Union. This tells us that Bosnia and Herzegovina considerably stays behind other countries on the way to the European Union membership. The air traffic of passengers and goods constantly increases, as it can be concluded in the first chapter of this paper. Traffic growth of all airline carriers, for the most part of the low-cost ones, causes a need for larger infrastructure.

The first important step has been made; the civil air agency that would be authorised for the establishment of functional blocks of air space and for certifying the providers of air traffic control services has been established. An essential agreement that was signed by Bosnia and Herzegovina is the European common air space and the Agreement that would enable competitiveness of air carriers, simplify the procedures in preparations of international flights and control of performing air traffic and would largely help Bosnia and Herzegovina in the procedure of change and adjustment of regulations of the European Union.

With signature of that Agreement, Bosnia and Herzegovina has fully equalized its legislation with the legislation of other signatory countries in the process of adjustment with the regulations of the European Union. There are already several master plans and finally, the project of reconstruction and development of the airports in Bosnia and Herzegovina has recently been allocated by the European Union. Perhaps at this point such a big project is not indispensable for the airport of Sarajevo, however, when Bosnia and Herzegovina joins the European Union, when free movement of goods, people, assets and capital is achieved, it can become one of the larger regional centres for exchange of these. The airports in Sarajevo, Tuzla, Banja Luka and Mostar will then require new and much bigger passenger terminals and the air bridges that are inevitable today. Undoubtedly, there is a huge potential in this area for the air traffic growth and the governments, air carriers and airports should together find the best models for promotion of tourism and travel. The undeveloped network of air connections within the region is a fact and that should be a challenge for all.

8 REFERENCES

Boeing Commercial Airplanes: World Air Cargo Forecast 2010-2011. Seattle, 2010.

BOREL, G.: Airports - Evolving business models and social and economic impact, Air Traffic Workshop "Importance of Air Transport Sector in Economic and Social Development of the South Fast Europe", Energy and Infrastructure Unit Regional Cooperation Council, Sarajevo, SEETO Comprehensive Network Multi-Annual Plan (MAP) 2012.

CONRATH, E.-M. und Maertens, Sven und Berster, Peter und Gelhausen, Marc: Brexit: Mögliche Auswirkungen auf Luftverkehrsangebot und –nachfrage. In: Wirtschaftsdienst, 96. Heft 9, pp. 675-681. 2016.

Eurocontrol: Briefing: Business Aviation in Europe in 2010. Brüssel, 2011.

Eurocontrol: Briefing: Business Aviation in Europe in 2012. Brüssel, 2013.

Eurocontrol: Business Aviation in Europe – Eurocontrol Trends in Air Traffic. Brüssel, 2010

Eurocontrol: Market Segments in European Air Traffic 2015. Brüssel, 2016.

European Commission, TEN-T Network, http://ec.europa.eu

European Commission, White Paper Roadmap to a Single Transport Area-Towards a Competitive and Resource Efficient Transport System, COM(2015) 144, Brussels, 2015.
GILLEN, D., Lall, A.: Competitive advantage of low-cost carriers: some implications for airports. In: Journal of Air Transport Management, 10 (1), pp. 41-50. 2014.
HIRST, M.: Published by Woodhead Publishing Limited, Abington Hall, Granta Park, Great Abington, Cambridge CB21 6AH, England, 5-7 2008.
HSH Nordbank: Business Jets: Markt, Betreibermodelle, Eigentümer, Markttrends, Gebrauchtmarkt. Hamburg, 2005.
http://www.mostar-airport.ba/o nama.php , 2015.
http://www.vecernji-list.hr/newsroom/news/bih/326759/index.do
http://www.woodheadpublishing.com
IATA CASS: Luftfrachtdatenbank 2015.
IATA: Passenger Demand Grew as Air Cargo Declined in 2012. Press Release No. 2, 31 Jan. 2013
ICAO: Internationale Luftverkehrsstatistiken, 2016.
NURKOVIĆ, R.: Contemporary bases of clasification of the roads and their influence on regional development of Bosnia and Herzegovina. IN: Proceedings ,University of Tuzla, Faculty of natural sciences, Bosnia and Herzegovina, 19-31. Tuzla, 2007.
NURKOVIĆ, R.: Geographical aspects of contemporary aviation in Bosnia and Herzegovina. In: Geographical review, Vol. 37, pp. 35-50. Sarajevo, 2016.
State Agency for Statistics of Bosnia and Herzegovina, 2016.
Statistisches Bundesamt: Fachserie 7 Reihe 1 - Zusammenfassende Übersichten für den Außenhandel 2015. Wiesbaden, 2016.
Statistisches Bundesamt: Luftverkehrsstatistiken 2000-2015. Wiesbaden, 2016
Statistisches Bundesamt: Sonderauswertung der Außenhandelsstatistik zum Luftverkehr. Wiesbaden, 2016.
Statistisches Bundesamt: Statistisches Jahrbuch Deutschland 2015. Wiesbaden, 2016.
STEINER, S. Tatalović, M. Bajić, J.: Competition and Cooperation on European Southeast Air Transport market, 7th International Conference „Economic integrations, competition and cooperation“. Opatija, 2010.

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reviewed paper

Integrale Planung: Merkmale zur Identifizierung und Initialisierung in der kommunalen Praxis

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1 ABSTRACT

Der Beitrag knüpft an einen Konferenzbeitrag zur Anpassung des Konzeptes der Integralen Planung für den Kontext der Stadtentwicklung an (vgl. Rexroth u. Both 2016b) und geht weiter auf die praxisrelevante Frage ein, welche Merkmale eines Planungsprozesses erfasst werden müssen, um diesen als „integral“ zu qualifizieren, bzw. welche Merkmale im Vorfeld einer Planung spezifiziert werden sollten, um einen integralen Planungsprozess zu ermöglichen. Es wird dargelegt, dass eine “Integrale Planung” allgemein über prozessbezogene Kriterien und erstnachgeordnet, im speziellen fachlichen Kontext, über inhaltliche Kriterien spezifiziert werden kann. Auf Grundlage der Ergebnisse mehrerer planungsmethodischer Untersuchungen, die im Rahmen der Begleitforschung zum “Wettbewerb Energieeffiziente Stadt” des Bundesministeriums für Bildung und Forschung (BMBF) durchgeführt wurden, werden Kriterien vorgestellt, die zur Beurteilung und damit auch Vorbereitung von Planungsprozessen bezüglich ihrer „integralen“ Qualität herangezogen werden können.

Keywords: Integral Planning, Kriterien, Merkmale, Integrale Planung, Stadtentwicklung

2 EINLEITUNG

Als sozio-räumliches System zeichnet sich der Planungsgegenstand „Stadt“ gegenüber (rein) technischen Systemen durch eine selbstregulierende und eigendynamische Entwicklung aus: „Stadt“ entwickelt sich mit oder ohne planerische Eingriffe. Wird“Stadt” als ein sich fortlaufend veränderndes Ergebnis eines eigendynamischen kulturellen Prozesses verstanden, das aus dem Zusammenwirken von stadtgesellschaftlichen Anforderungen an eine Stadt und den Umfeldbedingungen und Kapazitätendieser Stadt entsteht (vgl. Abbildung 1-1), dann sind Planungsprozesse als integraler Bestandteil dieses kulturellen Prozesses zu verstehen.Daraus leitet sich die Frage ab, wie Planungsprozesse beschaffen sein sollten, um diesem Verständnis zu entsprechen.

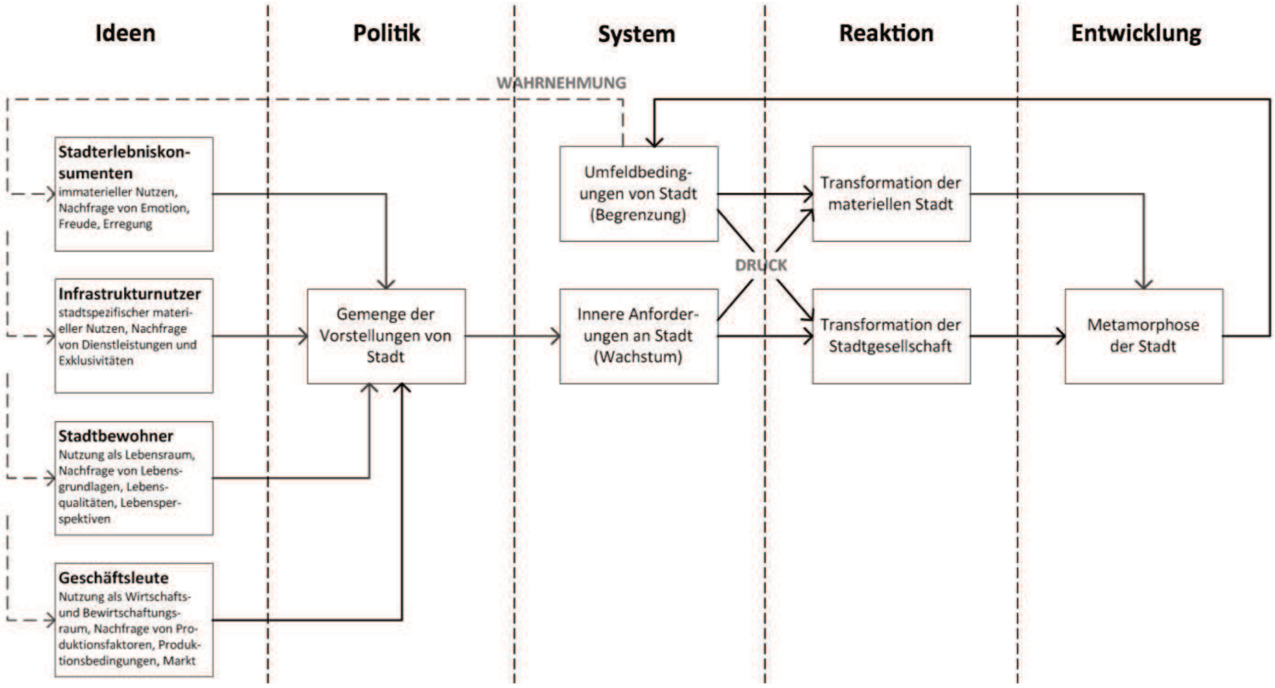

Abbildung 2-1: Modell einer fortlaufenden Veränderung von Stadt (eigene Darstellung)

Mit dem Ziel dernachhaltigen Entwicklung, wird auch im kommunalen Kontext die Umsetzung einerIntegralen Planung gefordert, ohne das Konzepteingehender zu definieren. Auch wenn der Begriff in verschiedenen Disziplinen (z.B. Nachhaltiges Bauen) verwendet wird, ist je nach Intention des Verwenders auch eine synonyme Verwendung von Begriffen, wie „integrativ“, „integriert“ oder „ganzheitlich“

anzutreffen. Im Rahmen der Begleitforschung zum Wettbewerb Energieeffiziente Stadt wurden Ansätze entwickelt, wie das Konzept einer Integralen Planung von anderen Planungsansätzen differenziert werden kann und es wurden Untersuchungen mit dem Ziel vorgenommen, die „Integrale Planung“als Planungsansatz zu qualifizieren (vgl. Rexroth & Both 2016a, 2016b). Nachfolgend werden die wichtigsten Ergebnisse zu den identifizierten Merkmalen einer Integralen Planung vorgestellt, die aus drei Untersuchungsebenen abgeleitet wurden: (1) der begrifflichen Abgrenzung, (2) den Vorgehensweisen und (3) den Rahmenbedingungen.

Die nachfolgenden Absätze zur Beschreibungen der Merkmale enthaltenim wesentlichen Exzerpte des Schlussberichtes zur Begleitforschungim „Wettbewerb Energieeffiziente Stadt“.

3 MERKMALE EINER INTEGRALEN PLANUNG

3.1 Begriffliche Abgrenzung der Integralen Planung

3.1.1 Merkmale bezüglich derErfassung, Einbeziehung, Beteiligung und Einflussmöglichkeit der Betroffenen

Im Verständnis dieser Arbeit setzt eine Integrale Planung voraus, dass die Planung als Bestandteil eines kulturellen Prozesses verstanden wird und nicht ein in sich selbst abgeschlossenes, autonomes Wirkungsgefüge darstellt. Schönwandt stellt diesen Austauschprozess vergleichbar einem Kern-Hülle-Modell dar, zwischen einer „Planungwelt“ (Kern, Fachwelt) und einer „Alltagswelt“ (Hülle, Umfeld der Planung) (vgl. Schönwandt 2011). Die Ziele einer Planung ergeben sich aus einem von den Beteiligten in der Planungssituation ausgehandelten Gemenge von Erfahrungen und Interessen (vgl. Abbildung 1-1). Damit diese Ziele auch eine Gültigkeit erreichen können, ist eine grundlegende Beteiligung der von einer Planung betroffenen Personen erforderlich. Als Hinweis auf eine Integrale Planung kannso eine systematische Erfassung und begleitende Einbeziehung der Betroffenen gelten. Als weitere Merkmale können gelten, wenn die Betroffenen bereits in die Initialisierungsphase der Planung und den Zielfindungsprozess einbezogen werden, die betroffenen Personen einen wirksamen Einfluss auf die Ziele der Planung und im weiteren Verlauf auch auf die Entscheidungen im Planungsprozess nehmen können. Darüber hinausgehend sollten für eine Integrale Planung spezifische inhaltliche Ziele formuliert und insbesondere die Ziele der Planung begründet werden.

3.1.2 Merkmale bezüglich derThemenauswahl im Planungsprozess

Eine Integrale Planung setzt auf inhaltlicher Ebene voraus, dass in einem systemischen Verständnis eine Auswahl und integrierte Betrachtung relevanter Themenfelder erfolgt, die in der Planung berücksichtigt werden. So kann im Kontext der „energieeffizienten kommunalen Entwicklung“als Hinweis auf eine Integrale Planung beispielsweise die integrierte Betrachtung konstituierender und strukturbildender Bedingungen (z.B. Themenfelder Bevölkerung,Energienutzung und Mobilität)zur Orientierung bei derFestlegung der thematischen Breite gelten. Zudem kann als ergänzender Hinweis herangezogen werden, wenn die Nicht-Berücksichtigung bestimmter Themen und die Abgrenzung des Planungsgegenstandes stichhaltig begründet wird. Es ist zu berücksichtigen, dass inhaltliche Kriterien für spezielle fachliche Kontexte lediglichals Ergänzung zu prozessbezogenen Kriterien dienen und für sich genommen noch nichtzur Qualifizierung einer Integralen Planung genügen (vgl. Absatz 3.1.3).

3.1.3 Merkmale bezüglich der thematischen und organisationalen Abgrenzung im Planungsprozess

Das Wesen einer Integralen Planung liegt idealtypisch in der Offenheit bezüglich der Themen und der beteiligten Akteure (Rexroth & Both 2016b), und adressiert in mehrstufigen Planungsprozessen insbesondere die Gestaltung der frühen Planungsphasen. Damit stellt sich als Ausgangspunkt der Integralen Planung die Frage, wie die verteilten Erfahrungen und Interessen der verschiedenen Akteure angemessen in den Planungsprozess eingebunden werden können. Eine Integrale Planung ist noch nicht durch eine ausschließlich integrierte Betrachtung verschiedener Themen gegeben, ohne eine grundlegende Beteiligung der von einer Planung betroffenen Personen an der Entscheidungsfindung. Dies ist im Verständnis dieser Arbeit als „Integrierte Planung“ zu bezeichnen. Ebenso ist eine Integrale Planung noch nicht durch den ausschließlichen Einsatz partizipativer Planungsinstrumente gegeben, ohne bei der Planung in strukturierter Art und Weise die systemisch erforderliche Breite der relevanten Themen zu erörtern und diese in die

Entscheidungsfindung einzubeziehen. Dies ist im Verständnis dieser Arbeit als „Integrative Planung“ zu bezeichnen.

Die vorzeitige Begrenzung der thematischen oder organisationalen Breite in einem Planungsprozess ist somit ein Hinweis auf einen fokussierten Planungsansatz, der einer Integralen Planung entgegensteht.

3.2 Vorgehensweisen bei der Planung

Zur Identifizierung geeigneter Vorgehensweisen wurden Vorgehensmodelle zum Entwerfen und Planen aus der Literatur verschiedener Fachdisziplinen gegenübergestellt, die im Bereich „energieeffiziente kommunale Entwicklung“ beteiligt sind– z.B. Architektur (Engel 2002), Maschinenkonstruktion (Pahl et al. 2007), Systems Engineering (Haberfellner et al. 2012) – und auf ihre strukturellen Übereinstimmungen und Abweichungen überprüft. Als Zwischenergebnis konnte daraus ein idealisiertes (literaturbasiertes)Modell synthetisiert werden, welches als Referenzmodellzur weiteren Analyse praktisch durchgeführter Planungen auf Grundlage von Fallbeispielen des „Wettbewerb Energieeffiziente Stadt“ diente. Das idealisierte Modellwurdeim weiteren Verlauf mit denin der Praxis angetroffenen Vorgehensweisenabgeglichen und zu einem generalisierten Phasenmodell für diesen Anwendungsbereich modifiziert (vgl. Tabelle 3-1).

	Planungsphase	Aktivitäten (parallele Bearbeitung)
0	Einleitung der Problembearbeitung	Problem empfinden und Potentiale erkennen Handlungsbedarf und Handlungsziele erkennen Bearbeitung beschließen und veranlassen
1	Kontext der Konzepterstellung	Organisatorische Verortung (Agentur, Manager, Stabstelle) Erfassen der Vorbedingungen Beteiligte und Betroffene ermitteln und Einbeziehung strukturieren Paradigmen und Planungsgegenstände erfassen, benennen und auf Systemebenen zuordnen Lenkungskreis einberufen (optional) Kommunikations- und Öffentlichkeitsarbeit einrichten Planungsprozess und Agenda vorläufig strukturieren und beschließen
2	Konzeptentwicklung* Analysetätigkeiten	Ausgangszustand erfassen Betrachtungsausschnitt erweitern und ggf. neu festlegen Wechselwirkungen und Funktionen benennen und auf Systemebenen zuordnen Bedarfe, Zielsetzungen und Zeithorizonte überprüfen, formulieren und beschließen Anforderungen, Bewertungskriterien und Prioritäten erarbeiten und parallel zur Lösungsentwicklung fortschreiben und verfeinern
(3)	Synthesetätigkeiten * situativ paralleles, iteratives oder sprunghaftes Vorgehen (Phase 3 integriert)	Alternative Lösungsprinzipien entwickeln und auswählen Kritische Elemente erkennen Priorisierte Lösungskonzepte fortscheiben und verfeinern Kosten-, Finanzierungs- und Terminplanung Lösungskonzepte bewerten, auswählen und beschließen
4	Konzeptumsetzung	Spezifizierung und Fortschreibung der Umsetzungspläne und Umsetzungsdetails Umsetzung veranlassen oder beauftragen Qualitäts-, Kosten- und Terminüberwachung
5	Nutzung + Wirkung	Monitoring der Maßnahmen, Dienstleistungen, Netzwerke Monitoring der Gesamtentwicklung Fortschreibung der Energie- und CO_2-Bilanzierung Rückführung der Erkenntnisse in Stadtentwicklungsprojekte

Tabelle 3 1: Generalisiertes Phasenmodell (Modifikation der Aktivitäten aus praktischen Vorgehensweisen kursiv)

Bei der Gegenüberstellung der idealisierten und praktischen Vorgehensweisen zeigt sich in den Planungsphasen eine unterschiedliche Übereinstimmung. Eine hohe Übereinstimmung zeigt sich in den Phasen 0 (Einleitung der Problembearbeitung) und 1 (Kontext der Konzepterstellung). Die Aktivitäten haben hier einen stark analytisch ausgerichteten Schwerpunkt und können strukturiert abgearbeitet werden. Eine Generalisierung und Standardisierung ist möglich, sollte jedoch ausreichende Adaptionen an die individuelle Planungssituation zulassen. In den Phasen 2 (Grundlagen der Konzepterarbeitung) und 3 (Konzepterarbeitung) zeigen sich Abweichungen zum idealisierten Modell. Eine streng sequenzielle Abarbeitung der Aktivitäten wird in der praktischen Planung nicht angetroffen. Vielmehr werden Aktivitäten der Grundlagen- und Konzepterarbeitung parallel und iterativ und in wechselseitiger Abhängigkeit durchgeführt. Die Abfolge der Aktivitäten ergibt sich im Prozess situativ und aus der Nutzung von „Gelegenheiten“ für die gewählte Zielsetzung. Als Konsequenz wurden diese beiden Phasen des idealisierten Modells zu einer Phase „Konzeptentwicklung“ zusammengefasst. Für die Phase 4 (Konzeptumsetzung) zeigt sich wiederum eine hohe Übereinstimmung. Die Aktivitäten dieser Phase können vergleichsweise strukturiert abgearbeitet werden und sind auf die Detailierung und Realisierung eines bereits formulierten

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Lösungsansatzes gerichtet. So kann in dieser Phase bereits auf eine abgegrenzte Aufgabenstellung aufgebaut werden, die es auch erlaubt ggf. weitere fachliche Expertise einzubeziehen. Zudem bieten die Methoden des Projektmanagements für diese Phase generalisierbare Hilfestellungen an. Abweichungen in der Phase 5 (Nutzung + Wirkung) sind besonders auf den inhaltlichen Bezug des Planungsgegenstandes zurückzuführen, der bisher mit keinem der in der Literatur beschriebenen Vorgehensmodelle berücksichtigt wurde. Die Aktivitäten des idealisierten Modells wurden um spezifische Aktivitäten, die in den Fallbeispielen festgestellt wurden, ergänzt.

In weiteren Schritten wurde für die Fallbeispiele der jeweilige Kontext der Konzeptentwicklung untersucht. Hierbei wurde beispielsweise nach dem spezifischen Anlass und vorausgehende Aktivitäten bei der Konzeption eines Projektes gefragt, oder danach, wie die erforderlichen Untersuchungsschritte zur Vorbereitung einer Konzeptentwicklung durchgeführt wurden. In Kürze lässt sich daraus festhalten, dass Planungsprozesse durch Menschen eingeleitet werden, die ein Problem empfinden, welches sie aus ihrerAlltagserfahrung heraus erkennen (unmittelbare Problematisierung) oder auf welches sie durch ihr Umfeld aufmerksam gemacht werden (mittelbare Problematisierung). Die bereits vorausgegangenen kommunalen Aktivitäten und Konzepte, beispielsweise im Klimaschutz, nehmen stets einen Einfluss auf die Ziele, die berücksichtigten Themen und den gewählten Ansatz einer neuen Planung. Die damit verbundene Tendenz zur Pfadabhängigkeit von Planungsprozessen erschwert allerdings eine (idealisierte) „unbefangene“ Planung. Bei einem fortgeschrittenem Planungsstand, mit bereits zugeordneten personellen und materiellen Ressourcen, ist eine Abweichung von einer bereits eingeschlagenen Planungsrichtung nicht zu erwarten, wenn nicht ein grundsätzliches Scheitern der bisherigen Planungsrichtung offensichtlich wird und dadurch eine grundsätzliche Neuausrichtung ins Auge gefasst wird. Der tatsächliche Spielraum für alternative Planungsansätze und Planungsrichtungen entsteht folglich in der Phase der Initialisierung eines Planungsprozesses – am originären Startpunkt oder bei einer Neuausrichtung (z.B. nach einem Scheitern der bisherigen Planung).

Auf Ebene der Vorgehensweisen wurden nachfolgende Merkmale als Hinweise für eine Integrale Planung identifiziert:

3.2.1 Merkmale bezüglich der Ableitung und Begründungvon Zielen

Eine grundlegende Bedingung jeglicher Planung ist die intendierte Zielsetzung, die mit den geplanten Maßnahmen erreicht werden soll. Dies kann sowohl das Erreichen, das Verhindern, das Erhalten oder das Beseitigen eines Zustandes betreffen. Die Zielsetzungen einer Planung werden durch externe Zielvorgaben vorgegeben oder im Rahmen des Planungsprozesses entwickelt bzw. konkretisiert. Für die Nachvollziehbarkeit der Entscheidungen in einem Planungsprozess ist die Darstellung und Begründung der konkreten Zielsetzungen essenziell. Als Hinweis auf eine Integrale Planung kann die Darstellung und Begründung der konkreten Ziele berücksichtigt werden. Die Ziele sollten entweder auf eine belastbare Quelle zurückzuführen sein, einer hoheitlichen Zielsetzung entsprechen oder systematisch im Planungsprozess entwickelt werden. Eine freihändige Zielformulierung oder eine ungeprüfte Übernahme von Zielen entspricht hingegen nicht den Merkmalen einer Integralen Planung.

3.2.2 Merkmale bezüglich der Betroffeneneinbindung

Da sich eine Integrale Planung durch eine Offenheit bezüglich der Themen und Akteure auszeichnet, ist bei der Initialisierung eine besondere Aufmerksamkeit darauf zu legen, wie der Prozess zur Zusammenstellung der Themen und der Akteure gestaltet ist. Beispielsweise ist zu hinterfragen, ob die Bürger in geeigneter Art und Weise zur Mitwirkung aufgefordert und einbezogen werden. Merkmale, die auf eine Integrale Planung hinweisen, könnenbis zur aktiven persönlichen Kontaktaufnahme gegenüber den Betroffenen, persönlichen Aufklärungsgesprächen im Haushalt der Betroffenen und einer stetigen Betreuung und Ermutigung zur Mitwirkung an der Planung reichen (aktive Betroffeneneinbindung), ein Vorgehen, das weit über eine förmlich geregelte Beteiligung hinausgeht (passive Betroffeneneinbindung).

3.2.3 Merkmale bezüglich der Einbindung externer Akteure

Um einen breiten Blick auf relevante Themen zu erhalten, sollte im Planungsprozess darauf hingewirkt werden, dass gruppeninterne Sichtweisen und beschränkend wirkende Handlungsroutinen einer Arbeits- oder Planungsgruppe stets reflektiert werden. So können als Hinweise auf eine Integrale Planung beispielsweise strukturelle Vorkehrungen gesehen werden, mit denen die Einbindung von externen Teilnehmern aus anderen Kommunen oder die Einbindung von externen Experten zu relevanten Themenkomplexen, wie Stadtentwicklung, Mobilität oder Energieversorgung geregelt wird.

3.2.4 Merkmale bezüglich der Prozessstruktur

Transparenz im Planungsprozess bedeutet auch, dass für alle Beteiligten und Betroffenen stets offensichtlich ist, wie ein Entscheidungsprozess strukturiert ist und in welchem Umfang tatsächlich durch die eigene Mitwirkung ein Planungsergebnis beeinflusst werden kann. Als weiterer Hinweis auf eine Integrale Planung kann gesehen werden, wenn ein Planungsprozess vorstrukturiert wird und zu allen Phasen die Mitwirkungsmöglichkeiten der Betroffenen, die von den Planern zu erwartenden Zwischenergebnisse, deren Verlässlichkeit und die zur Weiterführung der Planung erforderlichen Entscheidungspunkte in einem Meilensteinplan (öffentlich) dargelegt werden.

Bei der Integralen Planung sind in der kommunalen energieeffizienten Entwicklung unterschiedliche Wirkungs- und Entscheidungshorizonte miteinander abzustimmen. Durch eine phasenorientierte Vorgehensstruktur,die vom Groben hin zum Detail ausgerichtet ist, können dieseWirkungs- und Entscheidungshorizonte schrittweise koordiniert werden. Als Hinweis auf eine Integrale Planung kann eine phasenbezogene Meilensteinplanung mit Darstellung der Entscheidungspunkte einbezogen werden.

3.2.5 Merkmale bezüglich des gewählten Planungsansatzes

Die Phase der Konzeptentwicklung ist praktisch durch ein situativ paralleles, iteratives oder sprunghaftes Vorgehen mit wechselnden analytischen oder synthetischen Tätigkeitsschwerpunkten charakterisiert (vgl. Tabelle 3-1). In der theoretischen Betrachtung können aus der Abfolge dieser analytischen oder synthetischen Tätigkeiten verschiedene Ansätze abgeleitet werden, die entweder eher eine Problembestimmung oder eine Lösungsbestimmung als Leitprozess der Konzeptentwicklung aufweisen. Im ersten Fall, dem eines problemorientierten Planungsansatzes, steht zunächst das Problemverständnis im Vordergrund, auf dessen Grundlage Lösungsprinzipien gesucht, ausgewählt und weiter ausgearbeitet werden. Im zweiten Fall, dem eines maßnahmenorientierten Planungsansatzes, steht die Suche nach einer potentiellen, konkreten Lösung im Vordergrund, die im weiteren Verlauf auf ihren funktionalen Beitrag zur Problemlösung (Funktionalwert) überprüft und zur weiteren Bearbeitung ausgewählt oder verworfen wird. Auch wenn in der praktischen Durchführung der Konzeptentwicklung beide Ansätze nicht zu trennen sind und Hand in Hand ausgeführt werden, muss die extreme Ausprägung des einen oder anderen Ansatzes unterschiedlich bewertet werden.

Mit einem hohen Maß an Erfahrung im jeweiligen Gegenstandsbereich (Expertenwissen) können maßnahmenorientierte Planungsansätze auf effiziente Weise zu Planungsergebnissen führen. Die Voraussetzung hierzu liegt in der Fähigkeit zur treffenden (intuitiven) Einschätzung der wesentlichen Merkmale einer Problemsituation. Je neuartiger und komplexer sich das Planungsproblem darstellt, um so weniger kann dieses aus der Intuition und Erfahrung heraus beurteilt werden.Maßnahmenorientierte Planungsansätze eignen sich somit nicht für Planungen, die durch Personen erfolgen, die in einem Gegenstandsbereich unerfahren sind bzw. mit einem neuartigen Planungsproblem konfrontiert sind.

Mit einem strukturierten problemorientierten Planungsansatz können komplexe Gegenstandsbereiche und deren systemische Zusammenhänge schrittweise erfasst werden. Bei der Zusammenarbeit mit Laien kannmit problemorientierten Planungsansätzen ein durchgängig nachvollziehbarer Entscheidungsweg erreicht werden.Für den Kontext der energieeffizienten kommunalen Entwicklung stellt die problemorientierte Vorgehensweise, auf Grundlage einer intuitiven vorläufigen Problembestimmung und anschließender systematischer Verifizierung der grundlegenden Annahmen, einen praktikablen Mittelweg zwischen rein analytisch- und rein maßnahmenorientierten Ansätzen dar. Als Hinweis auf eine Integrale Planung kann ein problemorientierter Planungsansatz gelten, da dieser es allen Betroffenen ermöglicht, an der schrittweisen Entwicklung des Problemverständnisses mitzuwirken und den Entscheidungsprozess nachzuvollziehen.

3.2.6 Merkmale bezüglich der Umfeldanalyse

Die grundlegenden Entscheidungsschritte in einem Planungsprozess können ohne explizite Kenntnis des Kontextes einer Planung nicht beurteilt werden. Die Analyse, Beurteilung und Darlegung des Kontextes ist im Sinne eines systemischen Verständnisses, welches der Idee der Integralen Planung zu Grunde liegt, ein wesentlicher Teil des Planungsprozesses. Wird die Bearbeitung des Kontextes in einer frühen Planungsphase

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explizit durchgeführt und als Grundlage strategischer Entscheidungen verwendet, kann dies als Hinweis auf eine Integrale Planung herangezogen werden.

3.2.7 Merkmale bezüglich des Methodeneinsatzes bei der Konzepterarbeitung

Durch gezielten Methodeneinsatz im Planungsprozess können zwei kritischeEbenen der Konzeptentwicklung adressiert werden: (1) die Vollständigkeit desKonzeptes(z.B. durch Systematik) und (2) die Originalität der Ideen (z.B. durch Varianz).Bei einem Vergleich der aus der Literatur entnommenen, theoretischen Vorgehensmodelle und der bei der praktischen Konzeptentwicklung angetroffenen Aktivitäten zeigt sich, dass ein strikter Methodeneinsatz nicht in allen Planungsphasen konsequent umgesetzt werden kann. So ist in der Phase der Konzepterarbeitung ein hohes Maß an Flexibilität erforderlich, da der Weg zur „kreativen Lösung“ oft sprunghaft und teilweise auch opportunistisch zwischen der Ideenfindung und der Reflexion über den Lösungsbeitrag einer Idee verläuft. Ein strikter Methodeneinsatz erscheint hier oft unangemessen. Die Intuition hat einen hohen Stellenwert im Rahmen der kreativen Problemlösung und kann in dieser Phase treffender durch einen flexiblen Methodeneinsatz unterstützt werden. Diese situative Flexibilität ist auch sicherzustellen, wenn Entwicklungsoptionen in einem moderierten Rahmen erarbeitet werden sollen, was je nach Thema und Zielgruppe „von Agendakonferenz bis Zukunftswerkstatt“ (vgl. Schulze u. Kast 2011) eine Vielzahl von Varianten zulässt.

Aus dem Bereich der Kreativitätstechniken kommen Methoden zur Anwendung, welche die Bearbeiter (einzeln oder in der Gruppe) darin unterstützen, eine hohe Varianz an Ideen zu erzeugen, alle Teilnehmer an der Ideenfindung zu beteiligen, und zunächst die Ideenfindung von der Ideenbewertung zu trennen, um einen Ideenfluss zu erzeugen, sich nicht mit Bedenken zu blockieren und sich nicht mit der ersten vermeintlich guten Idee zufrieden zu geben. Kreativitätstechniken sind allerdings den „Weak Methods“ zuzurechnen, mit denen kein verlässliches Ergebnis – „die gute Lösung“ – garantiert werden kann. Auch diese Methoden erfordern etwas Übung und ggf. einen Moderator. Es sind vier Methodenfamilien herauszustellen, die im Bildungs- und Praxisbereich als aus der Erfahrung heraus bestätigt und akzeptiert gelten: die Familien der Brainstorming-Methoden, der Synektischen Methoden, der Morphologischen Methoden und des Lateral Thinking (vgl. Rickards 1980). Die gezielte Verwendung solcher Methoden in der Phase der Konzepterarbeitung kann als ein Hinweis auf eine Integrale Planung gesehen werden.

Im Gegensatz zur Phase der Konzepterarbeitung kann in den früheren analytisch ausgerichteten Planungsphasen und in den späteren umsetzungsorientierten Planungsphasen eine Unterstützung durch systematische Methoden und einen strikteren Methodeneinsatz erreicht werden. In den frühen Planungsphasen kommen hier insbesondere Methoden aus dem Bereich der Sozialforschung, wie Umfragen und Interviews, aus dem Bereich der statistischen georeferenzierten Datenauswertung, der Raumforschung, sowie der Modellierung und Simulation von Energiesystemen zum Einsatz. Im Rahmen der kommunalen energieeffizienten Entwicklung sollte hierzu die Expertise von wissenschaftlichen Einrichtungen oder den Energie- und Klimaagenturen einbezogen werden.

3.2.8 Merkmale bezüglich der Kommunikation über den Umsetzungsprozess

In den späteren umsetzungsorientierten Planungsphasen kann auf das Methodenspektrum des Projektmanagements zurückgegriffen werden, beispielsweise Netzplantechnik und Kostencontrolling.Darüber hinaus aber sind in diesen umsetzungsorientierten Phasen das Monitoring von Energie- und Klimakennzahlen und die regelmäßige Information über den Fortschritt des Umsetzungsprozesses in derlokalen Presse ein wichtiger Teil eines Projektes. Als Hinweise auf eine Integrale Planung können die Einbeziehung externer Experten und die umfangreiche Kommunikation über den Planungsprozess gegenüber der Öffentlichkeit einbezogen werden.

3.3 Rahmenbedingungen der Planung

Die Analyse der Fallbeispiele zeigte sehr unterschiedliche individuelle Voraussetzungen und Entwicklungspfade in den Städten. Beispielsweise wirken sich die allgemeinen soziodemografische Trends (z.B. Veränderung der Altersstruktur) auf kommunaler Ebene ganz unterschiedlich aus und werdeninsbesondere durch regionale Migrationenderart überformt, dass dies einen erheblichen Einfluss auf die Auslastung des kommunalen Gebäudebestandes und der Infrastruktur hat.Da Migration in befriedeten Zeiten meist mit (erwerbs-)biografischen Grundsatzentscheidungen sowie mit den individuellen und familien-wirtschaftlichen Handlungsalternativen verbunden ist, kann die Motivation zur Migration in diesem

Kontext auf die Chancenwahrnehmung (z.B. Bildungs- und Arbeitsmarkt) oder eine existentielle Notwendigkeit (z.B. wirtschaftliche Krise) zurückgeführt werden (vgl. Oltmer 2013).

Um die Bedingungen der Kommunen zu differnzieren, wurden zwei Dimensionen untersucht – „Attraktivität für junge Bevölkerung“ und „Wertschöpfung der Bevölkerung“ – und durch Kennwerteer Kommunalstatistik (hier: Bildungswanderung und Anteil an Sozialleistungsbeziehern)in einem Benchmarking ausgewertet und klassifiziert (Tabelle 3-2).

Attraktivität für junge Bevölkerung

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">Wertschöpfung der Bevölkerung</td></tr>
<tr><td>gering</td><td>mittel</td><td>hoch</td></tr>
<tr><td rowspan="3">Attraktivität für junge Bevölkerung</td><td>hoch</td><td>Leipzig
Magdeburg*</td><td>Aachen
Düsseldorf
Hamburg
Oldenburg</td><td>Landau
München
Rosenheim
Stuttgart*</td></tr>
<tr><td>mittel</td><td>Duisburg
Essen*</td><td></td><td>Schwäbisch Gmünd</td></tr>
<tr><td>gering</td><td>Delitzsch*
Schneeberg</td><td>Göda</td><td>Wolfhagen*</td></tr>
</table>

*Kommunen der Umsetzungsphase

Tabelle 3 2: Klassifizierung der Kommunen (Rexroth u. Both 2016a)

Die Auswertung wurde den Konzepten zur energieeffizienten kommunalen Entwicklung gegenübergestellt (vgl. Rexroth u. Both 2015, 2016a, 2016b). Aus der Annahme, dass eine moderate Dynamik in der Entwicklung einer Kommune über ein ausgewogenes Verhältnis von Attraktivität und Wertschöpfungsmöglichkeit entsteht, wurde gefolgert, dass extreme Ausprägungen der Parameter zu differenzierbaren Situationen führen.Diese Situationen erfordern jeweils eine eigene strategische Grundausrichtung des kommunalen Handelns, welches sich auch auf die kommunalen Aktivitäten im Bereich Klimaschutz und Energieeffizienz auswirkt und bezogen auf die Integrale Planung unterschiedliche Schwerpunkte bei der Wahl des Planungsansatzes erfordert (Rexroth u. Both 2016b).

Die bestimmenden kommunalen Herausforderungen (prior concerns) wurden anhand der Fallbeispiele der Umsetzungskommunen abgeleitet und zeigen, dass Kommunen im rechten oberen oder linken unteren Feld tendenziell unter einem starken materiellen Transformationszwang stehen: Im linken unteren Feld (Fallbeispiel Delitzsch) durch „Schrumpfung“, mit Herausforderungen im Bereich Daseinsvorsorge, Überalterung, Gebäudeleerstand, Infrastrukturauslastung und Infrastrukturunterhaltungskosten. Im rechten oberen Feld (Fallbeispiel Stuttgart) durch „Wachstumsdruck“, mit Herausforderungen im Bereich Wohnraumversorgung, Infrastrukturkapazität, Lebenshaltungskosten und Gentrifizierung. Es wurde weiter abgeleitet, dass Kommunen im linken oberen und rechten unteren Feld tendenziell unter einem programmatischen Transformationszwang stehen: Im linken oberen Feld (Fallbeispiel Magdeburg) durch „Beschäftigungsdruck“, mit Herausforderungen insbesondere im Bereich der Wirtschaftsansiedlung. Im rechen unteren Feld (Fallbeispiel Wolfhagen) durch „Visionszwang“, mit Herausforderungen in der Neubestimmung des Wesens der Kommune und möglicherweise auch in einer Öffnung hin zu neuen experimentellen Lebensformen (vgl. Rexroth u. Both 2016a, 2016b).

Darüber hinaus begünstigen aber auch bestimmte organisationale Strukturen die Durchführung und Verstetigung einer Integralen Planung im jeweiligen situativen Kontext. Im Verständnis einer Integralen Planung sollten folglich kommunale Energieeffizienz-Maßnahmen in Übereinstimmung mit den Rahmenbedingungen der räumlich-sozialen Dynamik der Kommune beurteilt werden und es sollten organisationale Strukturen geschaffen werden, die eine Integrale Planung in der Kommune unterstützen und verstetigen.

Auf Ebene der Rahmenbedingungen wurden nachfolgende Merkmale als Hinweise auf eine Integrale Planung identifiziert:

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3.3.1 Räumliche Entwicklungstrends

Bei der Auswahl bestimmter Maßnahmen zur energieeffizienten kommunalen Entwicklung, können diese, um Wirksamkeit zu entfalten, nicht nur untereinander abgestimmt werden, sondern müssen auch die übergreifenden räumlichen Bedingungen und Herausforderungen aus Sicht der Kommune (bottum-up) berücksichtigen. Ausgangspunkt langfristiger konzeptioneller Überlegungen stellt die räumliche Entwicklung und deren mögliche Auswirkungen auf die individuelle Kommune dar. Neben gesamtgesellschaftlichen Trends, nehmen beispielsweise Faktoren des lokalen und regionalen Umfeldes, wie die Erreichbarkeit von Arbeitsmärkten, Kultur- und Bildungsangebote, die Lebensqualität in der Stadt oder der lokale Wohnungsmarkt Einfluss auf die Migrationsentscheidungen bestimmter Bevölkerungsgruppen. Als Hinweise auf eine Integrale Planung können die Einbeziehung von Entwicklungstrends und die Durchführung von Umfeldanalysen oder Stärken-Schwächen-Analysen in den frühen Planungsphasen gewertet werden.

3.3.2 Beteiligung und Netzwerke

Die frühzeitige Beteiligung der Betroffenen am Planungsprozess wird zunehmend durch normative Regelungen oder Empfehlungen gefordert. Dennoch stehen im Planungsprozess die Potentiale solcher Beteiligungsformen im Vordergrund, um ein schlichtes Abarbeiten einer förmlichen Beteiligung zu vermeiden. Insbesondere kann die Chancen ergriffen werden, frühzeitig die vielfältigen Alltagserfahrungen zum komplexen räumlich-sozialen Gefüge in die Planung einzubeziehen, zusätzliche personelle oder finanzielle Ressourcen zu erschließen, und Unterstützung oder Erfahrung aus bestehenden Netzwerken zu nutzen. Die Durchführung von Beteiligungsformen wie beispielsweise „Runden Tischen“ oder die Teilnahme an Netzwerken und Förderprogrammen zur kommunalen Energieeffizienz und Klimaschutz können als Hinweise zur Öffnung gegenüber einem erweiterten Beteiligtenkreis im Sinne einer Integralen Planung gesehen werden. Die konkrete Ausgestaltung der Beteiligungsform sollte in Bezug zur entwicklungsdynamischen Situation der Kommune und den Interessen und Erfahrungen der Betroffenen angepasst werden.

3.3.3 Schmale Verwaltungsstruktur

Greift man den Dienstleistungsgedanken auf, der heute einem modernen Verwaltungshandeln zu Grunde liegt, sollte mit dem Ziel einer energieeffizienten kommunalen Entwicklung eine schmale Verwaltungsstruktur (Verantwortung auf wenige Linien gebündelt) angestrebt werden – in diesem Kontext jedoch nicht mit dem Ziel einer reduzierten Personaldecke, sondern einer Reduzierung von dezernatsübergreifendem Abstimmungsbedarf. Im Sinne einer Integralen Planung kann die fachliche Integration durch eine inhaltliche Bündelung innerhalb der Verwaltungsstruktur erleichtert werden. Die zeitlichen und personellen Kapazitäten, die ansonsten für eine dezernatsübergreifende Abstimmung erforderlich wären, können für andere Aufgaben genutzt werden, beispielsweise für den höheren Aufwand bei der Durchführung von Beteiligungsprozessen. Somit können auch Merkmale einer schmalen Verwaltungsstruktur als Hinweise für die Umsetzung einer Integralen Planung gesehen werden.

4 CONCLUSION

Abschließend sind die wichtigsten Merkmale einer Integralen Planung im Kontext Energieeffiziente Stadt nochmals in der nachfolgenden Tabelle zusammengefasst (Tabelle 4-1).

Zusammenfassend ist herauszustellen, dass es sich bei dem Konzept der Integralen Planung um ein Paradigma handelt, welches Spielraum bei der Interpretation und praktischen Umsetzung zulässt. Planungsprozesse bestehen i.d.R. aus eine Kette von Entscheidungen, die jeweils situativ getroffen werden, was einen absoluten Maßstaßstab zur Qualifizierung einer Intergalen Planung ausschließt. Eine Integrale Planung kann folglich nicht über ein einzelnes Merkmal oder eine strikte Metrik qualifiziert werden. Vielmehr sind es eine Vielzahl von Merkmalen, die einen Planungsprozess und eine Planungssituation auszeichnen. Die Berücksichtigung der in diesem Beitrag beschriebenen Merkmalen erhöht nach Auffassung der Autoren eine praktisch mögliche Annäherung an das Ideal einer Integralen Planung.

Das diesem Beitrag zu Grunde liegende Vorhaben wurde durch das Ministerium für Bildung und Forschung (BMBF) unter dem Förderkennzeichen 03SF0415B gefördert.

	Positive Hinweise	Negative Hinweise
Begriffliche Abgrenzung	• Systematische Erfassung und Einbeziehung der Betroffenen • Beteiligung in der Initialisierungs- und Zielfindungsphase • Einflussmöglichkeit der Betroffenen auf Ziele und Entscheidungen • Formulierung und Begründung spezifischer Ziele • Integration der Themenfelder Bevölkerung, Energie und Mobilität • Nicht-Berücksichtigung / Abgrenzung von Themen erfolgt begründet	• Vorzeitige Begrenzung der thematischen oder organisationalen Breite des Planungsansatzes
Vorgehensweise	• Darstellung und Begründung konkreter Ziele durch belastbare Quellen, hoheitliche Zielsetzungen oder die Erarbeitung im Planungsprozess • Aktive Betroffeneneinbindung, z.B. durch persönliche Kontaktaufnahme, Aufklärungsgespräche, Betreuung und Ermutigung zur Mitwirkung • Einbindung externer Teilnehmer • Einbindung externer Experten • Vorstrukturierter Planungsprozess (Meilensteinplan) und Darstellung der Mitwirkungsmöglichkeiten und der erwarteten Zwischenergebnisse • Problemorientierter Planungsansatz • Frühzeitige Umfeld-/Kontextanalyse • Kreativitätstechniken / Methodeneinsatz in der Konzepterarbeitung • Kommunikation über den Planungsprozess	• Freihändige Zielformulierung • Ungeprüfte Übernahme von Zielen • Lediglich förmlich geregelte Beteiligung (passive Betroffeneneinbindung)
Rahmenbedingungen	• Analyse von Entwicklungstrends, Umfeldanalysen, Stärken-Schwächen-Analysen in frühen Planungsphasen • Beteiligung der Betroffenen • Teilnahme an Netzwerken und Förderprogrammen • Schmale Verwaltungsstruktur	

Tabelle 4 1:Merkmale zur Identifizierung einer Integralen Planung im Kontext Energieeffiziente Stadt

5 REFERENCES

ENGEL, Heino: Methodik der Architekturplanung. Berlin : Bauwerk, 2002

HABERFELLNER, Reihard.; de Weck, Olivier; Fricke, Ernst; Vössner, Siegfried: Systems Engineering : Grundlagen und Anwendung. 12. Aufl. Zürich : Orell Füssli, 2012

OLTMER, Jochen: Migration. In: Meier-Braun, K.-H.; Weber, R. (Hrsg.): Migration und Integration in Deutschland. Bonn : bpb, 2013. S. 31-34

PAHL, Gerhard; Beitz, Wolfgang; Feldhusen, Jörg; Grote, Karl-H.: Konstruktionslehre. 7. Aufl. Berlin : Springer, 2007

REXROTH, Karsten; Petra von Both: An Approach to Adapt the Paradigm of Integral Planning to Urban Development. In: Schrenk, M.; Popovich, V.; Zeile, P.; Elisei, P.; Beyer, C. (Eds.): Real Corp 2016. Proceedings. 2016b. p. 99-106

REXROTH, Karsten; Petra von Both: Integrale Planung für die Energieeffiziente Stadt. In: Hermann-Josef Wagner; Petra von Both (Hrsg.): Wettbewerb Energieeffiziente Stadt. Band 8: Gute Beispiele der Umsetzungsphase. Münster : LIT-Verlag, 2016a. S. 137-148

REXROTH, Karsten; Petra von Both: Kommunale Profile: Grundlagen für eine Übertragung von Energieeffizienzstrategien im Kontext der Stadtentwicklung. In: Marko K. Koch; Volker Krüger; J. Alexander Schmidt (Hrsg.): Wettbewerb Energieeffiziente Stadt. Band 4: Stadtentwicklung und Mobilität. p. 20-28. Münster : LIT-Verlag, 2015. S. 19-28

RICKARDS, Tudor: Designing for Creativity: A State of the Art Review. Design Studies, Vol. 1 (1980), No. 5, p. 262-272

SCHÖNWANDT, Walter: Probleme als Ausgangspunkt für die Auswahl und den Einsatz von Methoden. In: Akademie für Raumordnung und Landesplanung (Hrsg.): Grundriss der Raumordnung und Raumentwicklung. Hannover : ARL, 2011. S. 291-310

SCHULZE, Gesine; Kast, Alexandra: Von A wie Agendakonferenz bis Z wie Zukunftswerkstatt. Formen informeller Beteiligung. In: oekom e.V. (Hrsg.): Bürgerbeteiligung 3.0. München : oekom, 2011. S. 36-41

Integrated Spatial and Transport Development along European Corridors: A Look through the Lens of Stakeholder Cooperation

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1 ABSTRACT

International transport corridors are becoming increasingly important in enhancing the sustainable mobility of goods and people around the world. In Europe, such a mobility issue has a much deeper meaning. Namely, European transport corridors have a long tradition in constituting the backbone of territorial cohesion among the member-states of the European Union. Thus, European integration strongly depends not only on multilateral coordination of trade and transport flows, but also on the cooperation-building projects aimed at achieving integrated spatial and transport development, most easily perceivable at the local level, i.e. in the hot-spots – places with major spatial implications of transport infrastructure development. However, such an integrated approach is difficult to achieve. On the one hand, the impact of globalisation on urban development poses a threat to infrastructure investments in adjacent urban regions. On the other hand, the differences in dealing with large infrastructural and spatial development projects among various states, legal and administrative families, and finally, planning cultures also affect the transparency and inclusion of all the relevant aspects. For example, the ongoing transformation of former transport areas (railway nodes, harbours and airports) situated along the waterfronts into new urban centres is only one of many spatial conflicts between transport and urban functions. Therefore, multi-level strategic planning strategies to minimise the risks of spatial conflicts are needed. By reflecting on the findings of two bottom-up initiatives aimed at improving the cooperation among stakeholders along two European transport corridors – Rhine-Alpine and Orient/east-Med(iterranean), the paper emphasises the importance of the transportation nodes as strategic sites for inward development. Therefore, two hot-spots are presented – inland port in Basel and railway station in Belgrade. As the cases describe quite different approaches in dealing with integrated spatial and transport development, the paper concludes that the better stakeholder cooperation help to overcome the administrative obstacles and enhance integrated development at the local level. This is surely then to be tranferred to the regional and transnational levels, too.

Keywords: Urban Nodes, Hinterland Hubs, Port and Urban Development, Transport and Spatial Development, Stakeholder Cooperation, European Corridors

2 TRANS-EUROPEAN TRANSPORT NETWORK: TWO CORE EUROPEAN CORRIDORS

The TEN-T (Trans-European Transport Network) Core Network Corridors – "Connecting Europe Facility" (EC, 2011) is the most recently revised programme related to the development of transport infrastructure in Europe. Initiated for the first time by the European Union (EU) in the 1980s, the TEN-T was introduced with the general aim of addressing the main objectives of European development – economic, social, and territorial cohesion. More precisely, the idea behind is to remove bottlenecks, build missing cross-border connections and promote modal integration and interoperability among the core international transport corridors identified within the EU (EC, 2011). To ensure that the corridors are bounded into a network in an effective manner, numerous EU policies and programmes are directed at improving the interregional cooperation among stakeholders at the national, regional and local levels, and, respectively, increasing the mobility levels and enhancing the transport system – a precondition for a smart, inclusive and sustainble growth of Europe.

Looking through the lens of the EU, the TEN-T is of a great relevance for spatial planners: having in mind that TEN-T is of earlier date and contains more important premises than the European Spatial Development Perspective (ESDP), as a key EU document on the spatial planning issue, the TEN-T can be considered the first spatial development intervention of the EU (Peters in Dühr et al., 2010: 300). Following this line of argument, we argue the cohesion among European countries can be improved through sustainable spatial and transport development. However, in order to establish the interconnections between transportation, spatial development and broader socio-economic context as an inevitable background within which all the developmental processes are deeply embedded, there is a clear need for spatial planners to understand and coordinate integrated spatial and transport development at various levels: transnational/macro-regional, national/regional, and local (Perić and Scholl, 2017b). Before we proceed with a deeper look at this topic, the basic information on two core European corridor are provided below (see also Figure 1).

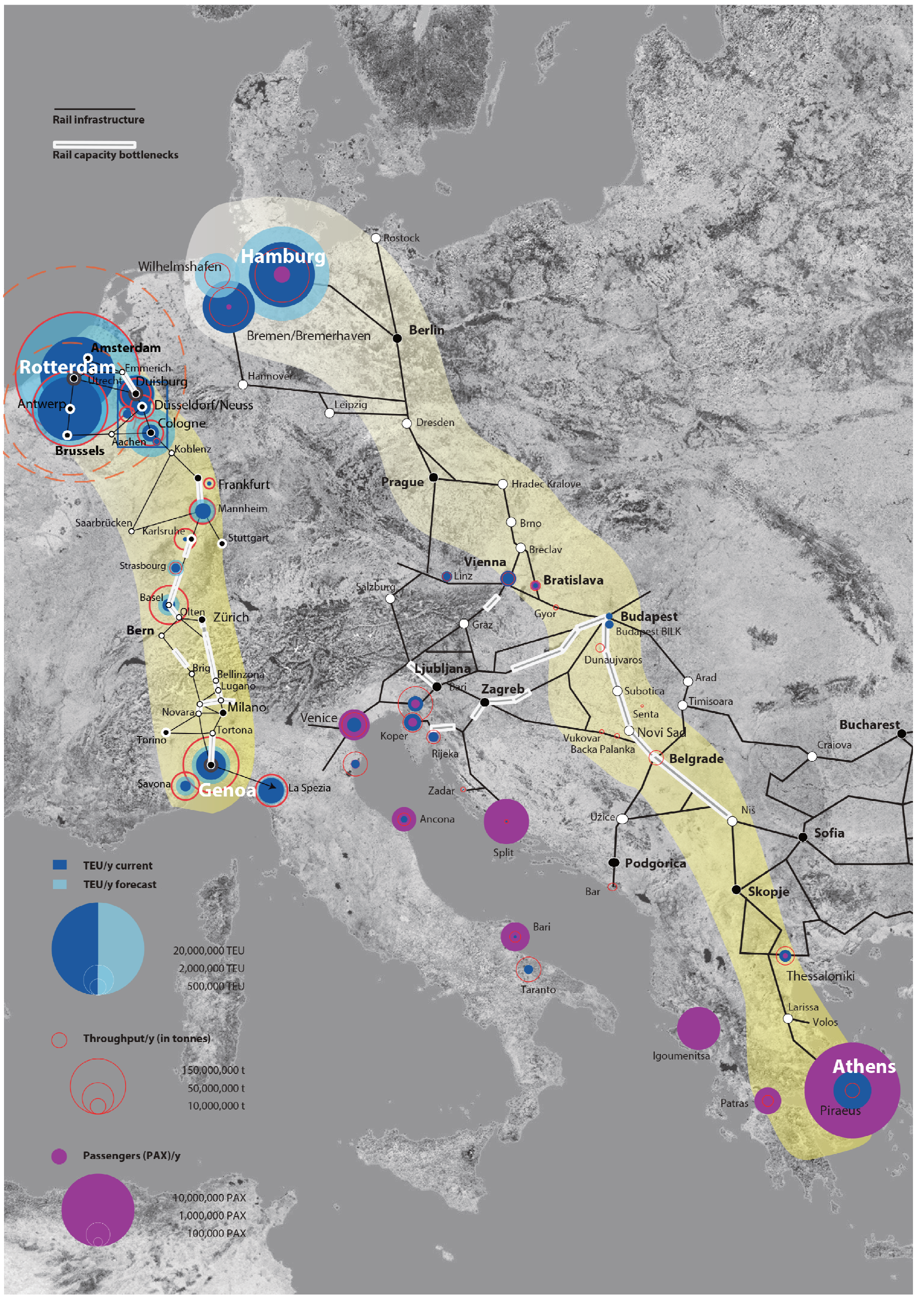

Fig. 1: Rail and port infrastructure along two European corridors. (Source: Scholl, 2016b)

2.1 Rhine-Alpine Corridor: Rotterdam-Genoa

The Rotterdam/Antwerp-Genoa corridor, defined also as the Corridor 24 (TEN-T policy) and as the Rhine-Alpine corridor (EU Core Network Corridors), constitutes one of the busiest freight routes of Europe, connecting the North Sea ports of Rotterdam and Antwerp to the Mediterranean basin in Genoa, via Switzerland and some of the major economic centres in the Rhein-Ruhr and the Rhein-Main-Neckar regions as well as the agglomeration of Milan in northern Italy. In its length of more than 1,200 km, this multimodal corridor includes the Rhine as inland waterway. As matter of fact inland ports are becoming increasingly important as logistic hinterland-hubs (Braun, 2015) and influential players along the corridor because their expanding function might trigger regional-economic growth (Scholl, 2016 and Braun, 2015).

The key infrastructure projects include the immense investments in container transshipments in the Port of Rotterdam, the Gotthard and Ceneri base tunnels (partly already completed) in Switzerland and the missing links and access routes in Germany and Italy (Wojciechowski, 2016). In terms of transport, 700 million tonnes of freight are transported along this north-south link, while 70 million people, roughly nearly a fifth of the entire population of the EU, live in the catchment area of this important European north-south connection (Drewello and Scholl, 2016).

2.2 Orient/East-Med Corridor: Hamburg-Athens

The Hamburg-Athens corridor, defined as the Corridor 22 in the TEN-T policy and as the Orient/east-Med(iterranean) corridor within the more recent EU Core Network programme is one of the key north-south transport corridors in Europe. In its length of more than 2,500 km, it connects the ports of northern Germany with the Adriatic and the Danube ports, as well as the seaports in Thessaloniki and Athens. Hence, by strengthening its transportation features, the Hamburg-Athens corridor is considered an axis with a huge potential for triggering off spatial development, which would finally lead to territorial cohesion in Europe (Scholl et al., 2016).

However, the Hamburg-Athens corridor is currently an example of genuine shortcomings in various domains: it runs through the states with traditionally low economic performances in comparison with the developed Western European countries; there is also a significant lack of efficient infrastructural network – seen in numerous missing links and bottlenecks; the corridor nowadays coincides with the so-called migrants' route; finally, administrative obstacles caused by mistrust among stakeholders are common practice in cross-border issues, as well as among various authorities of the nation states (Perić and Scholl, 2017a).

3 INTEGRATED SPATIAL AND TRANSPORT DEVELOPMENT: A MULTI-LEVEL APPROACH

Integrated spatial and transport development is considered a challenging task. This is particularly true if we take into account the territorial scope associated with such a development, different contexts (political, social, economic), and finally different ways of 'how thing are done' (Faludi, 2005), i.e. the planning cultures. Therefore, one of the most demanding issues, besides the compliance of infrastructural equipment and technical specificities, is the question of the governance of such a development (Perić, 2016). How to achieve effective cooperation among a number of nation states? How to integrate the visions of various sectorial departments at the state level? And, how to make the consensus-based decisions among the various parties involved in certain urban development? Figure 2 describes the most important levels and types of cooperation needed to be taken in due account when it comes to the integrated spatial and transport development, while the following lines elucidates how it has been emerging in the concrete strategic projects related to two mentioned corridors.[1]

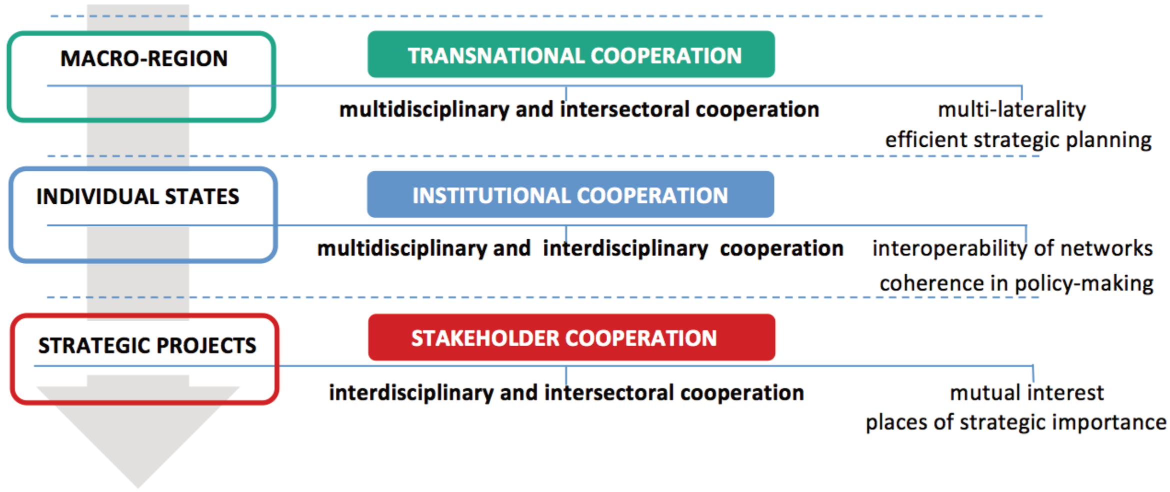

Fig. 2: A cooperative approach to integrated spatial and transport development. (Source: Perić, 2016)

[1] Authors of the paper actively participated in the mentioned projects. Therefore, most of the information presented in the next section stem also from the personal engagement in the project.

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3.1 Rotterdam-Genoa Corridor: From a Strategic Initiative to an Interregional Alliance

The project entitled CODE24 (COrridor DEvelopment 24) along the Rotterdam-Genoa corridor (ex-TEN-T corridor no. 24) is in fact a bottom-up strategic initiative in the framework of the EU INTERREG IVB NWE programme. It concerns the interconnection of economic, spatial, transport and environmental aspects along the core network Rhine-Alpine corridor and contributes to address the urgent conflicts of capacity and quality of life along the corridor. The project was set off in 2009 by the Swiss Federal of Insititute of Technology (ETH Zurich) aimed at gathering different stakeholders/partners to create a common strategy for the development of the Rhine-Alpine corridor. To tackle this task, an overiew of integrated planning of landscape, settlement and transport was needed as the solid foundation for the definition of spatial development strategies in all regions. Planning was considered to be carried out collaboratively by all stakeholders involved: responsible authorities (national/regional/local), transport sector and the users. Thus, cooperation-building projects, enhancing the international and cross-bordering processing of activities and the implementation of the corresponding tasks in the spaces of European importance, demanded relevant networks for cooperation. Hence, the CODE24 project was divided in four thematic work packages, each consisting of several actions and identifying the problems in the field of: 1) spatial and infrastructural development, 2) environmental aspects and noise reduction, 3) regional economic bebefits, and 4) communicaation, acceptance and interregional cooperation (ETH/IRL, 2013).

The overall output of the CODE24 project was the common strategy for the development of the corridor and the preparation of a legal form for cooperation after the end of the funding period of the project. In other words, the European Grouping of Territorial Cooperation called "Interregional Alliance for the Rhine-Alpine Corridor EGTC"[2] was established to continue the strategic initiative of CODE24 for the sake of securing a long-term partnership and cooperation. This legal form provides all the opportunities for a sustainable cooperation between European partners and has been chosen as the appropriate framework for continuous cooperation (ETH/IRL, 2013). In order to facilitate transnational cooperation between the partners along the axis and to manage the complex challenges of this corridor development, the EGTC acts as multitude of common interests and interrelations between ist single regional areas and speaks with one voice for its members (Scholl, 2016a).

3.2 Hamburg-Athens Corridor: From a Knowledge Transfer to a Common Strategy

The findings presented below stem from the ongoing three-year project titled "Spatial and Transport Development in European Corridors: Example Corridor 22, Hamburg-Athens", being conducted currently by the German Academy for Spatial Research and Planning (ARL). Since the ARL members recognised the necessity to take also the needs and challenges of the non-EU states affected by the official corridor into consideration, and since the route from Budapest to Thessaloniki via Belgrade is the shortest (400 km) and the most logical way of connecting the north and south of Europe, the axis covered by the ARL project slightly differ from the official EU route – it runs through Serbia as a primary line, while the way through Romania and Bulgaria is of secondary importance.

The project methodology and the tasks conducted, respectively, are based on an inductive research approach. This practically means that the project participants through genuinely bottom-up initiative firstly reach the relevant stakeholders at the local level (i.e. hot-spots), across the national government and public enterprise representatives, with the final aim of presenting the draft strategy (the main project recommendations) to the EU relevant bodies, e.g. official EU Orient/east-Med corridor coordinator, DG REGIO and DG MOVE representatives, etc (Scholl et al., 2016). As the project is focused on integrated spatial and transport development, the key partners to collaborate with come form the transportation and spatial and urban planning fields. At the level of hot-spots (mainly capital cities located along the Hamburg-Athens corridor), the most valuable exchange of international experiences (brought by the project participants) and the local values, challenges and problems is conducted through organising the field trips on the sites of great urban, regional, and then, national importance. Through sharing main visions and priorities related to the hot-spot, the support from local key stakeholders – representatives of various departments within the city administration, and the experts from different domains (public enterprises, academia) is considered an important tool for triggering the challenging topics. Usually, such workshops succeed in bridging the gap

[2] The EGTC was appointed as a member of the EU-Corridor Forum for new core network corridor, representing the local and regional stakeholders within this corridor.

among the local participants in case there is no general strategy on integrated spatial and transport development needed to be followed. In order for the certain views discussed for the hot-spots to be easily applicable, the next step within the project cooperative approach is addressing the representatives of responsible ministries, public infrastructural enterprises, as well as the private sector (developers, logistic companies). The project participants take the advisory role in this phase trying to elucidate the methods and principles for the nation states to easily correspond to the European standards, trends and needs in the domain of spatial and infrastructural development. Mainly it is done through clarifying the technical demands (signalisation and electrification of the railway network; port facilities for handling the TEUs; cargo freight standards) as well as providing the guidelines on territorial multi-level governance. The input form the state authorities and other nationally relevant stakeholders is important for getting a clearer picture on the current status and future incentives in the states along the corridor. Such information serve as a profound base for formulating as much as precise recommendations for the relevant EU officer. This phase is still to come, but taking into account the current research findings, it is believed that, besides the offical EU policy, this project will provide additional guidelines on how to deal with integrated spatial and transport development at the macro-scale of the Hamburg-Athens corridor.

4 STAKEHOLDER COOPERATION IN HOT-SPOTS

The following section describes the current activities related to the infrastructural projects with a great effect on spatial development. These are usually important not only from the city/urban perspective, but also from a regional stand. The focus is on elucidating the key actors that have been influencing the dynamics and the main vision for future development. As various sectors influence the developmental outcomes, it is interesting to elucidate the stakeholder-network buidling as well as the main obstacles emerging in such a complex process.

4.1 Port transformation in Basel, Switzerland

4.1.1 Balance of port and urban development

The growth ambitions of the port of Rotterdam pose many challenges for inland ports along the Rhine-Alpine corridor (Witte et al., 2016). As a response, many inland ports, e.g. the Port of Switzerland (port authority in Basel) plan their expansion projects. In the case of Basel, located at the meeting point of France, Germany and Switzerland, the role of the port is a very significant one. The Port of Switzerland not only greatly affects the economic development of the trinational region, but also represents the gateway to the world oceans. Thus, it is considered as the most important hub in Switzerland: 10-12% of all imported goods reach the country throught the ports (SRH, 2016). In order to keep improving the port as a logistic hub and meet the Swiss transportation policies that foresee a shift from road to rail traffic, the development of a new trimodal transshipment terminal (Gateway Basel Nord) is planned. This undertaking offers the possibility to reorganise the existing port infrastructure and allows certain areas adjacent to the Rhine river to be transformed into potential areas for urban development.

4.1.2 Strategic project: Gateway Basel Nord

Because of its strategic location and function, the Port of Switzerland is not only of local and regional but also of national importance in Switzerland. On top it is also considered a crucial logistic hinterland-hub along the main north-south transport corridor in Europe. Due to its direct rail, road and barge connection to the North Sea, large volumes of cargo are increasingly transported in large containers on inland vessels, leading to a considerable inrease in container traffic on the Rhine river (Stölze et al., 2014). Thus, the three Swiss logistics and freight companies, Contargo AG, Hupac SA and SBB Cargo AG, established a joint planning company named Gateway Basel Nord, which is pushing for a new container terminal in the Kleinhünigen Rhine port north of the city of Basel. The gateway is planned as a trimodal (road/rail/barge) terminal for the transhipment of containers and other load carriers used in intermodal transport. Being located between the railway and the motorway, the new terminal is expected to handle growing container volumes efficiently. In opposition, Swissterminal (together with the two transport operators Ultra-Bag and Danser) are planning a new container terminal in Weil am Rhein to replace the terminal on the Westquai, which will be closed to make way for urban development. New port developments enforcing the

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infrastructural reorganisation of the port will allow the City of Basel to transform former port areas into new settlement areas adjacent to the Rhine river (Braun, 2015).

4.1.3 Stakeholder analysis

As the city of Basel is overrun by an avalanche of trucks on a daily basis, new solutions in dealing with the increasing amount of container traffic are needed to be found. Here, the Port of Switzerland can be play a crucial role in handling the country's import/export freight traffic. However, there is a strong disagreement about which infrastructural plan in favour of its development shall be followed. In fact, different stakeholders, specifially long-time based logistical operators in the port of Basel-Kleinhüningen, pursue different goals. The container terminal planned by Gateway Basel Nord AG (public limited company in partnership with the Port of Switzerland) has been considered the only and best option for many years. Yet, Swissterminal, together with two partners Ultra-Brag and Danser (also logistics operators in the area) is currently planning a new container terminal in Weil am Rhein to replace the terminal on the Westquai, which will be closed in the near future to make way for urban development (Braun, 2014). Swissterminal and its two partners are discerned about the prognosed modal split increase in barge as they want to maintain the efficacy of the current decentralised terminal infrastructure. Despite the different goals and fair competition infringements, the nature of the spatial conflict as such is cooperative. In fact, the development of a 'big picture for Basel' (Gesamtperspektive Basel) as a logistic centre without involving all currently active operators in the port to be part of the process lack thorough coordination. Nevertheless, the cantonal authorities (Basel-Stadt and Basel-Land) worked at first closely with the Port of Switzerland to plan the rearrangement of the port infrastructure in ways that would allow the urbanisation of waterfronts, before the actual plans for the development of the Gateway Basel Nord container terminal were introduced (Braun, 2014). The long-term cooperation between the city of Basel and its port reinforced the development of the logistic site and initated the debate on the operator model of the new terminal. The stakeholder structure and their mutual relationships are briefly presented in Figure 3.

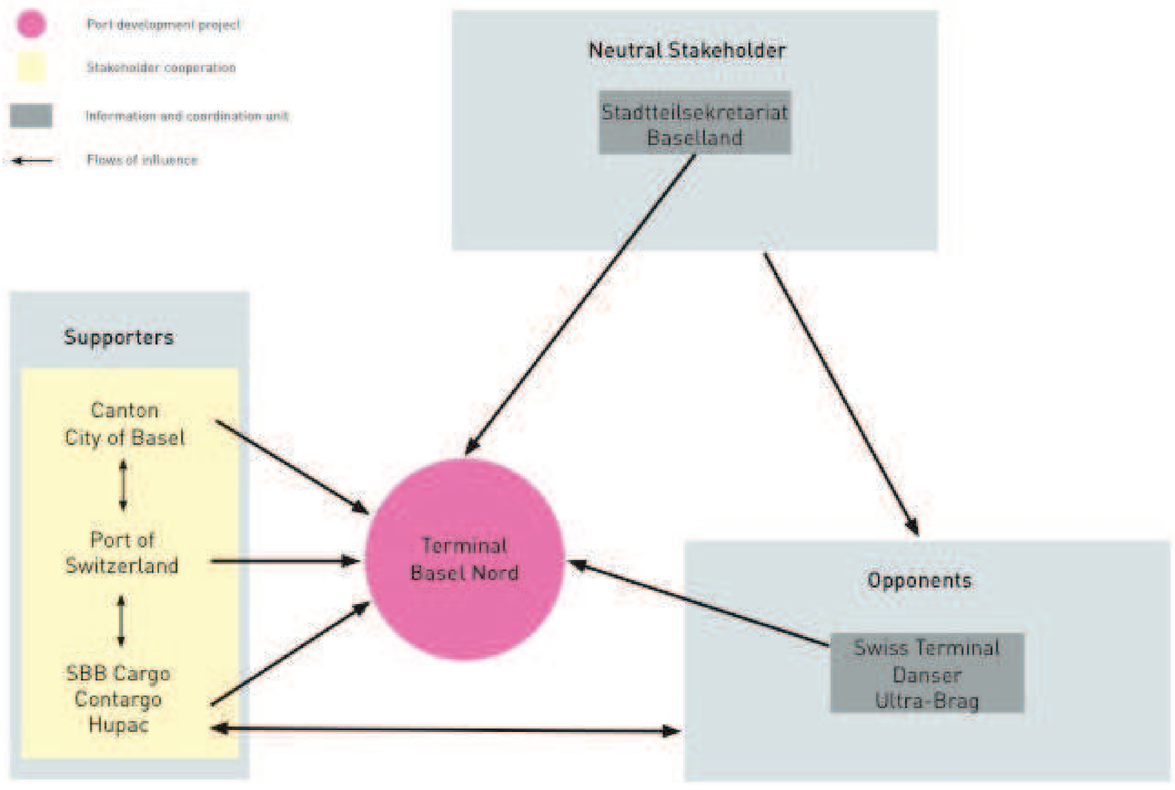

Fig. 3: Stakeholder analysis in the case of Basel inland port. (Source: Braun, 2017)

4.2 Transformation of the main railroad complex in Belgrade, Serbia

4.2.1 Railway network in Belgrade

As Belgrade was recognised as one of the most important nodes along the Pan-European Corridor X,[3] most studies in recent decades were devoted to strenghtening the railway network in its agglomeration and consequently in the rest of Serbia. However, Serbian transportation and spatial planning experts felt the need for a reconstruction of the railways in Belgrade even earlier – the first studies appeared in the 1960s, followed by the first construction works in the 1970s. The main feature that coloured new transport scheme was influenced by the urban studies, however, different than the one experienced in most of European capitals. Namely, while Berlin, Vienna, Zurich saw the upgrade of the railway station complex as rising the urban life, too, the centrally located main railway station of Belgrade was seen as a great obstacle in connecting the urban pattern with its river. This was mainly due to the large shunting yard that was placed in close proximity of the station, thus occupying one of the most exclusive plots in Belgrade. Therefore, the construction of the new railway station was relocated out of the central zone, and the area of the main station has been a subject of planning debate and a number of open competitions for decades. In 2012, the investor for the development of the entire area was found and soon the removal of the majority of the railway tracks began. Although this station is still in operation, i.e. it is the one and only node where international train routes intersect, the previous activities designated the birth of the Belgrade Waterfront project.

4.2.2 Strategic project: Belgrade Waterfront

According to the discourse of current political power structures, the Belgrade Waterfront project is the 'best practice' example of recent urban development in Serbia. Contrary to this, the professional perspective on this topic is quite the opposite – it is a drastic case of usurpation of both the formal planning procedures and the professional expertise in the creation of planning solutions.

Three years after initiating the idea on the Belgrade Waterfront project (during the political campaign of then-largest opposition party), the cornerstone for a 90 ha land on the river bank was set in October 2015, thus marking the beginning of the 30-year long development period. Moreover, due to its position (close to the confluence of two rivers and the historical city core), this brownfield site redevelopment is not only of city, but also of regional and even national importance, thus attracting mainly foreign investors (Maruna, 2015). The current construction work is financed by the investor from the United Arab Emirates (UAE). According to the agreement between the UAE company Eagle Hills and the national government of Serbia, the state is obliged to remove the old railway tracks (currently at the site since this is the broader area of railway station still in use), invest in constructing the new railway station, provide all the infrastructural equipment to and on the site and even lease the land to the UAE investor for 99 years.

4.2.3 Stakeholder analysis

Besides the two dominant actors in the story on Belgrade Waterfront, the position and roles of professional community and the civil sector should be mentioned to grasp the broader picture of the development project. In contrast to the former Yugoslav planning professionals who were acting in concert with the authorities, highly appreciating multidisciplinarity in the planning process and being recognised as the bearers of the public interest, Serbian planners are today completely side-lined for public interest lost its privileged position as the 'higher' reason that cannot be brought into the question (Vujosevic and Nedovic-Budic, 2006). Planners cannot cope effectively with the private interest requests expressed in the Belgrade Waterfront project for their expertise did not evolve through time: they do not know how to swim in the whirlpool of multiple interests, i.e. they did not adapt to the pluralistic society and still try to keep their exclusive position.

The global shift of the planning paradigm addressed the raising awareness of the stakeholders' collaboration in creating the spatial development policies (Vujosevic et al., 2012). Nevertheless, in the case of the Belgrade Waterfront project, strategic decisions were made at the political level (with the key role of the prime minister), hence, avoiding any kind of a public debate with a range of interested parties. The professional planners' society was completely ignored by the political power structures: on the one hand,

[3] The initiative on the PEC (Pan-European Corridors and Areas) was the first one, created in the 1990s. More precisely, it was developed during two Ministerial Conferences – in Crete (1994) and in Helsinki (1997), with the aim of connecting the EU-15 with the then neighbouring countries.

they were the advocates of public interest, but what is worse is that on the other hand, they never showed any understanding of a contemporary society's demands and the need of adjusting their own profile to it. The clear example of the Serbian expertise position was the complaint of the National Association of Architects when its president stressed the unfair exclusion of experts in the project: the comment was mainly on the quality and design of the project, and not on the strategic decision-making procedure that caused such a design. Persistent adherence to the outdated position made them players without power in a stakeholder arena, thus easily disregarded by the powerful political structures. The civil sector, i.e. several non-governmental organisations, also raised its voice pointing to the irregularity of the legal basis of the Belgrade Waterfront project, thus trying to address the broader public audience. They were underlining the importance of safeguarding public interest and compliance with planning and construction legislation (Maruna, 2015). However, the exclusion of both the planning profession and the public in such an important project is a clear sign of an elementary ignorance of democratic decision-making.

5 CONCLUSION

The social and institutional context affects to a great extent the collaboration and communication among the stakeholders participating in complex spatial issues such as integrated spatial and trasnport development. Creating and enabling the possibilities for implementation of the strategic projects among these stakeholders is a key to minimise the risks of spatial conflicts in hot-spots and, thus enhance integrated development in a cross-border and large-scale planning framework.

The shortage of areas available for further expansion of the traditional maritime ports asks for innovative solutions in order to connect them to other water-based terminals in their catchment areas, influencing also the internal spatial configuration of the nodes in the inland port system itself. As seen from the Basel case, the transformation process profits from a better coordinated strategy and a comprehensive survey of the available opportunities. Although such a large developmental projects always involve the opponent parties, the kind of an informal approach in coordinating all important stakeholders was proven as a successful planning tool. In the case of Belgrade, it is evident that neither formal nor informal iniatives are not strong enough with the power holders in both the public and private sector. Non-transparent procedures and dominance of the political structures deeply degrade spatial development in Serbian capital.

Having previous in mind, strategic developments in the hot-spots along international transport corridors should be orchestrated as they can have a twofold impact – on urban life in cities and on the flow of the corridor as a whole. On the one hand, foreign direct investments in strategic locations that solely aim at profit maximatio, yet ignoring infrastructual improvements and the involvement of public impede a bottom-up strategic cooperation and integration among local stakeholders. On the other hand, as can be noticed from the transnational project initiatives and their approach at the local level, an advisory expert approach can offer new opportunities for urban development in prime locations and meanwhile, improve the flow of goods and passengers in strategically important hubs/hot-spots.

However, analysts go astray as they imagine spatial planning professionals are responsible for relations of social mistrust and cynical detachment. The plans can provide important testimony to the kind of purposeful deliberation that may anticipate and avoid the social and economic damage of urban developments that wilfully ignore future consequences for others. Nevertheless, bureaucratic indifference and patronage along with political favouritism and corruption cannot be remedied by planning. Changing these conditions requires a host of social, political and economic changes that extend well beyond what planning can do.

6 REFERENCES

BRAUN, C: Integrierte Hafen- und Stadtentwicklung. Vor dem Hintergrund der logistischen Anforderungen und den Potenzialen der Stadtentwicklung am Beispiel der Hafenstädte Mannheim und Strassburg. (ETH Zürich MAS These in Raumplanung). Zürich: Institut für Raumplanung, ETH Zürich, 2015.

BRAUN, C. Zwischen logistischen Anforderungen und potenzieller Stadtentwicklung im Hafen Basel Nord. Exposé MAS-Programm in Raumplanung 2013-2015. ETH Zürich, 2014

DREWELLO, H., SCHOLL, B. (Eds.): Integrated Spatial and Transport Infrastructure Development: The Case of the European North-South Corridor Rotterdam–Genoa. Cham: Springer International Publishing Switzerland, 2016.

DÜHR, S., COLOMB, C., NADIN, V.: European Spatial Planning and Territorial Cooperation. London & New York: Routledge, 2010.

EC (EUROPEAN COMMISSION): TEN-T Core Network Including Core Network Corridors. Brussels: European Commission, 2011. Accessed on April 5, 2017 from: https://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/corridors_en

ETH/IRL (INSTITUTE FOR SPATIAL AND LANDSCAPE DEVELOPMENT): CODE24 – A common strategy for the development of the Corridor Rotterdam-Genoa. Report, Workpackage 1. Zurich: Institute for Spatial and Landscape Development, ETH Zurich, 2013.

FALUDI, A.: The Netherlands: a culture with a soft spot for planning. In B. Sanyal (Ed.), Comparative Planning Cultures (pp. 285–308). London & New York: Routledge, 2005.

MARUNA, M.: Can Planning Solutions Be Evaluated without Insight into the Process of their Creation? In M. Schrenk, V. Popovich, P. Zeile, P. Elisei and C. Beyer (Eds.), Proceedings of the REAL CORP 2015 Conference "Plan Together–Right Now–Overall" (pp. 121-132). Vienna: REAL CORP, 2015.

PERIĆ, A.: Integrated Spatial and Transport Development: A Multilevel Perspective. In B. Scholl, K. Moraitis, V. Pappas, A. Peric and I. Frezadou (Eds.), CODE: ATHENS! Railway and City Development in Athens (pp. 37-47). Zurich: Institute for Spatial and Landscape Development, ETH Zurich, 2016.

PERIĆ, A., SCHOLL, B.: Transnational Cooperation in Europe: The Example of Integrated Spatial and Transport Development along the Hamburg-Athens Corridor. In: Athens Journal of Sciences, Vol. 4, Issue 2, pp. 101-114. Athens: ATINER, 2017a.

PERIĆ, A., SCHOLL, B.: Integrated spatial and transport development in Europe: The examples of two European corridors. In: AESOP 2017 Conference Proceedings "Spaces of Dialog for Places of Dignity: Fostering the European Dimension of Planning" (forthcoming). Lisbon, 2017b.

SCHOLL, B.: Spatial Planning and Development in a European and Macro-Regional Context. In H. Drewello & B. Scholl (Eds.), Integrated Spatial and Transport Infrastructure Development: The Case of the European North-South Corridor Rotterdam–Genoa (pp. 11-47). Cham: Springer International Publishing Switzerland, 2016a.

SCHOLL, B.: Academic Collaboration in Spaces and Projects of European Importance. In B. Scholl, K. Moraitis, V. Pappas, A. Peric and I. Frezadou (Eds.), CODE: ATHENS! Railway and City Development in Athens (pp. 17-36). Zurich: Institute for Spatial and Landscape Development, ETH Zurich, 2016b.

SCHOLL, B., PERIĆ, A., ACEBILLO, P.: Spatial and Transport Development in European Corridors – Example Corridor 22 (Orient/east-Med), Hamburg–Athens: A First Approach. (Internal document). Zurich: Institute for Spatial and Landscape Development, ETH Zurich, 2016.

SRH (SCHWEIZERISCHEN RHEINHÄFEN): Jahresbericht 2016. Accessed on May 3, 2017 from: http://www.port-of-switzerland.ch/wAssets/docs/Jahresberichte_Flyer/Jahresbericht_2016.pdf.

STÖLZE, W., HOFMANN, E., LAMPE, K., : Einblick in den Schweizer Logistikmarkt 2014. St. Gallen: Lehrstuhl für Logistikmanagement, Universität St. Gallen, 2014.

VUJOSEVIC, M., NEDOVIC-BUDIC, Z.: Planning and societal context – The case of Belgrade, Serbia. In S. Tsenkova, and Z. Nedovic-Budic (Eds.), The urban mosaic of post-socialist Europe: space, institutions and policy (pp. 275-284). Heidelberg: Physica-Verlag, 2006.

VUJOSEVIC, M., ZEKOVIC, S., MARICIC, T.: Post-socialist transition in Serbia and its unsustainable path. In: European Planning Studies, Vol. 20, pp. 1707-1727, 2012.

WITTE, P., WIEGMANS, B., BRAUN, C., SPIT, T.: Weakest link or strongest node? Comparing governance strategies for inland ports in transnational European corridors. In: Research in Transportation Business & Management, Vol. 19, pp. 91-105. Amsterdam: Elsevier, 2016.

WOJCIECHOWSKI, P.: Rhine-Alpine-Corridor. Second Work Plan of the European Coordinator. European Commission – Directorate General for Mobility and Transport. Directorate B – European Mobility Network. Unit B1 – Trans European Network. Brussels: European Commission, 2016. Accessed on April 5, 2017 from: http://ec.europa.eu/transport/index_en.htm.

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🏆 *reviewed paper*

Integrated TOD and Urban Land Use Planning: Evidence from Iran, Kashan

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1 ABSTRACT

Ignoring mobility in urban development policies leads to social and environmental costs. Therefore, reviewing these policies, in order to reach sustainable mobility, is necessary. This means that urban development programs should be directed towards strategies where walking, cycling and transit are key elements. This approach which is known as transit-oriented development (TOD), focuses on developing communities that push away from the car-oriented urbanism and mobility toward urban forms and land uses that are closely integrated with active, efficient, low-impact and people-oriented urban travel modes: walking, cycling and transit. The focus of this paper is on urban land use planning to shape sustainable mobility in cities, according to TOD principles. First, based on experts and practitioners' opinions and using a Multi-Criteria Decision Making (MCDM) model, most important variables and criteria were determined in order to effective TOD-based urbanism planning. Results showed that criteria related to land use are most important factors from experts' point of view. Then, as the case study from Iran, four bus stations in main squares of the city of Kashan were considered. Information about land use factors around these squares was extracted and analyzed using ArcGIS software, and those stations that are more prone to transit-oriented development, were determined. According to results, 15-Khordad square is an appropriate location for future development. Results can be of help to urban planners in future planning and policies, in order to achieve the sustainable mobility in urban environments.

Keywords: feasibility, MCDM, transit station, land use planning, TOD

2 INTRODUCTION

Sustainable development leads to a new approach in the transport and land use planning. Optimum use of land with approach of reclamation, preventing the sparse growth, increased density and mixed land uses, have been proposed in theories of sustainable development in urban areas. From most important impacts of sustainable development on transport and land use planning, are:

- Coordinating the planning of transit and land use to reduce the tendency to private car.
- The design of urban land use in such a way that access to travel destinations or services would be provided easily, through combination of walking, cycling and transit.
- Strengthening the role of neighborhood units deployed around transit stations, especially stations of rail system.

Today, urbanization and population growth in the process of urban development, and increasing people's dependence on private car, has been caused traffic problems and congestion, parking problems, Increased travel time, inadequate public transport and increased use of lands (Alberti & Waddell, 2000).

In the modern urbanism, urban development and transport cannot be realized independently of each other, because they are closely and undeniably interconnected with each other and with the urban quality standards. Urban development due to urban transport components, has been considered always and has been done with different objectives and methods at different times. In this context, what is emphasized in the Third Millennium is transit-oriented development (TOD) that is dense development with the right mix of land uses in the vicinity of public transport stations and routes (Hrelja, 2015).

Transit-oriented development is a dense development with the right mix of land uses in the vicinity of transit stations and routes. This creates lively neighborhoods with a high quality of life. In this approach, living and working in dense environments with diverse utilities and multiple options for mobility would be possible. Furthermore, TOD will result in Less driving time and will reduce car travel demand (Crane, 2000).

In the following, definition, principles, objectives, and benefits of TOD are presented in section 3. Then, some evidences about relationship between travel demand and land use characteristics are shown in Section 4. An AHP model was applied on expert opinions about most important TOD factors and results are shown in section 5. After determining the most important TOD vriable (land use), some bus stations in the city of Kashan were investigated as case study, with reference to land use criteria, in section 6. Finally, the paper is concluded in section 7.

3 TRANSIT-ORIENTED DEVELOPMENT (TOD)

Many definitions of transit-oriented development were provided so far. One of the most comprehensive definitions have been provided by Colthorpe, one of leaders of new urbanism movement. He defines TOD in this way: Transit-oriented development is functional combination of land use and public transportation by creating compact, walkable and mixed-use neighborhoods within the walking distance around transit stations. Synthetizing residential, retail, official and public land uses in a walkable environment, facilitates using of public transport, cycling and walking. This type of development, put together individuals, businesses and services, and is designed so that traveling by varios travel modes will become safe, efficient and comfortable (Calthorpe, 1993).

Components of transit-oriented development has been shown in Figure 1. These principles can be applied to creating societies based on public transport and also integrating the development and transportation (Dimitriou & Gakenheimer, 2011).

Source: Institute for Transportation & Development Policy (ITDP)

Fig. 1: Transit-oriented development (TOD) principles

The main objective of the transit-oriented development in most societies is reducing the share of private car. However, such development has other benefits as follows (Curtis, Renne, & Bertolini, 2009; Ramírez & Rosas, 2014):

- Efficient and sustainable use of land, energy and resources.
- Increasing the share of public transport and its profit from fares.
- Reduction of congestion and transportation costs by reducing the share of private car.
- Improvement of air quality and reducing greenhouse gas emissions.
- Ensuring a healthier and more active lifestyle by encouraging people to walking.
- Improving the access to jobs and economic opportunities for business owners and low-income people.
- creation of centralized activities.

European project of integrated transport and land use planning, explicitly states the following suggestion: transportation and land use policies are successful only if necessary criteria for sustainable urban transport are provided. Foe example: reducing distances and travel times, and reducing the share of private car Such that traveling by car becomes less attractive (slower or more price) (Paulley & Pedler, 2000).

In practice, this definition means that TOD should be lead to more attractive transit, cycling and walking, relative to the private car. People tendency to use transit, cycling and walking is known as sustainable mobility.

Mobility management policies and programs would be result to more efficient travel behavior. This policy can be used as an alternative option to expand road capacity and increase the number of parking. Mobility management affects directly on land use by eliminating the need for more roads and parking. Comprehensive programs to reduce the travel demand by car and achieve sustainable mobility, reduce number of trips usually between 4 to 20 percent during peak periods. Effects of these programs varies according to location and social-economic profile. Programs that have not economic incentives, result usually less than 10% reduction. In downtown areas, these policies will shift the modes of travel to walking and transit (sustainable mobility). While in areas with low density, will be shifted to cycling and carpooling (Moudon & Stewart, 2013).

The aim of mobility management is reducing total traffic in general, and shifting trips by car to other travel modes and increasing the share of cycling and walking during the peak period. In table 1, impacts of these policies on different TOD objectives, have been rated (Su & Zhou, 2012).

Objective	**Rating**
Reduces total traffic.	2
Reduces peak period traffic.	3
Shifts peak to off-peak periods.	2
Shifts automobile travel to alternative modes.	3
Improves access, reduces the need for travel.	1
Increased ridesharing.	2
Increased public transit.	2
Increased cycling.	2
Increased walking.	2
Increased Telework.	2
Reduced freight traffic.	0
Rating from 3 (very beneficial) to –3 (very harmful). 0 indicates no impact or mixed impacts.	

Table 1: Rating the impact of mobility management policies on TOD objectives

4 TRAVEL DEMAND ELASTICITY WITH RESPECT TO LAND USE CHARACTERISTICS

In this section, elasticity in travel demand with respect to changes in land use will be discussed. In this context, Elasticity means that how travel damand will be changed, by doubling factors that affecting travel.

Ewing and Cervero have studied travel demand elasticity with respect to factors such as density, diversity, design and accessibility. Results have been shown in Table 2. Numbers in the table means that, for example, by doubling the density, vehicle trips and vehicle miles traveled (VMT) are decreased by 5% (Poulenez-Donovan & Ulberg, 1994).

Factor	**Description**	**Trips**	**VMT**
Local Density	Residential and employees divided by land area	-0.05	-0.05
Local Diversity (Mix)	Jobs/ residential population	-0.03	-0.05
Local Design	Sidewalk completeness/ route directness and street network density.	-0.05	-0.03
Regional Accessibility	Distance to other activity centers in the region.	---	-0.20
This table shows the elasticity values of vehicle trips and vehicle miles travelled (VMT) with respect to various land use factors.			

Table 2: Travel demand elasticity with respect to some land use factors

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In another study by Madden and Stewart, elasticity of vehicle miles traveled (VMT) and demnd for other modes of travel such as walking and public transport, were calculated with respect to factors such as density, diversity, design, accessibility and distance to the bus station. Results have been shown in Table 3. Numbers in the table means that, for example, by doubling the density of residential areas, vehicle miles traveled (VMT) is decreased by 4%, and using of public transport and walking are increased by 7% (Litman, 2006).

Category	Variable	VMT	Walking	Transit
Density	Household/population density	–0.04	0.07	0.07
	Job density	0.00	0.04	0.01
	Commercial Floor Area Ratio (FAR)	n/a*	0.07	n/a
Diversity	Land use mix	-0.09	0.15	0.12
	Jobs/housing balance	-0.02	0.19	n/a
Design	Distance to a store	n/a	0.25	n/a
	Intersection/street density	-0.12	0.39	0.23
	Percent 4-way intersections	-0.12	-0.06	0.29
Destination accessibility	Job accessibility by auto	-0.20	n/a	n/a
	Job accessibility by transit	-0.05	n/a	n/a
	Jobs within one mile	n/a	0.15	n/a
Distance to Transit	Distance to downtown	– 0.22	n/a	n/a
	Distance to nearest transit stop	-0.05	0.15	0.29

* not applicable

Table 3: Travel demand elasticity with respect to some land use factors

5 EXAMINING THE ROLE OF LAND USE PLANNING IN TOD APPROACH, USING AHP MODEL

Today, what is done in the design of urban systems, is a comprehensive urban development program aimed at creating maximum possible match between urbanism and land use policies on one hand, and urban transportation systems optimized according to the characteristics of the urban network on the other hand. Since each of the bus stops influences over peripheral environment gradually, development planning of stations should be considered with their periphery as a coordinated and interacted set. Many models can be applied in the integrated land use and transport planning. Some of these models are:

- Linear regression
- Fuzzy-GIS
- Neural-fuzzy
- IHWP
- MCDM[1]

In this study, AHP (an MCDM model) has been used. The Analytic Hierarchy Process (AHP), introduced by Thomas Saaty (1980), is an effective tool for dealing with complex decision making, and may aid the decision maker to set priorities and make the best decision. By reducing complex decisions to a series of pairwise comparisons, and then synthesizing the results, the AHP helps to capture both subjective and objective aspects of a decision. In addition, the AHP incorporates a useful technique for checking the consistency of the decision maker's evaluations, thus reducing the bias in the decision making process (Dodgson, Spackman, Pearman, & Phillips, 2009).

The AHP considers a set of evaluation criteria, and a set of alternative options among which the best decision is to be made. It is important to note that, since some of the criteria could be contrasting, it is not true in general that the best option is the one which optimizes each single criterion, rather the one which achieves

[1] Multi-criteria decision making

the most suitable trade-off among the different criteria. The AHP generates a weight for each evaluation criterion according to the decision maker's pairwise comparisons of the criteria (Dodgson et al., 2009).

At first, as shown in figure 2, two variables and eight criteria was selected. In order to evaluating preferences about these variables and criteria, a questionnaire was designed and distributed among experts. Four questionnaires were completed and after proccessing, following weights (table 4) were obtained. As it clear, in gereral, criteria related to land use vriable are most important factors for future development.

Variables	Criteria	Weights of criteria	Weights of variables
Land use	population/ residential density	0.266	0.787
	mixing and diversity	0.342	
	station complexes development	0.161	
Design	walk-friendly/ cycling friendly	0.183	0.027
	parking limit	0.285	
	continuity and connection to passages	0.113	
	accessibility to services	0.086	
	active space	0.105	

Table 4: TOD variables and criteria weights based on expert's opinion

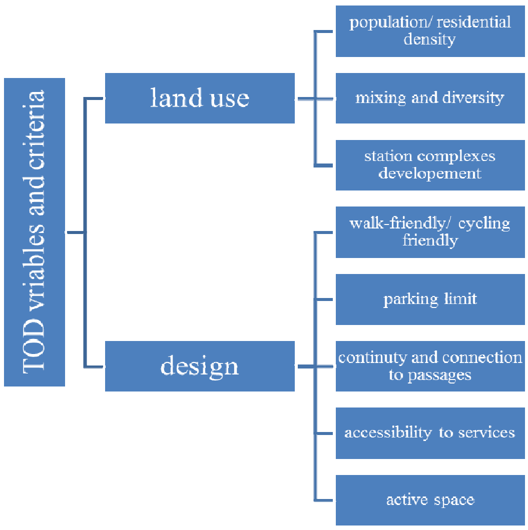

Fig. 2: Examined TOD variables and criteria

Questionnaires were distributed and inconsistency index, for all criteria and variables, were obtained 0.03 (namely less than critical value of 0.1). The importance of inconsistency rate is in preliminary verification of paired comparisons data and using them in decision-making. If the inconsistency rate is higher than 0.1, matrix of paired comparisons data will have little validity. Resulted inconsistency rate of less than 0.1, indicating appropriate reliability of information which was obtained from the questionnaires.

6 EVALUATING THE POTENTIAL OF BUS STATIONS IN THE CITY OF KASHAN FOR TOD

Kashan city is located in the northern of Isfahan province, in the center of Iran. Kashan and suburbs bus company was founded in 1991. Currently, 159 civilian buses and 35 buses of private sector are in service on 16 lines. 530 minibuses, under supervision of that company, are also responsible for passenger transport. all lines originate from one of these squares: Valiye-asr, 15-Khordad, Kamal-ol-molk, Darvaze-dolat. Therefore, this study evaluates the potential of these squares for future transit-oriented development, such as construction of station complexes around them. This evaluation will be conducted based on criteria related to land use, which was most important vriable according to expert opinions in previous section.

In oreder to feasibility study, at first, a circle was struck with the radius of 500 meters (the usual distance of walking) around four abovementioned squares in the ArcGIS software. Then, feasibility of TOD around these squares are investigated based on three land use criteria including population, land use type and population density of residential area in the affected zone.

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6.1 Population

As more people live around an station, there has more potential to become a TOD center. In order to study the population criterion, blocks around stations Valiye-asr, 15-Khordad, Kamal-ol-molk and Darvaze-dolat, are shown in different colors according to their population. As it is clear in figure 3, Valiye-asr and 15-Khordad Squares have the greatest potential to convert to TOD centers, based on population criteria.

6.2 Density

The second criterion for examining the potential of stations, is the population density around four aforementioned squares, within the radius of 500 meters from them. Residential areas with high and medium density, have more potential to build the station complexes. For this purpose, blocks around these squares were classified into 4 categories based on the density, in terms of persons per hectare: low (less than 100), medium (101 to 200), high (201 to 300) and very high (301 and above) that has been shown by yellow, blue, green and purple colors respectively, in figure 4. As this figure shows, based on population density, Valiye-asr and 15-Khordad squares are more preferred than other squares.

6.3 Land use type

The third criterion to evaluate the feasibility of building station complexes around four above bus stations in the city of Kashan, is the type of land use. At first, land use has been divided into two categories: restrictive and provider. Utilities such as military, green space, educational, historical, cultural, urban facilities, and agriculture are restrictive. In contrast, commercial, residential and official utilities are among provider. Provider and restrictive utilities have been shown by arrangement with green and red colors in figure 5. By calculating the percentage of restrictive and provider areas within block of 500 meters radius around squares, results show that Kamal-ol-molk and 15-Khordad have greatest feasibility for TOD in future.

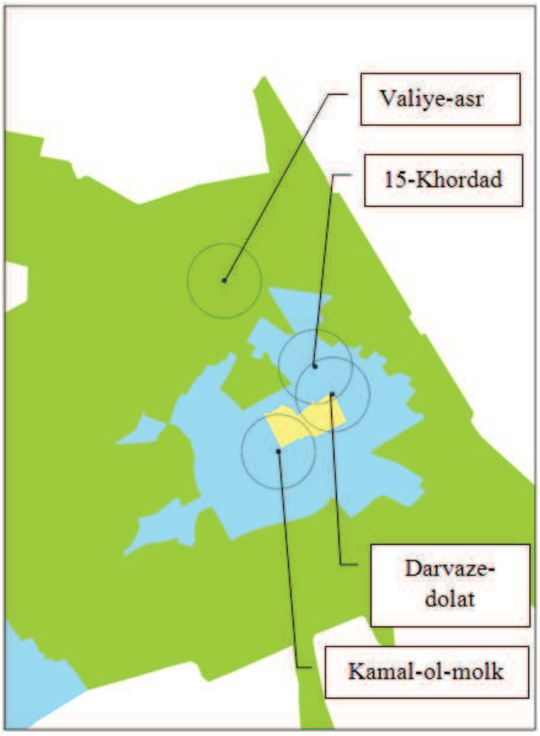

Fig. 3: Differences between four squares in Kashan city, based on population criterion (yellow: from 1005 to 1320 persons, blue: 1320 to 2000 persons, green: more than 2000 persons)

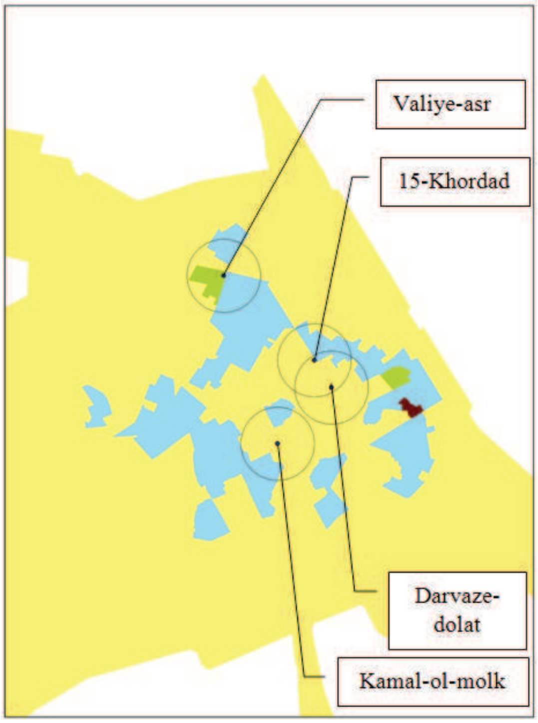

Fig. 4: Differences between four squares in Kashan city, based on density criterion (yellow: 5 to 100 (persons/ hectare), blue: 101 to 200 (persons/ hectare), green: 201 to 300 (persons/ hectare), purple: more than 300 (persons/ hectare))

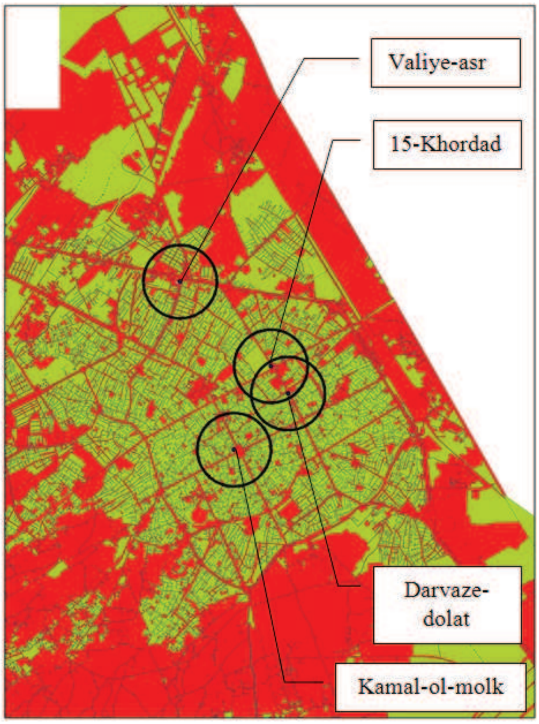

Fig. 5: Differences between four squares in Kashan, based on land use criterion (green: provider, red: restrictive)

7 CONCLUSION

The world is urbanizing and motorizing at an increasing speed. However, most developments around the world have taken place in an unsustainable manner, with priorities given to cars than public transit, walking and cycling. This development pattern has provoked problems that cities are facing today, such as tra¬ffic congestion and air pollution. Transit-oriented development (TOD), which promotes dense, mix-used urban development with good walking and cycling connections around transit stations, is a useful and important concept for future urbanism. Some principles and criteria have been proposed to achieve TOD-based urbanization. In this study, by interviewing with transportation planning experts and applying an AHP model, it was found that land use criteria are most important factors for transit-oriented development in

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future. Population, density and land use type, either provider or restrictive, were considered as land use related criteria. Using ArcGIS software, information about these criteria were extracted from 500 meters radius blocks around four bus stations in main squares in Kashan, Iran. According to outputs, 15-Khordad square is one of the most feasible and potential bus stations for transit-oriented development and constructing a station complex around it. Indeed, due to the limited resources allocated to urban projects, it is necessary to determine most feasible and potential stations, especially with reference to land use factors, before any planning for TOD. Results show that land use parameters are key factors for detecting potential locations to achieve the sustainable development and mobility. It is suggested that more land use factors to be considered in future studies to obtain more reliable results.

8 REFERENCES

ALBERTI, M., & Waddell, P.: An integrated urban development and ecological simulation model. Integrated Assessment, 1(3), 215-227. 2000.

CALTHORPE, P.: The next American metropolis: Ecology, community, and the American dream: Princeton architectural press. 1993.

CRANE, R.: The influence of urban form on travel: an interpretive review. CPL bibliography, 15(1), 3-23. 2000.

CURTIS, C., Renne, J. L., & Bertolini, L.: Transit oriented development: making it happen: Ashgate Publishing, Ltd. 2009.

DIMITRIOU, H. T., & Gakenheimer, R.: Urban transport in the developing world: A handbook of policy and practice: Edward Elgar Publishing. 2011.

DODGSON, J., Spackman, M., Pearman, A., & Phillips, L.: Multi-criteria analysis: a manual. 2009.

HRELJA, R.: Integrating transport and land-use planning? How steering cultures in local authorities affect implementation of integrated public transport and land-use planning. Transportation Research Part A: Policy and Practice, 74, 1-13. 2015.

LITMAN, T.: Smart Growth Policy Reforms. Retrieved from www.vtpi.org/smart_growth_reforms.pdf. 2006.

MOUDON, A. V., & Stewart, O.: Tools for Estimating VMT Reductions from Built Environment Changes. Olympia, Washington: Washington State Department of Transportation. 2013.

PAULLEY, N., & Pedler, A.: TRANSLAND–Integration of Transport and Land Use Planning. Final Report of Transland, 2000, 169-182. 2000.

POULENEZ-DONOVAN, C. J., & Ulberg, C.: Seeing the trees and missing the forest: qualitative versus quantitative research findings in a model transportation demand management program evaluation. Transportation Research Record, 1-1. 1994.

RAMÍREZ, S. M., & Rosas, J. V.: Transit Oriented Development: Regenerate Mexican Cities to Improve Mobility. 2014.

SU, Q., & Zhou, L.: Parking management, financial subsidies to alternatives to drive alone and commute mode choices in Seattle. Regional Science and Urban Economics, 42(1), 88-97. 2012.

reviewed paper

Introducing Additional Low Emission Mobility Offers in a Well Connected Area: Challenges and Opportunities

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1 ABSTRACT

European cities and regions strive for energy efficiency to meet the Europe 2020 goals on climate change and energy sustainability. At present, the transport sector is one of the main sources of greenhouse gas emissions due to the dependence on fossil fuels. The switch to renewable energies together with improvements in energy efficiency often cause rebound effects (e.g. increased use as a result of the environmentally friendly image) and therefore only partially serves the objectives sought. Hence, making the current mobility behavior more sustainable is of major importance to tackle environmental challenges and secure a high standard of living in European cities and regions.

Many cities already offer a well-developed and efficient transport network for public and individual transport. Previous efforts concentrated on a shift from car to public transport to improve transport performance within the city, avoid congestion and reduce air pollution. Taking into account progressive urbanization, it is obvious that public transport will reach its limits without major improvements (new lines, decreases in intervals) which are slow and very expensive and hence cannot be the sole solution. Together with the increasing individualization of society, more flexibility is needed. Therefore, an additional pool of mobility options targeting these user requirements and needs has to be provided.

In the EU project "Smarter Together" CO_2 savings are targeted by implementing projects in the fields of energy, renovation and mobility in Lyon, Munich and Vienna. An essential part of the project is the introduction of additional low emission mobility options in the Viennese project area in the northwest of the 11th Viennese district covering 1.5 km^2. The area is well linked to public transport and the general transportation network. Our research focusses on the potential of mobility behavior changes in such a wellconnected area in terms of the individual and public transport network, and on opportunities provided by additional services (e.g. sharing offers) and challenges in the implementation of theses new services.

To develop successfull new concepts, residents' requirements and needs have to be taken into account. Hence, a survey was conducted to capture information on mobility behavior and available vehicles, attitudes of the residents towards certain transport modes and willingness to use active modes, e-mobility and sharing services. The survey, including roughly 1% of the area population (N=21,300; n=241), was conducted partially online and partially face-to-face to ensure participation among different groups. Based on the collected data, the potential for alternative low emission mobility options was captured in a multi-level survey analysis. The results disclosed challenges and opportunities related to current options concerning user friendliness and communication strategies of existing services along with crucial points for the implementation of additional options.

One of the results showed that sharing services are hardly known to the residents. The participants revealed that e-bikes are not yet considered as an appropriate form of transportation since their features and advantages are not known. Offering car- or e-bike sharing services therefore does not only require a location with certain characteristics but also campaigns targeting the lack of knowledge. Active mobility has a good standing, particularly cycling. Many residents want to cycle more, but the surrounding structure does not encourage them, e.g. due to missing public bike parking at shopping facilities, transport stations and transportation hubs. Public transport is already heavily used, but could be stronger linked to other types of transportation. This should be achieved by implementing a "mobility point" offering locally bundled mobility options and information. The "mobility point" links different (multimodal) mobility services and acts as a major component of ICT solutions. This relatively new concept leaves ample room for additional low emission mobility options within the area leading to greater support, services and satisfaction to the travelers and users.

Keywords: mobility behaviour, implementation of social services, low emission mobility, environment, ICT

2 PROBLEM STATEMENT

The Europe 2020 goals on climate change and energy sustainability targeting greenhouse gas emissions, energy from renewables and energy efficiency pose a particular challenge for cities and regions (European Comission 2015). To meet these goals, an holistic approach is needed that takes into account various components of the city that are expected to contribute to the achievement of the objectives.

Smart city projects that concentrate on energy, renovation and mobility are a tool to approach energy related challenges and tackle them from various angles. Incorporating transportation is an essential part since it is one of the main contributors to greenhouse gas emissions due to the prevalent dependence on fossil fuels. In 2015, the transportation sector was accountable for one quarter of the total EU-28 greenhouse gas emissions and despite various efforts, emissions increased by 0.7 % compared to the previous year (European Environment Agency 2016). To alter the current development, technological solutions as the sole action are not enough to increase efficiency (Binswanger 2001). Rebound effects as a sideeffects of the transition to renewable energy and energy efficient technology (e.g. increased use as a result of the environmental friendly image) contribute to a negativ development and underline the importance of behavioral aspects in transportation. To achieve goals of effectiveness, consistency and sufficiency (Linz 2004, Fischer/Grießhammer 2013, Buhl/Acosta 2016), the mobility behavior has to be recorded in the respective social and spatial contexts (Scheiner 2009, Dangschat 2013) and changed towards more environmentally-friendly mobility (Hunecke 2015, Dangschat 2016).

More sustainable mobility behavior helps tackling environmental challenges and serves a high standard of living in European cities and regions. Main obstacle to the pursued behavior are predominant everyday routines which make decisions easier, give (behavioral) security and increase the identification. The confrontation with new and complex things, such as change, requires a great deal of attention and concentration (Roth 2003). This can be unsettling and is therefore often avoided or rejected. From a social psychological perspective, routine activities are a prerequisite for dealing with complex social situations (coping strategies) (Risser/Chaloupka-Risser 2011, Wilde 2013). To overcome routines of unsustainable mobility is not the only challenge in the field of transport policy since settlement development or the existing technical transport system can be regarded as “constraints” in terms of altering transportation choices.

To foster environmentally-friendly mobility behavior, influencing factors have to be investigated not only targeting the existing infrastructure, mobility patterns and needs but also taking into account previous transport policies and their outcome. After a period of car-orientation, improving and promoting public transport was one of the main agendas for several years in order to avoid congestion and reduce air pollution. The result is a well-developed and efficient transport network for public and individual transport in many European cities. Current challenges such as progressive urbanization and increasing individualization of society pose new challenges for the transport system since they cannot be addressed by public transport solely.

Major improvements in public transport are slow and very expensive. They also often do not address the flexibility needed. An additional pool of mobility options targeting these user requirements and needs has to be provided. Additional low emission mobility offers therefore concentrate on sharing services and active modes (walking, cycling). The usage of sharing services is quite different from owning a vehicle and therefore needs rethinking of how we go from point A to point B. Active modes on the other hand are partially integrated in our daily routines but require self discipline. Thus, additional low emission mobility offers are needed to break old habits. This is particularly challenging in an area with good traffic connections and infrastructure, such as many areas near the city center of European cities and regions are, since residents already have convenient options to go places.

3 RESEARCH FRAMEWORK

The smart city project “Smarter Together” aims to increase energy efficiency and reduce CO_2 emissions in the fields energy, renovation and mobility in Lyon, Munich and Vienna. This is done by implementing light house projects in selected urban areas in these cities; the introduction of additional low emission mobility services as the most promising in the mobility domain for the city of Vienna.

3.1 Study area

The Viennese study area covers the northwest of the 11th district “Simmering” with a surface of 1.5 km^2 and 21,300 inhabitants. The area is well connected to the public transport (underground and one commuter train line as well as several tram lines) and the general transport network (there are several major roads as well as a an exit from the city highway).

The existing structure prevents major rebuilding work in terms of infrastructure which is one reason for taking a more behavioral approach towards energy savings in the field of mobility. The introduction of additional low emission mobility as a light house project in this field offers not only opportunities but also poses challenges due to the existing structure and related usage patterns.

By now, additional low emission mobility services are mainly introduced in urban development areas and not in existing urban structure. Altering mobility behavior is challenging itself but even more in an area that is well-connected in terms of individual and public transport network. Our research therefore focusses on the potential of mobility behavior change in a well-connected area as well as the opportunities provided by additional services and challenges in the implementation of these new services.

The provision of additional low emission mobility services alone is not sufficient to bring about behavioral change. According to the behavioral model of Fietkau/Kessel (1981), behavior is determined as a combination of influencing facors with knowledge transfer and explained as a component which is “[…] indeed a necessary but often not sufficient condition for behavioral change” (Schlaffer et al. 2002:13). The attractiveness of behavioral opportunities and incentives for a certain behavior play an important role. In order to create such offers and incentives, an extensive knowledge of the needs, desires and preferences of the target group is required.

3.2 Research design

To cover the above-mentioned knowledge of the needs, requirements and preferences of the residents in the study area, it was decided to conduct a mobility survey. Since all mobility options should be available to the respondents, persons aged 18 years and above living or working in the study area were identified as target group. The aim of the survey was to find out about

- the current mobility behavior of the respondents,
- the current use of transport by the respondents,
- the availability of different modes for households and the ability of persons to use the mobility options available,
- the prevailing attitudes towards different forms of travel,
- preferences with regard to an extention of the services,
- willingness to use active forms of mobility and
- behavioral change since the last relocation.

The survey thus covered questions on demographic data, current mobility patterns and related predispositions (e.g. driver’s licence), the image of transport modes and the attitudes towards them, usage of alternative modes of transport and the willingness to change towards more sustainable transport modes in the future. It was carried out as a combination of face-to-face and online-survey.

3.3 Survey realization

Due to the geographically restricted area of investigation, some survey distribution channels had to be excluded from the start. Therefore, the main focus was on dissemination activities of the urban renewable office GB*3/11, direct mail and the support from the adult education center VHS Simmering in combination with a minor compensation for the survey participants. Due to the commitment of the urban renewable office GB*3/11, the residents were not only able to participate online in the survey but also had the opportunity to complete the questionnaire jointly with the multi-lingual staff of the GB*3/11 at the local mall. This ensured that persons with little or no German skills as well as persons with no internet access could participate in the survey.

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The survey was conducted in the period from August to December 2016. 482 persons participated in the survey but only half of the questionnaires were completely filled in and could be used for the analysis. Nonetheless, roughly 1% of the area population (N=21,300; n=241) provided complete datasets for the mobility survey.

99 fully completed questionnaires were provided by GB*3/11, 21 were the result of a cooperation with the VHS Simmering and 121 completed questionnaires were obtained by the online survey. It is thus a hybrid-sample, which ensures the participation of different groups of persons in the survey as mentioned above.

3.4 Survey evaluation

To capture the potential for alternative low emission mobility options, a multi-level survey analysis was carried out. This methodology builds upon conventional mobility surveys complemented by additional survey items on the meanings of different modes of transport and stated preference mode choice questions. Clusters were formed using the current mobility behavior as an input. These clusters were further analyzed to estimate the potential of different modes of transport. In addition, respondents had to take mode decisions for several stated preference questions in typical situations in the area (e.g. shopping trips). To study the potential of sharing projects for electric vehicles, these modes were given as options in the stated preference questions. The results of the mode decisions were applied to estimate a mode choice model that included the new modes. Finally, associated meanings of the different modes were given and analyzed for the groups to get a deeper understanding of how the different modes are perceived. This in turn can help with improving targeted measures to promote the modes amongst different groups.

4 BASELINE

As already mentioned, the study area is well-connected in terms of public and private transport. To underline this statement, the basic infrastructure components and main findings from the survey in terms of accessiblity and usage are summarized.

Fig. 1: Viennese study area in the 11th district.

4.1 Available infrastructure in the study area

The study area offers a close meshed road network with parking space at public ground. Furthermore, it is bordered in the west by the highway A23 (see Fig. 1). High-ranking transport stations in this area cover metro (U3 stations Enkplatz and Simmering) and rapid rail transit (S80 station Simmering and S7 station Geiselbergstraße). The local public infrastructure consists of trams and buses (lines 6 and 69A alongside the Geiselbergstraße, line 71 alongside the Simmeringer Hauptstraße, line 15A alongside Grillgasse/Dommesgasse).

Footpath connections are quite good whereas there is no uninterrupted cycling infrastructure within the study area. A continous cycling connection can be found alongside the boundaries in the East and West. With only the one in the West being a seperated bikeway, the one in the East an on-street cycle path next to parked cars. This cycle path links the area to the city center but does not serve the inner development. Public bicycle parking areas are very limited. Additional mobility options such as sharing services are only partially introduced so far. Bike sharing service providers concentrate on the city center and do not cover this territory; car sharing is available almost throughout the study area depending on the service provider.

4.2 Accessibility and usage of transport modes

The findings from desk research on the transport infrastructure and spatial design are supported by the survey results.

88 % of the survey participants have a public transport stop nearby their residence (5-7 minutes walking distance). 77 % state that they have an annual ticket for public transport, which reflects their usage and is above the Viennese average of 51 % (Tomschy et al. 2016). Half of the respondents use public transportation every day (see Fig. 2). Only walking is a more prominent day-to-day mode of locomotion in this area.

The majority of the people surveyed said that they walk on their daily routes; this applies for about 60 % for both leisure trips and trips to work. These walks are often part of a longer trip that includes public transportation. Traveling to work, many walk less than 15 minutes. Longer foothpaths are not that common among the participants of the survey and are often replaced by using public transport.

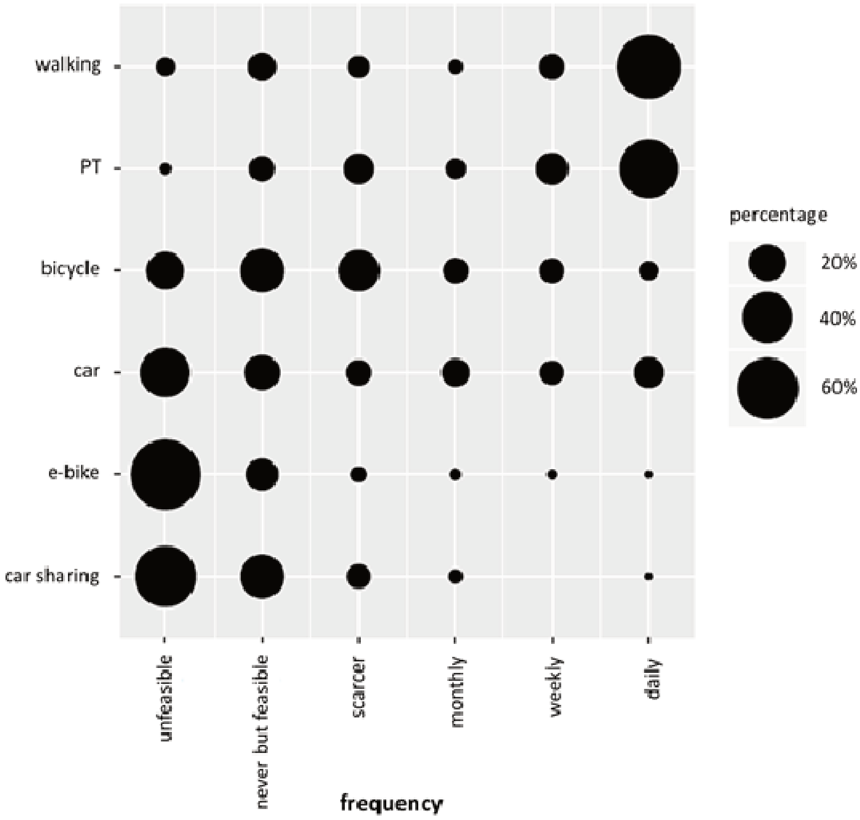

Fig. 2: Current usage of transport modes for the trip to work.

In Vienna, 47 % of the population has a driver's licence (Tomschy et al. 2016). Compared to the Viennese population, driver's licences are more widespread in the study area. 75 % have a driver's licence for a car and 19 % for a motorcycle. Even though two thirds of the survey participants have a driver's licence, only 59 % live in a household with one or more cars and 9% with one or more motorcycles or mopeds. 12 % have one car per household, 46 % have two cars and 41 % have no car at all. This means that most households are either oriented towards car or towards environmental friendly transport modes.

Owning a car is convenient in this part of Vienna. 51 % of the participants have a private parking space, 28 % have access to a public garage and 60 % can use public space for parking.

15 % of the respondents stated that they have a car sharing membership, which does not automatically equal the usage. 9 % actually use car sharing while 60 % state that they are not able to use car sharing for trips to work or leisure trips. The mobility patterns of the survey participants show that some use car sharing on a monthly basis with more frequent use on the trip to work. Those people who travel multimodal tend to use frequent car sharing offers compared to everyday drivers that are less likely to do so.

81 % of the respondents stated that they live in a household with at least one bicycle and 4 % live in a household with at least one e-bike. This result is rather good compared to an average Viennese household (Tomschy et al. 2016). Asked about the existing infrastructure on their everyday routes, 51 % indicate that they have access to cycle paths or bicycle-friendly roads. 59 % can use a storage space in their apartment building but only 21 % have a public bicycle parking space in their residential area.

Even though bike sharing is currently not available in the study area, 9 % of the respondents state that they use bike sharing. Therefore, they most likely use it in the city center that is the operation area of the Citybike provider and not in their residential area.

4.3 Concept of a mobility point

As already mentioned, the aim of the project in the field of mobility isa reduction of CO_2 emissions from fossil fuels by increasing the usage of alternative options through vehicle supply, promotion of services, awareness raising and consequently mobility behavior change. Desk research and the survey results revealed that public transport is already heavily used, but there is potential to connect it stronger to other types of transport and foster multimodal mobility lifestyles. This can be achieved by implementing a "mobility point" offering locally bundled mobility options and information.

The "mobility point" is a link for different (multimodal) mobility services and acts as a major component of ICT solutions. As it is a relatively new concept, the implementation varies from one country to another regarding offered services and information for users. Additional low emission mobility options can cover various sharing services (e-bike, cargo bike, bike, e-car, car), public transportation, taxis, bicycle storage and car parking spaces and even packaging boxes at one location or within a specific radius. The different services provided can be used via one booking platform which makes it easier and leads to greater support, service and satisfaction to the travelers and users.

The survey was performed to reveal the main aspects regarding the portfolio of services, the site selection and other criteria that have to be considered to ensure its practical use.

5 POTENTIAL OF ADDITIONAL LOW EMISSION MOBILITY OPTIONS

The current usage and attitude towards low emission mobility options have to be taken into account to provide not only the right service but also place it at the right location and design it in an appealing way. The survey revealed that cycling and sharing services are not at their best regarding publicity and as a result acceptance and should therefore be investigated in detail. The survey results offer the opportunity to capture different aspects regarding these modes of transport which are reflected in the following section.

5.1 (e-)Bike offers

Even though only a few survey participants cycle on a regular basis, 41 % of the respondents stated that they would like to cycle more often (see Fig. 3). Preferred trip purposes for cycling are doing groceries (87 %), traveling to work (41 %) and accessing the nearest public transport stop (22 %).

Whereas cycling is regarded as very attractive and many respondents feel the desire to travel more frequently by bike, the e-bike is classified as much more unattractive. Both are regarded as environmental friendly and leisure vehicles but the e-bike is perceived as the “lazy version” of a bicycle and rated as a little less independent (due to the rechargeable battery). Particularly in households with lower incomes, e-bikes are regarded as unnecessary luxury. The bicycle on the other hand is perceived as more conventional than the e-bike and hardly associated with luxury, laziness and high income.

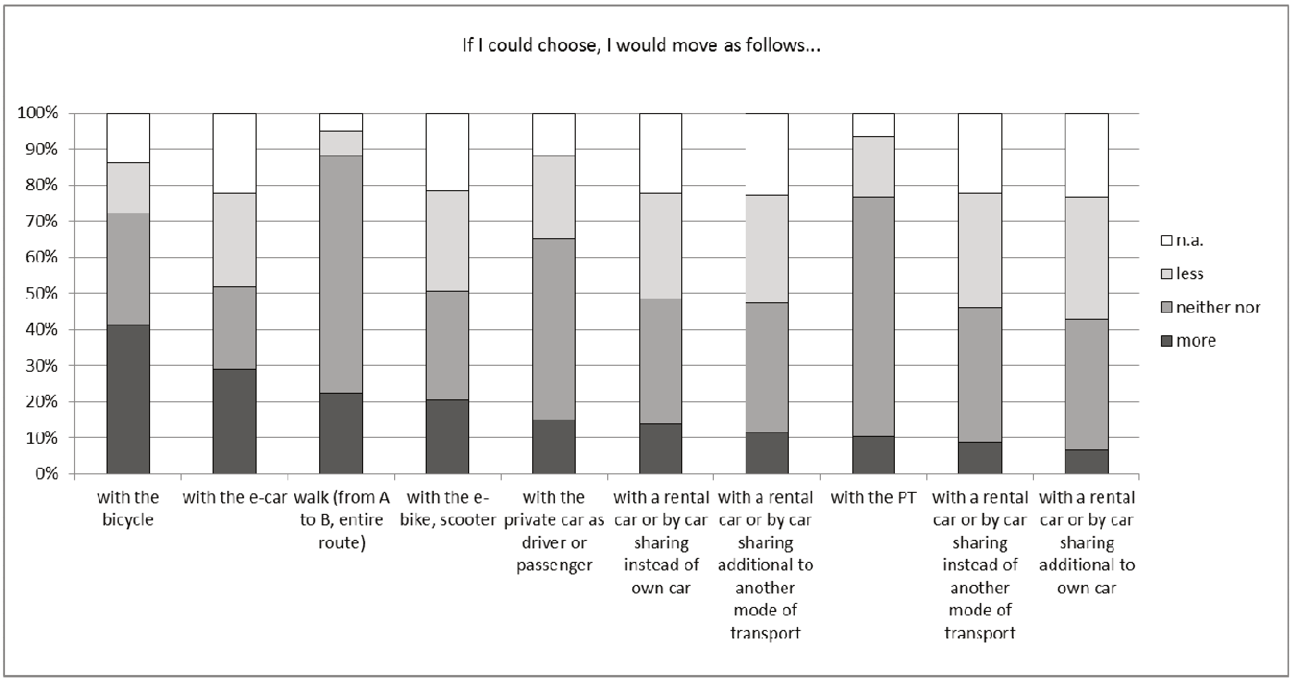

Fig. 3: Preferences for different mobility options.

The availability of private bicycles suggests that an upgrade to e-bikes is automatically associated with additional costs due to the investment needed. Interviews in a different project in Vienna called „flexiTrike“ (FFG 2017) revealed that people are not adequately informed about bike sharing options and related costs. The majority of the interviewees did not know bike sharing from the provider Citybike is free of charge for one hour. This should be taken into account interpreting the survey results. Current reservations to e-bike sharing can therefore arise from the fact that (a) it is regarded as unnecessary for those who already have a bicycle at their disposal, (b) e-bikes are associated with additional costs and (c) the study area is relatively flat and the additional drive therefore does not seem necessary at first not taking into account the transport of goods on the e-bike. The survey shows that the benefits of e-bikes are not obvious to the residents and that they tend to ignore the fact that it can be a useful means of transportation for loads or less athletic people.

While travel times of cars and public transport have no significant influence on the choice of means of transport, travel times of active modes have a negativ effect on this choice. The travel times by bike and foot are assessed as approximately the same. Overall, the evaluation of the stated preference questions shows that people would use an e-bike sharing system at a cost of 1 Euro per trip if a time saving of approximately 6 minutes can be achieved. This highlights once more the importance of the location of such a service. If a detour of several minutes has to be accepted to reach the service provider, the likelihood of this 6 minute time saving is reduced and thus the probability of the use of the bike sharing system. It is therefore all the more important to achieve an optimal positioning of the sharing service to ensure useful connections and to offer a service with additional benefit e.g. e-cargo bikes for the transport of larger goods.

5.2 (e-)Car offers

Three quarter of those surveyed have a driver’s licence but only half of them live in a household with access to a car. Although the majority of the residents could use car sharing, there are concerns regarding the concept. Asked about their preferences, 14 % would like to use car sharing more often instead of their own car. 11 % would like to use it on a regular basis in addition to other modes of transport. Therefore, their current use and preferences towards (e-)car sharing show that many people do not regard it as a desirable form of mobility which they intent to use in the future (see Fig. 3).

There are several reasons why (e-)car sharing is perceived that way: (a) little experience with car sharing which therefore cannot be assessed, (b) no need for several cars per household, (c) access or availability is currently difficult, (d) advantages are not known and inhabitants are thus not sufficiently informed.

By means of stated preference questions it could also be found that the travel time with e-car sharing has no significant influence on the choice as transport mode. The choice is heavily linked to the cost of public transport and walking distance as the alternative. Taking into account rather short foothpaths to public transport stops and the significant cost savings using public transport, attractive e-car sharing depends on a good distribution of the vehicles within the area. Car sharing or e-car sharing is especially interesting in areas which are not well-connected to the public transport network or for journeys that lead into such an area.

6 CHALLENGES AND OPPORTUNITIES IN THE IMPLEMENTATION

Apart from the potential described, the implementation of different mobility options involves challenges and opportunities on the matter of reaching the target groups through additional services. Important aspects from the view of the users of different modes of transport are pointed out to raise awareness for prerequisites of mobility behavior change.

6.1 Car users

Currently, a car is available in about every second household in the study area. Households with two cars are extremely heavily represented, which means that high dependency in everyday life can be attested. Due to the high car-affinity of these people, other transportation options are hardly considered by them, especially since parking space is not a scarce good in the study area. Interventions targeting the travel to work show therefore only limited potential. Leisure and other paths are far more promising and could have potential for minor behavioral changes.

In general, it appears difficult to persuade this group to use the car less often without a corresponding image change in the area. The unlimited parking space does support car usage and there are hardly any reasons not to use the car besides environmental and financial aspects. In this respect, people with lower incomes may be easier to win over by cost-effective alternatives; additionally, arguments like higher efficiency or shorter travel times can have some potential to encourage this target group to use alterntives for specific trips.

6.2 Public transport users

The well-elaborated public transport in the study area can be regarded as hindering in terms of the introduction of additional low emission mobility options. The only notable weakness is the tram connection from East to West which is overcrowded during rush hour and can not be replaced or increased easily. Walking is rather unattractive along the main road (connection Hauffgasse to Enkplatz). The attractive bicycle infrastructure along the road „Am Kanal“ is not connected to high-ranking transport stations in a convenient way. Although the distance would be quite appealing, in particular anxious people and persons with children hardly use bicycle lanes next to busy streets and would need structurally separated bicycle paths. The highly-frequented tram line however provides the opportunity to introduce additonal low emission mobility options successfully if these conditions are taken into account.

Apart from that, cycling is already regarded as acceptable mode of transport and can increase its attractiveness by providing bicycle parking spaces at transport stations.

6.3 Motorcycle/moped users

Due to the low degree of penetration in the study area, motorcycle/moped drivers are a small group. Among the households with access to this type of transport there are mainly households with two motorcycles/mopeds which suggests use in the leisure time. Driving experience and speed are therefore essential usage criteria and environmental friendly alternatives can hardly compete.

6.4 Pedestrians

Both the current mobility behavior and the attitudes towards footpaths show that the majority of the inhabitants regard walking as essential part of their mobility. The situation for pedestrians could be improved by providing additional options like bike sharing for longer distances. This allows for time saving as well as a more convenient transport of goods. E-bike sharing can contribute to their quality of life as long as the offer is adequate in terms of availability, accessibility and related costs.

6.5 Cyclists

Those already using the bicycles want to maintain or expand this mobility pattern. The equipment of the households with conventional bikes does not encourage e-bike usage. E-bike sharing could be interesting for those people as long as unconventional and practical designs are available for rental.

7 CONCLUSION AND OUTLOOK

Achieving CO_2 savings in a well-connected area in terms of public and privat transport is challenging. As habitants usually do not have to deal with major shortages or inconveniences on their day-to-day journeys and leisure trips, they are hardly required to alter their mobility behavior. The only way to encourage behavior change is the provision of attractive options that bring an absolute added value. The survey results show that a successful introduction of additional low emission mobility options strongly depends on the characteristics of the offer itself and how well the implementation addresses requirements for performance, minor shortages in the current infrastructure as well as the spatial conditions.

The results of the exploration of mobility habits and attitudes show that the limited openness towards transport alternatives is partly also related to the scarce information and experiences the habitants have regarding several transport options, especially e-vehicles and sharing services. For boosting the potenetial for behaviour changes, it is therefore reasonable to install infrastructures providing both information and low-level access to try out and test unfamiliar mobility alternatives for the local population. These insights were used for the conceptualisation of mobility points in the study area.

Based on the collected information from the survey, the technical features and site of the envisaged mobility point have been fixed. The approval is still pending and therefore the information on the services provided has not yet been officially disclosed to the public. The mobility point is about to be constructed on the centroid next to the Geiselbergstraße, a rapid rail transit station in the center of the area. The success of the introduction of additional low emission mobility options is to be evaluated in a second and third survey in the study area after two and three years, respectively.

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9 REFERENCES

BINSWANGER, M.: Technological progress and sustainable development: what about the rebound effect? In: Ecological Economics, Vol. 36, Issue 1, pp. 119-132. 2001.

BUHL, J., Acosta, J.: Indirect Rebound effects from resource sufficiency behaviour in Germany. In: T. Santarius et al. (Ed.): How to improve energy- and climate policies? Understanding the role of rebound effects. Springer. Wiesbaden, 2016.

DANGSCHAT, J.S. 2013: Eine raumbezogene Handlungstheorie zur Erklärung und zum Verstehen von Mobilitätsdifferenzen. In: Scheiner et al. (Ed.): Mobilitäten und Immobilitäten. Dortmunder Beiträge zur Raumplanung. Klartext Verlag: pp. 91-104. Essen, 2013.

DANGSCHAT, J.S.: Wie bewegen sich die (Im-)Mobilen? Ein Beitrag zur Weiterentwicklung der Mobilitätsgenese. In: M. Wilde et al. (Ed.): Verkehr und Mobilität zwischen Alltagspraxis und Planungstheorie – ökologische und soziale Perspektiven. Springer. Wiesbaden, 2016.

EUROPEAN COMMISSION: Europe 2020 targets. Brussels, 2015. URL: http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/targets/index_en.htm, access 16/05/2017.

EUROPEAN ENVIRONMENT AGENCY: Greenhouse gas emissions from transport. Brussels, 2016. URL. https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-6, access 16/05/2017.

FFG: flexiTrike. Flexibel einsetzbares Maßnahmenpaket für (Wieder-)Einsteigerinnen und (Wieder-)Einsteiger im Radverkehr. Vienna, 2017. URL: https://www2.ffg.at/verkehr/projekte.php?id=1258&lang=de&browse=programm, access 20/05/2017.

FIETKAU, H.-J., Kessel, H.: Umweltlernen: Veränderungsmöglichkeiten des Umweltbewußtseins. Modelle – Erfahrungen. Schriften des Wissenschaftszentrums Berlin, Vol. 18, Issue 1. Hain. Königstein/Ts., 1981.

FISCHER, C., Grießhammer, R.: Working Paper. Mehr als nur Suffizienz: Begriff, Begründung und Potenziale. Öko-Institut e.V. Freiburg, 2013.

HUNECKE, M.: Mobilitätsverhalten verstehen und verändern. Psychologische Beiträge zur inter-disziplinären Mobilitätsforschung. Springer. Wiesbaden, 2015.

LINZ, M.: Weder Mangel noch Übermaß. Über Suffizienz und Suffizienzforschung. Wuppertal Papers 145. Wuppertal Institut für Klima, Umwelt, Energie GmbH. Wuppertal, 2004.

RISSER, R., Chaloupka-Risser, C.: Motive und Kriterien. In: C. Chaloupka-Risser et al. (Ed.): Verkehrspsychologie – Grundlagen und Anwendungen: pp. 82-103. facultas.wuv Universitätsverlag. Vienna, 2011.

ROTH, G.: Fühlen, Denken, Handeln: Wie das Gehirn unser Verhalten steuert. Auflage: Neue, vollständig überarbeitete Auflage. Suhrkamp Verlag. Frankfurt am Main, 2003.

SCHEINER, J.: Sozialer Wandel, Raum und Mobilität. Empirische Untersuchungen zur Subjektivierung der Verkehrsnachfrage. VS – Verlag für Sozialwissenschaften. Wiesbaden, 2009.

SCHLAFFER, A., Hunecke, M., Dittrich-Wesbuer, A., Feudenau, H.: Bedeutung psychologischer und sozialer Einflussfaktoren für eine nachhaltige Verkehrsentwicklung. In: Umweltforschungsplan des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit. Forschungsbericht 200 96 132 / 03 UBA-FB 000297. Berlin, 2002.

TOMSCHY, R., Herry, M., Sammer, G., Klementschitz, R., Riegler, S., Follmer, R., Gruschwitz, D., Josef, F., Gensasz, S, Kirnbauer, R., Spiegel, T.: Österreich unterwegs 2013/2014. Ergebnisbericht zur österreichweiten Mobilitätserhebung „Österreich unterwegs 2013/2014“. Bundesministerium für Verkehr, Innovation und Technologie (Ed.). Vienna, 2016.

WILDE, M.: Mobilität als soziale Praxis: ein handlungstheoretischer Blick auf Bewegung. In: Scheiner et al. (Ed.): Mobilitäten und Immobilitäten. Dortmunder Beiträge zur Raumplanung. Klartext Verlag: pp. 35-48. Essen, 2013.

reviewed paper

Kombiniertes Carsharing und Ridesharing: eine gemeinschaftsbasierte Mobilitätslösung für den ländlichen Raum?

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1 ABSTRACT

Mobil sein in ländlichen Regionen ist für Personen ohne Fahrberechtigung oft schwierig da alternative Mobilitätsangebote fehlen. Eine Alternative können gemeinschaftlich organisierte Mobilitätsangebote wie Ridesharing und Mitfahrdienste bieten. Lokale und gemeinschaftlich orientierte Carsharing-Gruppen sind ein interessanter Ausgangspunkt für deren Etablierung.

Wie groß ist das durch die Verknüpfung von Carsharing und Ridesharing entstehende Potenzial? Mittels quantitativer Befragung unter Mitgliedern gemeinschaftlich organisierter Carsharing-Gruppen konnten Erkenntnisse dazu gewonnen werden. Zentrale Befragungsinhalte sind sind neben der Bereitschaft zum Ridesharing auch Einstellungen gegenüber Umwelt und Mobilität sowie Motive für die Carsharing-Nutzung.

Die Ergebnisse zeigen, dass Zusammenhänge zwischen Carsharing-Nutzungsmotiven sowie Umwelt- und Mobilitätseinstellungen und der Bereitschaft Mitfahrgelegenheiten anzubieten bzw. in Anspruch zu nehmen bestehen. Zudem werden Gründe für die Ablehung der Partizipation an Mitfahr- und Mitnehm-Angeboten beschrieben. Abschließend wird auf Basis der Ergebnisse das Potenzial zur Verknüpfung von Carsharing und Ridesharing im ländlichen Raum diskutiert und weiterer Forschungsbedarf erörtert.

Keywords: Mobilität, ländlicher Raum, Ridesharing, Carsharing, Smart City

2 AUSGANGSLAGE: MOBILITÄT IM LÄNDLICHEN RAUM

2.1 Herausforderungen

Mobilität im ländlichen Raum stellt ohne eigenen Pkw vielerorts eine große Herausforderung dar. Dies ist primär auf die geringe Bevölkerungsdichte zurückzuführen, die in einer niedrigen Nachfragedichte resultiert und folgende Konsequenzen nach sich zieht:

- Die geringe Nachfrage rechtfertigt nicht die Kosten für ein hochqualitatives ÖV-Angebot. Deshalb besteht in vielen Regionen lediglich ein Grundangebot, das nicht selten stark an Schüler- und Schülerverkehren orientiert ist. Die Mobilitätsbedürfnisse hinsichtlich räumlicher Abdeckung und zeitlicher Flexibilität kann dieses Angebot kaum befriedigen (vgl. Canzler und Knie 2009, Kagermeier 2004). Zudem sind räumliche Strukturen am motorisierten Individualverkehr orientiert, was sich ebenfalls negativ auf die ÖV-Nachfrage auswirkt.
- Die Dichte an Versorgungseinrichtungen ist aufgrund der geringen Nachfrage niedriger. Gemeinsam mit dispersen Siedlungsstrukturen führt dies dazu, dass durchschnittlich längere Wege zurückgelegt werden müssen, um Gelegenheiten zu erreichen. Dies reduziert die Zahl der nicht-motorisiert erreichbaren Ziele (vgl. Perschl und Posch 2016). Ca. 50% der österreichischen Bevölkerung des ländlichen Raums leben in Gebieten, in denen die Leistungserbringung der Daseinsvorsorge gefährdet ist (vgl. Rosinak&Partner 2005).

Die Problematik der Immobilität ohne eigenen Pkw betrifft insbesondere Personengruppen, die aus verschiedensten Gründen nicht über einen eigenen Pkw verfügen bzw. nicht in der Lage sind, diesen selbständig zu steuern (z.B. ältere Menschen, Kinder und Jugendliche). Folglich sind diese Personen entweder auf Hol- und Bringdienste anderer angewiesen oder müssen teils lange Wartezeiten für die Nutzung des ÖV in Kauf nehmen. Neben der organisatorischen Belastung sehen sich viele Haushalte mit hohen Mobilitätsausgaben konfrontiert, da sie sich zur Anschaffung mehrere Fahrzeuge gezwungen sehen (vgl. Herget 2016).

2.2 Sharing als Lösung?

Neben flexiblen Bedienformen im ÖV stellt auch Sharing in verschiedenen Ausprägungen eine Möglichkeit der Mobilitätssicherung in ländlichen Räumen dar. Obwohl kommerzielle Anbieter ihre Aktivitäten auf Ballungsräume fokussieren, finden sich in vielen ländlichen Gemeinden gemeinschaftliche Carsharing-Angebote. Diese Initiativen sind häufig in mehr oder minder geschlossenen Gruppen organisiert (vgl. Gugg 2015, Shibayama et. al. 2013, Meaton und Low 2003). Neben rein privaten Initiativen finden sich auch Beispiele, in denen die Initiative von Gemeinden (Politikerinnen und Politiker oder Verwaltungsmitarbeiterinnen oder Verwaltungsmitarbeiter) ausgeht. Carsharing ist jedoch nur in der Lage einen Teil der mobilitätsbezogenen Herausforderungen im ländlichen Raum zu adressieren. Um die Mobilitätschancen für Personen ohne Fahrerlaubnis zu verbessern, reicht Carsharing für sich genommen nicht aus. Erst durch Kombination mit Ridesharing-Diensten kann auch die Mobilität dieser Personen erleichtert werden.

Im Gegensatz zu Carsharing sind Ridesharing-Initiativen für spontane Wege im ländlichen Raum weitaus seltener. Aktuelle Projekte fungieren primär als Ergänzung zum ÖV, wie die folgenden beispielhaft angeführten Vorhaben unterstreichen:

- Das Projekt „Mobilfalt“ ergänzt das ÖV-Angebot in drei Pilotregionen in Nordhessen (D) durch Ridesharing, wodurch Fahrten im Stundentakt in den Projektgemeinden sowie zu nahegelegenen Bahnhaltestellen ermöglicht werden. Um eine hohe Zuverlässigkeit zu gewährleisten, übernimmt der Nordhessische Verkehrsverbund (NVV) die Fahrt mittels Taxi, Mietwagen oder Bürgerbus, falls kein Fahrt-Anbieter zur Verfügung steht (vgl. Nordhessischer Verkehrsverbund 2015, Sommer und Schmitt 2013).
- Beim „Mitfahrnetzwerk Schwarzwald-Baar-Kreis“ (D) kooperiert die private Fahrtenvermittlungsplattform flinc mit dem ÖV-Betreiber SüdbadenBus GmbH. Um Synergien zwischen ÖV-Angebot und privater Fahrtenvermittlung zu schaffen, wird eine technische Integration der elektronischen Fahrplanauskunft mit der Online-Ridesharing Plattform geschaffen, wodurch Nutzerinnen und Nutzer auf einen Blick sowohl das ÖV-Angebot als auch Mitfahrgelegenheiten sehen (vgl. SüdbadenBus GmbH 2015).

3 CARSHARING UND RIDESHARING VERKNÜPFEN

Das Ziel die Mobilitätschancen in ländlichen Räumen mittels Verknüpfung von Carsharing und Ridesharing zu verbessern wird gegenwärtig im Projekt MICHAEL (MIkro-ÖV und CarsHAring ELegant verknüpfen) verfolgt. Das vom Bundesministerium für Verkehr, Innovation und Technologie im Rahmen des Programms „Mobilität der Zukunft“ geförderte Projekt Vorhaben integriert Carshring und Ridesharing zu einem neuen Mobilitätsangebot. Basierend auf bestehenden Carsharing-Gemeinschaften soll das Mitnehmen von anderen Personen unterstützt und als soziale Praxis etabliert werden (vgl. Rückert-John et. al. 2013). Neben Ridesharing auf ohnehin stattfindenden Fahrten mit dem Carsharing-Fahrzeug ist auch das Anbieten von nicht-gewerblichen Fahrtdiensten im Rahmen der Nachbarschaftshilfe angedacht. So kann auf gemeinschaftlicher Ebene ein neuartiges, selbstorganisiertes Mobilitätsangebot entstehen.

Um diese Integration von Carsharing und Ridesharing voranzutreiben und einen neuartiges, selbstorganisiertes Mobilitätsservice zu schaffen, bedarf es einer sozialen und organisatorischen Innovation sowie einer technische Integration. Im Mittelpunkt der Implementierung steht die Schaffung von Voraussetzungen, damit die folgenden Synergien gezielt genutzt werden können:

- Ressource Auto: Das gemeinsame Auto wird sowohl für Carsharing als auch Ridesharing genutzt, wodurch die Auslastung weiter gesteigert wird.
- Ressource Fahrerin oder Fahrer: Die Fahrerverfügbarkeit ist v. a. für Personen relevant, denen ohne Fahrerin oder Fahrer die Benutzung des Carsharing-Systems nicht möglich wäre.
- Ressource Fahrt: Durch das Teilen von Fahrten wird das Verkehrsaufkommen bei gleichbleibender Mobilität reduziert und somit Energie gespart und die Umwelt geschont.

Die Rolle des Projektteams liegt primär in der Unterstützung von sozialer Innovation zur Etablierung neuer Mobilitätsroutinen und in der Bereitstellung unterstützender (technologischer) Tools (s. Abbildung 1). Dazu werden unterschiedliche Gruppen von Nutzerinnen und Nutzern identifiziert und deren Bedürfnisse analysiert und eingeordnet. Darauf aufbauend werden gemeinsam mit den beteiligten Nutzerinnen und Nutzern aus den Projektgemeinden Seekirchen am Wallersee (Salzburg) und Gaubitsch (Niederösterreich) Ideen für den Prozess der Fahrtenvereinbarung sowie für unterstützende (technologische) Lösungen zu Fahrtenmatching und Kommunikation erarbeitet. Diese pilothaft entwickelten Lösungen werden anschließend in den Projektgemeinden getestet und daraus Schlüsse zur sozialen Innovation gezogen.

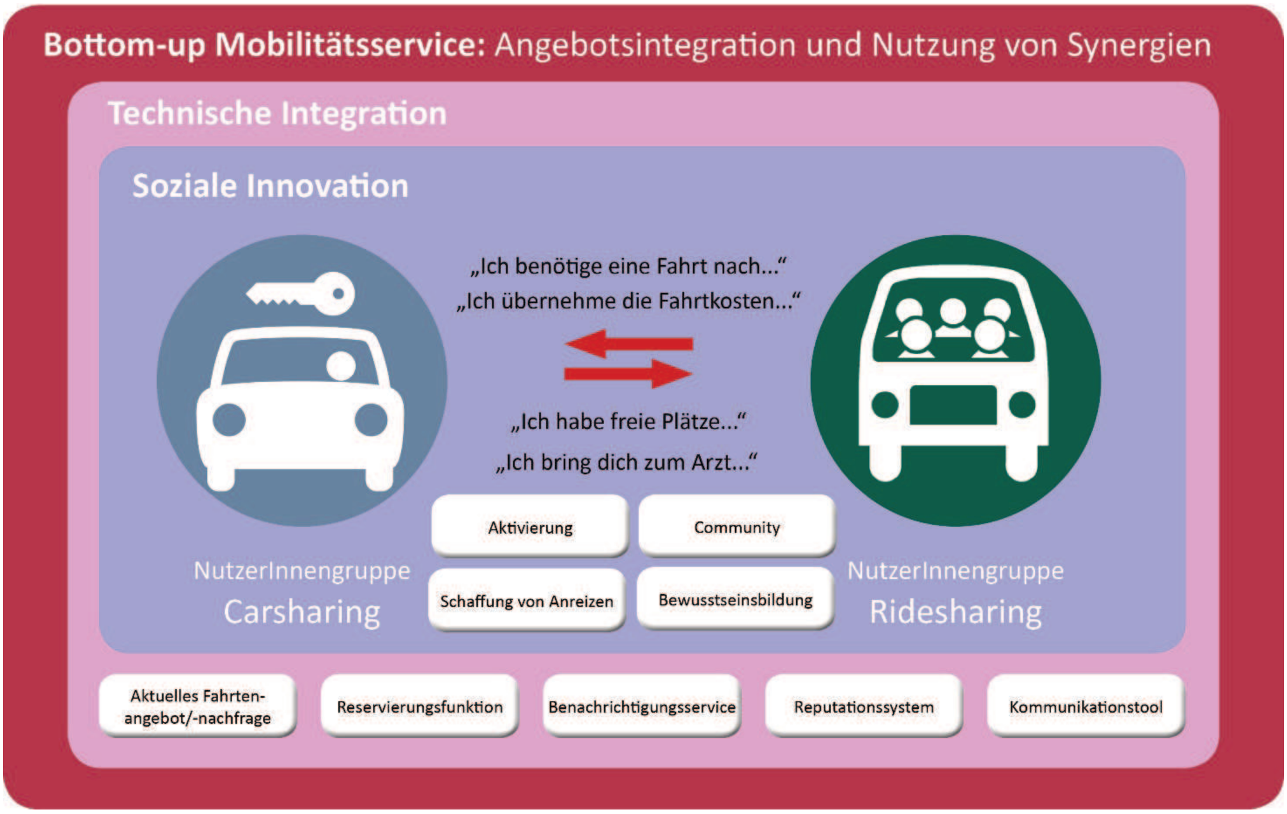

Abbildung 1: Skizzierung des Projekts MICHAEL

4 VORGANGSWEISE UND METHODIK

Um abzuschätzen, ob und unter welchen Bedingungen Carsharing-Nutzerinnen- und Carsharing-Nutzer bereit sind, Fahrten zu teilen, und für welche Personengruppen dies überhaupt in Frage kommt, wurde im Zuge der Analyse ein Multi-Methoden Zugang gewählt. Neben Nutzerinnen- und Nutzer-Workshops in den Projektgemeinden und einer Grobabschätzung von Zielgruppen die auf Daten der Mobilitätsbefragung „Österreich unterwegs" fußt (vgl. BMVIT 2016), wurde auch eine Online-Befragung durchgeführt, deren Ergebnisse anschließend präsentiert werden.

Zweck der Befragung war es, ein Bild über die Einstellungen von Carsharing-Nutzerinnen und Carsharing-Nutzern in Österreich in Bezug auf Ridesharing zu erlangen. Zudem wurden Aspekte der Fahrtvereinbahrung und -durchführung und deren Bedeutung aus Sicht der Nutzerinnen und Nutzer abgefragt. Der Fragebogen wurde mittels Online-Tool umgesetzt und über mehrere Kanäle von Caruso Carsharing verbreitet. Diese Kanäle umfassten einen E-Mail Newsletter, direktes Anschreiben von Gruppenleiterinnen und Gruppenleitern lokaler Carsharing per E-Mail mit Bitte um Weiterleitung an Gruppenmitglieder, Einträge auf der Facebook-Seite sowie ein Hinweis auf der Website von Caruso. Neben personen- und haushaltsbezogenen Merkmalen gab es folgende zentralen Befragungsinhalte: Carsharing-Nutzungsverhalten, Einstellungen gegenüber Ridesharing sowie, falls zutreffend, welche Gründe aus Sicht der Befragten gegen das Teilen von Fahrten sprechen.

Für die Abfrage von Motiven der Nutzung von Carsharing sowie der Umwelt- und Mobilitätseinstellungen wurden Items verwendet und mit fünf- bzw. sechsstufigen Likert-Skalen kombiniert. Die Items zu den Umwelteinstellungen wurden von der Umweltbefragung des International Social Survey Programme entnommen (vgl. ISSP 2010), während die Items zu den Mobilitätseinstellungen an Schreier et. al. (2015) angelehnt sind. Um die Carsharing-Motive abzufragen, wurden Items entwickelt, die stellvertretend für die Motive Komfort und Flexibilität, Kosten, soziale Norm, persönliche Umweltnorm sowie Symbolik stehen.

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Die Auswertung der Daten erfolgt über deskriptive Statistiken (Häufigkeiten, Mittelwerte) und Korrelationsanalysen. Die deskriptiven Statistiken werden, wenn entsprechende Daten vorhanden, in Relation zu Erkenntnissen aus der Mobilitätserhebung „Österreich unterwegs" gesetzt. Einstellungen zu Umwelt und Mobilität sowie Carsharing-Motive wurden mittels Likert-Skalen abgefragt, weshalb die Daten nominal skaliert sind. Die Stärke von Zusammenhängen und deren Relevanz wurden deshalb mittels Rangkolleration nach Spearman analysiert.

5 ERGEBNISSE

5.1 Befragungsteilnehmerinnen und Befragungsteilnehmer

Die Online-Befragung wurde von 278 Personen ausgefüllt, wovon 164 Nutzerinnen und Nutzer in gemeinschaftlich organisiertes Carsharing nutzen, das in lokalen Gruppen, vertreten durch eine Gruppenleiterin oder einen Gruppenleiter, organisiert ist. Da die Größe der einzelnen Gruppen und somit auch die Grundgesamtheit der gemeinschaftlichen Carsharing-Nutzerinnen und Carsharing-Nutzer, die Caruso als Buchungsplattform verwenden, nicht bekannt ist, kann keine Rücklaufquote berechnet werden. Im Zuge der weiteren Auswertung kann deshalb auch keine Einschätzung darüber getroffen werden, ob die Verteilungen über personen- und haushaltsbezogene Merkmale hinweg, die Grundgesamtheit der Mitglieder widerspiegeln. Wie die bisherige Literatur zu Mobilitätssharing zeigt, weichen die Carsharing-Nutzerinnen und Carsharing-Nutzer von der Grundgesamtheit der Gesamtbevölkerung insofern ab, als dass Männer und höher Gebildete stark überrepräsentiert sind (vgl. Riegler et. al. 2016, Schuster et. al. 2015, Loose 2010). Aus diesem Grund wäre ein Abgleich der Merkmalshäufigkeiten der Befragungsteilnehmerinnen und Befragungsteilnehmer mit jenen der Gesamtbevölkerung ebenfalls nicht sinnvoll.

Mit 68,6% überwiegen die männlichen Teilnehmer an der Befragung, Teilnehmerinnen machen lediglich 31,4% der Befragten aus. Der jüngste Teilnehmer wurde 1997 geboren, der Älteste 1936; der Median liegt im Geburtsjahr 1969 – ein Blick in das Histogramm zeigt, dass insbesondere die Jahrgänge von 1965 bis 1975 stark vertreten sind. Der formale Bildungsgrad unter den Befragten ist sehr hoch: 71,8% verfügen über eine Matura und 45,9% über einen (Fach-)Hochschulabschluss. Insofern decken sich diese Ergebnisse mit den Erkenntnissen aus anderen Studien zum Thema Carsharing, dass männliche und höher gebildete Personen überproportional viele Nutzer stellen. 63,1% der Teilnehmerinnen und Teilnehmer sind unselbständig Beschäftigte, weitere 20,1% selbständig beschäftigt, 13,1% der Nutzerinnen und Nutzer sind Pensionistinnen und Pensionisten. Bei der Einkommensverteilung zeigt sich, dass die beiden unteren Quintile mit 7,1% (erstes Quintil) und 8,8% (zweites) stark unterrepräsentiert sind während das dritte (21,7%) und vierte (22,1%) in etwa der Gesamtbevölkerung entsprechen. Das höchste Einkommensquintil ist mit 40,3% stark überrepräsentiert.

Die am stärksten genutzte Organisationsform unter den Befragten ist Carsharing über eine lokale Gruppe mit 164 Personen. 63 geben an das E-Carsharing Netz in Vorarlberg zu nutzen, während 53 angeben (auch) auf Carsharing anderer Anbieter zurückzugreifen. Da man mehrere Angebote gleichzeitig nutzen kann, waren bei dieser Frage Mehrfachantworten möglich. Zehn Personen gaben an, nicht zu wissen, welche der angegebenen Carsharing-Formen sie nutzen. Die nachfolgende Auswertung basiert auf den Daten der Nutzerinnen und Nutzer von gemeinschaftlich organisiertem Carsharing.

5.2 Mobilitätsausstattung Haushalt

Im folgenden Abschnitt wird der Frage nachgegangen, ob ein Zusammenhang zwischen der Mobilitätsausstattung eines Haushalts und der Nutzung von Carsharing besteht. Dazu werden die Indikatoren Fahrzeuganzahl, Anzahl von ÖV-Zeit- und Ermäßigungskarten sowie die Gehdistanz vom Wohnort zur nächsten ÖV-Haltestelle aus der Befragung mit Daten der österreichweiten Mobilitätserhebung Österreich unterwegs (ÖU) verglichen. Die Daten wurden dazu auf die Stadt-Land-Typologie der Statistik Austria heruntergebrochen, um räumliche Unterschiede zu identifizieren. Die Stadtregionen umfassen die größeren Ballungsräume in Österreichs, während Regionale Zentren Klein- und Mittelstädte abseits der Agglomerationen sind. Zudem werden ländliche Räume danach unterschieden, ob sie im Einzugsbereich einer Stadtregion liegen oder nicht (vgl. Statistik Austria 2016).

Raumtyp	Durschn. Anzahl Pkw			Durschn. Anzahl Fahrräder		
Stichprobe	ÖU – Haushalte o. Carsharing	ÖU – Haushalte m. Carsharing	Befragung – gemeinschaftl. Carsharing	ÖU – Haushalte o. Carsharing	ÖU – Haushalte m. Carsharing	Befragung – gemeinschaftl. Carsharing
Stadtregionen	1,27	0,96	0,69	2,09	2,40	3,69
Regionale Zentren*	1,55	1,75	1,00	2,47	3,00	3,38
Ländl. Raum im Umland von Zentren	1,72	1,27	1,34	2,45	2,91	3,17
Ländlicher Raum	1,75	1,53	1,72	2,48	2,47	3,32
Gesamtergebnis	**1,52**	**1,04**	**1,07**	**2,30**	**2,47**	**3,46**

Tabelle 1: Mobilitätsausstattung der der Haushalte – Individualverkehr
* geringe Aussagekraft aufgrund niedriger Fallzahl

Tabelle 1 zeigt deutlich, dass gemeinschaftliches Carsharing hinsichtlich des Fahrzeugbesitzes in Haushalten ähnliche Wirkungen, wie auch andere Carsharing-Formen hat: Die Ausstattung mit Pkws ist im Durchschnitt geringer, wobei diese Wirkung schwächer wird je peripherer die Wohngemeinde liegt. Haushalte mit Carsharing-Nutzerinnen und Carsharing-Nutzer können auf eine größere Anzahl von Fahrrädern zurückgreifen wobei auffallend ist, dass Haushalte mit Nutzerinnen und Nutzer von gemeinschaftlichem Carsharing über mehr Fahrräder verfügen als dies österreichweit bei Nutzerinnen und Nutzern anderer Carsharing-Formen der Fall ist. Die Unterschiede sind nur bedingt auf größere Haushaltsgrößen bzw. mehr Kinder und Jugendliche im Haushalt zurückzuführen (CS nach ÖU: Durchschn.: 2,47 Pers./HH, davon 0,41 unter 18; gemeinschaftliches CS: 2,70 Pers./HH, davon 0,59 unter 18).

Raumtyp	Anteil Personen mit Zeitkarten			Anteil Personen mit Ermäßigungskarten			Gehdistanz zur nächsten ÖV-Haltestelle in Minuten		
Stichprobe	ÖU – HH ohne Carsh.	ÖU - HH m. Carsh.	Befr.-Gem. Carsh.	ÖU – HH ohne Carsh.	ÖU - HH m. Carsh.	Befr.-Gem. Carsh.	ÖU – HH ohne Carsh.	ÖU - HH m. Carsh.	Befr.-Gem. Carsh.
Stadtregionen	35,89%	63,92%	57,44%	23,06%	27,02%	57,67%	5,5	3,9	5,3
Regionale Zentren*	16,92%	0,00%	19,23%	16,62%	0,00%	53,21%	8,2	3,3	7,6
Ländl. Raum im Umland von Zentren	13,19%	35,79%	38,69%	16,54%	32,63%	41,01%	10,2	7,5	6,4
Ländlicher Raum	12,69%	29,27%	28,59%	15,67%	21,95%	45,40%	9,7	7,5	6,5
Gesamtergebnis	**22,64%**	**57,79%**	**47,03%**	**19,10%**	**27,16%**	**51,85%**	**8,2**	**4,5**	**5,8**

Tabelle 2: Mobilitätsausstattung der Haushalte - Öffentlicher Verkehr
* geringe Aussagekraft aufgrund niedriger Fallzahl

Im Vergleich zur Gesamtbevölkerung verfügt unter Carsharing-Nutzerinnen und Carsharing-Nutzern ein höherer Anteil von Personen über Zeit- bzw. Ermäßigungskarten für den Öffentlichen Verkehr. Zudem scheint ein Zusammenhang zwischen Gehdistanz zur nächsten ÖV-Haltestelle und Carsharing-Nutzung zu bestehen. Die durchschnittliche Gehdistanz zur nächstgelegenen Haltestelle ist unter Carsharing-Nutzerinnen und Carsharing-Nutzern deutlich geringer. In lokalen Gruppen organisierte Carsharing-Nutzerinnen und Carsharing-Nutzer tendieren zudem eher zum Kauf von ÖV-Ermäßigungskarten, während unter Carsharing-Nutzerinnen und Carsharing-Nutzern generell Zeitkarten weiter verbreitet sind.

5.3 Carsharing-Nutzungshäufigkeit

Die Verteilung der Carsharing Nutzung zeigt deutlich, dass Carsharing von den meisten Nutzerinnen und Nutzern gelegentlich genutzt wird. Mittels Spearman-Rangkorrelation konnte dabei ein signifikanter Zusammenhang zwischen der Häufigkeit der Carsharing-Nutzung und der individuellen Pkw-Verfügbarkeit festgestellt werden (Korrelationskoeffizient -0,165, p 0,36, N=161): Personen, die nur gelegentlich oder nie über ein Privat- oder Firmenfahrzeug verfügen können, nutzen Carsharing häufiger.

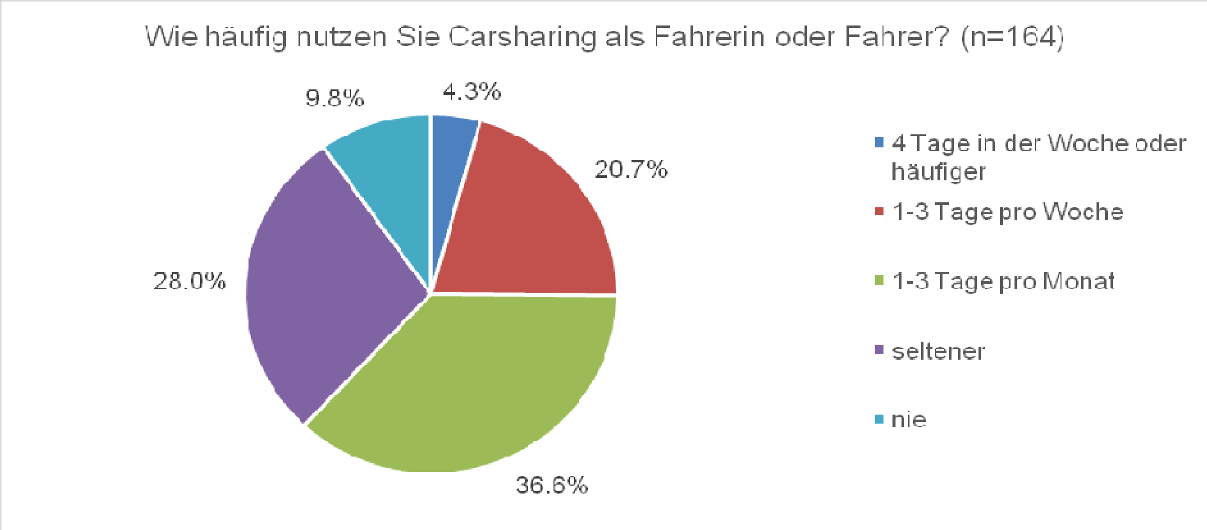

Abbildung 2: Verteilung der Carsharing-Nutzungshäufigkeit

5.4 Ridesharing

Im Mittelpunkt der Befragung steht die Bereitschaft der Carsharing-Nutzerinnen und Carsharing-Nutzer zum Mitnehmen und Mitfahren bei anderen Privatpersonen. Auf einer siebenstufigen Likert-Skala wurden die Teilnehmerinnen und Teilnehmer gebeten, ihre Haltung zum Ridesharing anzugeben. Die Befragten nehmen einerseits stark die neutrale Mittelposition ein (26,8% Mitnehmen, 31,1% Mitfahren), andererseits gibt es in schwächerer Form auch eine Tendenz zu den Extrempositionen. Darunter sind Personen, welche bereit sind selbst Fahrten zu teilen, stärker vertreten als solche, die sich nicht vorstellen können zu partizipieren.

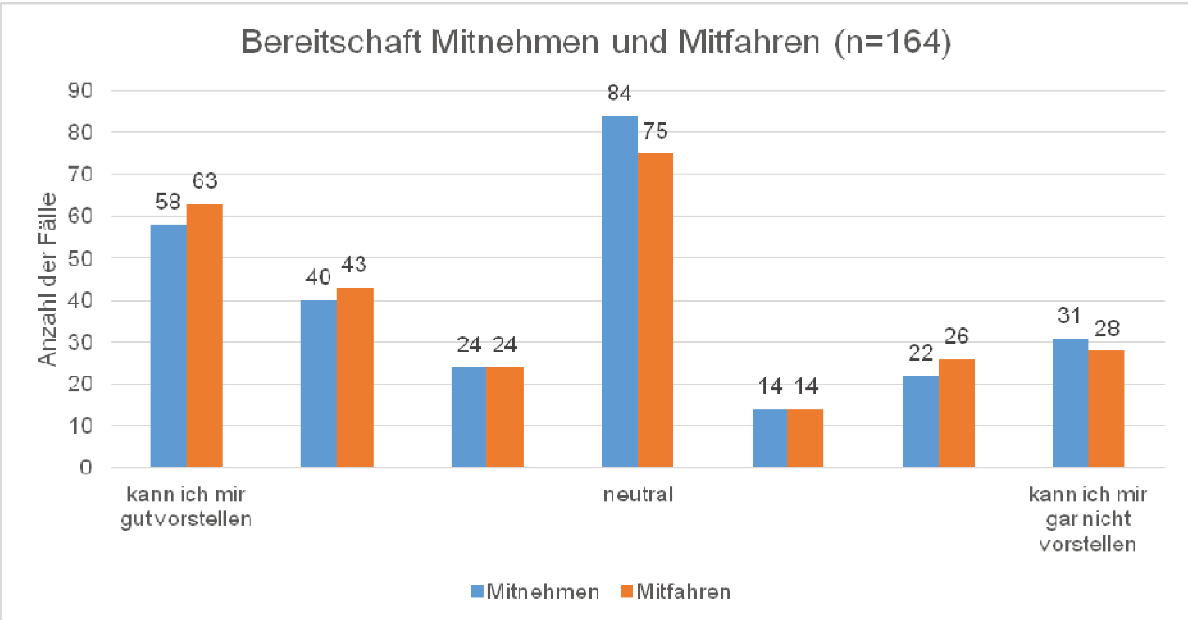

Abbildung 3: Häufigkeitsverteilung nach Bereitschaft zum Mitnehmen und Mitfahren

Die Korrelationsanalyse (Spearman) zeigt, dass ein starker und hochsignifikanter Zusammenhang zwischen der Bereitschaft zum Mitnehmen und der Bereitschaft zum Mitfahren besteht (Korrelationskoeffizient 0,700; p=0,000; N=164). Personen, die dem Mitnehmen anderer Personen gegenüberstehen sind also auch eher bereit bei anderen Personen mitzufahren. Interessant wäre bei künftigen Befragungen eine geradzahlige Likert-Skala zu verwenden, um zu sehen ob jene, die dem Mitnehmen bzw. Mitfahren neutral gegenüber stehen auf eine Seite tendieren.

Um die Bereitschaft zum Mitnehmen bzw. Mitfahren erklären zu können, wurden eine Reihe von personen- bzw. haushaltsbezogenen Merkmalen Korrelationsanalysen unterzogen. Sozio-demographische, sozio-ökonomische Merkmale, die Mobilitätsausstattung der Haushalte und die Lebensführungstypen nach Otte (vgl. Otte 2004) zeigten keine belastbaren Zusammenhänge zur Bereitschaft Fahrten zu teilen. Entgegen den

Erwartungen konnten jedoch signifikante geringe bis mittlere Korrelationen zu Umwelt- und Mobilitätseinstellungen sowie einzelnen Motiven der Nutzung von Carsharing identifiziert werden.

5.4.1 Mitfahren

Je positiver Personen gegenüber Mitfahren eingestellt sind, desto eher lassen ihre Einstellungen in Umweltfragen auf ein hohes Umweltbewusstsein schließen. Sowohl zur Ansicht, dass Umweltprobleme das eigene Alltagsleben beeinflussen als auch zu einer erhöhten Bereitschaft Zeit und Geld aufzuwenden um etwas für die Umwelt zu tun, ergeben sich hochsignifikante positive Korrelationen zur Bereitschaft bei anderen Personen mitzufahren.

Item	**Korrelations-koeffizient**	**Signifikanz (2-seitig)**	**N**
Für mich ist es einfach zu schwierig, viel für die Umwelt zu tun.	-0,117	0,159	147
Ich tue das, was für die Umwelt richtig ist, auch wenn es mich Zeit und Geld kostet	0,257	0,001	154
Es gibt Wichtigeres im Leben zu tun als die Umwelt zu schützen.	-0,086	0,300	148
Es ist zwecklos einen Beitrag zur Umwelt zu leisten, solange andere sich nicht genauso verhalten.	-0,028	0,734	146
Viele Behauptungen über die Gefährdung der Umwelt sind übertrieben.	-0,088	0,288	147
Umweltprobleme wirken sich direkt auf mein Alltagsleben aus	0,232	0,004	155

Tabelle 3: Korrelationsanalyse (Spearman Rangkorrelation) Umwelteinstellung - Bereitschaft Mitfahren

Weniger klare Zusammenhänge ergeben sich zwischen der Mitfahrbereitschaft und Mobilitätseinstellungen. Lediglich die Aussage „Privater Pkw-Besitz ist für mich nicht wirtschaftlich“ ist signifikant (Korrelationskoeffizient 0,216; p=0,008;N=152). Geringe negative Korrelationen weisen die Statements, dass der ÖV nur in Ausnahmefällen (Korrelationskoeffizient .0,155; p=0,065;N=143) sowie, dass Strecken nach Möglichkeit mit dem Pkw zurückgelegt werden Korrelationskoeffizient -0,113; p=0,180;N=142) auf – diese sind jedoch nicht signifikant.

Ein unklareres Bild ergibt sich bei den Carsharing-Motiven, da jeweils ein Item für die Motive Gemeinschaft, Symbolik sowie Komfort und Flexibilität einen signifikanten geringen bis mittleren Zusammenhang aufweisen. Obwohl es einen deutliche Zusammenhänge zwischen Umwelteinstellungen und der Bereitschaft Ridesharing zu praktizieren gibt, ist die Korrelation zwischen Mitnahmebereitschaft und persönlicher Umweltnorm als Carsharing-Motiv nur schwach und nicht signifikant. Ähnlich verhält es sich mit Kosten als Motiv Carsharing zu nutzen und wirtschaftlichen Überlegungen zum Autobesitz in Bezug auf Ridesharing: Während die Aussage, Pkw-Besitz sei nicht wirtschaftlich unter den Mobilitätseinstellungen den stärksten Zusammenhang zeigte, spielen unter den Personen, die dem Mitfahren offen gegenüber stehen, Kosten kaum eine Rolle für die Carsharing-Nutzung.

Item	**Korrelations-koeffizient**	**Signifikanz (2-seitig)**	**N**
Ich nutze Carsharing, weil Personen, die mir wichtig sind, auf klimafreundliche Mobilität achten.	0,156	0,063	143
Ich nutze Carsharing, weil ich dadurch flexibler mobil sein kann als mit anderen Verkehrsmitteln.	0,221	0,006	152
Ich tausche mich gerne mit den anderen Mitgliedern unserer Carsharinggruppe aus.	0,199	0,018	141
Ich werde darauf angesprochen, wenn ich als Carsharing-Nutzerin oder Carsharing-Nutzer erkannt werde und kann über Carsharing erzählen	0,188	0,023	146
Ich nutze Carsharing, weil dies auch meine wichtigsten Vertrauten (z.B. Familie, Freundinnen und Freunde, Kolleginnen und Kollegen) tun.	0,146	0,088	137

Tabelle 4: Ausgewählte Korrelationen (Spearman Rangkorrelation) Carsharing-Motive - Bereitschaft Mitfahren

Insofern ergibt sich trotz einiger deutlicher Zusammenhänge zu Umwelt-Einstellungen und Carsharing-Motiven ein etwas diffuses Bild. Klar ist, dass die Offenheit gegenüber dem Teilen von Fahrten mit einem erhöhten Umweltbewusstsein einhergeht. Ob dies auch handlungsleitend ist, lässt sich vor dem Hintergrund der geringen Bedeutung der persönlichen Umweltnorm als Motiv für die Carsharing-Nutzung nicht abschließend beantworten. Zusätzlich scheinen unter den Befragten, die eine positive Einstellung gegenüber Mitfahren haben, Gemeinschaft, Symbolik sowie Komfort und Flexibilität wichtige Motive für die Carsharing-Nutzung zu sein. Da gerade Flexibilität einer der Schwachpunkte beim Ridesharing ist, stellt sich die Frage inwiefern diese Motive auch für die Inanspruchnahme von Mitfahrgelegenheiten handlungsleitend wären.

5.4.2 Mitnehmen

Ähnlich wie beim Mitfahren sind unter Befragten, die gegenüber dem Mitnehmen anderer Personen offen sind, Zusammenhänge mit einer erhöhten umweltorientierten Einstellung erkennbar. Die beiden Items, die einen positiven Bezug zu Umweltbewusstsein repräsentieren sind positiv und signifikant zur Bereitschaft andere Personen mitzunehmen korreliert. Aussagen, die auf ein niedriges Problem- und Verantwortungsbewusstsein hinsichtlich Umweltthemen schließen lassen, weisen wiederum geringe und nicht signifikante negative Korrelationen auf. In Bezug zu Mobilitätseinstellung sind keine signifikanten Zusammenhänge gegeben zu Ridesharing gegeben.

Item	**Korrelations-koeffizient**	**Signifikanz (2-seitig)**	**N**
Für mich ist es einfach zu schwierig, viel für die Umwelt zu tun.	-0,184	0,026	147
Ich tue das, was für die Umwelt richtig ist, auch wenn es mich Zeit und Geld kostet	0,237	0,001	154
Es gibt Wichtigeres im Leben zu tun als die Umwelt zu schützen.	-0,062	0,456	148
Es ist zwecklos einen Beitrag zur Umwelt zu leisten, solange andere sich nicht genauso verhalten.	-0,100	0,230	146
Viele Behauptungen über die Gefährdung der Umwelt sind übertrieben.	-0,069	0,408	147
Umweltprobleme wirken sich direkt auf mein Alltagsleben aus	0,236	0,003	155

Tabelle 5: Korrelationsanalyse (Spearman Rangkorrelation) Umwelteinstellung - Bereitschaft Mitnehmen

Klare Zusammenhänge ergeben sich zu den Carsharing-Motiven. Beide Aussagen, welche das Motiv Gemeinschaft repräsentieren, weisen mittlere und hochsignifikante Korrelationen auf. Ein etwas schwächerer Zusammenhang besteht zur sozialen Norm: hier ist eines der beiden Items hochsignifikant, die Korrelation jedoch geringer. Ähnliches gilt für die Symbolik, hier ist ebenfalls ein Item von zwei signifikant, wobei der Korrelationskoeffizient nochmals geringer ist.

Item	**Korrelations-koeffizient**	**Signifikanz (2-seitig)**	**N**
Mit Carsharing kann ich einen Beitrag zum Umwelt- und Ressourcenschutz leisten.	0,147	0,064	160
Ich nutze Carsharing, weil Personen, die mir wichtig sind, auf klimafreundliche Mobilität achten.	0,203	0,015	143
Ich nutze Carsharing, weil ich dadurch flexibler mobil sein kann als mit anderen Verkehrsmitteln.	0,157	0,031	152
Ich tausche mich gerne mit den anderen Mitgliedern unserer Carsharinggruppe aus.	0,225	0,007	141
Ich werde darauf angesprochen, wenn ich als Carsharing-Nutzerin oder Carsharing-Nutzer erkannt werde und kann über Carsharing erzählen	0,181	0,029	146

Tabelle 6: Ausgewählte Korrelationen (Spearman Rangkorrelation) Carsharing-Motive - Bereitschaft Mitnehmen

Mit steigender Bereitschaft Mitfahrgelegenheiten anzubieten steigt auch die Bedeutung von gemeinschaftsorientierten Motiven an Carsharing teilzunehmen. Das lässt den Schluss zu, dass der „Gemeinschaftssinn" auch ein relevanter Treiber ist, Mitfahrgelegenheiten anzubieten. Zwischen Umweltbewusstsein und Ridesharing scheint ein allgemeinerer positiver Zusammenhang zu bestehen, der sowohl das Mitfahren als auch das Mitnehmen betrifft. Es stellt sich allerdings die Frage, ob dieser positive Zusammenhang letztendlich auch handlungsleitend ist. Dazu bedarf es weiterer, vertiefender Untersuchungen.

5.4.3 Gründe für die Ablehnung von Mitfahren/Mitnehmen

Jene Befragungsteilnehmerinnen und Befragungsteilnehmer, die in der Frage nach der Bereitschaft zum Ridesharing, eine ablehnende Position einnahmen, bekamen anschließend jeweils eine Frage nach den Gründen der Ablehnung gestellt (s. Tabelle 7 und Tabelle 8).

	Aus welchen Gründen und Überlegungen haben Sie Bedenken bei jemand mitzufahren? (Mehrfachantworten möglich) (n=39)					
	Einschränkung der Flexibilität	Vereinbarung der Fahrt ist umständlich	Fahrerin oder Fahrer könnte einen gefährlichen Fahrstil haben	möchte nicht mit Unbekannten im Auto sein	kein Bedarf	Sonstiges
absolut	29	12	9	14	15	10
Prozent	74%	31%	23%	36%	38%	26%

Tabelle 7: Häufigkeiten und relative Verteilung der Gründe gegen Mitfahren

	Aus welchen Gründen und Überlegungen haben Sie Bedenken jemanden mitzunehmen? (Mehrfachantworten möglich) (n=37)					
	Einschränkung der Flexibilität	Vereinbarung der Fahrt ist umständlich	Auto ist wichtiger Rückzugsort	möchte keine Ungekannten im Auto	Auto ist meistens ohnehin voll	Sonstiges
absolut	27	14	5	11	2	10
Prozent	73%	38%	14%	30%	5%	27%

Tabelle 8: Häufigkeiten und relative Verteilung der Gründe gegen Mitnehmen

Während bei der Ablehnung des Mitfahrens vor allem die dadurch entstehende Abhängigkeit von der Fahrerin oder dem Fahrer deutlich am häufigsten genannt wird, spricht aus Sicht der Befragten gegen das Mitnehmen vor allem der als umständlich erwartete bzw. wahrgenommene Prozess der Fahrtenvereinbarung. An zweiter Stelle folgen bei beiden Fragen Bedenken, mit einer nicht oder wenig bekannten Person ein Fahrzeug zu teilen.

6 DISKUSSION UND AUSBLICK

Carsharing-Nutzerinnen und Carsharing-Nutzer stellen nicht nur aufgrund ihrer in der Befragung gezeigten hohen Bereitschaft zum Ridesharing eine interessante Zielgruppe dar, sondern auch aufgrund der Haushaltsmobilitätsausstattung. Neben einer gegenüber der Gesamtbevölkerung deutlich geringen Zahl an Privat-Pkws lässt sich anhand des durchschnittlichen Bestandes an Fahrrädern pro Haushalt sowie in Bezug auf die ÖV-bezogene Ausstattung auf ein stärker multimodal ausgerichtetes Mobilitätsverhalten schließen. Dies dürfte einerseits den Bedarf an Mitfahrgelegenheiten erhöhen und andererseits eine erhöhte mentale Flexibilität in der Verkehrsmittelwahl ausdrücken.

Ridesharing ist gegenüber individueller Mobilität mit Einbußen in der Flexibilität verbunden ist. Damit es für Nutzerinnen und Nutzer dennoch eine akzeptable Mobilitätsalternative bleibt, muss es mit einem gewissen Gegenwert verbunden sein, der je nach individuellen Motivlagen und Einstellungen unterschiedlich ausfallen kann. Deshalb ist bei der Etablierung von Ridesharing a) auf einen entsprechenden Zielgruppen-Fokus und b) auf die richtigen motivationalen Anreize zu achten. Wie die vorliegenden Ergebnisse zeigen, kann die Zielgruppe nicht an sozio-demographischen oder sozio-ökonomischen Merkmalen festgemacht werden. Hingegen sind Zugänge erfolgsversprechend, die sich an psychologischen Merkmalen. In der Kommunikation an potenzielle Mitnehmerinnen und Mitnehmer sollte beispielsweise an den Gemeinschaftssinn bzw. die soziale Norm appeliert werden.

Die Gründe für die Ablehnung von Ridesharing zeigen, dass die Fahrtenvereinbarung als umständlich und die Abhängigkeit von anderen Personen als in der Flexibilität einschränkend wahrgenommen werden. Werden dafür keine praktikablen Lösungen gefunden, kann dies auch die Begeisterung von Personen, die offen gegenüber dem Mitnehmen und Mitfahren sind, rasch bremsen. Während die Flexibilität stark von externen Rahmenbedingungen (z. B. ÖV-Angebot als Alternative, Mitfahrangebot auf nachgefragter Relation) abhängig ist, resultiert der Aufwand der Fahrtvereinbarung primär aus der internen Organisation. Die Herausforderung besteht darin ein System zu schaffen, das einerseits einfach zu nutzen andererseits

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einzelne Nutzerinnen- und Nutzergruppen nicht exkludiert (was bspw. bei App-basierten Lösungen häufig der Fall ist).

Weiterer Forschungsbedarf besteht darin, den Zusammenhang zwischen weiteren psychologischen Merkmalen und der Bereitschaft zum Ridesharing zu untersuchen. Eine Ausweitung der Analyse auf andere Gruppen als Carsharing-Nutzerinnen und Carsharing-Nutzer oder die Gesamtbevölkerung wäre dabei sinnvoll. Zudem sollte geprüft werden, ob die Zusammenhänge nur hinsichtlich der grundsätzlichen Bereitschaft zum Ridesharing bestehen, oder ob diese auch handlungsleitend sind.

7 REFERENCES

CANZLER, Weert; KNIE, Andreas: Radikales Umdenken im öffentlichen Landverkehr! In: In: LandInform - Magazin für ländliche Räume, H. 3, pp. 28-29, 2009

BUNDESMINISTERIUM FÜR VERKEHR, INNOVATION UND TECHNOLOGIE (BMVIT): Österreich unterwegs 2013/2014. Ergebnisbericht zur österreichweiten Mobilitätserhebung „Österreich unterwegs 2013/2014. Wien: BMVIT, 2016

GUGG, Gilbert: Organisation nicht kommerziellen Carsharings. Diplomarbeit. Technische Universität Wien. Institut für Verkehrssystemplanung, 2015

HERGET, Melanie: Mobilität von Familien im ländlichen Raum. Arbeitsteilung, Routinen und typische Bewältigungsstrategien. Wiesbaden: Springer VS, 2016.

INTERNATIONAL SOCIAL SURVEY PROGRAMME (ISSP): Austria ISSP 2010 – Environment III Questionnaire, 2010

KAGERMEIER, Andreas (Hrsg.): Verkehrssystem- und Mobilitätsmanagement im ländlichen Raum. Studien zur Mobilitäts- und Verkehrsforschung Band 10, 2004.

LOOSE, Willi: Aktueller Stand des Car-Sharing in Europa. momo – more options for energy efficient mobility through Car-Sharing – Endbericht C 2.4 Arbeitspaket 2. Berlin: Bundesverband CarSharing e. V., 2010

MEATON, Julia & LOW, Christopher: Car Club development: The role of local champions. World Transport Policy and Practice, Vol. 9, Issue 3, pp. 32-40. Lancaster 2003

NORDHESSISCHER VERKEHRSVERBUND: Das Mobilfalt-Angebot. Mobilität für alle – flexibel und bezahlbar. Online: http://www.mobilfalt.de/das-mobilfalt-angebot/, abgerufen am 22.12.2015.

OTTE, Gunnar: Sozialstrukturanalysen mit Lebensstilen. Eine Studie zur theoretischen und methodischen Neuorientierung der Lebensstilforschung. Wiesbaden: VS, 2004.

PERSCHL, Magdalena; POSCH, Alfred: Carsharing – ein Mobilitätsansatz im ländlichen Raum? In: EGGER, Rudolf; POSCH, Alfred (Hg.): Lebensentwürfe im ländlichen Raum – Ein prekärer Zusammenhang? Lernweltforschung: Band 18. Wiesbaden: Springer Fachmedien, 2016.

ROSINAK & PARTNER: Aufrechterhaltung der Funktionsfähigkeit ländlicher Räume. Dienstleistungen der Daseinsvorsorge und Regionale Governance. Präsentation auf der ÖROK Szenariokonferenz zum ländlichen Raum in Österreich, Wien 18. Mai 2005.

RIEGLER, Sebastian; JUSCHTEN, Maria; HÖSSINGER, Reinhard; GERIKE, Regine; RÖSZGER, Lars; SCHLAG, Bernhard; MANZ, Wilko; RENTSCHLER, Christoph; KOPP, Johanna: Carsharing 2025 – Nische oder Mainstream? Berlin: Institut für Mobilitätsforschung, 2016

RÜCKERT-JOHN, Jana; JAEGER-ERBEN, Melanie; SCHÄFER, Martina; ADERHOLD, Jens; JOHN, René: Soziale Innovation für nachhaltigen Konsum : Kriterien zur Analyse und Systematisierung. Beiträge zur Sozialinnovation Nr. 11. Berlin, 2013

SCHREIER, Hannes; BECKER, Udo; HELLER, Jochen: Evaluation CarSharing (EVA-CS) Landeshauptstadt München. Endbericht, 2015.

SCHUSTER, Markus; STEINACHER, Irene; TOMSCHY, Rupert: Carsharing Wien – Evaluierung, 2015

SHIBAYAMA, Takeru; LEMMERER, Helmut; WINDER, Manuela; PFAFFENBICHLER, Paul: Cooperative car sharing in small cities and scarcely populated rural area – an experiment in Austria. Wien, 2013

SOMMER, Carsten; SCHMITT, Volker: „Mobilfalt"– Integration of ride-sharing into public transport as a new approach for rural areas. In: Proceedings of 13th WCTR. Rio de Janeiro, 2013

SÜDBADENBUS GMBH: Start des Mitfahrnetzwerks flinc. Online: http://www.suedbadenbus.de/suedbadenbus/view/aktuell/presse/flinc.shtml, abgerufen am 22.12.2015

Korneuburg's way2smart – Mobility Concept, Energy Platform and Social Interaction

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1 ABSTRACT

This paper aims to present the methods employed by the demonstration project "Korneuburg Way2Smart" to contribute to the municipality's plan of achieving energy self-sufficiency by 2036. The municipality of Korneuburg plans to refurbish two municipality-owned residential buildings. This includes the compaction of two buildings by way of super structures and annexes, as well as utilization of facade and roof areas for energy-generation. In an attempt to answer the questions arising in a general public along the way to a broader acceptance of this smart city vision, an online energy platform with interactive maps is employed to visualize the current energy situation city-wide, and highlight the future potential of renewable energy sources and refurbishment measures for individual buildings. The energy platform aims to support residents and stakeholders with energy forecasts according to different development scenarios to underpin energy and building decisions and for them to achieve their goal of energy self- sufficiency. The implementation of the web platform's user interface must meet several requirements: It is required to be both intuitive and easy-to-use by non-professionals. In addition, it must be able to cover a wide range of use cases such as input of building energy calculation parameters and energy scenario parameters, as well as various measurement data. The inclusion of citizens and neighbourhoods in the transition process is another focus of the project. Residents are informed about the municipality's actions from an early stage and can partake in decision processes. With the so-called "buddy-program", the education of a wider public on technical topics, possibilities for self-organisation, management of car sharing, etc. are also part of the project. New and innovative mobility concepts such as "tenants-mobility" are also explored. The buildings of the project are planned as "nearly car-free" buildings.

Keywords: nearly car-free, databases, energy platform, Korneuburg, simulation

2 INTRODUCTION TO THE PROJECT: WAY2SMART KORNEUBURG

Cities in Austria are constantly evolving and need to reinvent themselves continuously, especially due to impending changing climate, increasing scarcity resources and urbanization. A small town, Korneuburg near Vienna, with about 12,000 inhabitants, gets ready to meet these challenges. Until 2036, the forecasts predict a population increase in Korneuburg of up to 50%. To meet the needs of a growing city, citizens, politicians and administration planned Korneuburg's path to 2036 with ambitious objectives in terms of energy and CO2-saving and concentration on "social togetherness":

The Masterplan 2036 (17&4 Organisationsberatung GmbH et. al 2014), Korneuburg's urban development concept, created with a big public participation-project in the year 2011, is based upon three pillars: social interaction, education and water. Public participation and energy-self-sufficiency are the foundation, on which these pillars are built. The Project Way2smart aims to demonstrate how energy-self-sufficiency and high quality of life is affordable also for small budgets.

The three-year project is funded by the Austrian Climate and Energy Fund, with a consortium of researchers, grid operators, energy planners, mobility planners and architects, as well as the municipality of Korneuburg. The specific goals of the project are the refurbishment of two municipality-owned residential buildings and the creation of a mobility hub in the area of the rehabilitated objects and thus create alternatives to the use of private cars. In this prototype housing scheme, affordable small apartments are to be provided to young tenants in a targeted manner. Figure 1 shows the two municipality-owned residential buildings that the municipality of Korneuburg intends to rehabilitate, with the intention to live up to its 2036 Vision Statement and Master Plan.

Figure 1: The two municipality-owned residential buildings to be rehabilitate (HuB architekten ZT KG 2013)

As accompanying measures, (i) communications programmes are to reconcile measures and needs of existing and new tenants on a level-playing field with experts. The main goal here is to achieve acceptance for rehabilitation measures as well as self-organisation. (ii) Tenants and other citizens will be informed of and mobilised for the objective of the energy-self-sufficiency of Korneuburg. (iii) Property developers are involved in the process which is monitored by sociologists. An energy platform should support the involvement of the citizen in the transformation process.

3 ENERGY PLATFORM

The purpose of the proposed energy platform is (i) to provide examples of best-practice buildings, (ii) to visualize the status-quo of Korneuburg's energy situation, (iii) to highlight energy potentials and (iv) to accumulate detailed building data through input of measurement and audit results.

Purpose (i)-(iii) aims to guide residents and stakeholders of Korneuburg municipality to achieve their goal of energy-self-sufficiency. The accumulation of building data (purpose iv) supports that by gradually improving the underlying data, thus strengthening both accuracy and validity of the proposed measures and scenarios.

Implementation: The implementation of such a platform requires three key components: First, a means to store the various data of each subject matter in a consistent and useful form. Second, a way of determining the energy status and potential of the whole city. Last, an accessible interface for residents and other stakeholders to access this information and provide additional data.

3.1 Energy Database

The first requirement is met by a database that stores all relevant information. This energy database collects building energy information in the forms of energy performance calculation and literature for best practice examples, measurement and bill data, as well as simulation results.

The data comes from different sources: Participating residents and key stakeholder can provide measurement data, utility bills and energy performance certificates to better qualify existing buildings. Best practice examples and potential measures are derived from previous research and literature. A designated simulation engine provides results for energy scenarios, both on the level of a single building, as well as the whole municipality.

Table 1 shows data types A – D being used concurrently and combined for purposes i) through iv). The challenge is to relate these different data types to use them for both information and simulation purposes.

Data type	**Accuracy**	Purposes **(i)**	**(ii)**	**(iii)**	**(iv)**
A- Simulation result	low	(m)	(m)	(m)	
B - Energy performance certificates	medium	(*r)	(*r)		(in)
C - Utility bills	high	(*r)	(m)	(m)	(in)
D - High-res measurement	Very high	(*r)	(*r)		(in)

Table 1 Data types for information and simulation purposes

Purposes: (i) Best Practice, (ii) Status-Quo, (iii) Potentials, (iv) Data accumulation, (m) Matlab simulation engine, (*r) data from reference projects and project tasks, (in) web platform user (in)put

Key aspects:

- Data sources: Residents, Stakeholder, Researchers
- Data types: Measurements, energy performance certificates, utility bills, simulation results
- Data security & privacy: User inputs must be secured, and anonymised if displayed for a general audience
- Data appreciation: With time, low quality data and underlying estimates can be gradually replaced by higher quality data through the web application interface described below.

3.2 Simulation engine

The purpose of the simulation engine is twofold: First, calculate the energy balance for individual buildings with detailed input data and high resolution. Second, provide grand-scale simulation capabilities for energy scenarios of Korneuburg, taking into account different refurbishment standards and rates, as well as different time frames. Both features can use building data from the energy database as input.

The grand-scale simulation groups individual buildings together according to their energetic characteristics. Each group is represented by an automatically created building model using predefined components according to the group's characteristics (e.g. '60ies detached single family house'). These virtual building models contain properties of geometry, usage characteristics and thermal properties which are predefined according to typical Austrian conditions.[1]

This approach entails additional synergies: The grand-scale simulation benefits from detailed resident input to refine the assumptions from the 'typical buildings' model by adding measurement data on top of it.

3.2.1 Simulation method

The method is based on tools from two pre-projects. The first tool was conceived by master students of the University of Applied Sciences Technikum Wien (Galosi et. al 2012) and performs static simulations of the energy balance of Korneuburg. The user inputs are building data regarding geometry, construction method and energy systems. This approach was tested and validated with results from existing energy registers of Korneuburg (2008). For this project, input handling was generalized to include prebuilt libraries of building components, energy systems and default standards, which group typical building components and energy systems for a given building period, construction method, geometry type and usage.

The second tool originated from two research project conducted by the Austrian Institute of Building and Ecology (IBO). It provides dynamic calculation methods for thermic building simulation in a single thermal zone and yields energy usage, energy supply, humidity and temperatures in a quarter-hour resolution, as well as CO2- and primary energy balances. The tool was validated using a TRNSYS reference model and provides a basis for the simulation engine of the energy platform (Rondoni, et.al. 2015).

As a combination of these two tools, the simulation engine can deliver detailed dynamic energy simulation results on any particular building, be it with detailed user input or using the existing building libraries shown in in Table 2.

For the purposes of grand-scale scenario calculation, the engine performs two separate steps: First, calculate the detailed energy performance of all defined building types/models. Then, aggregate the results according to the spatiotemporal occurrence of these buildings throughout the scenario to obtain a city estimate.

For simulation purposes, any building – virtual or real – requires an orientation associated to its geometry for weather and insolation effects to be applied correctly. Therefore, the simulation of real city quarters needs to take the effects of orientation into account when appending the same virtual building for every real building of similar type but different orientation.

Korneuburg is located on the river Danube, which runs from the North-West to South-East, and the roads network matches that cardinal direction. Since most buildings are in line with their street direction, the

[1] Episcope: Regional Case Studies (RCS) Austria, 2015

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overall distribution of the city favours South-East and South-West orientations. To accommodate for this effect, building and street orientations from GIS data are analysed and matched with the overall built area. The result is a distribution of building quantities and areas for each orientation.

Construction method	Building Standard	Geometry	Type of usage
Reinforced concrete	1900	Single family house	Home
Brick	1920	Apartment building	Commerce
Solid wood	1950	Business	Office
Lightweight	1960	Industry	Business
Mixed	1970	Commerce	Industry
	1980	Office	Kindergarten
	1990	Miscellaneous single-storey	
	Renovated conventional	Miscellaneous multistorey	
	Renovated –low-energy-building		
	Renovated –passive house		

Table 2 Properties of geometry, usage characteristics and thermal properties

In the second step of the grand-scale simulation, the virtual typical buildings in their distinct orientations are scaled by the total floor area occupied by the respective building type. The distribution of building types can also be time- dependent with a transition function. This so called 'refurbishment rate' reflects gradual transitions of one type to another through refurbishment and densification.

3.2.2 Data for building description

Buildings can include solar active components. The performance of such systems (i.e. Photovoltaic, hybrid and solar thermic collectors) depend heavily on their orientation. For this reason, they cannot be included in a generic building type geometry, because types have no defined orientation.

Instead, the simulation applies an allocation function to obtain optimal solar active component configuration as a function of building orientation and building geometry.

The allocation algorithm is a function of orientation and area of the building's surfaces. The allocation is optimized for cost-efficiency of the components but any optimization criteria are possible.

3.3 Web application

The web application is devised to facilitate the following use cases:

(i) Users can provide additional data of their own house to improve the database and obtain more accurate results for themselves.

(ii) Users can browse best practice examples and compare them with their current building.

(iii) Users can analyse the effects of suggested refurbishment measures on their own house and the city in total.

Key aspects of this platform are:

- Provide Project identity constituencies and motivate participants as opposed to mere supply of information
- Social inclusion: design for accessibility.
- Focus on Gender & Diversity principles for web applications
- Data visualization: The main part of the web application is an interactive 2D/3D map of Korneuburg
- Data integrity: The interface must ensure that data provided meets the database requirements
- Data validity: Syntactically correct but (semantically) wrong data pose a threat.

4 MOBILITY-CONCEPT

Korneuburg is a small, but growing city. Plus nearly 50 % inhabitants until 2036 is also a big challenge for mobility. Business as usual would lead to daily traffic jams, a loss of life-quality. And not at least to environmental impact: individual motorised transport is responsible for about one third of greenhouse gas emissions.

There are 1,3 cars / household in Korneuburg(Rosinak und Parter 2015) – and people use their car for more than 50 % of their daily ways. Urban mobility, that offers a mix of transport-modes for all daily ways of the inhabitants, is necessary, to get people independent of the possession of an own car.

Public transport is a part of the solution. Korneuburg’s connection via train to Vienna and Stockerau is rather good (5 trains per hour), but the connection to the surrounding region per bus is insufficient. Although in Austria the provinces are responsible for public transport offers – Korneuburg plans to increase its quality and make public transport more visible in the town. Bus stations will be changed to “multi-modal-mobility-points” –the first one will be settled at the bus station in front of the way2smart building.

4.1 Offers for tenants-mobility

The way2smart building is planned as a “nearly car-free building”. The demonstration-project includes different options to make alternatives to the “own car” more attractive.

- bike stands: easy to reach for the tenants, theft-proof, in a sufficient amount (1 bike per person)
- e-car sharing
- e-bike and/or cargo-bike sharing
- optional screen-display of the mobility-point also inside the building

Korneuburg’s building code requires to build 1 ½ parking spaces for each new flat. This regulation will not be changed for the way2smart, but will be political discussed after evaluating the mobility-project-results. It was a big challenge to find ways to fulfil the requirements of the building code, especially because “small flats for low costs and high energy-efficiency” is a main part of the way2smart demonstration project. 27 underground-parking-spaces are planned, but that is not enough for 25 new flats. So, it is necessary also to reserve surface parking-space at the building site and in the near surrounding.

In 2015 Korneuburg conducted a mobility survey (in preparation to a mobility-concept). The results: an average household in Korneuburg owns 1,3 cars and 2,6 bikes, 11% of the household do not own a car (32 % own more than one car).

The tenants and people interested to become tenant of the way2smart project where also asked for their mobility-behaviour. The results: 0,75 cars and 1,3 bikes per household and 47 % of the households do not own a car (only 19 % own more than one car).

So, it is visible, that tenants of community housing show a different mobility behaviour, that also might be taken into consideration.

4.2 Awareness and education

Social interaction and communication is also an important part of the mobility-concept of way2smart. The buddy-program of way to smart (see chapter “social interaction”) also includes information about mobility and the costs of an own car versus multi-modal mobility.

There are many other reasons for alternative mobility, like environmental impact, quality of live and prevention of traffic-jams, that also will be part of the buddy-program. The most important fact for the target-group of community housing tenants will be, that multi modal mobility is cheaper than using the own car.

5 SOCIAL INTERACTION AND COMMUNICATION

It’s not only the technical equipment, that makes living smart. Social interaction and communication play a key role in our project. The residential building with up to 50 flats is also meant to be a model for best practice housing community.

It's a small town's advantage, that neighbours know each other, learn to respect each other and finaly help each other. Especially if the monetary income is not too high (there are income-limits for getting a community housing in Korneuburg), the value of a good neighbourhood should not be underestimated.

5.1 The "buddy-program" – tenants information at eye-level

The way2smart includes also a so called „buddy-program" for information and education on topics like the correct use of the technical equipment, possibilities for self-organisation (person of trust as representing the tenants, management of car-sharing and common rooms, and so on). At eye-level is important for the acceptance of the "teacher" and the content, that shall be transmitted. That is why speakers and teachers will come from relief organisations as well as „ordinary citizens" from Korneuburg, sharing their special knowledge. It's easier to accept or believe, to discuss and finally be inspired from a message, if it is delivered from someone, you can identify with.

The way2smart includes a special offer for young people searching for their first own housing. „Starter-flats" can be hired for a limited time (3 years) for a lower rent. The first step to independence and a possibility to find out, what is important for the own lifestyle. The buddy-program reaches it's goal, when „the starters" are inspired by the lifestyle of way2smart and carry their experience to their next housing community

On the one hand, users training is important to gain the full efficiency of the technical equipment. If tenants understand the technical background of users-instructions it's easier to act accordingly. On the other hand neighbourhood-assistance helps saving money, strengthens the self-confidence and supports cooperation, respect and good relation between tenants.

5.2 Early communication with neighbours and tenants

Communication with tentants and neighbours will take place as early as possible, at a time, when the extentions and plans of the building are not fixed. So the wishes and worries of tentants and neighbours can be taken in consideration, if they are useful and sustainable.

Korneuburg is a small town with limited construction area and a high population growth. Building densification and its (non-)acceptance in public and particulary in the neighbourhood plays an important role in the Masterplan2036. Many construction-projects of the last years lent to controverses with the neighbours, some of them were temporary stopped by the protests. The solution for this problem provided in the Masterplan is earlier and better communication between building owners and affected citizens.

The first information-session for former tenants took place in spring 2016. About 40 tenants and intersted people got an overview of the planned building and smart-city measures and provided input and experiences, that will be taken into account for the further plannings.

Due to delays of the construction-shedule information-sessions and workshops will be continued in June 2017, when planning, pricing and construction completion are more detailed. Especially young people will not wait 2 years if they decide to start their own lifes in their own flat. Further information-sessions will be held periodical and allow cross-entry for new interested people.

Preparatory a survey on the tenants and people interested in a community housing flat was startet, to get information about the whishes of former tenants. The results are in accordance with the previous planning: people want small and cheep flats and some of them are interested in alternativ forms of housing like flat-sharing and assisted living. Also a different mobility-behaviour became visible (see chapter mobility) – way2smart-interested people own a lower number of cars in their households than the population average.

Also the first information-session for neighbours took place in spring 2016, but only few accepted the invitation. So it is intended to repeat this first session in June 2017 and create the invitation in a more "populist" style.

5.3 Property developers' workshops

How to motivate property developers to build smart?

Experiences made in the realisation of the construction project, the mobility measures and the participation-process will be shared and discussed in property developer's workshops. Possibilities for local councils promotion and support of smart-city measures in further construction projects will be the result of these workshops.

6 CONCLUSIONS

This paper provides a deeper insight into the project developments of “Korneuburg’s Way2Smart”. It summarizes the current status-quo of the project with already accomplished milestones, including the energy platform, the mobility concepts and social interaction and communication.

The Energy Platform has the goal to support the residents and stakeholders of Korneuburg’s municipality to achieve their goal of energy- self- sufficiency. Big challenge is the implementation of user interface must be both intuitive and easy-to-use by non-professionals while being able to cover a large number of use cases such as input of building energy calculation parameters, energy scenario parameters, input of various measurement data, et cetera. At this point, especially input processing and validation remains as a big concern in the future. The inclusion of the tenants and the neighbours in this changing process is a main point in this project. So the citizen, tenants and neighbours are informant about the actions from the early stage. With the so-called “buddy-program” the education on technical topics, possibilities for self-organisation, management of car sharing, etc. is part of the project. Also the mobility concept is looking for new innovative ideas, like tenants-mobility. The buildings of the project are planned as a “nearly car-free building”.

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8 REFERENCES

17&4 Organisationsberatung GmbH, Universität für Bodenkultur, HUB-Architekten, 2014. Leben im Zusammenfluss, Leitbild der Stadt Korneuburg, Korneuburg

Altmann-Mavaddat N., Solacher E., Tretter H., 2015. Energetische Qualität und Sanierungstrends des österreichischen Wohngebäudebestands mit Fokus auf die Sanierungsentwicklung in Salzburg, Austrian Energy Agency, Wien

Galosi A.Klepic V., Köbl K., Rößler M., Ziegler M., Zelger T., 2012. Energieautarke Gemeinde Korneuburg 2036, Technikum Wien, Wien

HuB architekten ZT KG 2013., Strukturanalyse der Stadtgemeinde Korneuburg: Leitbildprozesses „Korneuburg 2036“, Korneuburg

Rondoni, M., Santa, U., Klammsteiner, U., Demattio, M., Bancher, M., Told, A., Zelger, T., 2015. ProCasaClima 2013: CasaClima building simulation software, Building Simulation Applications 2015 - 2nd IBPSA-Italy Conference, Bolzano, Italy

Rosinak und Partner 2015. Mobility survey September 2015, Tomorrow’s workforce: data driving mobility 2015–16 Global Mobility Effectiveness Survey, Vienna, 2015

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Land Administration to Decrease the Poverty?

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1 ABSTRACT

Land administration is a proper tool to identify the resources of a country and to document physical and legal properties connected to it. Land administration constitutes a basic requirement for land governance processes, like land management or land use planning (Mattsson and Mansberger, 2017). Therefore, development work in numerous countries of the south often includes the setup of a land administration system. During the last 20 years, the World Bank, for example, financed a large number of projects related to the implementation of land administration systems in Africa, in Asia, and in South-Eastern Europe. However, experience showed that the beneficiaries of land administration systems did not always meet to combat poverty. Due to the security of land use, also agro-industrial companies rent land, which often common land or land used by nomads. This “land grabbing” is an upcoming phenomenon that is increasingly endangering the life of underprivileged groups. Raising awareness for the problem is a significant part of dealing with the situation. However, a change can only happen, if the people making the decisions and designing the processes are aware of the problem and if they try to find alternative approaches avoiding land grabbing. Thus, the challenges of land administration have to be included into the education of experts.

The paper discusses challenges connected to the implementation of land administration systems in developing countries with a focus to the situation in Africa. Afterwards the authors discuss practical experience gained from a capacity-building project in Ethiopia.

Keywords: Land Grabbing, Poverty, Land Administration, Ethiopia, Developing Countries

2 INTRODUCTION

Developing countries in Africa have a typical set of difficulties to overcome:

- High rate of population growth and problems with food security.
- Social disparity between political and economic leaders and the majority of the population.
- Gender inequality resulting from traditional role models.

Ethiopia is no exception in this regard. Like in many other developing countries, land is the major socio-economic asset for the rural population in Ethiopia. Land rights influence the use and development of land resources, and hence, the economic growth. The basic objective of land policy is to bring nationwide sustainable development. This effectively incorporates economic, social, and environmental factors within the framework of institutional, political, legal, and technological systems. An effective land administration system addressing the land tenure, land use, land value, and land development at all governmental levels is of paramount importance to enable an appropriate decision-making in order to achieve sustainable land development.

Land tenure describes the manner in which rights on land are held (FAO, 2002). This definition refers to both, legally and customarily defined rights, but also to rights among individuals, groups, or tribes. But land rights also includes rights on natural resources and water. Tenure security is “the certainty that a person’s rights to land will be recognized by others and protected in cases of specific challenges” (FAO, 2002:18).

In Ethiopia, even though land is important for the social, political, and economic life of the people, land tenure security has been challenged in the past. Major problems were raised by changing types of land tenure systems in the recent history: the pre-1975 land tenure system, the land tenure system during the Derg era (1974 – 1991), and the current land tenure system (since 1992).

The pre-1975 Ethiopian land tenure system was highly complex. Regional variations reflected the country’s geographical, ethnic, and cultural diversity (Deiniger et al., 2008; Bruce et al., 1994). This resulted in different types of tenure systems such as rist/kinship, communal, diessa/village, private, state, church, and others (Rahmato, 1984). In the rist system, rights were transferred by inheritance, gift, lease, rent, and sharecropping (Adal, 2002; Ambaye, 2013). The private land ownership, which was a type of land granting by emperor to those who were trustworthy to the regime (e.g. royal family members, military, and civil officials) was a dominant system in the southern part of the country (Rahmato, 1984). Overall, the pre-1975 land tenure system had inadequate security of land rights, and people criticized the system for its hindrance of the country's economic development.

When the military Derg regime overthrew Emperor Haile Selassie in 1974, it followed the socialist doctrine and exercised centrally planned economy. As part of this decision, Derg enacted the 1975 land reform proclamation (Proclamation No 31/1975) thereby making all rural land public property. The rist/gult imperial land tenure system was abolished, all previous land rights were extinguished, and all land was declared public property (Bruce, et al. 1994).

In 1991, the Derg regime was overthrown and the Ethiopian People's Revolutionary Democratic Front (EPRDF) came into power. EPRDF espoused a free market economy system. Many Ethiopians expected private land ownership to be re-established, but the National Constitution (1995) stated that the government of Ethiopia own all land. However, landholders got the right to use their land in perpetuity and were protected from eviction.

The federal state and regional governments of Ethiopia formulated a number of strategic and policy issues addressing aspects of food security, environmental protection, natural resources management, and land tenure. The implementation of a land administration system provides many socio-economic benefits for the society, such as assurance of land tenure security, creating of stable society, providing of security for credits, labour mobility, increased productivity, improved urban planning and infrastructural development, fair taxation, support resources management, and social development. Cognizant of this fact, registering and certifying land rights for lifetime entitlement is under the federal government strategy of the country. This has an immediate impact of improving the livelihood situation of the farmers by motivating them to undertake land-related-investment and by improving the fertility status of the soil besides the other benefits listed above.

Such a solution addresses some of the difficulties mentioned above. Food security is the most obvious goal that land administration addresses. However, good land administration will also aim at fair land distribution and must address land rights for underprivileged groups, e.g., women. Thus, good land administration is a key issue for the development of a country. The quality of land administration can be achieved by the rules of good governance, where indicators like equity, reliability, or transparency are essential (compare Mansberger et al., 2012).

3 LAND ADMINISTRATION SYSTEMS IN DEVELOPING COUNTRIES

Many of today's developing countries were colonies and the first 'modern' land administration systems were introduced by the colonial powers (Shibeshi et al., 2015). They were mainly interesting for the colonial powers, not for the local population since they could not cope with the local land use customs. This is a problem nowadays for many African countries in their efforts to fight poverty. The lack of established land administration systems thwarts the newly established pro-poor laws and prevents progress in poverty reduction, productivity, and governance (Deininger et al., 2008).

3.1 Collision of Systems

Many developing countries traditionally had informal land rights systems. Williamson et al. (2010) distinguish between

- Formal and informal tenures: The separation between formal and informal tenures depends on the recognition of the tenures. Formal tenures are recognized by the land administration system, informal tenures by other normative systems.
- Customary, traditional, indigenous, and native tenures: These types of tenure generally cover land use rights and are based neither on the exercise of brute force nor on a guarantee by government statute (or at least evidence thereof). However, the (local) community recognizes these rights as legitimate. They are acquired and transferred by usually explicitly or generally known rules, which are normally not documented.

On top of these systems, many countries installed land administration systems based on European examples (title-based, deed-based or mixed systems as copies of the Austrian, Dutch, English, Finish, German, Swedish, etc. system). This produces a gap between the two systems since the informal or customary rights are difficult to be addressed in the conventional land administration systems. How, for example, should the right of nomads to use a specific, temporally varying part of a larger area for setting up a camp and grazing their animals be documented in a system based on the idea of exclusive land ownership situations and geographically stable settlements?

3.2 Gender Issues

European laws typically do not distinguish between male and female citizens. Theoretically, the same situation exists in developing countries. A study from 2008 showed that even though gender equality is specified in the laws, the customs and traditions restrict the access of women to land by missing or inadequate implementation (Englert and Mansberger, 2008). An important aspect of this situation is connected to the inheritance rules. It may happen that the male descendent is registered as the landowner although there is also a female descendent. This situation happened for example in Kenya, when women were inadequately informed. In general, male descendants are traditionally privileged in the succession. This may even be based on missing (because never issued) legal documents. Divorce presents a similar situation. In Ethiopia, the wife is entitled by law to receive half of the common property. In reality, however, customary right contradicts this idea and prevents its implementation. The situation in Zimbabwe or Kenya is similarly complicated (Englert and Mansberger, 2008, p. 20-22).

The first step to solve this situation is raising awareness. Political leaders may assume that creating gender-neutral laws is sufficient to solve the problem. Unfortunately, without suitable controls, the laws will be ignored and the inequality continues. Land administration systems provide the data for some of these checks, e.g., if females own a share of the land that corresponds to their proportion of the total population. These simple tools could be used during expert training because experts can only solve issues they are aware of.

A second approach is increasing the number of female experts since they will have a personal interest to solve this kind of inequalities and they do not need to be explicitly pointed to the gender issues. Williamson et al. (2010) identified a list of gender land tools that should be developed and implemented. Five of them (land titling, shared tenure, cooperative purchase, inclusion of women's names on utility bills, and recognition of agricultural and domestic labour) are directly connected to land administration. The others are legal, economical, and general tools.

In cooperation between European and African universities and while setting up new curriculum and research and teaching organisations, gender issues can be addressed in different ways:

- Promoting the land property rights of rural women: Equal access and ownership of property rights is one of the major problems of women in developing countries. Until the near past, women in Ethiopia were not considered as a right holder towards land property rights. Currently, there is great endeavour to provide women with full access to these property rights. The students have to receive education on international standards in land administration and land rights. With this education they will be able to identify and address this problem. Therefore, installing a land administration curriculum plays a pivotal role in strengthening the property rights of women all over Ethiopia.
- Incorporating gender and property rights courses: Curriculum have to be designed and developed by giving attention for gender inclusiveness to enhance the awareness and knowledge of land administration professional on gender issues. Courses on gender and property rights have be incorporated in the curriculum.
- Hiring female instructors: During employment of instructors, female instructors have to be motivated for application. They have to be preferred during the selection process.
- Giving priority for female instructor capacity building: Female instructors have to be prioritized for obtaining a master or PhD degrees abroad.
- Motivating female students to enrol in the program: To increase the capacity of female students, at least 30% of the total numbers of students enrolled to the program each year have to be female. Even during the teaching-learning process, a special tutorial program have to be launched to support female students who require additional academic support

- Strengthening the gender, disables and HIV/AIDS directorate: Educational institutions have to implement a gender, disables and HIV/AIDS directorate in order to provide special support for these segments of the university community. Curricula have to support and strengthen this directorate in order to enable not only the gender issues, but also the other two key cross cutting issues. At least once per year, attitude-changing training programs have to be organized and delivered to students.

3.3 Pro-poor Solutions

Recently, the Social Tenure Domain Model was developed from the Core Cadastral Domain Model (FIG, 2010). The idea of the social tenure model is to include the local population in the data collection process and to enabling the documentation of informal rights. This concept requires tools, which have been implemented in the last decade in the context of Web 2.0 and of crowd sourcing. The focus shifts from a precise documentation of boundaries to a complete documentation of rights. Technically, this leads to a kind of cadastre, in which rights are not represented by the affected boundaries, but only represented as points. This approach can already provide insights into the distribution and variety of land rights (compare Navratil, 2011). The geographic information could be provided by an orthophoto, which enables the right owners to identify the location where they have land rights. Hackman-Antwi et al. (2013) show an example.

An introduction to participatory and pro-poor land administration systems has been published by Shibeshi et al. (2015). The key aspects are:

Policy and law: The property needs a solid definition and the rights connected to the property must be unambiguously defined. Land rights and procedures need to be seen in the context of society and meet the demand. The goal must be security for all stakeholders and a contribution to sustainable development.

Institution and management: Institutions structure human interaction based on formal and informal rules in connection with enforcement characteristics (North, 1993). The functionality is typically centralized in one or two organizations and both types may be efficient (compare Schallert and Navratil, 2014). The goal for the management is to achieve efficiency and clarity or the organization, develop and implement successful strategies to achieve the objectives, and to verify private sector involvement (Steudler et al., 2004).

Monitoring and evaluation: Monitoring and evaluation must include external factors and facilitate a review process (Steudler and Williamson, 2005). It provides feedback on capacity and efficiency.

4 LAND ADMINISTRATION EDUCATION IN ETHIOPIA

4.1 General Remarks

Ethiopia is located at the Horn of Africa. It is a federal state consisting of nine regional states: Amhara, Tigray, Afar, Oromia, Somali, Benishangul-gumuz, Southern Nations and Nationalities and Peoples, Gambela, and Harari. In addition, there are two city administrations: Addis Ababa and Dire Dawa. Ethiopia covers an area of 1.1 million square kilometres and has a great diversity of terrain with a wide variation in climate, soil, natural vegetation, and settlement patterns. The vertical extent ranges from 110 m below sea level to 4550 m above sea level (CSA 2009). The Ethiopian highlands cover most part of the country. Most of the major cities are located at elevations between 2000 and 2500 m above sea level. Like most African countries, Ethiopia is experiencing a growing urbanization and concomitantly a transformation of peri-urban land tenure from agricultural to urban land use.

Establishing an overarching and progressive land administration system in the country is of top priority for the federal and regional governments of Ethiopia. A proper administration of the crucial resource land is essential for the economic growth and sustainable development of any country. This requires trained and qualified workforce in this discipline. Currently, there is only one land administration institute opened in 2004 at Bahir Dar University with support of the Swedish International Development Cooperation Agency (SIDA) and Swedish Royal Institute of Technology (KTH). However, a single institute is not able to sufficiently provide the person-power required for the implementation of the governmental agendas.

As indicated in the 5 Years Strategic Plan for Land Administration in Ethiopia, other universities have to give attention to land administration issues and to establish academic programs on this topic. Even though there is the great desire of the government and universities to open the program, the main constraining factor is the lack of trained personnel and the lack of resources for education. Technical and financial support is required for training and capacity building of professionals, who will

- teach at the universities,
- undertake different developmental activities in public and private land administration institutes, and
- conduct land-related research activities.

Recent studies of the Institute of Land Administration at Bahir Dar University (ILA) outline a demand of at least 50,000 new land administration professionals for the next ten years (Medendorp et al., 2014). In contrast, less than 600 professionals are currently available in the country. To fill the gap of the trained person-power, the national government is establishing land administration programs at different universities. This is an imperative necessity to guarantee the roll-out of second level certification (mapping of parcels) in the Ethiopian land administration. The budget for the roll-out phase is already prepared and the roll-out will be co-financed with 150 million dollars by an international consortium (consisting of World Bank, and public bodies from Finland, UK, EU, Norway, US, Germany, and Austria). The implementation of education and research on land administration is imperative for the project.

With financial support of the Austrian Development Agency (APPEAR-Partnership-Project 'EduLAND2 - Implementation of Academic Land Administration Education in Ethiopia for Supporting Sustainable Development'), the Debre Markos University (DMU) established the Institute for Land Administration (ILA/DMU), developed and implemented a curriculum for the undergraduate program (BSc, 4 years) of 'Surveying and Land Administration' in 2016 to meet these demands. The authors of this article are the Austrian coordinators of the EduLAND2 - project.

DMU is located in Debre Markos City, 300 km northwest from Addis Ababa and 265 km southwest of Bahir Dar, the capital of Amhara National Regional State (ANRS). The university has the overarching vision of becoming one of the best universities in Africa by the year 2030 with the mission of producing competent and innovative professionals. This should be achieved by providing quality instructional, co-curriculumr and cultural involvement, by carrying out problem solving research, and by delivering demand driven community services. DMU is organized in six colleges and one school. DMU provides currently 34 undergraduate programs and 9 programs in post graduate level. DMU has more than 17,000 students enrolled in regular, evening and summer programs. The latter two programs are dedicated for professional continuing education. In addition to teaching, DMU is engaged in research and consulting focused on regional challenges related to DMU expertise. DMU is running projects in an effective manner. Construction projects may be mentioned: Because of the newness and the rapid increase in student and staff numbers, DMU constructs required infrastructure by their own. DMU is also running businesses, like dairy farms and fattening farms. Currently, DMU is undertaking joint research projects with Addis Ababa University in the Choke Mountains funded by international NGOs. DMU is doing its best for the successful accomplishment of these activities and has exhibited good progress. Besides, the regular budget of 400 million Birr (national currency; equivalent to approximately 16 million Euro) is being accomplished successfully.

4.2 BSc Programme Land Administration and Surveying at Debre Markos University

A first step for the curriculum creation was an initial survey of the educational needs in spring 2016. DMA academic staff conducted a need assessment study. They consulted 103 respondents from land administration affiliated governmental institutions with a comprehensive questionnaire containing structured, semi-structured, and open-ended questions. The study confirmed the current shortage of trained land administration experts and the increasing future demand as documented by Medendorp et al. (2014). Based on the outcomes of the needs assessment the structured of the BSc programme "Land Administration and Surveying" was developed. Additionally, the results were used for the detailed elaboration of course contents (learning outcomes).

Starting point of the curriculum development was the harmonised curriculum on 'Land Administration and Surveying' of Institute of Land Administrations of Bahir Dar University (ILA/BDU), Woldia University (WU), and Haramaya University (HU). These study programs contain subjects of technical, natural, legal, and socio-economic sciences. Specific attention for the study course in Debre Markos was given to be fit-for-future and fit-for-purpose land administration by covering measures of land consolidation and the assessment of land-related information by remote sensing techniques. Gender aspects are addressed prominently in

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relevant lectures. Specific courses covering the principles of gender mainstreaming and gender issues in land rights are part of the study programme. The whole curriculum development process was conducted within six months.

4.3 First results

The recruitment and employment of additional teaching staff and the upgrading of existing teaching staff is essential for the success of the curriculum. Currently, an insufficient number of staff members have a PhD or master degree. This issue needs to be addressed in the future. Staff members could be sent abroad to obtain PhD and Master degrees from European or Asian universities. For students coming to Austria, funding for the scholarships of these three students can be requested from the appear grants program. Other countries have similar programs for incoming students. A significant portion of the trained staff members should be female. The final group of teaching staff can consist of four different groups: permanent staff of DMU, external instructors from Bahir Dar University, experts from public institutions (Bureau of Environmental Protection and Land Administration and Use, BoEPLAU), and from international experts. Currently, one staff members is enrolled for further education in a master program and one staff member in a PhD program at the University of Natural Resources and Life Sciences Vienna (BOKU).

The enrolment of students in BSc program was conducted at DMU in autumn 2017. According to the plan, 50 students were accepted for first year. The limitation to 50 students was made for practical reasons, since all courses in the curriculum have to be developed. This will require specific efforts at the beginning by the ILA/DMU staff members. In the following years, the amount of students continually will be increased.

As indicated in the project document, at least 30% of all accepted students have to be female. Reality showed an immense interest of female students for this study program and finally 36 (72%) female and 14 (38%) male students were enrolled for the ‘Land Administration and Surveying’ bachelor program.

4.4 Gender Perspectives

Gender mainstreaming and the support of unprivileged groups is a focus of the presented EduLAND2 project. Females were preferred during staff recruitment, in staff training, and in student enrolment. Delivering of short-term training in gender-related issues is a key element of the project. All project partners insisted on the integration of gender perspectives into the curriculum. The following activities to support females and other underrepresented groups were outlined:

4.4.1 Advisory Board with Representatives of Unprivileged Groups

On advise of the APPEAR Selection Board representatives of unprivileged groups became members of the Advisory Board of the project. One is the head of Women’s Association in Debre Markos, the other is a representative of the local Farmers Association. Both provided valuable inputs for the curriculum development and for the final set-up of the project.

4.4.2 Staff Recruitment for Institute of Land Administration at DMU

As one of the first activities of EduLAND2 project, DMU implemented – in cooperation with the other project partners - the Institute of Land Administration. Staff was recruited from other colleges of the university as well as from the market. During staff recruitment, affirmative action was given to attract female instructors to the institute. Unfortunately, the market of female land professionals (especially with academic degree) is very limited and only two of 12 recruited staff members are female. Two additional female experts were employed as non-academic staff members, one as technical assistant and one as computer attendant.

4.4.3 Curriculum Development

All project partners took special endeavours to integrate gender perspectives into the curriculum with the results, that a separated course ‘Gender and Land Rights’ is included in the curriculum of the Bachelor programme on ‘Land Administration and Surveying’. Additionally, concerns of unprivileged groups and raising awareness for mitigating their disadvantages are mainstreamed in different courses of the curriculum.

4.4.4 Gender related lecture for DMU students

In the project a short training on gender related issues for 100 students is scheduled for the second year. Due to the importance of the matter, the training on gender and development was delivered also in the first project year. The training was successfully conducted by a gender expert from DMU for 90 students in February 2017.

4.4.5 Students Enrolment

The announcement for the BSc study program 'Land Administration and Surveying' motivated female persons to apply. Finally, a huge number of female students applied for the program – as outlined above.

4.4.6 Scholarships

In the PhD scholarship application process, preferences were given to women. Despite the fact, that Land Administration (also worldwide) is a male dominant area, it was possible to recruit one female candidate for a PhD scholarship application. Unfortunately, due to application requirements at BOKU, the PhD scholarship had to be changed to a MSc scholarship with the option of a PhD scholarship after graduation.

Another female instructor of ILA/DMU, who is a bachelor holder in land administration, registered at ILA/BDU and is attending a MSc study program in land valuation.

5 CONCLUDING REMARKS

The development of a curriculum in land administration is in line with the Sustainable Development Goals (SDG). The project contributes to the efficient implementation of rural and urban development strategies and programs. A successful project implementation will contribute to poverty reduction, food security, quality education, gender equality and it will help to strengthen the Ethiopian land administration sector.

It is known that a proper land administration is the backbone of land tenure security and by that it

- plays a pivotal role in combating poverty;
- is desirable for planning and managing resources in an integrated approach;
- reduces gender disparity in access and control to land;
- helps to design appropriate land policies, which strengthen the role of indigenous people and communities; and it
- plays a pivotal role for sustainable development of a country, since it addresses the economic, social, and environmental pillars of sustainability.

The centrality of land for development and the need for proper land management has also been clearly stipulated in the land policy initiative of the African Union.

The development is also in line with the Growth and Transformation Plan (GTP) of Ethiopia. The Federal Republic of Ethiopia has recently adopted a five year strategic plan for sustainable land administration in the country. The plan addresses the SWOT analysis of the existing land administration system in practice and potential areas of intervention. The planned activities include

- the finalization of the certification process (first level of land registration process) and the roll-out
- of cadastral surveying (second level of land registration activities),
- the review and preparation of an operational legal framework and the digitalisation of land records,
- the development of a strategic master plan for the nation and of local development maps in an appropriate scale,
- the strengthening of existing land administration organs and implementation of new ones, where they do not exist, and the capacity building on human and material resources.

The Ethiopian Strategic Plan clearly outlines the different levels of education and training required for sustainable land management in the country. Thus, by 2025 it is planned to produce nearly 56,000 professionals in land management. Out of this 22,500 will be trained in short-term-programs (3 months), 27,500 in diploma, 4,640 in under graduate degree, and 60 in post graduate degree (these figures are in accordance with the results of the study Medendorp et al. (2014). However, the lack of academic programs is the constraining factor for all these levels of education and training.

The development and sustainability of a launched land administration system at all levels of government thus requires the availability of well trained and skilled person-power in land administration. However, shortage

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of trained person-power in the field of land administration is one of the challenges to implement effectively the launched land administration system in the country. Currently, the government employs non-professionals or experts from other disciplines to solve the problem temporarily. The education and training of these persons is carried out in short-term trainings, which leads to inefficiency and strongly hinders the effectiveness in land administration processes. The country in general and Amhara National Regional State in particular will benefit from the implementation of a curriculum in land administration by getting access to competent and innovative professionals.

The academic education program will enable a sustainable management of Ethiopian land resources through ensuring security of tenure among land holders. Additionally, research activities will address problems of land use and land tenure and will contribute to find solutions for land-related problems of the local societies. Finally, community services developed in parallel would enable the knowledge transfer to the local community. All these activities will have a positive impact in terms of poverty reduction and food security.

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7 REFERENCES

ADAL, Y. (2002): Review of landholding systems and policies in Ethiopia under different regimes: Ethiopian Economic. Association Policy Research Institute, Addis Ababa, Ethiopia.

AMBAYE, D. (2013): Land rights and expropriation in Ethiopia. Doctoral Thesis, Royal Institute of Technology (KTH), Stockholm, Sweden.

BRUCE, J.W.; HOBEN, A. & RAHMATO, D. (1994), After the Derg: An assessment of rural land tenure issues in Ethiopia. University of Wisconsin-Madison, USA.

DEININGER, K., ALI, D.A., HOLDEN, S., ZEVENBERGEN, J. (2008): Rural Land Certification in Ethiopia: Process, Initial Impact, and Implications for Other African Countries. World Development, 36(10): 1786-1812.

ENGLERT, B., MANSBERGER, R. (2008): Vergleichsstudie zu Gender und Landrechte in den Schwerpunkt- und Kooperationsländern der Österreichischen Entwicklungs- und Ostzusammenarbeit. Vienna Institute for International Dialogue and Cooperation (VIDC), Vienna, 41 p.

FAO (2002): Land tenure and rural development. FAO land tenure studies 3, Rome, Italy.

FIG (2010): The Social Tenure Domain Model: A Pro-Poor Land Tool; edited by Christiaan Lemmen. FIG publication Nr. 52. International Federation of Surveyors & Global Land Toll Network (GLTN) & United Nations Human Settlements Programme (UG-Habitat), Copenhagen, Denmark, 24 p.

HACKMAN-ANTWI, R., BENNETT, R.M., DE VRIES, W., LEMMEN, C.H.J., MEJER, C. (2013): The point cadastre requirement revisited. Survey Review, 45(331): 239-247.

MANSBERGER, R., NAVRATIL, G., MUGGENHUBER, G., TWAROCH, C. (2012): Is Good Governance in Land Administration Measurable and Comparable? Die Bodenkultur, 63(1): 27-34.

MATTSSON, H., MANSBERGER, R. Land Governance / Management Systems (2017): In HEPPERLE et al. (eds.) Land Ownership and Land Use Development, vdf Hochschulverlag AG, Zürich: 13-24.

MEDENDORP, J., SCHULTINK, G., BONNELL, J., WOUBE, M., DAGNEW, A., PITORO, R. (2014): Ethiopia Land Administration and Nurture (LAND) Project – Ethiopian Land Administration Professional Educational Demand Assessment, and Basic Curriculum and Instituional Capacity Review. US AID. Tetra Tech. ARD.

NAVRATIL, G. (2011): Cadastral Boundaries: Benefits of Complexity. Journal of the Urban and Regional Information Systems Association (URISA), 23(1): 19-27.

NORTH, D.C. (1993, December 9). Nobelpriz.org. Retrieved from nobel_prizes: <http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1993/north-lecture.html>.

RAHMATO, D. (1984): Agrarian Reform in Ethiopia. Scandinavian Institute of African Studies, Uppsala, Sweden.

SACHALLERT, M., NAVRATIL, G. (2014): Cadastre and Land Registration - One or Two Organizations? A Comparison between Austria and Sweden from a User's Perspective. In: MEDAK, REZO, ZRINJSKI (eds.) Fifth Croatian Congress on Cadastre – Proceedings, Croatian Geodetic Society: 7-14.

SHIBESHI, G.B., FUCHS, H., MANSBERGER, R. (2015): Lessons from Systematic Evaluation of Land Administration Systems. The Case of Amhara National Region State of Ethiopia. World Development, 68(3): 282-295.

STEUDLER, D., RAJABIFARD, A., WILLIAMSON, I.P. (2004): Evaluation of Land Administration Systems. Land Use Policy, 21(4): 371-380.

STEUDLER, D., WILLIAMSON, I.P. (2005): Evaluation of National Land Administration System in Switzerland. Survey Review, 38(298), 317–330.

WILLIAMSON, I.P., ENEMARK, S., WALLACE, J., RAJABIFARD, A. (2010): Land Administration for Sustainable Development. ESRI Press, New York.

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Landwirtschaftliche Konversion – Chancen der Umnutzung ehemaliger Landwirtschaftsbetriebe an den Siedlungsrändern

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1 ABSTRACT

Seit 1972 wird in der Schweiz zwischen Baugebiet und Nichtbaugebiet unterschieden [KOLL-SCHRETZENMAYR 2008, 37]. Letzteres ist dabei, bis auf sehr wenige Ausnahmen, von Überbauung grundsätzlich frei zu halten (vgl. Art. 16 Raumplanungsgesetz). Dennoch befindet sich heute rund jedes vierte Gebäude der Schweiz im Nichtbaugebiet [ARE 2012, 18]. Grund hierfür ist in erster Linie die Landwirtschaft, die zur Bewirtschaftung Ihrer Flächen auf diesen Standort angewiesen ist. Dieser Sektor ist jedoch seit Jahrzehnten durch einen anhaltenden Strukturwandel geprägt, der sich vor allem durch den stetigen Rückgang landwirtschaftlicher Betriebe äussert. In der Folge stehen immer mehr vormals landwirtschaftlich genutzte Gebäude leer oder werden, mehr oder weniger legal, umgenutzt ("landwirtschaftliche Konversion"). Letzteres hat dabei oftmals negative ökologische aber auch ökonomische und landschaftsästetische Folgen.

Eine Kontrolle dieser Entwicklung gestaltet sich in der Praxis aufgrund der mangelnden Datenbasis schwierig. Übersichten oder eine Monitoring bestehen bestensfalls im Ansatz. Im Zuge des vom Schweizer Nationalfond geförderten Forschungsprojekts "Handlungsoptionen für bestehende Gebäude ausserhalb der Bauzonen" wird versucht einen Beitrag zum Schliessen dieser Forschungslücke zu leisten. Im Zuge des Projekts wurde eine schweizweite Übersicht über die Quantitäten und, soweit möglich, auch Qualitäten des Gebäudebestandes im Aussenbereich geschaffen. Die Forschungsergebnisse zeigen dabei, dass ein differenzierte Herangehensweise lohnenswert ist. So befinden sich schätzungsweise etwa 10 bis 15% der Gebäude im rechtlichen Nichtbaugebiet, innerhalb des Siedlungskörpers. Während diese Gebäude jedoch nicht genutzt werden dürfen, werden gleichzeitig neue Baugebiete auf der grünen Wiese erschlossen. Könnten diese Gebäude hingegen, beispielsweise zu Wohnzwecken, genutzt werden, bieten diese eine schweizweite Kapazität für rund 45'000 bis 140'000 zusätzliche Einwohner. Das Potenzial befindet sich dabei vor allem im wachsenden Mittelland, nahe der grossen Zentren und somit genau dort, wo Flächen für das Einwohnerwachstum benötigt werden. Landwirtschaftliche Konversion kann daher auch an geeigneten Stellen im Aussenbereich Chancen für eine geornete Besiedlung des Landes bieten.

Keywords: Konversion, Flächensparen, Umnutzung, Bauzone, Landwirtschaft

2 EINFÜHRUNG

2.1 Zentrale Aspekte der Schweizer Raumplanung

Mit Inkrafttreten des Gewässerschutzgesetztes 1972 erfolgte die erste schweizweite Trennung zwischen Baugebiet und Nichtbaugebiet [KOLL-SCHRETZENMAYR 2008, 37]. Seit der Einführung des Raumplanungsgesetztes 1980 wird in der Schweizer Raumlanung offiziell in Bauzonen sowie Nichtbauzonen unterschieden. Letzteres ist dabei im Wesentlichen von Überbauung frei zu halten (vgl. Art. 16 Raumplanungsgesetz RPG). Nichtbauzonen umfassen vor allem Schutzzonen aller Art sowie Landwirtschaftszonen, d.h. Areale die vorwiegend der bodenabhängigen Produktion dienen. Die Besiedelung, d.h. zum Beispiel Bebauung zu Wohn- und Arbeitszwecken, ist hingegen in den Bauzonen zu konzentrieren (Art. 15 RPG). In einer Volksabstimmung bekräftigte das Schweizer Stimmvolk den Trennungsgrundsatz durch die deutliche Annahme (63%) des revidierten Raumplanungsgesetztes. Ziel der 2014 in Kraft getretenen Gesetzesänderung ist es, durch die Förderung einer kompakte Siedlungsentwicklung die Zersiedelung in der Schweiz zu bremsen. Dazu sollen überdimensionierte Bauzonen verkleinert und bestehendes Bauland effizienter genutzt werden. [ARE 2017a]

Trotz des vorhandenen Trennungsgrundsatzes befindet sich heute schweizweit schätzungsweise jedes vierte Gebäude ausserhalb der Bauzonen [ARE 2012, 18]. Dies im wesentlichen aus drei Gründen: Zum einen stehen mit rund zwei Dritteln ein Grossteil der Gebäude ausserhalb der Bauzonen im direkten Zusammenhang mit der Landwirtschaft (Zonenkonformität nach Art. 16a RPG). Zum anderen sind etwa ein Viertel des Gebäudebestandes altrechtliche Bauten sowie ehemals landwirtschaftlich genutzte Gebäude

(Bestandsschutz nach Art. 24c RPG). Zuletzt spielen standortgebundene Bauten nach Art. 24 RPG (z.B. Infrastrukturbauten und Gebäude, die touristischen bzw. gastronomischen Zwecken dienen) mit weniger als 10 % eine vergleichsweise untergeordnete Rolle. [BRP 1994, 3 f.]

2.2 Transformation des Nichtbaugebiets

Die Schweizer Landschaft wird massgeblich durch die Landwirtschaft geprägt: rund ein Viertel des Landes wird landwirtschaftlich genutzt, ein weiteres Achtel dient der Alpwirtschaft [BfS 2016, 4]. Der landwirtschaftliche Strukturwandel zeigt sich dabei deutlich in der Landschaft. Unter dem Begriff des Strukturwandels in der Landwirtschaft wird zum einen der Verlust der volkswirtschaftlichen Bedeutung des primären Sektors, zum anderen die Rationalisierung der landwirtschaftlichen Produktion, in Folge der durch Globalisierung- und Technisierungsprozesse entstehenden niedrigen Lebensmittelpreise, verstanden [HOFER 2010, 2]. Wesentliche Folge des Strukturwandels ist die abnehmende Betriebsanzahl bei steigender Flächengrösse der verbleibenden Betriebe. So gab es 2015 in der Schweiz rund 53‘000 landwirtschaftliche Betriebe und damit rund 17‘000 Betriebe weniger als noch im Jahr 2000. Obgleich sich der Strukturwandel im europäischen Vergleich mit einer jährlichen Betriebsabnahme von rund 1,7 % in der Schweiz eher gemässigt zeigt, stellen dennoch aktuell täglich rund drei Betriebe ihre Arbeit ein [BfS 2016, 8].

Nach der Betriebsaufgabe werden die Wohngebäude meist weiterhin bewohnt - allerdings nur selten durch aktive Landwirte. Die Folge ist eine Zunahme landwirtschaftsfremder Bevölkerung sowie ungenutzter Ökonomiegebäude ausserhalb der Bauzonen. Bereits heute werden nur noch etwa ein Drittel der Wohngebäude ausserhalb der Bauzonen von Beschäftigten des primären Sektors bewohnt [ARE 2005, 31]. Ehemalige Bauernhöfe sind insbesondere im Schweizer Mittelland, wo sich der Grossteil der Betriebe befindet, begehrte Kaufobjekte, mit denen oftmals Millionengewinne erzielt werden können. Der zunehmende Siedlungsdruck innerhalb der Bauzone wirkt dabei als zusätzlicher Katalysator auf die Transformation. Die gesetzlichen Einschränkungen, die durch Inkrafttreten des neuen Raumplanungsgesetztes 2014 nochmals verstärkt wurden, stehen dem Wunsch nach einem „Haus im Grünen“, der noch immer vielfach verwurzelt ist, entgegen. In den bestehenden Bauzonen wird zunehmend dichter gebaut. Das Angebot an „klassischen“ Einfamilienhäusern am Ortsrand wird stetig reduziert. Der Kauf eines Gebäudes ausserhalb der Bauzonen ist daher, insbesondere im Mittelland, für viele eine interessante Alternative. Folgen sind unter anderem ein erhöhter MIV-Anteil mit allen ökologischen und ökonomischen Folgeeffekten sowie hohe Infrastrukturkosten und eine Beeinträchtigung des Landschaftsbildes.

Ein Dilemma offenbart sich für die Nicht-Wohnegebäude ehemaliger Landwirtschaftsbetriebe: Entgegen den Wohngebäuden ist eine landwirtschaftsfremde Nutzung ehemaliger Ökonomiegebäude sehr problematisch. Gehört das Gebäude nicht zu einem aktiven Landwirtschaftsbetrieb, kommt lediglich eine Hobbymässige Tierhaltung (Art. 24d RPG) oder eine Umnutzung ohne bauliche Massnahmen (Art. 24a RPG) in Frage. Beide Regelungen sind jedoch mit zahlreichen Restriktionen verbundenden, die de facto in den meisten Fällen eine Umnutzung per se ausschliessen. Auf der anderen Seite verhindert die in der Bundesverfassung festgeschriebene Eigentumsgarantie (Art. 26 BV) die Durchsetzung des Rückbaus. Zwar gibt es die Möglichkeit im Zuge der Baubewilligung ein so genanntes Rückbaurevers einzutragen, jedoch haben die Kantone hiervon in der Vergangenheit nur sehr selten Gebrauch gemacht. In der Folge bestehen heute in der Schweiz unzählige ehemalige Ökonomiegebäude, die entweder aufgrund der fehlendenden Nutzung zunehmend verfallen oder aber illegal umgenutzt werden. Die fehlende qualitative Raumbeobachtung sowie der schwache Vollzug begünstigten letzteres insbesondere im Mittelland – also jenem Gebiet in dem auch der Nutzungsdruck besonders hoch ist.

2.3 Stand der Forschung und aktuelle Gesetztes-Diskussion

Art. 45 der Schweizer Raumplanungsverordnung verpflichtet das Bundesamt für Raumentwicklung zum Monitoring der Bautätigkeit ausserhalb der Bauzonen. Damit „soll geprüft werden, ob die durch die Gesetzgebung angestrebten Ziele auch tatsächlich erreicht werden und die räumliche Entwicklung in die gewünschte Richtung verläuft.“ [ARE 2012a, 13] Vier Berichte hat der Bund bisher zu diesem Thema veröffentlicht [vgl. BRP 1994, ARE 2005, ARE 2012, ARE 2016]. Neben einer Übersicht über die Quantitäten und teilweise Qualitäten des Gebäudebestandes ausserhalb der Bauzonen, zeigen diese auch die Defizite in der vorhandenen Datenbasis auf. So sind detaillierte und insbesondere handlungsorientierte

Analysen nur für Gebäude möglich, die ganz oder teilweise Wohnzwecken dienen. Das trifft jedoch nur auf ein knappes Drittel der Gebäude zu. Für einen Grossteil des Bestandes bleiben daher viele Fragen, insbesondere nach dem Zweck, der Nutzung und dem Alter des Gebäudes sowie allenfalls vorhandener Leerstände, offen. Für Nichtwohngebäude beschränken sich die bisherigen Untersuchungen daher auf die reine Quantität. Allerdings ist selbst diese nur näherungsweise bestimmbar, wie die unterschiedlichen Angaben in den Berichten zeigen. Zu begründen ist dies insbesondere in der lückenhaften, digitalen Datenbasis, aber auch in der Erfassungsmethodik und –qualität der einzelnen Daten. Herausfordernd ist in diesem Zusammenhang auch der ausgeprägte Föderalismus in der Schweiz. Die Herangehensweisen der 26 Kantonen unterscheiden sich teils stark, wodurch eine schweizweite Übersicht erschwert wird. Einige Kantone führen zwar selbstständig ein eigenes Monitoring durch, jedoch fehlt auch diesen die Datenbasis für eine fundierte Auseinandersetzung mit dem Altbestand [vgl. z.B. KANTON BASEL-LANDSCHAFT 2015, KANTON ZÜRICH 2014]. Die kantonalen Übersichten gehen daher vor allem hinsichtlich dem Monitoring von aktuellen Bautätigkeiten ausserhalb der Bauzonen weiter.

Diese, noch immer ungebremste, Bautätigkeit sowie der Transformationsprozess allgemein gaben dem Bund Anlass eine Studie zum Thema Fehlanreize in Auftrag zu geben. Der 2015 veröffentlichte Bericht „Bauen ausserhalb der Bauzonen: Fehlanreize im Nichtbaugebiet – eine Übersicht“ identifizierte verschiedene systematische sowie vollzugsbedingte Fehlanreize. Der Bericht gibt somit Aufschluss darüber an welchen Stellen im System einzugreifen ist um die Bautätigkeit und damit den wachsenden Bestand ausserhalb der Bauzonen einzudämmen. [vgl. IWSB 2015]

Neben den vorangegangenen Untersuchungen hat sich auch die Architektur eingehend mit dem Thema beschäftigt. Zahlreiche Studien und Praxisbeispiele zeigen, wie ehemalige Ökonomiegebäude sinnvoll umgenutzt und alte Bauernhäuser zeitgemäss saniert werden können [vgl. z.B. HOCHBAUDEPARTMENT ZÜRICH 2004]. Dadurch wird deutlich, welchen grundsätzlichen Wert diese Gebäude habe. Aus Sicht der Raumplanung ist das Thema Umnutzung jedoch bislang im Aussenbereich rein negativ besetzt – obgleich eine differenzierte Auseinandersetzung mit den Qualitäten der Gebäude bislang fehlt.

Eine solche Herangehensweise, für die eine fundierte qualitative Übersicht unerlässlich ist, ist jedoch gerade vor dem Hintergrund der angestrebten zweiten Teilrevision des RPG wünschenswert. In Fachkreisen besteht weitestgehend Einigkeit darüber, dass das Raumplanungsrecht im Bereich Bauen ausserhalb der Bauzonen überarbeitet werden muss [vgl. bspw. KISSLING 2016, FÜEG 2016]. Die stetigen Änderungen der vergangenen Jahre, deren Treiber häufig spezifische Nutzerinteressen waren, haben zu einem äusserst komplexen Regelwerk geführt. Dies führte einerseits zu einem schleichenden Unterlaufen des Trennungsgrundsatzes, andererseits aber auch, aufgrund der zunehmenden Unübersichtlichkeit, zu mangelnder Rechtssicherheit. Um dem zu begegnen erarbeitet des Bundesamt für Raumentwicklung aktuell einen revidierten Gesetzentwurf für den Bereich Bauen ausserhalb der Bauzonen. Die aktuelle Planung sieht dabei vor, dem Bundesrat bis Mitte 2017 die revidierte Version des Gesetztes zur Entscheidung vorzulegen. [ARE 2017b] Aufgrund der Komplexität und vielfältigen Akteursinteressen, ist jedoch sehr wahrscheinlich dass nach mehrjährigen Diskussionen am Ende das Volk über die Annahme des Gesetztes entscheidet. Die Schaffung einer handlungsorientierten Übersicht käme daher zum aktuellen Zeitpunkt gerade noch rechtzeitig.

3 LEERSTÄNDE AN DEN SIEDLUNGSRÄNDERN AUSSERHALB DER BAUZONEN

3.1 Methodisches Vorgehen

Ziel des Forschungsprojekts „Handlungsoptionen für bestehende Gebäude ausserhalb der Bauzonen“ ist es eine handlungsorientierte Übersicht über Gebäude ausserhalb der Bauzonen zu erstellen. Aufgrund der zuvor aufgeführten lückenhaften Datenbasis, wurde für die nachfolgenden Ergebnisse vielfach mit geschätzten Parametern gearbeitet.

Die Gebäude selbst entstammen, soweit vorhanden, aus der amtlichen Vermessung, ersatzweise aus dem Topografischen Landschaftsmodell (Erfassung mittels Photogrammetrie). Die Daten wurden geometrisch bereinigt und methodisch auf eine Grösse zwischen 30 und 4000 m2 sowie auf die Lage ausserhalb der Bauzonen eingegrenzt. Zur Identifizierung der Bauzonen werden die harmonisierten Bauzonen des Bundesamts für Raumentwicklung herangezogen.

Einer von zwei zentralen „Knackpunkten“ der Auswertung bildet die Bestimmung der Siedlungskörper („weitgehend überbautes Gebiet“) der aufgrund des gesamtschweizer Fokus nicht manuell sondern automatisch abgegrenzt werden musste. Hierzu wurden in einem GIS schweizweit alle Gebäude (Topografisches Landschaftsmodell, TLM) mit einer max. Distanz von 50 m zu Objekten mit einer Grösse von min. 5 ha aggregiert. Die Mindestanzahl von 100 Gebäuden sowie die Schnittmenge mit den Bauzonen sowie anderen Siedlungskörpern wurde in einem iterativen Prozess festgelegt.

Zweiter „Knackpunkt“ ist die Abschätzung der Leerstände von ehemaligen Ökonomiebauten, da hier bewährte Methoden aus der Siedlung nicht greifen. Die Abschätzung beruht dabei auf einer rechtsbasierten Annahme: Gemäss RPG dürfen freistehende Ökonomiegebäude sowie der Grossteil des Ökonomieteils bei Mehrzweckgebäuden nicht zweckfremd genutzt werden. Auf der Grundlage einer schweizweiten Analyse der Bauernhoftypolie wurden deren charakteristische Merkmale, insbesondere Gebäudedistanz, -anzahl, -grösse und –typ, bestimmt. Diese dienten im Anschluss als Anhaltspunkt zur Identifikation von Bauernhöfen. Ein Verschnitt mit den aktuellen Betriebsstandorten ermöglichte schliesslich die Auswahl der vermutlich aufgegebenen Betriebe. Durch stichprobenartige Ortsbegehungen in verschiedenen Regionen der Schweiz sowie Gespräche mit Gemeinden im Kanton Schwyz konnte das Ergebnis verifiziert werden.

3.2 Quantitative Einordnung

Auf der Basis der vorangegangenen methodischen Ausführungen, existieren schweizweit knapp 465‘000 Gebäude ausserhalb der Bauzonen. Aufgrund des Einbezugs verschiedener Datengrundlagen (TLM und AV) sowie der uneinheitlichen Vorgehensweise bei der Erfassung von Gebäuden, wird nachfolgend auch jeweils die Gebäudefläche („Gebäudefootprint“) als Referenzgrösse aufgeführt. Die genannten 465‘000 Gebäude ausserhalb der Bauzonen weisen insgesamt eine Gebäudefläche von knapp 8‘700 ha auf.

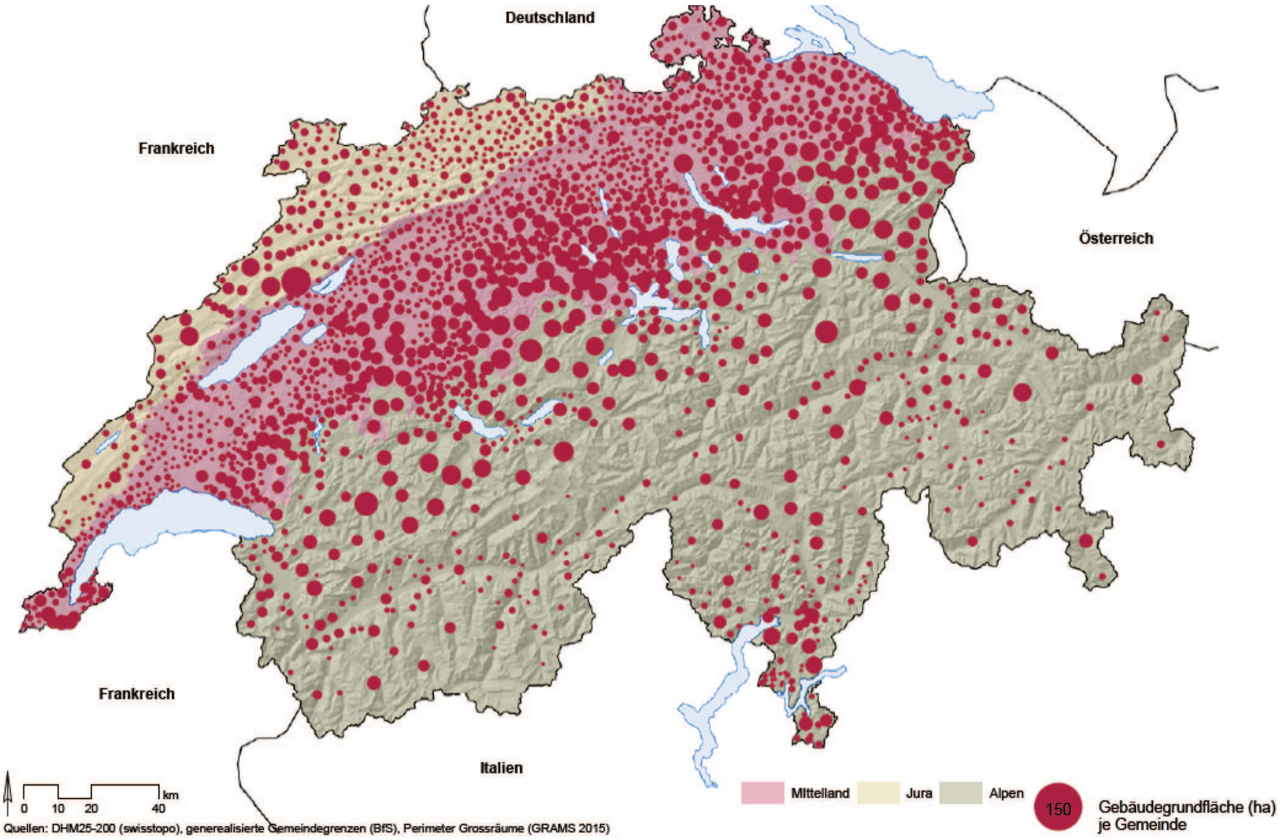

Abbildung 1: Grossräumige Lage der Gebäude ausserhalb der Bauzonen (Quelle: eigene Darstellung)

Grossräumlich betrachtet befindet sich der grösste Teil (54 %) der Gebäudefläche im Mittelland, d.h in dem zentralen Siedlungs- und Wachstumsraum der Schweiz. Abbildung 1 veranschaulicht die Konzentration hauptsächlich in dessen Süden, der so genannten Hügelzone, d.h. dem Übergang zu den Alpen. Dieser Bereich ist vor allem durch kleinteilige Strukturen, insbesondere durch viele kleine Milchproduzenten geprägt. In den flachen Lagen des Mittellandes sind die Betriebe, bedingt durch die Topografie und betriebswirtschaftliche Ausrichtung (v.a. Ackerbau) hingegen grösser. Dementsprechend gibt es dort weniger

Höfe und folglich weniger Gebäude. Die Alpenregion ist historisch durch die Drei-Stufen-Wirtschaft geprägt. Daraus resultiert der hohe Anteil an Gebäuden ausserhalb der Bauzone bei vergleichsweise geringem Flächenanteil. Es wird somit auch deutlich, dass sich im Mittelland eher grosse Gebäude befinden, in den Alpen eher kleine.

Betreffend der kleinräumigen Lage zeigt sich, dass mit rund 38 % der Gebäudefläche ein überraschend grosser Anteil nahe der Siedlungskörper (max. 500 m Entfernung) liegt. 10 bis 15 % der Gebäude befindet sich sogar innerhalb des Siedlungskörpers. Diese Gebäude sind rechtlich betrachtet in der Nichtbauzone, räumlich-funktional gesehen jedoch Bestandteil der Siedlung (vgl. bspw. Abbildung 2). Häufig handelt es sich hierbei um landwirtschaftliche Betriebe am Ortsrand. Absolut betrachtet sind das etwa 43'000 Gebäuden resp. 1000 ha Gebäudefläche (11,5 %). Knapp 8000 dieser Gebäude (17 %) resp. 153 ha der Gebäudefläche (15 %) stehen vermutlich leer.

Abbildung 2: Beispiel eines Landwirtschaftsbetriebs ausserhalb der Bauzone am Siedlungsrand, Neftenbach ZH (Quelle: eigene Aufnahme)

Eine schweizweite, automatisierte Abgrenzung der Siedlungskörper gestaltet sich schwierig, da eine zuverlässige Beurteilung der Situation eine Augenscheinnahme bedingt. Die Quantitäten dieser Potenzialkategorie müssen daher aufgrund verschiedener Faktoren abgeschätzt werden (vgl. obenstehende Methodik). Aufgrund der automatisch ermittelten Siedlungskörper ergibt sich schweizweit ein Potenzial von rund 2,8 bis 4,7 Mio. m2 (Brutto-)Geschossfläche in bestehenden Leerständen ausserhalb der Bauzonen. Manuelle Abgrenzungen der Siedlungskörper in den Kantonen Thurgau, Schaffhausen und Schwyz lassen jedoch vermuten, dass die Summe der Gebäude innerhalb dieses Perimeters um 10-40 % höher ist. Unter Einbezug dieser Erkenntnis kann die Potenzialabschätzung auf 3,1 bis 6,6 Mio. m2 Geschossfläche erhöht werden (vgl. Abbildung 3). Rund ein Drittel dieses Potenzials befindest sich dabei schätzungsweise in Mehrzweckgebäuden, zwei Drittel in reinen Ökonomiegebäuden. Wird diese Fläche ausschliesslich für Wohnzwecke mobilisiert, kann diese Platz für 45‘000 bis 140‘000 neue Einwohner bieten.[1] Dies entspricht immerhin bis zu 8 % des prognostizierten Bevölkerungswachstums in den nächsten 30 Jahren. In dieser Zeitspanne hinzu kommende Leerstände sowie allenfalls vorhandene Reserven in Wohngebäuden sind dabei noch nicht inkludiert.

[1] Annahmen: 1,5-2 Stockwerke in freistehenden Ökonomiegebäuden, max. 1,5 in Mehrzweckbauten; 15-25 % Konstruktionsfläche; 40-50 m2 Nettogeschossfläche pro Person

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Abbildung 3: Geschätztes Potenzial in bestehenden Leerständen ausserhalb der Bauzonen am Siedlungsrand (Quelle: eigene Darstellung)

3.3 Umnutzungsmöglichkeiten und entstehende Chancen

Die besagten Gebäude liegen zwar ausserhalb der Bauzonen, sind aber dennoch Bestandteil des Siedlungskörpers. Die landwirtschaftliche Konversion, d.h. die Umnutzung ehemaliger Landwirtschaftsbauten, entspricht in diesen Lagen damit der Fokussierung der räumlichen Entwicklung auf bestehende Siedlungsfläche und ist damit im Grunde Innenentwicklung im klassischen Sinn. Grundgedanke dahinter ist, bei der Zulässigkeit von Umnutzungen den räumlich-funktionalen Zusammenhang in den Vordergrund zu stellen. Aufgrund der Lage innerhalb des weitgehend überbauten Gebiets ist dieser Zusammenhang gegeben. Obgleich im rechtlichen Sinne eine Aussenentwicklung vorliegt, findet diese de facto nicht statt.

Die landwirtschaftliche Konversion am Siedlungsrand birgt dabei entscheindende Vorteile gegenüber deren Alternative, die in der Regel die Neubebauung der grünen Wiese ist. Neben Aspekten der Ökologie und des Landschaftsbildes, hat diese Massnahme auch bedeutende ökonomische Vorteile für die Gemeinden. Dies vor allem aufgrund der Einsparung von Infrastrukturkosten: Aufgrund der räumlichen Nähe zur Siedlung ist davon auszugehen, dass der Modalsplit deutlich zu Gunsten des Langsamverkehr sowie öV verschoben ist. Knapp 75 % der Gebäude befinden sich max. 300 m von einer Haltestelle entfernt, die mindestens stündlich angefahren wird. Die strassenmässige Erschliessung ist sogar für nahezu alle Gebäude bereits gegeben. In den Kantonen Uri (Alpenraum) und Solothurn (Mittelland) konnte zudem die abwassermässige Erschliessung näher betracht werden. Dort zeigt sich, dass rund zwei Drittel der Gebäude bereits einen Kanalanschluss besitzen. Bis auf wenige Ausnahmen ist die Anbindung des restlichen Teils mit vergleichsweise geringem Aufwand, d.h. vor allem ohne Kostenbeteiligung der öffentlichen Hand, herstellbar.

Zudem ist die Nutzung des aufgezeigten Potenzials im Vergleich zum Bauen auf der grünen Wiese deutlich robuster, da sie nicht von Bevölkerungsprognosen bzw. der tatsächlichen Entwicklung abhängen. Selbst bei einem Bevölkerungsrückgang, kann die Nutzung des Potenzials ausserhalb der Bauzonen sinnvoll sein. Hinzu kommt ein weiterer entscheidender Vorteil der Potenziale ausserhalb der Bauzonen gegenüber den äusseren Reserven: Sie befinden sich am richtigen Ort. Eine Studie der Fahrländer Partner AG im Auftrag des ARE zeigte bereits 2008 deutlich auf, dass sich die vorhandenen Bauzonenreserven grossräumig betrachtet am falschen Ort befinden (vgl. Abbildung 4) [Fahrländer 2008, 34]. Die Potenziale an den Siedlungsrändern, befinden sich hingegen hauptsächlich im Mittelland in den Kantonen, die gemäss der BFS-Prognosen voraussichtlich das grösste Bevölkerungswachstum verzeichnen werden. Mit Blick auf die weitere Zukunft ist ausserdem zu vermuten, dass sich dort auch die künftigen Leerstände im Wesentlichen konzentrieren werden. Dies ergibt eine Analyse der Schwerpunkträume des landwirtschaftlichen Strukturwandels.

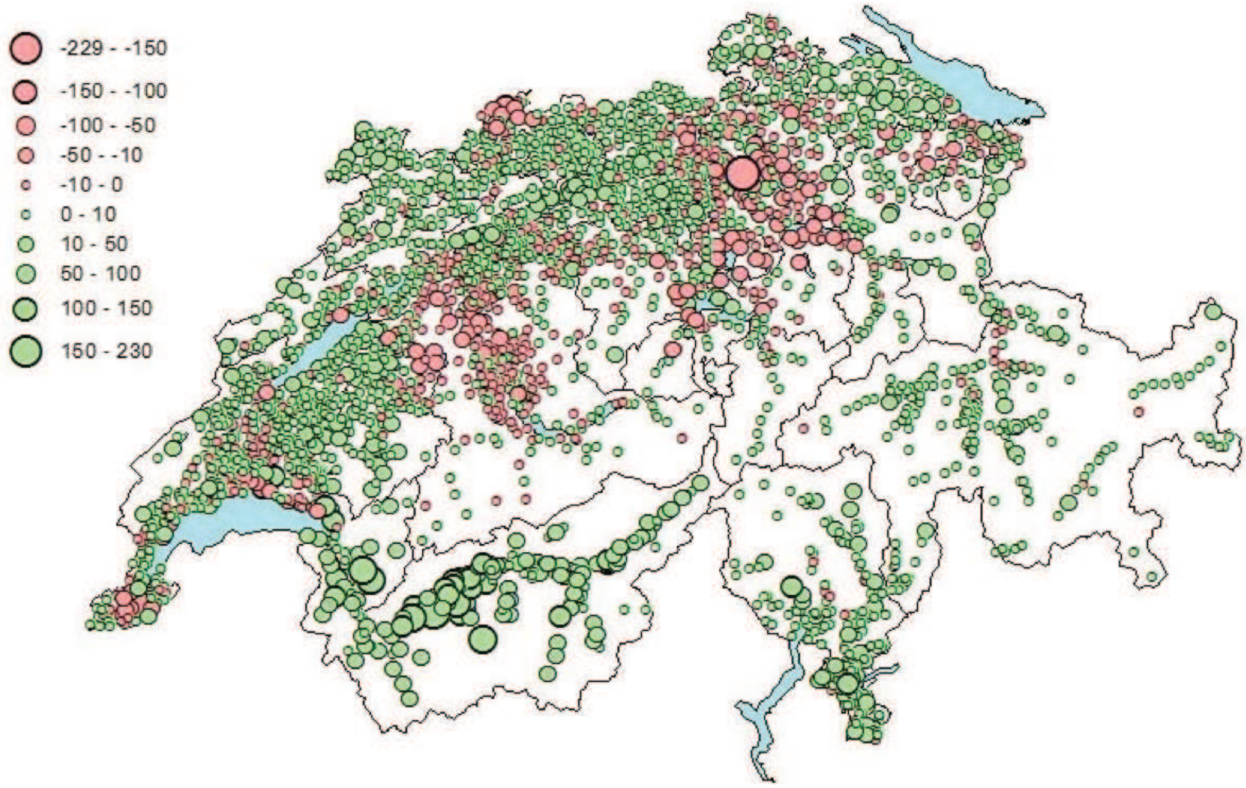

Abbildung 4: Bauzonenreserve (Stand: 2008) und zukünftige Nachfrage nach Bauzonenfläche (Wohnnutzung) nach Gemeinde (ha), (Quelle: FAHRLÄNDER 2008, 34)

Hinsichtlich des Umnutzungsspektrums orientiert sich der Vorschlag an der Vorgehensweise im benachbarten Deutschland. Nach §34 BauGB ist dort ein Vorhaben zulässig sofern es sich innerhalb der im Zusammenhang bebauten Ortsteile befindet und es sich „nach Art und Mass der baulichen Nutzung, der Bauweise und der Grundstücksfläche, die überbaut werden soll, in die Eigenart der näheren Umgebung einfügt und die Erschliessung gesichert ist" (§34 Abs.1 BauGB). Hinsichtlich der Gestaltung bedeutet das, dass etwa die Materialwahl oder die Grösse einzufügender Fenster in das nähere Umfeld eingepasst sein soll. Im Sinne des Immissionsschutzes gilt selbiges für die neue Nutzung. Grenzt das Gebäude beispielsweise an eine Wohnzone an, käme das Gebäude für Wohnzecke oder nicht störendes Gewerbe in Frage. Ist die Nachbarschaft hingegen eine Gewerbezone, ist eine gewerbliche Nutzung anzustreben.

4 FAZIT

Die vorangegangenen Ausführungen zeigen auf, dass eine differenzierte Auseinandersetzung mit der landwirtschaftlichen Konversion auch ausserhalb der Bauzonen lohnenswert ist. Entscheidendes Kriterium sollte dabei insbesondere die Lagebeziehung zur Siedlung, aber auch die infrastrukturelle Anbindung sein. Die Um- bzw. Wiedernutzung von Gebäuden innerhalb der Siedlungskörpers erscheint dabei aus der Perspektive der klassischen Innenentwicklung besonders sinnvoll. Es konnte aufgezeigt werden welche Vorteile deren Nutzung gegenüber dem Neubau auf der grünen Wiese – auch bei bereits vorhandener Einzonung – bergen. Auch hinsichtlich der Quantität erscheint es sinnvoll dieses Potenzial nutzbar zu machen. Hierzu sind rechtliche Anpassungen allerdings unumgänglich. In Frage kommt dabei einerseits eine jeweils individuelle Lösung in Form von Einzonungen, andererseits aber auch eine umfassende Lösung

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durch Anpassung des Raumplanungsgesetzes. Letzteres bietet sich aufgrund der aktuellen Revisionsbestrebungen an, birgt jedoch gleichzeitig auch einige Gefahren. Allen voran eine weitere Erhöhung der Gesetzteskomplexität und eine Begünstigung der Zersiedelung. Sollen die rechtlichen Grundlagen angepasst werden, ist daher ein grundsätzliches Überdenken der gesamten Regelungen zum Bauen ausserhalb der Bauzonen ratsam. In diesem Zusammenhang ist dem Schutz vor einer weiteren Ausdehnung der Siedlung besonderes Augenmerkt zu schenken.

5 REFERENCES

ARE, Bundesamt für Raumentwicklung: Revision des Raumplanungsgesetztes – 1. Etappe (RPG1) https://www.are.admin.ch/are/de/home/raumentwicklung-und-raumplanung/raumplanungsrecht/revision-des-raumplanungsgesetzes--rpg-/rpg1.html; Zugriff: 6.6.2017 (a).

ARE, Bundesamt für Raumentwicklung: Revision des Raumplanungsgesetztes – 2. Etappe (RPG2) https://www.are.admin.ch/are/de/home/raumentwicklung-und-raumplanung/raumplanungsrecht/revision-des-raumplanungsgesetzes--rpg-/rpg2.html; Zugriff: 13.5.2017 (b).

ARE, Bundesamt für Raumentwicklung: Monitoring Bauen ausserhalb der Bauzonen - Standbericht 2016, Bern, 2016.

ARE, Bundesamt für Raumentwicklung: Monitoring Bauen ausserhalb der Bauzonen, Standbericht 2011, Bern, 2012.

ARE, Bundesamt für Raumentwicklung und BfS (Bundesamt für Statistik) (Hrsg.): Gebäude, Wohnungen und Bevölkerung ausserhalb der Bauzone, Bern, 2005.

BFS, Bundesamt für Statistik: Landwirtschaft und Ernäherung, Taschenstatistik 2016: Landwirtschaft und Ernäherung, Taschenstatistik 2016, Neuchâtel, 2016.

BRP, Bundesamt für Raumplanung (Hrsg.): Bauten ausserhalb der Bauzonen – Eine Bestandesaufnahme, Bern, 1994.

FAHRLÄNDER, S. et al.: Bauzonen Schweiz, Wieviele Bauzonen braucht die Schweiz?, Studie im Auftrag des ARE, Zürich, 2008.

FÜEG, R.: Der Planungsansatz – Überlegungen im Bereich BaB. Präsentation im Rahmen des Symposiums „Handlungsoptionen für bestehende Gebäude ausserhalb der Bauzonen“, 7. September 2016, ETH Zürich.

HOCHBAUDEPARTMENT ZÜRICH: Umgenutzte Scheinen, eine Beispielsammlung, Zürich, 2004.

HOFER, T.: Strukturwandel in der Züricher Landwirtschaft, Entwicklungstrends eines Wirtschaftszweigs; in: Statistisches Amt des Kanton Zürich (Hrsg.): statistik.info 01/2010.

IWSB, Institut für Wirtschaftsstudien Basel: Fehlanreize im Nichtbaugebiet – eine Übersicht, Bern, 2015.

KANTON BASEL-LANDSCHAFT: Amt für Raumplanung, Raumbeobachtung, Bauen ausserhalb der Bauzonen Untersuchungszeitraum 1. Januar 2001 bis 31. Dezember 2014, Basel, 2015.

KANTON ZÜRICH: Raumplanungsbericht 2013, Bericht des Regierungsrates an den Kantonsrat vom 12. Februar 2014, Zürich, 2014.

KISSLING, S.: Der Grundsatz der Trennung von Baugebiet und Nichtbaugebiet und die heutigen Vorschriften zum Bauen ausserhalb der Bauzonen. Präsentation im Rahmen des Symposiums „Handlungsoptionen für bestehende Gebäude ausserhalb der Bauzonen“, 7. September 2016, ETH Zürich.

KOLL-SCHRETZENMAYR, M.: gelungen?misslungen?, Die Geschichte der Raumplanung Schweiz, Zürich, 2008.

Measuring Political Commitment in Statistical Models for Evidence-based Agenda Setting in Non-motorized Traffic

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1 ABSTRACT

When investigating national and international transport policies of the last decade, an ever increasing emphasis on promoting non-motorized transport modes such as walking or cycling can be identified, aiming at reaching multiple political targets (eg. reducing pollution, increasing health or lowering land consumption). However, despite substantial financial efforts being put into infrastructural or awareness-raising activities, achieving the desired modal shift towards active mobility remains a challenge. This is frequently due to unclear cause and effect patterns between active mode shares and their determinants, which in turn leads to uncoordinated or highly fragmented initiatives that impede target-oriented planning.

An internationally adopted approach to overcome this problem is applying aggregated statistical models that explain modal choice involving multiple regression techniques and hypothetical covariates. Still, general critique against these models points out that important intangible soft factors such as attitudinal characteristics of the local population or mind-sets and political commitment of decision makers are not duly reflected. Also, for Austria there is currently no systematic holistic approach to explain spatial variance in active travel shares on the scale of municipalities.

Hence the main objective of our research is to design a comprehensive macroscopic model-based approach for the quantitative explanation of modal split shares in active travel modes in Austria. In our approach we attach great importance to the inclusion of soft factors in order to contribute novel findings on the dynamics behind active travel. The research outcomes will aid decision makers and planners in their question where and more specifically, how to effectively invest into active mobility by revealing key soft factors and intangible determinants of active travel mode shares alongside a broad range of more known, traditional factors. Based on this evidence-based decision support approach it is possible to simulate impacts of actions when aiming at locally promoting active travel modes.

Keywords: transport policy, operationalization, proxies of political willingness and behaviour, statistical modelling, walking-cycling determinants

2 INTRODUCTION

2.1 Active modes in Austrian transport planning – problems and practices

Multiple historical views on the evolution of modern transport systems in the past decades have already pointed out that the alarmingly high shares of motorized transport modes (currently ~ 46.8%) (BMVIT, 2016) are closely related to negative externalities which manifest themselves in high social and environmental costs (Merki, 2008; Knoflacher 2013). In order to suggest appropriate actions as a remedy for these shortcomings including urban sprawl phenomena (VCÖ, 2007), pollution and traffic accident rates (Perschon, 2012), it is considered crucial to increase the share of active mobility modes (walking, cycling) (Knoflacher, 2007; Meschik, 2008; Perschon, 2012). Active modes offer a set of desirable ecological (resource neutrality, zero-emission, downsize of land consumption), economical (reflecting an indirect net product of up to 882.5 Mio.€, equivalent to 18,328 full-time jobs) (BMVIT, 2009) and socially (positive impact on health) sustainable properties (Meschik, 2008).

With this in mind, current Austrian transport strategy papers at the federal and state level show a clear commitment for the fostering of non-motorized transport modes. This is particularly reflected by Austrias national masterplan for walking (BMLFUW, 2015a), the national cycling strategy (BMLFUW, 2015b) as well as potent funding structures and multiple state-level strategy papers (eg. Stadt Wien, 2014).

Despite the actions taken at national and regional levels, recent surveys show that reaching the desired shift towards active mode shares at the local level of municipalities remains a challenge (BMVIT, 2016). This problem is on the one hand reflected by the strongly varying number of planning projects (BMLFUW, 2011; Raffler, 2016) and on the other hand due to the still greatly differing and generally low modal shares of walking and especially cycling (BMVIT, 2013). On top of that, the decentralized character of the Austrian planning system impedes coordinated actions of the federal strategies and funding programs. As it has been depicted in the overview of the Austrian bicycle planning system by Raffler (2016a) (s. fig. 1), the legally binding instruments for infrastructure planning are tied to the local level of approximately 2100 municipalities. This leaves Austrian active-mobility planners with a rather heterogeneous planning landscape and the problem “that investments in cycling promotion are currently not always put into action where they may be most expedient, but there, where local political will is the highest” (Raffler et al., 2016b, p. 2) which is also true for walking.

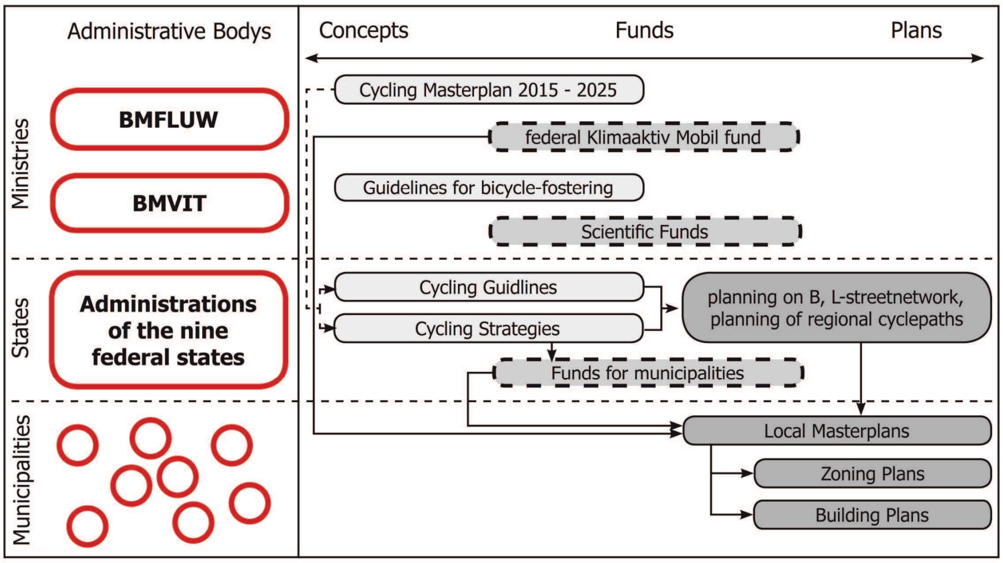

Fig. 1: Structure of Austrian bicycle planning (Source: Raffler, 2016a)

Summing up the current problems and practices, the lack of knowledge about cause and effect patterns between active modes and their drivers in the context of their respective users is currently limiting actions to achieve a substantial modal shift.

2.2 International approaches and methods

Investigating international research on active mobility planning reveals a broad spectrum of papers that aim at solving the above planning problems through the provision of decision support to planners and political stakeholders. Mainly lead by the approach of evidence-based planning (Faludi et al., 2006) whose influence shows itself especially in western-european planning culture, much research is focused on understanding factors that have an influence on active mobility. This is particularly true for research in the cycling domain whereas papers on pedestrian traffic tend to have a health science perspective (eg. Leslie et al., 2005; Cerin et al., 2009; Verhoeven et al., 2016). Hence they do not explicitly propose results that are designed for decision support; nevertheless they have an indirect implication for planning activities.

The main rationale behind explaining influencing factors is to reveal the relevant mechanisms planners may address in order to positively influence the development of active modal shares (eg. changes in infrastructures, accessibility, network topology, social structures, etc.) (Parkin et al., 2008). Another key advantage of a solid evidence base on the influencing factors of active mobility is that funding activities can be focused where they will provide the biggest return values in terms of modal spilt increase, hence tackling the problem of uncoordinated initiatives (Raffler et al., 2016b).

From a methodological point of view, research approaches are generally based in the field of quantitative statistical analysis. The assessment of influences can generally be facilitated by performing simple, monocausal correlational analyses (Leslie et al., 2005) or through the setup of more sophisticated models using regression techniques. They either estimate walking or cycling modal shares from census or survey data at the administrative level of municipalities or origin-destination flows (eg. aggregated approaches) or reflect the probability of choice to participate in active mobility at the individual level (eg. disaggregated approaches) (Parkin et al., 2007; Aoun et al., 2015). Prominent examples for models that calculate active modal shares from multiple variables representing the local conditions and situations exist for the Netherlands and Belgium (Rietveld et al., 2004; Vandenbulcke et al., 2010), Great Britain (Parkin et al., 2008) as well as the USA/Canada (Pucher/Buehler, 2006) and Australia (Cerin et al., 2009). In addition, Heinen et al. (2013) conducted an analysis on the choice to cycle at the individual level. The models can then be used by planners and decision makers to assess the impact of certain planning actions by consolidating the raw model equation. The barrier of dealing with raw mathematical constructs in planning support is even lowered by the recent work of Lovelace et al. (2017): The proposed Propensity to Cycle Tool opens the possibility to provide easier access to decision support for planning affiliated stakeholders via web-mapping applications. While there is a great deal of research investigating British, Dutch, Belgian or American situations, there are currently no such comprehensive models for Austria.

General critique on active mode share modelling approaches focuses on the representation of ‘soft’ influencing factors (in contrast to ‘hard’ factors, such as topography, infrastructure or accessibility). As Heinen et al. (2010) point out with regard to poorly reflected psychological factors (eg. personal attitudes towards active modes) we suggest to extend this critique to the insufficient reflection of political will or commitment, factors that are frequently cited as being crucial for the successful promotion of non-motorized modes. This assumption is strongly based on oral evidence sourced from local planning stakeholders – and therefore considered a relevant point of critique. Despite the efforts of preceding models to model the effects of “policy” (Rietveld, 2004; Pucher/Buehler, 2006) by measuring the impact through proxy-variables such as gasoline prices per litre, cycling fatality rate (Pucher/Buehler, 2006), parking costs, network speed or voter-proportion of certain political parties (Rietveld, 2004), the quality political will has internationally not yet been assessed properly in the context of quantitative aggregated mode-choice models.

2.3 Aim of this research

In face of the organisational problems in Austria (heterogeneous political commitment, lack of knowledge about cause and effect patterns, uncoordinated action) related to active mobility and the shortcomings of recent international approaches in terms of intangible factors, this paper aims to present an solution approach for using political commitment and other soft factors as predictor variables in the context of a comprehensive macroscopic modelling framework for active travel modes at the level of Austrian municipalities. We thus test the hypothesis stating that the local presence of political commitment does help promoting walking and cycling shares with respect to the specific local cultural context. Doing so, special methodological attention is devoted to the operationalisation and measurement of soft factor impacts on non-motorized modal shares. We also implicitly include past political decisions which already manifested themselves in the planning by including related variables in the models such as accessibility levels or infrastructural characteristics. In this context, our understanding of commitment and policy-related factors is therefore purely non-physical and oriented towards mind-sets rather than tangible attributes.

3 MATERIALS AND METHODS

3.1 Data

In order to be able to assess influences on walking and cycling modes, we acquired data from the traffic survey of the state of Upper Austria which was conducted in October 2012 (Government of Upper Austria, 2014). Although this decision narrows the focus of our research through the exclusion of the other eight federal states from the analysis, Upper Austria is one of the few states that feature nearly every element of the heterogeneous Austrian spatial structure (eg. alpine regions as well as rural forests, hills, urban and semi-urban zones). Furthermore it shall be noted that Upper Austria’s traffic survey is currently unique among Austrian surveys regarding its spatial granularity and detail.

Modal shares for a total N of 444 municipalities are based on mobility surveys of person-specific trips (specified by mode and trip purpose): numbers of trips were projected and statistically weighted in order to correct for sample bias. Active mode shares were calculated as the respective proportions of walking and cycling trips, in the total number of reported trips per municipality. In order to secure a sound 95% confidence interval of the modal shares, we excluded municipalities where the number of persons was less than 200. (s. Table 1, filtered). Also, we used the unweighted number of reported trips to weight cases (municipalities) when calibrating the regression models so to give relatively more weight to more robust values in the outcome variable. Those measures do not harm the models' representativeness but rather remove modal share values based on a weak empirical foundation. Related issues pertaining to the confidence levels of the non-motorized modal shares also impeded a further differentiation of the models in terms of trip-purposes. Though initially planned this would have asked for substantially larger sample sizes of the mobility survey and was therefore skipped. The descriptive statistics presented in table 1 show that Upper Austrian walking shares at the municipality level are considerably larger than cycling shares.

mode	model-type	N [municipalities]	mean [%]	min [%]	max [%]	SD [%]
walking	unfiltered	444	11,46	0,71	32,48	4,88
	filtered	338	12,21	3,32	32,48	4,83
cycling	unfiltered	444	3,55	0	21,4	2,70
	filtered	338	3,88	0,25	17,47	2,60

Table 1: Descriptives of the Upper-Austrian active modes' shares by municipality (Travel Survey 2012).

Cycling shares by municipality range between 0% and 21% and exhibit a substantial left skew resulting from a far from normal distribution.[1] Removing municipalities with less than 200 surveyed persons reduces N by 106 while slightly increasing the mean values for both modes. Also, some of the extreme values on the outer limits of the distribution have been excluded due to the filtering. Alongside these traffic data various additional data sources have been tapped including the thriving Austrian OpenData Initiative (data.gv.at) which was used to describe local spatial, infrastructural and socioeconomic properties. Further datasets range from spatial data (street graphs) from the national Graph-Integration-Platform (GIP) and OpenStreetMap (OSM), digital elevation models and population density rasters to more census related information. In terms of demographic and socioeconomic data as well as for data on various other items datasets published by Statistics Austria were used. Data on weather and climate was sourced from ZAMG (Zentralanstalt für Meteorologie und Geodynamik). Some data was directly obtained from representatives of the Upper Austrian state administration. Information on social milieus was procured from INTEGRAL Markt- und Meinungsforschung.

3.2 Methods

Our holistic research approach was guided by structuring the model building procedure in four major steps (s. Fig. 2). Firstly we built three main groups of factors that are known to have an influence non-motorized traffic from literature: spatial and environmental, infrastructural, demographic/socioeconomic factors and political commitment. In a second step, we gathered hypotheses on the expected impact direction and strength of these factors. The third working step was dedicated to operationalizing (geospatial and mathematical modelling, econometric techniques) of the determinants on the aforementioned data sources. The last work step constituted the statistical inference process and the formulation of multivariate regression models to predict non-motorized modal shares on the municipality scale as the outcome variable. At the time of writing this paper a dedicated survey by the research team among Upper Austrian municipalities has just been completed focussing on the self-evaluation of their political commitment towards active travel and the related local culture (mind-sets, attitudes, etc.). However, as the raw sample data needs yet to be post-processed it will be added to the model database at a later stage.

[1] The mean modal shares among Upper Austrian municipalities should not be mixed up with the overall Upper Austrian shares which amount to 14.6% for walking and 5.1% for cycling, respectively.

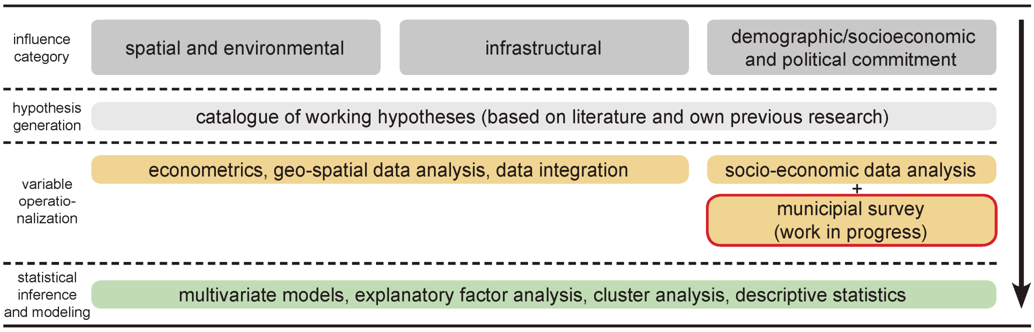

Fig. 2 Overview of workflow (Source: own, 2017).

3.2.1 Operationalization of influencing factors

The following section gives a brief overview by determinant category over the 700+ variables that were gathered and computed in the course of this research. The main tools that were applied in the variable-forming process include Geographic Information Systems (GIS) (in this case ArcGIS QGIS and PostGIS) as well as the statistical software package SPSS for the data management and processing testing and inference and model formulation.

Spatial and environmental determinants:

This group of factors deals with influences that are largely determined by spatial configuration such as settlement structure, but also various 'static' environmental characteristics that cannot directly be influence by planners (relief, climate). Settlement structure covariates include several types of accessibility specified for walking, cycling and car-driving modes. The calculation concept follows the approach of density-based intra-zonal and external distance estimation by Kordi et al. (2012): Local/regional walking, cycling and driving distances to different categories of trip destinations (e.g. health services, social infrastructure, shopping) were computed via network analysis in combination with weights extracted from population density grids (250m resolution). In order to realistically characterize the modal accessibilities of a municipality in single values, they were again weighted according to a literature-driven list of demand-factors reflecting their relative importance (frequency of visits per time interval) and specific weights related to the sizes of the respective target groups. Another group of variables to characterize local conditions for active travel was provided by calculating arithmetic ratios between car-based and walking/cycling-accessibilities. Related approaches were applied for the operationalization of environmental variables. Examples are the covariates on environmental determinants such as climate or topography (eg. number of snow cover days, frost, etc.) which were fine-tuned using population density grids. They therefore reflect the actual affectedness of the local population by the respective determinant.

Infrastructural determinants:

Determinants reflecting infrastructural conditions play a crucial role in this research, as they can be directly addressed by planning actions and local/regional development plans. We calculated measures describing the local topology of the road network (such as intersection density or connected node ratio) following the approach of Tresidder (2005) which describes the permeability of the municipal road network as these can influence the enjoyment and comfort of local active trips. Other variables in this determinant category include information on the density of cycle racks, the share of traffic-calmed streets or the density of traffic accident hotspots. On a methodical note due to unstable and incomplete information on cycle paths and cycle lanes along highways information from GIP and OSM was combined in order to calculate arithmetic ratios between the shortest path in the local network and the length of the most appealing and safe (most bikeable) path as a proxy for cycling detour disutility

Demographic and socioeconomic factors and political commitment:

Demographic and socioeconomic factors have frequently been a major point of discussion in the context of research on non-motorized traffic (Goodman, 2012; Heinen et al, 2010). Therefore we extracted several variables from census-based surveys which include aggregate measures on demographic structures, household structure (eg. mean household size), age groups, education, car ownership or purchase power per person/household. A more sophisticated view on local mind sets was provided by variables on social milieus (local shares of Sinus-milieu groups) that cluster population according to lifestyles and attitudes (milieus include conservatives, hedonists, or performers, etc.). In the specific context of this research, we aimed at shedding light on the operationalization of the local active travel mode culture and the local political commitment to support active modes. One approach consisted of collecting information on the municipality's membership in federal or state-level initiatives such as at the Upper Austrian cycling promotion programme (fahrradberatung.at, bicycle coaching initiative for municipalities), Klimabündnis Austria (an organisation promoting climate protection) or the number of projects realized in the Klima-aktiv programme (climate protection initiative of the Austrian BMLFUW). This information was used to calculate workable variables such as number of years since first assignment or simple 0/1 dummy variables. We also tested a variable reflecting a subjective evaluation of the state administration on the municipal level of pro-cycling activity. A second approach was based on including election results on municipal and state level elections. In this context it shall be noted that past political commitment may have implicitly manifested itself in kind of actually realized infrastructure projects or awareness-raising projects in favour of active travel modes whereas the above variables describe the current local 'climate' for active travel modes and potential for its promotion in the near future.

3.2.2 Project-specific survey of the municipalities' self-evaluation regarding cycling (add on)

The municipality survey that was designed and conducted by the research team aims at determining the local importance of cycling based on a self-evaluation by municipality representatives. It thus presents a picture of the pre-conditions and current efforts related to the actions to promote cycling and walking. The survey questionnaire was jointly agreed upon with the coordinator for cycling in Upper Austria and programmed as an online survey. To increase the response rate the web link for participating in the survey was sent by a known sender (Government of Upper Austria) to all 444 municipalities shortly afterwards the Summit for Cycling event in Linz, Upper Austria. The very high response rate of 54 percent (242 cases) proves that this approach has been successful.

The survey is also regarded a means of cross- check and comparing subjective perception with objective data (i.e. modal split or the variables on political commitment presented in this paper). A tabulation of the model data across a computed index based on the survey data will reveal if there is any accordance. The respective results presented in section 4 refer to the 242 participating municipalities.

3.2.3 Regression Model

In the context of this paper, both the results and conclusion sections of this paper refer to the model on cycling shares on the Upper Austrian municipality level.[2] This simplification is also done in order to provide a compact overview of our work. We derived a multivariate model aiming at identifying the relative importance of the determinants on the spatial variation of bicycle use at the scale of Upper Austrian municipalities. In a generic form the model can be written as:

$$y_i = b_0 + b_1 x_{1i} + b_2 x_{2i} + \cdots + b_n x_{ni} + \varepsilon_i$$

(Field, 2009.)

Where y_i is the outcome variable (share of walking/cycling trips in all trips in municipality i), b_0 is the regression intercept, b1 to bn denote the regression coefficients, x1i to xni is the matrix of the municipalities' characteristics in the independent variables or covariates and εi denotes the error term in municipality i. The final set of independent variables was derived iteratively from a pool of 700+ candidate variables by adopting a hierarchical scheme of model selection and a set of complementary tests and procedures (descriptives, factor analysis, cluster analysis, etc.). Note that any of these candidate variables fall in one of the three basic determinant categories described in 3.2.1. As sample size is relatively small (338 municipalities after applying the filter as described above) the possible number of predictor variables is somewhat limited. However, with 23 predictor variables the upper value following Green (1991) in minimum sample size is 234, which is well exceeded. As a guiding principle we were aiming at combining several individual variables to form combined indicators (such as merging several accessibility variables into

[2] Basically our research approach comprises two regression models (one for each major active mode). However, as the current model on cycling shares is most developed at the time of writing this paper and due to length restriction we focus on the cycling model

a single value) wherever feasible in order to reduce the number of covariates while increasing their explanatory power.

Starting off by testing the inclusion of a basic set determinants (largely based on previous research) which were force-entered into the regression model we continued to include thematic sets of additional variables in stepwise modes (both backward and forward) in order to check for incremental improvements by adding new predictors to the equation. Each step was checked in terms of theoretical plausibility and accompanied by applying statistical tests (e.g. checking for multicollinearity or suppressor effects) so not to leave crucial modelling decisions to purely statistical criteria or let them be unduly influenced by random sampling variation. For each model variant we tested for autocorrelation (independent errors) and heteroscedasticity.

4 RESULTS

Statistical results from the model explaining cycling shares among Upper Austrian municipalities are shown below in table 2. It shall be noted that while the focus of this paper is on determinants reflecting political commitment it is nonetheless crucial to include a comprehensive set of variables covering other thematic fields in order to control for the respective effects and explaining the corresponding variance proportions in the regression outcome variable. Omitting these controlling covariates one would run the risk of falsely attributing non-related parts of variance in y to political commitment while they are in fact due to other factors. In total the current model including 23 predictors accounts for 73.1% of the cycling share among the municipalities (R^2=0.731).

For the purpose of this paper the interpretation of coefficients will focus on the determinants reflecting political commitment to promote cycling on the local level and attitudinal factors. Regarding the former, we tested additional variables for inclusion before committing to the final variant of the model: the number of Klima-aktiv supported projects in the walking/cycling domain positively correlates with y (number of projects: +0.144, no. of projects by municipal area: +0.267, both correlations are significant at a level of 0.001). The subjective evaluation of the state administration on the municipal level of pro-cycling activity (on a scale between 0 and 3; 3 is best) proved to be positively correlated with y (+0.226, significant at a level of 0.001).

Variable	b	ß	t-statistic	Sig.	correlation with y
constant	0.145	-	226.077	0.000	-
ENV_no_frost_days	0.001	0,279	155.739	0.000	-0.310**
ENV_no_snow_cover_days	-0.001	-0,642	-353.809	0.000	-0.317**
ENV_hilliness_settlement_area	-0.010	-0,439	-387.230	0.000	-0.495**
ENV_share_agri_areas	-0.049	-0.403	-228.622	0.000	-0.499**
ENV_ratio_accessibility_pot_cycle_car	0.001	0.384	255.282	0.000	0.612**
ENV_ratio_accessibility_prim_schools_walk_car	0.001	0.206	188,593	0.000	0.494**
ENV_bikeability_routes_schools	0.007	0.043	43.164	0.000	0.410**
INF_share_pleasent_green_roadside	-1.467	0.330	222.058	0.000	-0.338**
INF_density_accident_hotspot	-0.004	-0.152	-149.548	0.000	0.322**
INF_dummy_highway_access	-6.030E-07	-0.053	-57.263	0.000	0.106**
INF_minimum_distance_highway	0.000	-0.190	-169.075	0.000	-0.189**
INF_bike_racks_per_1000_pop	-0.018	0.078	102.668	0.000	0.208**
INF_settlement_proportion	-1.022E-06	-0.122	-78.352	0.000	0.496**
INF_minimum_distance_major_cycle_routes	-0.039	-0.071	-84.454	0.000	-0.323**
INF_share_roads_GT_60kmh	-1.467	-0.079	-90.677	0.000	-0.030**
POP_share_out-commuters	0.000	-0.221	-181.178	0.000	-0.450**
POP_share_milieu_established	0.003	0.120	105.556	0.000	-0.378**
POP_share_milieu_performer	-0.006	-0.362	-168.032	0.000	0.321**
POP_mean_duration_work_commute	0.001	0.090	90.829	0.000	-0.183**
POP_dummy_klimabuendnis	0.002	0.030	37.810	0.000	0.154**
POP_years_participation_fahradberatung	0.001	0.082	98.310	0.000	0.329**
POP_share_workplaces_agri	-0.019	-0.112	-58.277	0.000	-0.531**
POP_purchase_power_index_person	-0.001	-0.152	-98.349	0.000	0.146**
R	0.855				
R^2	0.731				
R^2_{adj}	0.711				

Table 2: Cycling model coefficients, standardized coefficients, t-statistic, significance and correlation with outcome variable (** p < .001, * p < .005).

However, when controlling for the many other determinants affecting cycling modal shares those variables turned out not to be significant in the regression model and have consequently been excluded. The covariates on political commitment remaining in the model are 'POP_dummy_klimabuendnis' (1 if the municipality is a member of Klimabündis Austria, 0 otherwise) and 'POP_years_participation_fahradberatung' the number of years since the municipality first enrolled to the fahrradberatung.at programme are significant in the model context and the related coefficients generally suggest that political commitment in favour of cycling has a positive effect on the modal spilt share of cycling trips. More specifically, for every year since the first enrolment to fahradberatung.at the municipality gains an 0.11% increase in cycling share, i.e. after approx. 9 years of taking part in the initiative the cycling share will increase by 1%. Given that the average municipal cycling share is at some 3.5% proves that the programme does have an impact. In a similar fashion the enrolment to Klimabündnis will increase the cycling share by 0.22% constituting a one-time effect. It needs to be stressed here that these figures are incremental meaning that they reflect the net effect of the respective predictor while all other variables are kept constant. In this sense supporting planning actions affecting any of the other thematic areas will add up to an increase in cycling modal share.

In terms of attitudinal variables 'POP_share_milieu_established' (local population share of social milieu established) and 'POP_share_milieu_performer' (local population share of social milieu performers) have the most significant effects on cycling shares. On average approximately 10% of the Austrian population belong to the social milieu established. It represents the performance-oriented and success-oriented elite in middle age groups. With other effects being controlled for in the model, a 1% increase of established milieu among the total local population will increase the municipality's cycling share by approx. 0.3%. Performers being the younger part of the elite can be broadly characterized as being globally oriented, highly efficient, success-oriented with comprehensive skills in IT and business (making up approx. 9% of the Austrian population). Model results indicate that a 1% increase in performer population share will reduce the cycling share by -0.6%. Note that the zero-order correlations with y show reverse signs for both milieus. This is due to the inclusion of other factors which explain large parts of the variance in cycling. Hence the milieu population shares explain unique parts of the variance. Our interpretation is that both milieus share specific patterns of other mobility relevant factors such as choice of residential location or purchase power. Once these variables are controlled for and the other factors are kept constant, the coefficients for the milieu variables express the respective net effects while other things are being equal. While performers have a tendency towards high performance recreational sports they do not have environmentally conscious or cost-conscious mind-sets when it comes to everyday mobility (Dangschat et al, 2012). We even expect rebound effects on active travel shares to be related with performers' recreational behaviour (e.g. using the car to go to cycle routes). In Upper Austria, established milieu shares are over-represented in settlement structures typically associated with low cycling shares (suburban regions, regions with some agricultural land use, etc.). Also they exhibit above average household sizes generally associated with below average cycling shares as well as above average income levels and purchase power. Once we control for some of these effects, the model results show that attracting established population will help increase the local cycling share.

Interpreting the standardized coefficients allows a direct comparison of the determinants' impact magnitude. Table 2 reveals that the effects of political commitment on cycling shares are smaller than those of determinants that are traditionally scope of models, but considerable and within a range that fits our initial theoretical considerations. The beta values for the two social milieu shares show relatively higher, generally suggesting medium-sized effects on the local cycling share.

In a spatial dimension, figure 3 shows a classification of the municipalities based on a model residual analysis exercise. As a first element of an evidence-based decision support system the blue-marked areas indicate municipalities that are currently underutilizing their local potential for cycling, i.e. their respective modal shares are below what could be expected if they made decent use of the local conditions in the three thematic areas relating to the determinant categories described in section 3.2.1 (negative residuals). By contrast the areas marked in orange and red indicate municipalities leading by good example, i.e. their cycling share is higher than could be expected given their local preconditions (positive residuals). Spatial interpretation suggests that no fundamental amount of spatial heterogeneity can be concluded from the map, rather both categories are scattered all over Upper Austria. The same is true for the basic types of settlement structure (rural, semi-urban and urban). However, there are apparent spill-over effects as can be seen from the relative proximity of municipalities in both main categories (these effects might be considered in future updates of the model by including spatial autoregressive terms). From a strategical planning perspective the red/orange areas can be seen as best practice examples and results can be used as follows: if the planning agenda aims at reducing the existing disparities in cycling shares among the Upper Austrian municipalities it should focus on investing into areas marked in blue, starting at the locations marked deep blue. In case the agenda calls for maximizing the investments' marginal modal shift effect towards cycling the actions' spatial focus should be put on locations marked in red and orange.

Results from the added-on municipality survey can be summarized as follows: responses generally confirm the increasing importance of cycling (also e-biking). 27% of the municipal representatives consider cycling to be 'very important' for the local population and 61% state that it is 'rather important'.

However, cycling is mainly seen as a recreational activity. Many municipalities (44%) lack a dedicated administrative staff or other personnel resources specifically responsible for cycling or walking agendas. Among other things this results in bicycle infrastructure expenditure for 2017 being earmarked in only 26% of the municipal budgets, or the availability of bike racks at railway stations or large bus stops being confirmed by only 55% of the respondents. However, the (further) extension of the cycling network and engaging in awareness-raising measures are well supported by the local authorities.

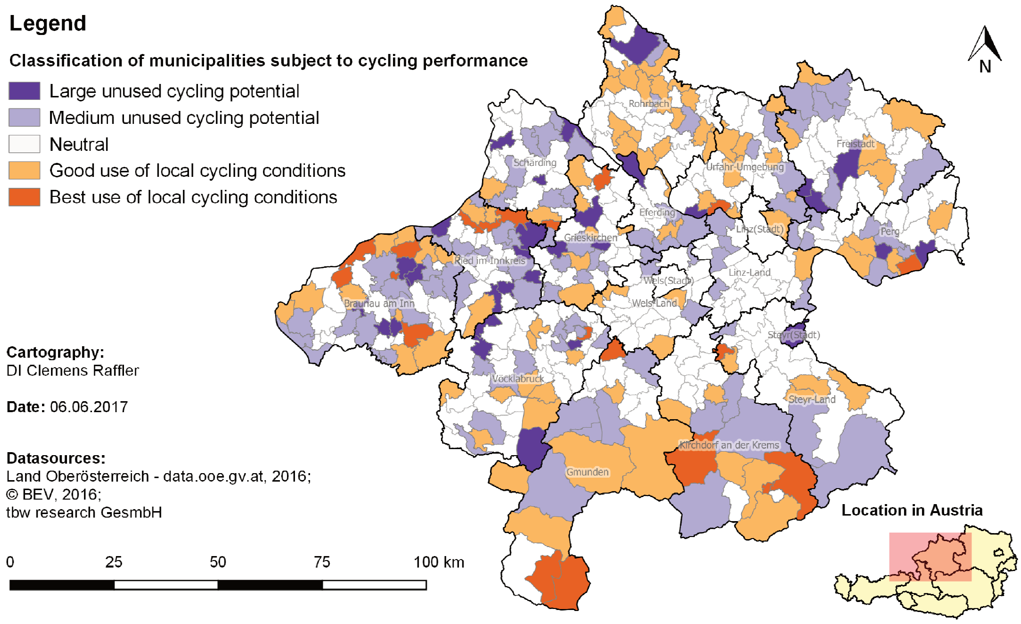

Fig. 3: evidence-based decision support: classification of Upper-Austrian municipalities based on model residuals analysis (Source: own, 2017).

The specific benefits of the survey lie in the mapping of the mood and the documentation of the importance of active mobility among local decision makers. The survey confirms our above model-based findings that a positive attitude among municipality representatives towards cycling as well as enrolling to the Fahrradberatung.at programme are important prerequisites for the sustainable improvement of regional cycling conditions, particularly pertaining to everyday mobility. Overall, the future relevance of local transport mobility is classified as 'rather large' (57%) on a four-stage scale. The analysis of non-participating communities (non-response analysis) is still in progress. A cross-check with other data sources will indicate whether these communities have not participated due to a lack of interest in cycling or for other reasons.

5 CONCLUSIONS

On a general note the added value of our research lies in providing a first systematic approach to model active mode shares on a municipal level in Austria laying the foundations for evidence-based decision making in the walking and cycling domain. Our current model framework is capable of simulating the modals-shift effects of various policy-relevant and planning-relevant domains at local and regional levels.

Our research proves that political commitment in favour of active travel modes in general and cycling in particular can be operationalized. Moreover, it could be demonstrated that political commitment has a positive effect on the relative importance of active traffic modes and that these effects can be quantified. That being said, in the absence of any periodical data it is not without doubt to draw a clear line between cause and effect or ultimately determine the direction of causality: the decision of enrolling to one of the pro-cycling or pro-environment initiatives under investigation might be due to an already existing critical mass of local decision-makers in favour of doing so. In this case a ‘friendly’ climate for active travel modes already exists in the municipality culminating in the enrolment decision. In contrast, taking part in the just mentioned programmes might be the triggering a change of mind-sets among local decision-makers even when local prospects seem difficult at first glance. Most likely the truth lies somewhere in between, it first takes a group of local stakeholders to generate sufficient interest to invest into active travel modes. The initial momentum can then be substantially sustained by joining a state-wide or federal programme. Ultimately when pursuing an increase in active travel mode shares the question of direction of causality is not of prime concern, particularly when facing rather low average cycling shares such as in Upper Austria.

We are aware that our current research resembles a work-in-progress state rather than a fully completed approach as some inputs are yet to be integrated (e.g. survey data on the municipalities’ self-evaluation or investigating spatial spill-over effects). Still as we go forward we regard the current results highly relevant for planning in that many of the determinants examined in our research can be influenced by planning actions and policy-making in a direct or indirect way within different respective planning horizons.

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7 REFERENCES

Aoun, A., Bjornstad, J., DuBose, B., et al.: Bicycle and pedestrian Forecasting Tools: State of the practice. Chapel Hill, 2015.

Cerin, E., Leslie, E., Owen, N.: Explaining socio-economic status differences in walking for transport. In: Social Science & Medicine, Vol. 68, Issue 2009, pp. 1013 – 1020. Houston, 2009.

BMLFUW – Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft: Masterplan Gehen. Strategie zur Förderung des Fußgängerverkehrs in Österreich. Vienna, 2015a.

BMLFUW – Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft: Masterplan Radfahren 2015 - 2025. Vienna, 2015b.

BMLFUW – Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft: Masterplan Radfahren. Umsetzungserfolge und neue Schwerpunkte 2011 – 2015. Vienna, 2011.

BMLFUW – Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft: Kurzstudie Wirtschaftsfaktor Radfahren. Vienna, 2009.

BMVIT – Bundesministerium für Verkehr, Innovation und Technologie: Der Radverkehr in Zahlen, Vienna, 2013.

BMVIT – Bundesministerium für Verkehr, Innovation und Technologie (Hrsg.): Österreich Unterwegs 2013/2014. Vienna, 2016.

Dangschat, J. et al.: Der Milieu-Ansatz in der Mobilitätsforschung. Vienna, 2012.

Faludi, A. Waterhout, B.: Introducing Evidence-Based Planning. In disP – The Planning Review, Vol. 42:165, Issue 2/2006, pp 4 – 13, Delft, 2006.

Field, A.: Discovering Statistics Using SPSS (and sex and drugs and rock’n’roll). London, 2009.

Goodman, A.: Walking, Cycling and Driving to Work in the English and Welsh 2011 Census: Trends, Socio-Economic Patterning and Relevance to Travel Behaviour in General. In: PLoS ONE, Vol. 8, Issue 8, pp. 1 – 11. Ghent, 2016.

Government of Upper Austria: Ergebnisse & Schlussfolgerungen der oberösterreichischen Verkehrserhebung. Linz, 2014.

Green, S.: How many subjects does it take to do a regression analysis? In: Multivariate Behavioural Research, Vol. 26, pp. 499 – 510. 1991.

Heinen, E., Van Wee, B., Maat, K.: Commuting by Bicycle: An Overview of the Literature. In: Transport Reviews, Vol. 30, Issue: 1, pp. 59 – 96, Delft, 2010.

Knoflacher, H.: Grundlagen der Verkehrs und Siedlungsplanung: Siedlungsplanung. Wien, 2007.

Knoflacher, H.: Zurück zur Mobilität. Vienna, 2013.

Kordi, M., Kaiser, C., Fotheringham, A. S.: A possible solution for the centroid-to-centroid intra-zonal trip length problems. In: AGILE 2012, pp. 24 – 27, Avignon, 2012.

Leslie, E., Saelens, B., Frank, L., et al.: Residents‘ perceptions of walkability attributes in objectively different neigbourhoods: a pilot study. In: Health & Place, Vol. 11, Issue 2005, pp. 227 – 236. Brisbane, 2005.

Lovelace, R., Goodman, A., Aldred, R., et al.: The propensity to Cycle Tool: An open source online system for sustainable transport planning. Leeds, 2017.

Merki, C.: Verkehrsgeschichte und Mobilität. Stuttgart, 2008.

Meschik, M.: Planungshandbuch Radverkehr. Vienna, 2008.

Parkin, J., Ryley, T., Jones, T.: Barriers to cycling. In: Cycling and Society, pp. 67 – 82. Hampshire, 2007.

Parkin, J., Wardman, M., Page, M.: Estimation of the determinants of bicycle mode share for the journey to work using census data. In: Transportation. Vol. 35, Issue 2008, pp. 93 – 109. Bolton, 2008.

Perschon, J.: Nachhaltige Mobilität – Handlungsempfehlungen für eine zukunftsfähige Verkehrsgestaltung. In: Stiftung Entwicklung und Frieden (Hrsg.) (2012): Policy Paper 36. S. 2 – 11. Bonn, 2012.

Pucher, J., Buehler, R.: Why Canadians cycle more than Americans: A comparative analysis of bicycling trends and policies. In: Transport Policy, Vol. 31, Issue: 2006, pp. 265 – 279, Newtown, 2006.

Rietveld, P., Daniel, V.: Determinants of bicycle use: do municipal policies matter? In: Transportation Research Part A, Vol. 38, Issue: 2004, pp. 531 – 550, Amsterdam, 2004.

Raffler, C.: Untersuchung des Körperenergieverbrauchs als evidenzbasierter Ansatz zur Unterstützung der Radverkehrsplanung. Master thesis submitted at Research Center of Transport Planning and Traffic Engineering, TU Vienna. Vienna, 2016a.

Raffler, C. Brezina, T., Emberger, G.: Cycling investment expedience: Energy expenditure based Cost-Path Analysis of national census bicycle commuting data. Conference paper at the Scientists for Cycling Symposion 2017. Up to the date of 05.06.2017 not yet published (review process ongoing), Vienna, 2016b.

Stadt Wien: Strategiepapier Fussverkehr 2014. Vienna, 2014.

Tresidder, M.: Using GIS to Measure Connectivity: An Exploration of Issues. Portland, 2005.

VCÖ: Einfluss der Raumordnung auf die Verkehrsentwicklung. In: VCÖ-Schriftenr. „Mobilität mit Zukunft“ 3/2007. Vienna, 2007.

Vandenbulcke, G., Dujardin, C., Thomas, I., et al.: Cycle commuting in Belgium: Spatial determinants and ‚re-cycling‘ strategies. In: Transportation Research Part A, Vol. 45, Issue: 2011, pp. 118 – 137. Brussels, 2010.

Verhoven, H., Simons, D., Van Dyck, D., et al.: Psychosocial and Environmental Correlates of Walking, Cycling, Public Transport and Passive Transport to Various Destinations in Flemish Older Adolescents. In: PLoS ONE, Vol. 11, Issue 1, pp. 1 – 19. Ghent, 2016.

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reviewed paper

Mobility for Valencia City Centre – a Case Study

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1 ABSTRACT

Valencia (Spain) has one of the largest historical centres in Europe with a dimension of almost 2 km between its two most distant points. Two years ago, municipal government decided to change policy about traffic in city centre in order to reduce traffic car and promote non-motorized modes of transport and public transport, that is, a sustainable mobility. This paper show the main results of a final work of Master in Transport, Territory and Urbanism of Polytechnic University of Valencia. It objective is adjust a methodology to apply the superblocks model in a big historical city centre such as Valencia. The work focuses on a possible superblock in city centre of Valencia. The Spanish cadastre allows mapping the all uses in buildings measured in square meters of ceiling. Between them, especially those uses that produces travel attraction such as commercial uses, parking, residential, offices, entertainment … These data allows stablishing a different networks to different modal mobility. The design of networks is done using the concept of offer management. That is, the objective of networks is satisfy the needs of mobility but not the demand of traffic. Go walking and cycling are the priority modes of transport, after public transport to access to city centre from outside by underground, bus or taxi and finally traffic car to emergencies, services for disable or old people, loading and unloading and access parking. The methodology to design networks is applied in case study and produces an integrate mobility model to superblock selected as area of study.

Keywords: Valencia, mobility, case study, transportation, networks

2 INTRODUCTION

For many years, different traffic specialists have considered the traffic calming as a way to get more liveable cities as Lockwood I.M. (1997), Hass-Klau, C. (1992) or Appleyard, D. (1981). In Spain, Sanz A. (1996, 2008) between others introduced this concept. Currently, the sustainable mobility is one of the objectives of European Commission policy (2013a, 2013b) and many European cities have carried out or carry out actions for it[1] and many authors studies this topic as Książek (2015) or Grana et al. (2008).

In Spain, municipalities must develop their Sustainable Mobility Urban Plan or, in Spanish, Plan de Movilidad Urbana Sostenible (PMUS). In this context, the experiences of municipalities of Vitoria and Barcelona about this question are important.

On the other hand, the Agència d'Ecología Urbana of Barcelona[2] developed the theory of superblocks as a system to improve public spaces by decreasing motorcar spaces and increasing pedestrian areas or areas for not-motorized transport.

Figure 1 show the superblocks model applied to Barcelona. The idea is design urban areas with pedestrian priority. These areas have a size about 400x400 metres. Inside these areas, the mobility is mainly pedestrian. But is also possible other transport services by other transport modes: emergency cars, cars for disabled person, loading and unloading zones or DUM (Distribution Urban Merchandise) areas, access to parking and bicycles ways.

This model allows to concentrate the traffic in streets around each superblock and increase pedestrian public spaces inside of each superblock. In other words, the model allows calming traffic inside of each superblock. In addition, if the city is organized by superblocks, the bus public transport network can be more efficient.

This theory was applied in the cities of Vitoria and Barcelona between among others. Particularly in its Mobility Urban Plans. Vitoria has a Plan de Movilidad Sostenible y Espacio Público (Sustainable Mobility

[1] http://www.eltis.org/
[2] http://www.bcnecologia.net/en

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Plan and Public Espace)[3] approved in 2007 to apply in period 2008-2023. On the other hand, Barcelona has approved its Sustainable Urban Mobility Plan[4] to period 2013-2018. Both plans uses the theory of superblocks to improve public spaces and mobility and apply the European policy in this matter.[5]

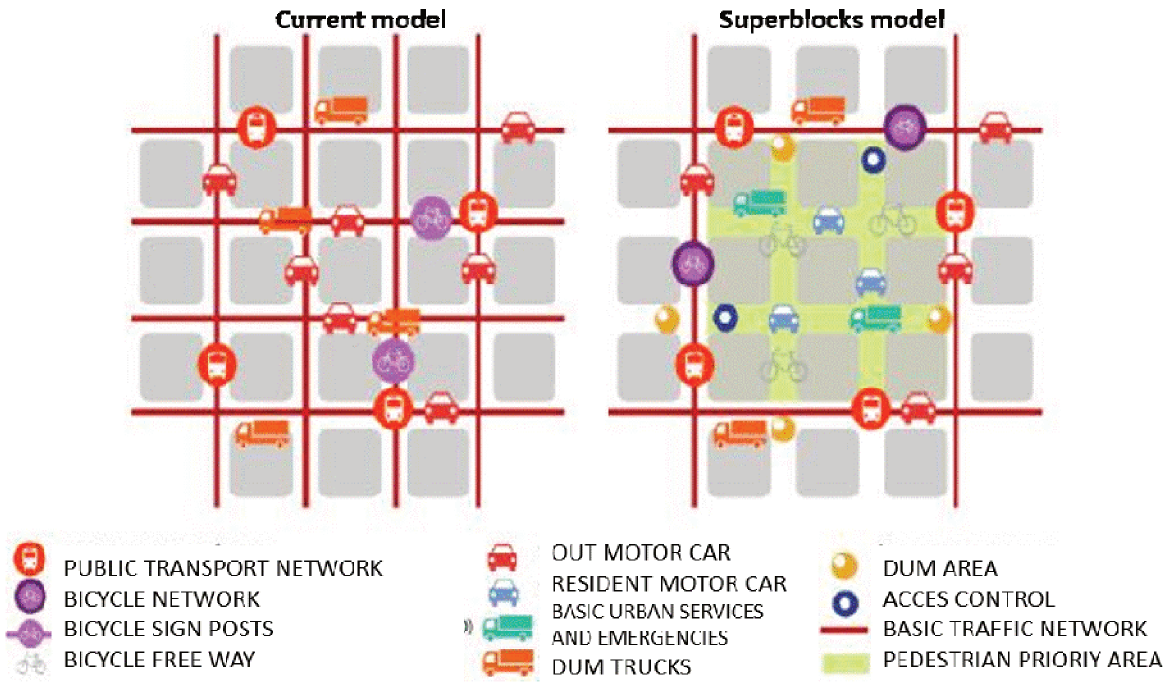

Figure 1. Superblocks model. Source: Agència d'Ecologia Urbana de Barcelona.

The city of Valencia is incorporated late to this trend but has carried out actions to promote non-motorized transport and improve public spaces (Gaja i Díaz, F. (2015); Broseta, M.T. (2015) and Pérez Igualada, J. (2015)).

València City has also its mobility plan[6] but this plan did not apply the theory of superblocks. Particularly it is difficult to apply this theory in city centre because of it is very large. The Valencia city centre with medieval origin has about 2 km for the longest distance by 1.5 km wide. Today Valencia city centre supports a lot of traffic.

In this situation, as a part of teaching objectives within the Master of Transport, Territory and Urbanism of Polytechnic University of València, was made a Final Work about Traffic management for sustainable mobility in Sant Francesc district. This paper show the proposal developed in this master's word about Sant Francesc district in Valencia centre. The study identify as a superblock the Sant Francesc district but really it is necessary a previous study to define the superblocks in city centre area that is very big.

3 OBJECTIVES

The objective of this paper is show a proposal of sustainable mobility model for Sant Francesc district in Valencia city centre. In order to achieve this objective, the following specific objectives will have to be met:

- To identify the zones in district that produce or attract traffic.
- To propose and evaluate possible alternatives for traffic management more sustainables that minimizes the use of private car vehicles.
- To generate new urban landscapes in public spaces.

3 http://www.vitoria-gasteiz.org/we001/was/we001Action.do?idioma=es&aplicacion=wb021&tabla=contenido&uid=1040577b_11ad7b633e2__7fc9

4 http://www.bcnecologia.net/en/projects/sustainable-urban-mobility-plan-barcelona-2013-2018

5 https://ec.europa.eu/transport/themes/urban/urban_mobility_en

6 http://www.ayto-valencia.es/ayuntamiento/trafico.nsf/vDocumentosTituloAux/13E8AC560711B1ADC1257C5B0041648A?OpenDocument&bdOrigen=ayuntamiento%2Ftrafico.nsf&idapoyo=&lang=1&nivel=6

Really these objectives are also oriented to a new landscapes low carbon, that is, new public spaces with a minimum carbon emission. Currently, transport modes as a walking, bicycle or public transport allows achieving its.

4 METHODOLOGY

The methodology is summarized in the following phases:

- Delimitation of the study area, according to the theory of superbloks, in order to establish pedestrian zones where the citizens are the main actor and main factor to design the public spaces.
- Description of mobility characteristics in the Valencia city center based in the analysis carried out in its Sustainable Urban Mobility Plan of Valencia.
- Identification of zones that generate or attract trips. Particularly residential uses, office buildings, commercial zones, parking, hotels, entertainment, health facilities, green zones or similar and public facilities. In Spain, the cadastre has a complete information of uses building to building for all buildings. So it is possible map all uses. The map of these uses allows design ways to access its by different transport systems.
- Alternative study of transport networks for different modes from the supply point of view to allows activities access.
- Public spaces design.

5 IDENTIFYING SUPERBLOCKS AND MOBILITY CHARACTERISTICS

The identification of superblocks in city centres is complex because, usually, European city centres have irregular forms with medieval origins. That is the case of València where the oldest streets are muslim origin. Figure 2 shows a possibility of superblocks for Valencia city centre but the proposal need further study.

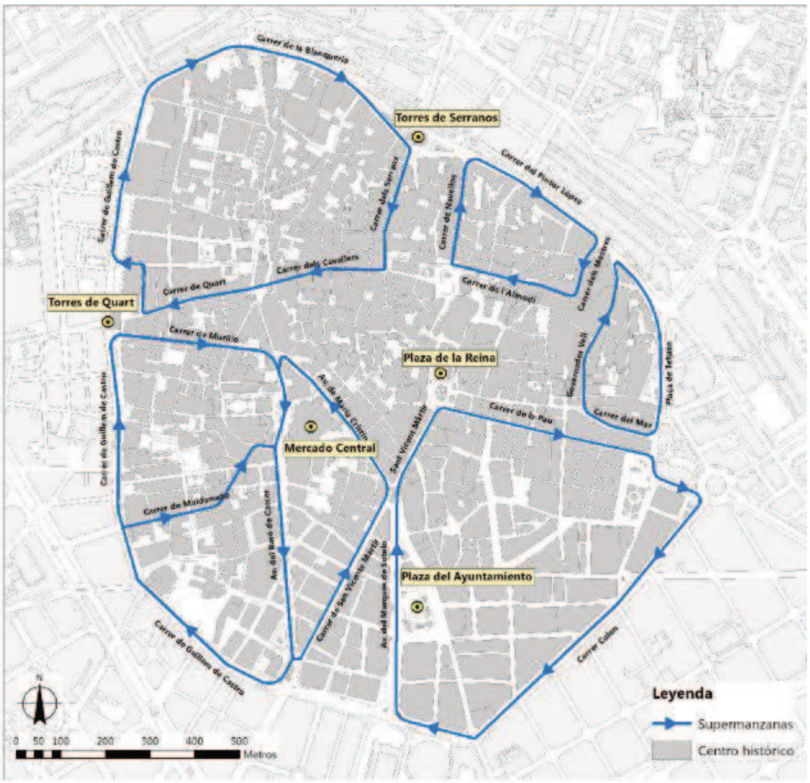

Figure 2. An example of superblocks for Valencia city centre.

However it exist a clear superblock, specifically the area of Sant Francesc on the south-est of the city centre or, simply, Sant Francesc district. This zone is the result of urban renewal project maede in the late nineteenth and early twentieth centuries and allows traffic for public transport or others. This work is focused in this area.

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On the other hand, Valencia is a compact Mediterranean city. It exist urban sprawl phenomenon on metropolitan area but not in Valencia City. On 27 December 2013 the PMUS (Sustainable Urban Mobility Plan) of Valencia was approved. The mobility plan includes a detailed analysis of Valencia's traffic characteristics that has served as the basis for the present study. However, this plan does not use the theory of superblocks and does not propose its.

Table 1 shows the general characteristics of mobility in Valencia City. Note you that the number of trips by not-motorized modes is high. In fact, this is a general characteristic of Mediterranean cities. Historically, because of climate, Mediterranean cities are compact and people like using public spaces.

In this situation, historical city centre of Valencia is a very important area of social and economic activity and, in consequense, is also a very important area that attracts trips.

Indicator	**Value**	
Total trips	1.575.973	
Not-motorized trips (pedestrian and bicycle)	834.289	52,9 %
Motorized trips	741.684	47,1 %
Average mobility by person (trips by person)	1,98	
Average mobility by person, not-motorized (trips by person)	1,04	
Average mobility by person, motorized (trips by person)	0,94	

Table 1. Basic characteristics of mobility in Valencia City. Source: PMUS of Valencia.

6 GENERATING AND ATTRACTING TRIPS

The cadastre in Spain is an updated database with all information about urban uses in all cities. The use in each building is measured in square meters of ceiling. Table 2 shows the uses considerated in this study and its ceiling square meters in study area of Sant Francesc district according to database of Spanish cadastre:

Uses	Ceiling m^2
Residential	416,011
Offices	176,042
Commercial	292,717
Parking	135,159
Hotels	54,258
Entertainment	28,211
Healt facilities	4,362
Green zones or similar	7,693
Public facilities	12,273

Table 2. Uses that generate or attract trips in Sant Francesc district.

The exactly location of this uses are mapping in one map for each use. Figure 3 shows, as an example, the location map of commercial uses. These maps serve to identify the needs to acces by car for services. Remember that the final objective is mainly produce a pedestrian area inside the superblocks but it exist some services that need motorized transport modes: access to private parkings of residents, emergency cars (fire trucks, ambulances, police cars), loading and unloading especially to commerce, access to facilities and offices, access of disable people and acces to public parking. The idea is offer the possibility of these services but not to satisfy the external potential demand by car traffic mode. The maps produced allows identifying where are the needs of access services.

By superposition of all maps it is possible to produce a map of activities or a map where the urban activities listed are concentrated. Figure 4 shows this map. The map shows the zones with the highest activities are.

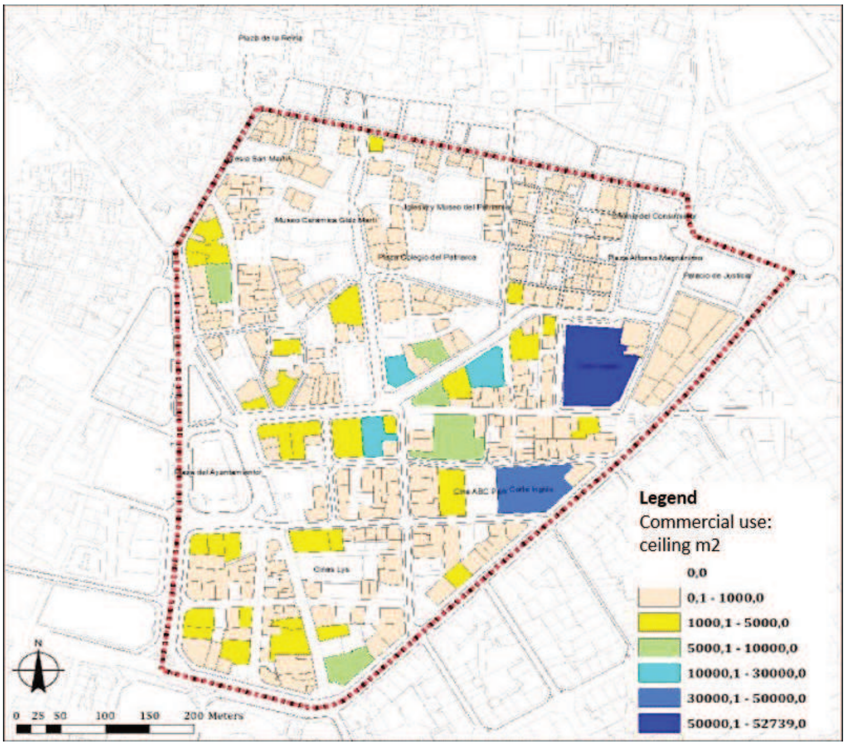

Figure 3. Location of commercial uses in Sant Francesc district (Valencia).

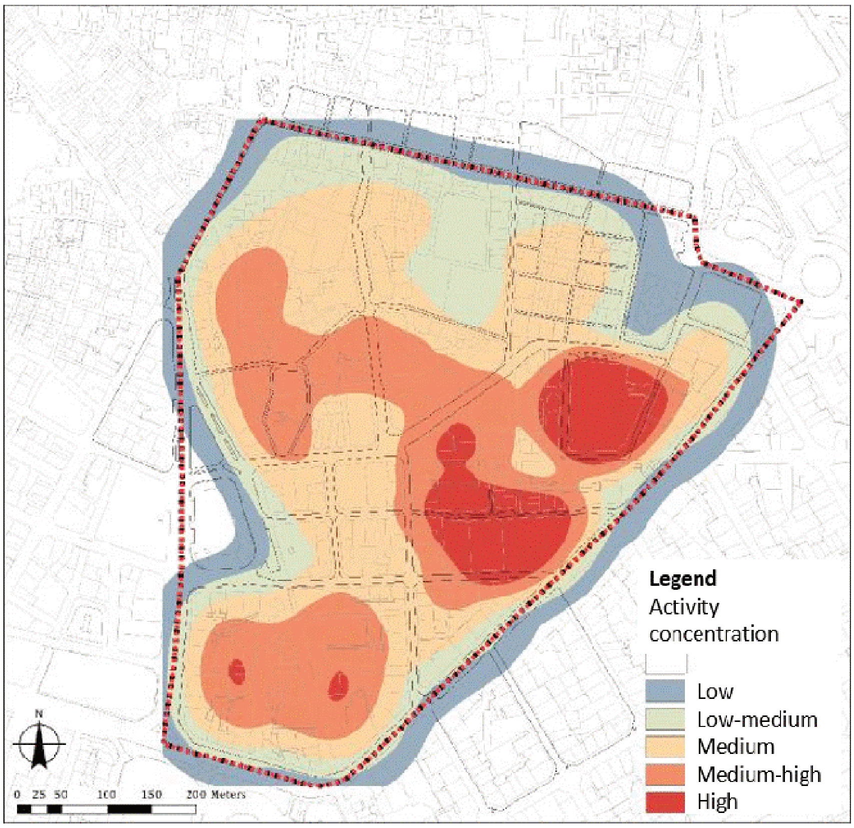

Figure 4. Activity concentration in Sant Francesc district (Valencia).

7 ALTERNATIVE ANALYSIS

Based on the above information, it is possible to begin the study of proposal. The analysis is sequential in two phases. On first phase is designed the proposal for the different transport network modes. On second phase is checked if the street sections allows the planning networks. If all transport networks do not fit in the section of a street, it will be necessary to find an alternative route for one or more of the networks. So on and on until the final solution.

First phase is also sequential. First it is developed a drawn proposal of traffic networks: network of motorized cars to access activities, network of public bus transport, bicycle network and pedestrian network. All networks have stop spaces for taxi, public bus, loading and unloading, motorbike and bicycles. The parking cars are not planning in streets, only in buildings or underground and the motorized network is planned to access its.

The motorized networks inside the superblock are planned only as a closed loop. So the motorized vehicles only can travel by a circular movement. This avoids the flow of passing traffic and allows only trips with origin or destination inside the superblock.

In our study, this phase finished after three iterations. In the first place, the access routes for cars services were designed to produce the car network.

During this analysis was incorporated as an objective the pedestrianization of the Town Hall Square due the city council made this goal public. Because of that, it was necessary to modify the superblock and incorporate another distribution street on the west. Figure 5 shows the car network in the final proposal of this phase.

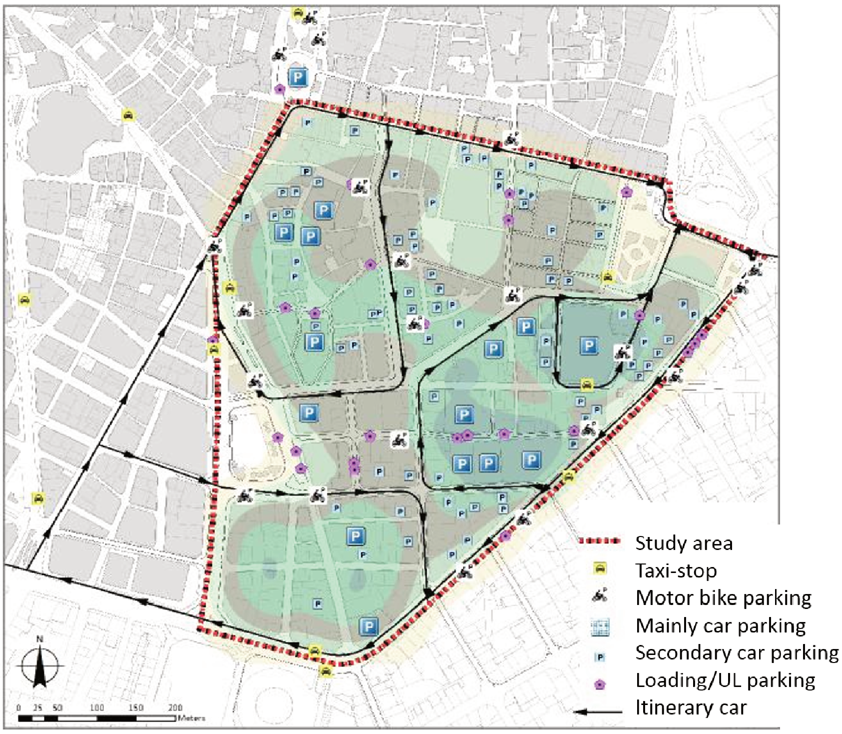

Figure 5. Car network on alternative after first analisys phase.

It was also carried out with all the networks of the different modes of transport provided with stop spaces: public bus, bicycle and pedestrian network. Overlapping all networks by GIS, as shown in Figure 6, you get the map of all transport routes. In this way, it is possible draw a complete map with all the itineraries for each mode of transport.

But this proposal is only theoretical because we still have to check if there is enough space in each street for the networks planned.

8 CHECKING STREET SECTIONS

For checking if different transport networks fit in the streets, a standard width was set for each network:

- 2.5 meters for bike path
- 3.0 meters for bus line
- 3.0 meters for car line
- 2.0 meters for line parking in street

According to these criteria was tested all streets and rethinking the paths of the networks. After this analysis, all the transport networks was redraw to adapt the transport networks to real possibilities of space in streets. In all case, all networks must be continuous and coherent.

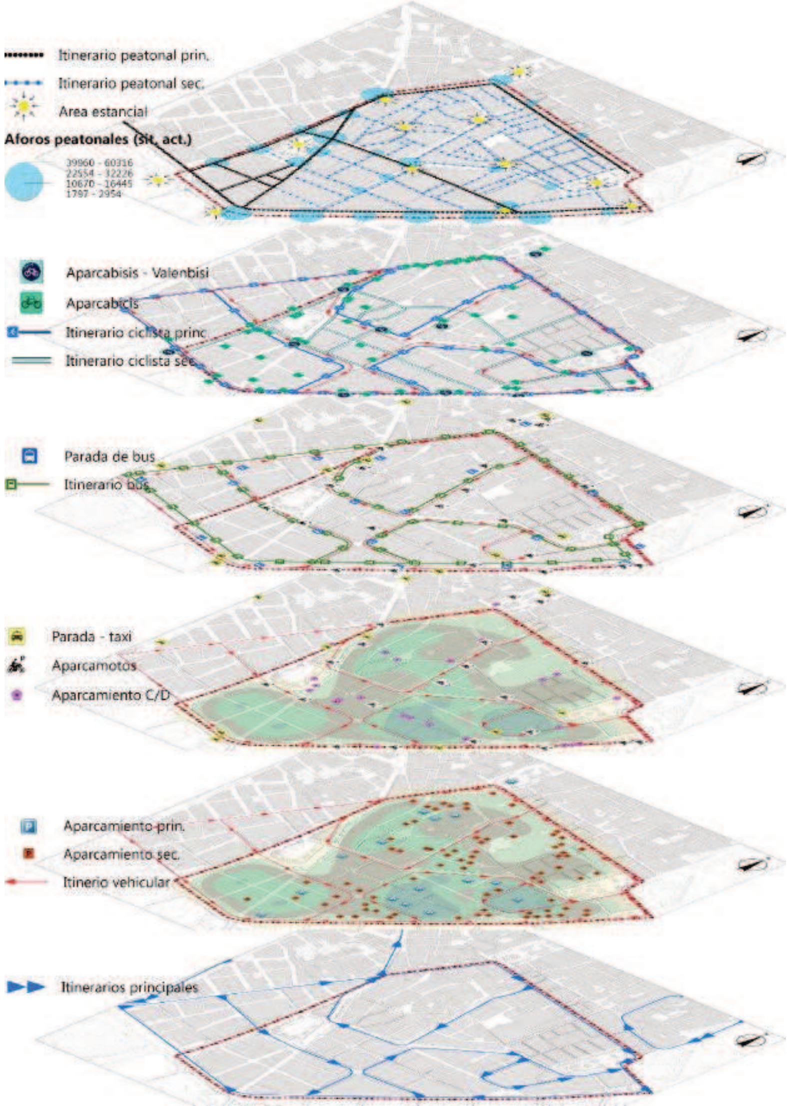

Figure 6. Overlapping network traffic of different modes (pedestrian, bicycle, public bus, car) in Sant Francesc district (Valencia) with parking and stop zones.

Figure 7 shows the final proposal for car network. The proposal has a basic network with a mainly closed loop and two secondary closed loop. This network allows connect all the area by car but only basic network, the street of round abour the whole historical centre, is designed to traffic flow. Secondary loops allows the access inside the superblock and, in other streets, cars can move by pedestrian areas (especially emergency cars or loading/unloading) or access ways to parking in buildings. Loading and unloading is limited in Valencia centre to certain times.

On the other hand, currently it exist some pedestrian streets in Valencia centre. When a street is changed to pedestrian street, according to Valencia experience, different urban activities was located it, for example, restaurants, pubs, shops ... In this case is very difficult to return the street with a design for motorized vehicles. These situations condition new designs of the zone.

The motor bike traffic present a special interest. In Spain, average car occupation is about 1.3 persons by car. On the contrary, although the number of passengers on a motorbike is about 1 per vehicle, three motorbikes occupy the space of a one car. That is, in practice, the use of the motorbike doubles the number of passengers in the same space. For this reason is important planning motorbike parking. Motorbikes use the same network of cars but need specific spaces to parking.

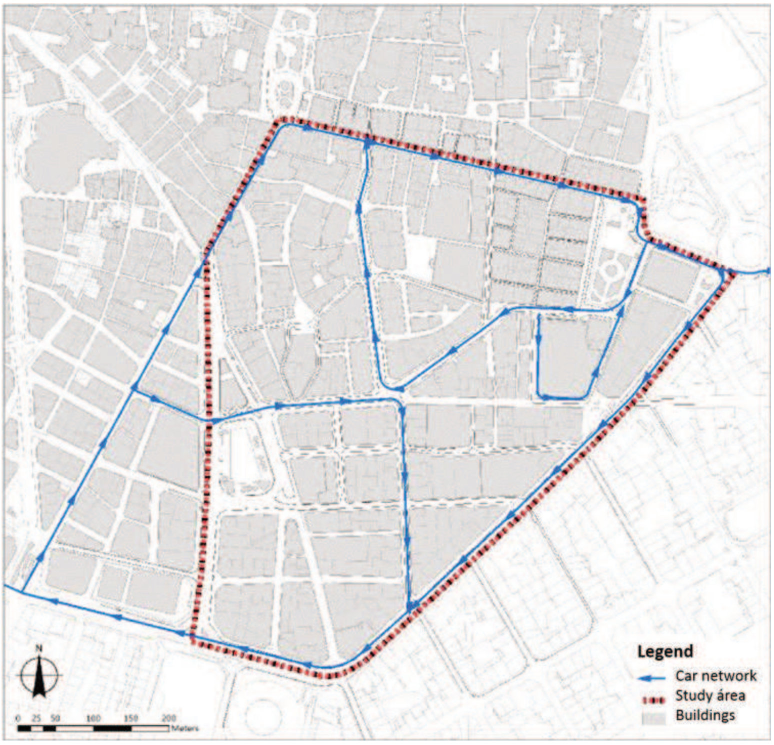

Figure 7. Final proposal car network in Sant Francesc district (Valencia).

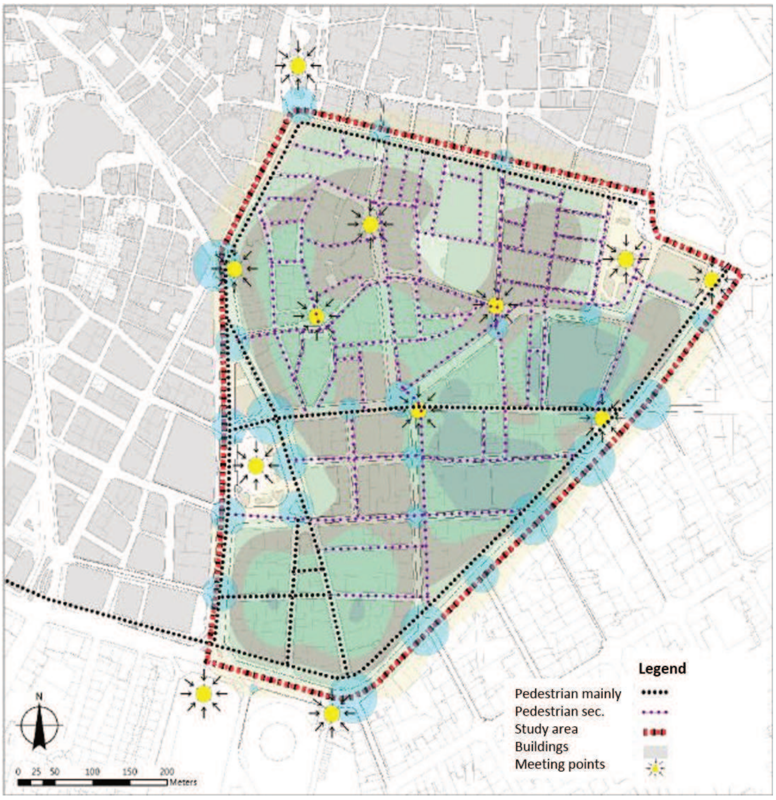

Figure 8. Final proposal pedestrian network in Sant Francesc (Valencia).

Figure 8 shows the final proposal for pedestrian network. With the proposal, most of the public space becomes pedestrian. The pedestrian network includes the meeting-points zones or public areas around the streets with a function of meeting people. This network includes symbolic public spaces as a Town Hall Square or commercial streets. Of course, the design of symbolic spaces, as a pedestrian zones, condition the design of networks.

By overlapping all network maps it is possible to obtain a complete map of urban public spaces with its functions as you can see in Figure 9.

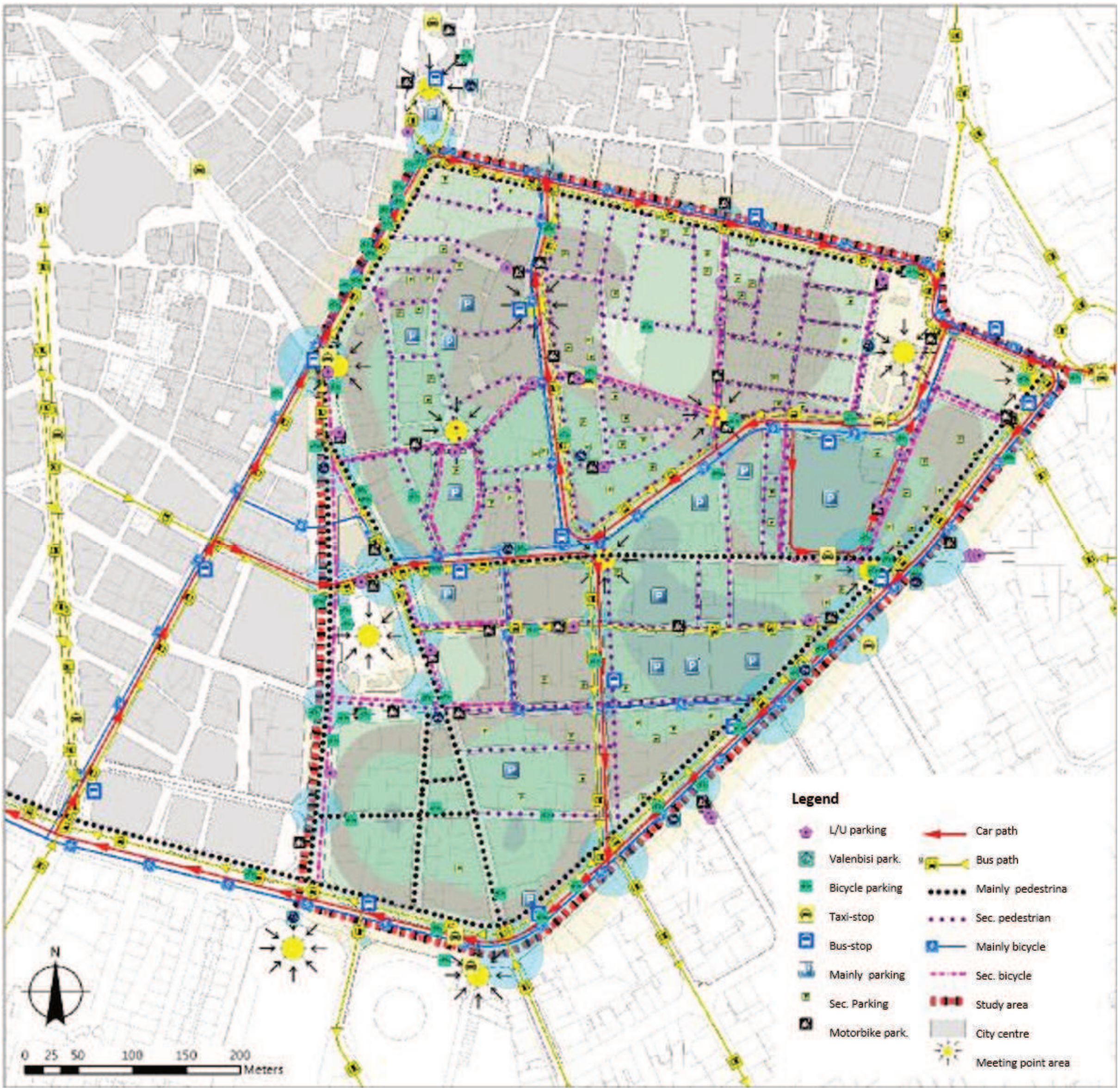

Figure 9. Final image of public spaces functions according to transport networks in Sant Francesc district (Valencia).

Finally, when the feasibility to locate the transport networks in the available space of the streets has been verified, then it will be possible to design the public spaces and the public street landscape. As a consequence, the pedestrian areas increase and the quality urban landscapes will also increase.

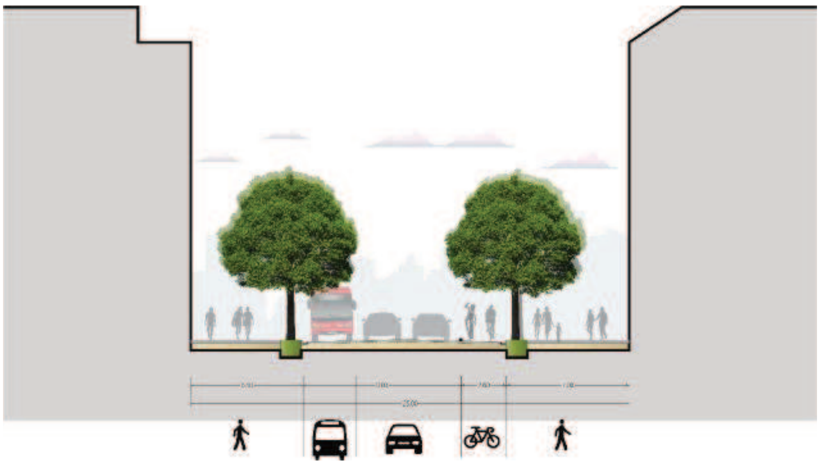

Figure 10. Proposed section for Colon Street (Valencia).

The study includes the standard section of all streets in superblock. Figure 9 shows, as an example, the section proposed for Colon Sreet, a stretch of round, that is currently one of the streets with the highest

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traffic intensity. In this case the section present an important increase of pavement for pedestrian. On the other hand, has been applied the general criteria according to which distributors streets haven't parking spaces to facilitate a fluid traffic. Note you that parking line in streets affect the space of two lanes: the lane of parking and the next lane to maneuver in order to park.

9 CONCLUSION

This study shows an example of application of theory of superblocks and traffic design based in traffic network offer to apply in city centre zone to calming traffic. The final objective is to promote non-motorized trips but maintaining the necessary basic services that must be performed by motor vehicles.

The Valencia city centre is very big to consider all it as a superblock. In consequence the study area is Sant Francesc district, a zone with more adequate dimensions. The study proves that is possible to significantly increase pedestrian public spaces while maintaining basic services through motorized transportation.

The action allows redesign the urban landscapes in city centre. Particularly the street sections to allow the different traffic network and zones of meeting points for people. The particular projects for these new urban landscapes would be developed in the future.

The applied methodology has proven to be useful for the reorganization of traffic in urban areas with the aim of promoting non-motorized traffic and generating new urban public spaces or low carbon urban landscapes.

10 REFERENCES

APPLEYARD, Donald. Livable Streets. University of Californai. Berkeley, 1981.

BROSETA, M.T. Urban quality improvement programs in the Sustainable urban Mobility Plan of Valencia (Spain). In: WIT Transactions on The Built Environment, Vol. 146, pp. 351-362. Southampton, 2015.

EUROPEAN COMMISSION. Study to Support an Impact Assessment of the Urban Mobility Package. European Commission, Final Report. Brussels, 2013. Web site: https://ec.europa.eu/transport/sites/transport/files/themes/urban/studies/doc/2013-10-urban-mobility-package-activity-31.pdf , accessed on May 2017.

EUROPEAN COMMISSION. Quantifying the Effects of Sustainable Urban Mobility Plans. JCR Technical Report. Brussels, 2013. Web site: http://ftp.jrc.es/EURdoc/JRC84116.pdf , accessed on May 2017.

GAJA I DÍAZ, F. The bicycle: mass urban transportation – a paradigm shift. Case study: the City of Valencia. In: WIT Transactions on The Built Environment, Vol. 146, pp. 27-38. Southampton, 2015.

GRANA, A., GIUFFRE, T. & GUERRIERI, M. Benefits of area-wide traffic calming measures: outcomes still to assess. In: WIT Transactions on Ecology and the Environment, Vol 117, pp 33-34. Southampton, 2008.

HASS-KLAU, Carmen. Civilised streets: a guide to traffic calming. Ed Environmental and Transport Planning. Brighton, 1992.

KSIĄŻEK, A. Approach to simulation assessment of area-wide traffic calming in the context of sustainable development. In: WIT Transactions on The Built Environment, Vol. 146, pp. 191-203. Southampton, 2015.

LOCKWOOD, I.M. ITE Traffic Calming Definition. In: ITE Journal, Vol. 67, Issue 7, pp 22-24 , Washington, 1997.

PÉREZ IGUALADA, J. The metro and the city: interaction with the urban landscape in the new underground stations in Valencia 1995-2010. In: WIT Transactions on The Built Environment, Vol. 146, pp. 363-374. Southampton, 2015.

SANZ, A. et al. Hacia la reconversión ecológica del transporte en España. S.L. CYAN. Proyectos y Producciones Editoriales. Madrid, 1996

SANZ, A. Calmar el tráfico. Pasos para una nueva cultura de la movilidad urbana. Ministerio de Fomento. Madrid, 2008.

reviewed paper

On the Path towards Smart Mobility: the Journey of three Forerunner Cities Eindhoven, Manchester and Stavanger

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1 ABSTRACT

Within the European Smart Cities and Communities Project - Triangulum (SCC1), focus areas have been selected for their transformation into living labs in the three cities, Eindhoven (NL), Manchester (UK) and Stavanger (NO). In Manchester it is a 2 km spine referred to as “The Corridor” that is home to two of the UK´s largest universities and one of the largest medical research campuses in Western Europe. In Eindhoven the former Philips industrial complex in the “Strijp-S” and the Eckart Vaartbroek neighbourhoods have been chosen for the implementation of the planned activities and in Stavanger the focus area is the Paradis/Hillevag district. These areas will be transformed into sustainable living environments during the course of the project, which started in February 2015 and will reach completion in January 2020. The aim is for them to become well-connected low carbon areas, which shall be reached by implementing clean technologies as well as innovative and alternative mobility concepts.

Understanding the city context, their approach, as well as the challenges the cities have faced in the implementation, is the basis for initiating a replication process of similar projects not only in the Triangulum Follower Cities but in any other city willing to invest in the field of sustainable and future-oriented mobility. This paper describes the Triangulum Lighthouse Cities’ journeys to becoming a reference for smart mobility.

Keywords: Stavanger, Manchester, smart mobility, Lighthouse cities, Triangulum

Disclaimer: This document reflects only the author’s view and the European Commission (Innovation and Networks Executive Agency) is not responsible for any use that may be made of the information it contains.

2 INTRODUCTION

2.1 The Triangulum Project

In Triangulum the aim of the Lighthouse Cities is to demonstrate that the integration of technologies from the energy, buildings, mobility and ICT sectors within a district can induce significant reductions in energy demand and local GHG emissions and at the same time enhance quality of life, and provide a basis for economic growth and development. The project consortium combines the interdisciplinary experience and expertise of 22 partners from industry, research and 6 municipalities, committed to develop and implement smart solutions which are planned to be further disseminated and replicated primarily, in the three Follower Cities: Leipzig (DE), Prague (CZ) and Sabadell (ES) but also beyond.

As an overarching objective, Triangulum seeks to develop a model for the replication of smart city solutions based on cost and benefit as well as maximize the dissemination and impact of the knowledge and innovation generated during the project. The replication approach has the following three stages as shown in the graphic below: demonstration, assessment and replication. In the demonstration phase projects such as E-bus lines in public transport are implemented to show how public and private actors can work together to jointly improve the quality of live in the cities. The assessment phase serves to generate robust evidence by describing and quantifying the impacts and the benefits. Later and based on the former, business models that enable replication in the Follower Cities and beyond are elaborated. To facilitate all this process ‘’on-site assessments’’ took place in the lighthouse cities. The visits took place between late 2015 and early 2016 and were led by researchers from the Institute of Human Factors and Technology Management (IAT) at the University of Stuttgart, the Fraunhofer Institute for Industrial Engineering (IAO), the Fraunhofer Institute for Open Communication Systems (FOKUS) and TÜV Süd. Each of the assessments took place over a period of approximately two weeks, undertook 25-40 interviews (political, management and technical) and a creativity workshop. All of this activity was supported by the local Triangulum coordinators in the cities.

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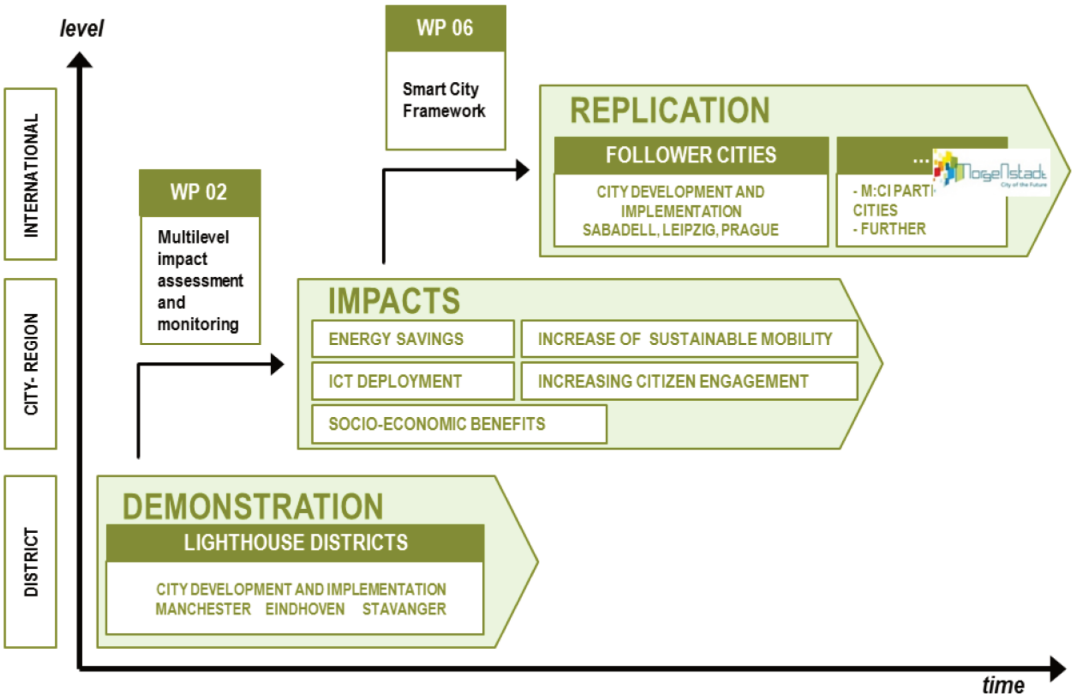

Figure 1: Triangulum Demonstration, Expected Impacts, Replication[1]

3 BACKGROUND

3.1 The Journey - How did it all start?

Each of the lighthouse cities in Triangulum has a particular story of how they became a smart city and this is linked to their city context.

In Manchester the journey began in the 90´s with the development of the cities “information society”. This promoted the development of digital inclusion projects and supporting digital infrastructure. Later in the 2000s a local digital agenda was set, working towards the growth of the digital sector through projects focusing on e-Government and digital innovation. Ten years later, the smart cities era began to deliver cloud computing and the potential of the internet of things. The current city-wide approach includes private and public partnerships with the focus laying on smart energy and transport.[2]

Although the city made unsuccessful bids to host the Olympic Games, this was part of a process that helped to raise the international profile of the city. The Commonwealth games in 2002 were a successful story and built on the legacy of the earlier submissions. The games attracted huge investments in infrastructures and were the beginning of strong partnerships that last until today.

The focus area for the Triangulum project is the Corridor area. This was established in 2002. The formal partnership Corridor Manchester integrates two of the UK´s most important universities, the University of Manchester and the Manchester Metropolitan University, with the Central Manchester University Hospitals NHS Foundation Trust, Manchester City Council and Manchester Science Partnerships; MSP is a private company and the UK’s leading provider of specialist environments and growth support to science and technology companies. The Corridor is therefore a unique location, at the heart of Manchester´s knowledge economy. With a 60,000 strong workforce and around 70,000 students, it is recognized as an innovation district with leading higher education, health, cultural and important commercial assets.[3]

Regarding Eindhoven, one of the main drivers for urban development has been the long history of entrepreneurship driven by companies like Philips and DAF. By the time Philips was founded in 1891, Eindhoven was a rural farm. The gradual evolution of Philips into a multinational company turned this city into a major industrial centre triggering a rapid urban growth during the 20th century. Next to the creation of

[1] EU SCC1 Triangulum Project , “Triangulum Grant Agreement”, 230.
[2] Nixon, “The Strategy of the City of Manchester”
[3] Corridor Manchester, “About Us.”

jobs, Philips played an active and important role in the city's urban development, e.g. by building neighbourhoods for workers, running schools, offering health care services, constructing a library, supporting the local football team and the Technical University Eindhoven TU/e.

During the recession in the 1980s, Philips moved its manufacturing processes to cheaper production sights, which included the giving up of around 14000 local employees until 1993. Additionally, the collapse of DAF cut 2.500 jobs.[4]

The Regional Authority for Greater Eindhoven was set up in the 1980s as a governmental initiative to improve the economic situation through cooperation on the regional scale. Later on, with the aim of mobilizing European funds, the economic development office (NV REDE) was founded in the 1990s and kicked-off the strong collaboration between the local stakeholders, e.g. the Chamber of commerce, TU/e and municipalities. This resulted in the foundation of the Commission for Regional Opportunities which eventually led to the foundation of the public-private partnership Brainport Development, which acts at regional level and has actively been shaped for becoming an innovation centre.[5]

Stavanger has been the centre of the Norwegian oil industry since 1969 when oil was discovered in the Norwegian waters. Nevertheless, with the decrease of the oil price in recent years new business areas have been promoted in the context of a smart city: e.g. solutions which address the high energy consumption, smart home care services that help the increased elderly population, technologies that replace the expensive labour force and smart mobility solutions that help reducing the traffic of the large number of commuters.[6]

In 2008 Stavanger joined the governmental project Cities of the Future which involved "Norway's 13 biggest cities in an urban development project to reduce greenhouse gas emissions and make the cities nicer to live in".[7] In 2009 the city signed the Covenant of Mayors agreement – to go further than the European ambitions on 20/20/20 by 2020. These were two important steps for becoming a smart city.

Moreover, Stavanger possesses excellent technological and infrastructural advances. The city has the highest density of EVs in Europe and a dense network of charging stations. There is a high concentration of fibre-optic cable which ensures a coverage of 86% of the population with 1GB internet since approximately 2005. This infrastructure was the basis for installing smart meters in homes and public buildings, which is endorsed by a law in Norway and special dedicated R&D programs by the Research Council of Norway (RCN).[8]

3.2 Smart city drivers & strategic approach

As every city is different from each other, very specific drivers can be identified for each of them. However there are certain conditions that have been present in all of them and that have promoted their development towards becoming a smart city;

- Political will and the expressed commitment to the sustainable development of the city have been keys for success. This is reflected in the number of strategies that have been elaborated and in the number of sustainable/smart city projects that these cities are involved in, Triangulum being one of them;
- Strategy development: the existence of a clear strategy and the definition of a common vision, has allowed for the alignment of sectorial plans and joined efforts towards the achievement of a common goal e.g. Greater Manchester Transport Strategy, Low carbon Strategy, Stavanger Roadmap for the smart city, Stavanger Common Strategic Business Plan 2013-2015;[9] [10]
- Innovation environment: the promotion of innovation being though a systematic model as in the Philips approach in Eindhoven, Lyse in Stavanger or through a founded institution as the Corridor in Manchester, has been a great push in the cities towards smart technologies in the transport sector.

[4] Winden et al., Urban Innovation System, 58.
[5] Ibid., 55.
[6] Schmidt et al., "Stavanger Onsite Visit Report- EU SCC1 Triangulum Project Smart City Replication Framework," 5ff.
[7] Nordregio, "Cities of the Future, Norway,"
[8] Schmidt et al. "Stavanger On-site Visit Report- EU SCC1 Triangulum Project Smart City Replication Framework," 10.
[9] Stavanger Kommune, "Roadmap for the Smart City Stavanger,"
[10] Greater Stavanger, "Strategic Business Plan 2013-2025,"

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With specific reference to Manchester, the city has developed a vision and aims to be in the top flight of word class cities by 2025. A smart city program is underway led by a small team responsible for drawing funding from a range of sources including the UK Government and the EU Commission. The smart city program is looking at new ways to make the city more efficient using technology. The program is based on the work the city is already doing around transport, health, environment and energy efficiency and encourages further investments by supporting pilot demonstration projects and working with partners in the universities, business and the public sectors. Furthermore, political stability in the leadership has allowed for long term planning and has promoted economic growth. E.g. the City Council Leader in Manchester has been in the leadership since 1996.[11]

The most important drivers for the smart city of Eindhoven are the strong research and development environment, start-up-incubators, co-working facilities, living laboratories and the entrepreneurial mentality of the inhabitants, all being components of the innovation system of the City of Eindhoven.

The system has been developed based on the fundamental idea of open innovation, the quadruple helix model, which together enable the process. The function for Eindhoven‘s innovation system, developed by the city's marketing organization Eindhoven 365, consists of three components: E= U x C, where E= Energy, U= Unconventional and C= Collaboration. This function characterizes the Eindhoven model and underlines the relevance of the collaboration between different actors, forming the basis of the economic structure of the Brainport Eindhoven Region.[12]

The city of Stavanger has had a regional office in Brussels for 25 years, which initiates international projects. In 2013 one of them introduced the city to the SCC1 program. This was the beginning of the cooperation with Eindhoven and Manchester and led to the design of the joint propossal of Triangulum in 2014. This led to the interest of joining forces with Eindhoven and Manchester to the birth of the idea of designing the integrated project Triangulum in 2014. Since the beginning of Triangulum in 2015, the Nordic Edge Expo takes place every year and constitutes one of the "most important smart city arenas in the Nordic Countries".[13] Stavanger is like Eindhoven also known for the quadruple helix concept (defined by the city as an extended version of the triple helix the strong involvement of the citizens), consisting of the city itself, research institutions (e.g. University of Stavanger), industry representatives (e.g. Lyse) and the citizens. This constellation allows face-to-face cooperation and co-development due to flat hierarchies and low bureaucracy. Stavanger's citizens participate more and more actively in urban development processes and have a high willingness to pay for new technologies, which has pushed forward inovation projects such as smart home applications and e-mobility.[14]

4 SMART MOBILITY PROJECTS IN THE LIGHTHOUSE CITIES OF TRIANGULUM

4.1 Manchester

The Triangulum mobility project in Manchester is focused on the modal shift towards more sustainable options. In the initial phase an investigation of the current state of mobility looking at movement of goods and services was carried out to capture key data and identify opportunities for implementation. Using interviews current initiatives and new opportunities were identified. The procurement and implementation of cargo bikes and electric vehicles (EV) followed this.

4.1.1 Cargo bikes

The procurement of a managed service to provide cargo "pedelecs", also known as e-bikes or power-assisted cycles, fitted with a battery powering a motor, which will assist the riders own pedalling efforts up 15.5mph was undertaken by MMC to identify a provider. The Cycle Waggle is providing a managed service for 4 cargo bikes fitted with GPS tracking along with access to other bicycles in their fleet. Partners have full access to them including training, fleet management and maintenance. Currently the bikes are being used for

[11] Nixon, "The Strategy of the City of Manchester."
[12] Schmidt et al., "Stavanger On-site Visit Report- EU SCC1 Triangulum Project Smart City Replication Framework," 6.
[13] AS, "Join the Expo | Nordic Edge Expo 2016,"
[14] Schmidt et al., "Stavanger On-site Visit Report- EU SCC1 Triangulum Project Smart City Replication Framework," 7,8,9.

post services and food delivery. The company is able to use their experience and knowledge to support the users and to identify new opportunities.[15] An additional stimulus has been the closure of the Oxford Rd in summer 2017. The road is closed between between 6 a.m. and 9 p.m. to all traffic other than buses, emergency and taxi vehicles plus "white listed vehicles" i.e. those on a centrally held list. The data from these assets is being collected and monitored, in order to inform future mobility choices.

Figure 2 E-cargo bike on loan to MMU post team[16]

Electric vehicles procurement and implementation

The MMU has procured two Nissan Leaf vehicles to be used as staff pool cars, while UNIMAN are leasing seven Nissan vans, replacing their diesel vehicles fleet. Additional charge points have been installed in each of the universities. Triangulum has therefore enhanced the business case for EVs and therefore reduced the number of diesel vehicles operated within the Corridor. Due to the success of the EVs at the MMU, they have acquired an additional vehicle at their own costs.[17]

4.2 Eindhoven

In Eindhoven, the mobility tasks involve on the one hand, the purchase of intelligent chargers and the development of effective means of communication, and on the other hand the implementation of innovative ICT solutions for better managing the parking facilities.

4.2.1 Smart charging of electric vehicles and mobility management

In Strijp-S, the existing electric vehicle charging infrastructure has been connected to the ICT backbone to allow for data transfer. The new charging poles include various functions for the clients such as making a reservation for a charging pool, receiving a message for the car when the car is fully charged, emission of a unique bill for parking and charging, among others. A real time parking guide system, able to be integrated in a navigation system will be developed. For this purpose, the existing ICT networks managing current parking spaces have been connected to the ICT backbone, and a management service has been developed and is currently available for usage.

4.2.2 Tender to stimulate the development of innovative smart city services

Furthermore, with the purpose of engaging the citizens and making good use of the new generation of the data through the newly installed sensor system in the public space, the city has designed and launched the iCity tender open to public applications, challenging SMEs, entrepreneurs and start-ups to present their ideas

[15] Triangulum Project, "Part B: Technical Periodic Reporting Version 2.0," 61.
[16] WP3 Triangulum Project, "D3.3 2nd Technical Implementation Report Manchester," January 2017, 25.
[17] Triangulum Project, "Part B: Technical Periodic Reporting Version 2.0," 62.

for the development of innovative products and services.[18] Here, one of the selected projects for the further development of its business case is an electric bike sharing system for the city.

5 STAVANGER

The mobility modules in Stavanger aim on the one hand, to "combine advanced ICT solutions and load management in the electricity grid in such a way that future demands are met in areas such as supercharging and traffic surveillance"[19] and on the other hand, to help achieving a reduction of emissions from traffic, by switching to electric mobility.[20]

5.1.1 Electric battery bus demonstration

The project, implemented by the Rogland County Council, includes investment of three 12 meter long electric buses through public tendering, ensuring their operation and maintenance, setting up charging infrastructure installations and the training of personnel. The buses' performance is analysed via an online monitoring system.[21] At the moment the busses are driving in regular city routes and data is being send to the University of Stavanger for research purposes. The design for the three busses was finalized through an open design competition in cooperation with the street art festival NuArt where students from three local high schools submitted their ideas. 25000 citizen voted online and chose their favorite design among 7 finalists. This process was done in cooperation with the local newspaper.[22]

Figure 3 Winning design 'Mother earth' by Morten Hansen Amdal[23]

5.1.2 Electric vehicle charging infrastructure

This module is being implemented by the company Lyse and includes the installation of ICT-based charging solutions for EV mobility in private homes (10 homes with 7-11kW AC chargers), as well as in apartment buildings (cable infrastructure in parking space with individual meters and 7-11kW AC chargers).[24] This project not only allows Lyse to gain data about energy consumption patterns and their effect on the grid but also gives customers the opportunity to avoid peak hours for charging their vehicles and gives them more flexibility.[25]

[18] Ibid., 85–87.
[19] EU SCC1Triangulum Project, "Grant Agreement-ANNEX 1 (Part A) Innovation Action, Number 646578," 53.
[20] EU SCC1 Triangulum Project, "Part B: Technical Periodic Reporting Version 2.0," 114.
[21] Shetty, Schmidt, and Stöffler, " Module Description Electric Battery Bus Demostrator,"
[22] EU SCC1Triangulum Project, "Part B: Technical Periodic Reporting Version 2.0," 115.
[23] "Design Competition for Buses in Triangulum's Lighthouse City Stavanger Receives Attention – Triangulum,"
[24] Shetty, Schmidt, and Stöffler, "Module Description Electric Vehicle Charging Infrastructure,"
[25] EU SCC1 Triangulum Project, "Part B: Technical Periodic Reporting Version 2.0," 125,126.

6 CHALLENGES AND LESSONS LEARNT

Important lessons emerge from the implementation in the lighthouse cities. They are principally about behavioural change. For example the promotion of the use of cargo bikes by non-cyclist require training and awareness raising as well as the willingness to try something new. Equally important is to consider all health and safety requirements before the implementation. People are for usually very hesitant to switch to bikes, when they feel unsafe or are unsecure. Risk assessments and training could help to mitigate the problem. Likewise it is important to think about training the staff for the use of an EV at an early stage. For instance the implementation of the electric bus in Stavanger has shown that the citizens not only choose the transport mode because of the clean technology (e.g. EV), but rather because of the services, benefits and confort (e.g. punctuality) that come with them.

Another challenge is the access to live data and the availability of interfaces to access the data i.e. APIs. In Manchester a new system had to be deployed to track the bikes and the API has been developed specifically. The EVs have relied on Nissan's own system, CarWings. However, this does not have the capacity to access remotely and accessing the data is via manual download. Nissan has no plans to introduce remote access and the only solution is to investigate a commercial service specifically for fleet management. Futhermore, the existing infrastructure also plays an important role. For instance when installing charging stations in private homes or apartment buildings, one has to check the ownership structure first. Private parking spots are the most suitable as an installation of a dedicated electric circle for the charging stations is necessary. Also, the existing capacity of the home electric circuit and the electric grid must be high enough to take the additional load. It is important to know that people like to charge their car right after coming home from work in the afternoon, so some measures have to be taken in order to shave peak loads. Here an effect based tariff could avoid expensive peak loads.

Legal policies are without doubt very important supporting factors. Particularly in the case of Stavanger they have been one of the significant drivers for EV. The privileges for EVs (tax benefits and priority road ways) as well as the National Transportation Plan, have helped to push this technology ahead,. Additional factors such as the cheap renewable energy and the technology oriented citizens further contributed to this development.

Finally, the involvement of the citizens from early stages and throughout the process has proven to be crucial for successful implementation in each of the cities. Taking into account the citizens preferences and requirements for designing the project, increases the probability for its acceptance afterwards. For example the payment method for a private home charging station can seriously affect the financing scheme, depending if the users prefer to pay a one-time installation or a monthly fee. Important is to remark that citizens need access to information and it has to be communicated in a way that it is easy to understand. The more the people are able to visualize and comprehend a specific solution or application, the easier they can contribute and give feedback.

7 CONCLUSION

Mobility can unquestionably be regarded independently from other sectors as energy and ICT. The evolution towards sustainable transport is a process - political, strategical and technical - which the cities in Triangulum have gone through for several decades.

This project has proved that strong established partnerships are the key for better networking and have enabled fast and joint innovation in all of the lighthouse cities. Smart mobility is on the one hand driven by a strong political will and on the other hand by the will of the citizens. Thus active citizen engagement and the use of new forms of communication are crucial for the realization and implementation of these kind of projects.

Finally, governace approaches as the quadruple helix model based on university-industry-government-collaboration and strong citizen involvement, have proven to be successful in its goal to meet local as well as regional challenges of urbanization, industrialization and economic down. Here strategic partnerships have not only been the key for better networking but have also formed the basis for the innovation landscape and constitute one of the main drivers for economic success on all levels.

The involvement and commitment to ambitious projects such as Triangulum, is something that evolves over time until building an international profile and reputation. Even if there is no instant or "one-fit-all solution"

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for becoming one of the leading cities in terms of mobility, strong partnerships, active citizen involvement in the city planning, and an innovation environment can be considered -based on the Triangulum experience- important pre-conditions for starting a successful journey towards smart mobility.

8 REFERENCES

About Us, Corridor Manchester. Accessed May 31, 2017. http://www.corridormanchester.com/about-us.html

AS, WordPress av Maksimer. “Join the Expo | Nordic Edge Expo 2016.” Nordic Edge Expo. Accessed June 12, 2017. http://www.nordicedge.org/expo/ .

“Design Competition for Buses in Triangulum’s Lighthouse City Stavanger Receives Attention – Triangulum,” accessed June 12, 2017,

http://triangulum-project.eu/index.php/2016/12/05/design-competition-for-buses-in-triangulums-lighthouse-city-stavanger-receives-attention/

Greater Stavanger. “Strategic Business Plan 2013-2025,” March 2015.

Nixon, Hayley. “The Strategy of the City of Manchester.” presented at the Workshop 1, Implementation Strategies, Stuttgart, February 22, 2017.

Nordregio. “Cities of the Future, Norway.” Accessed June 6, 2017. http://www.nordregio.se/en/Publications/Publications-2016/GREEN-GROWTH-IN-NORDIC-REGIONS-50-ways-to-make-it-happen/Green-cities-and-municipalities-/Cities-of-the-future-Norway-/

Padilla, Marielisa; Alexander, Schmidt; Kai, Tepe; and Nikolay, Tcholtchev. “Manchester On-site Visit Report- EU SCC1 Triangulum Project - Smart City Replication Framework,” March 2016.

Schmidt, Alexander; Kai, Tepe; Nikolay, Tcholtchev; and Nora, Fanderl. “Eindhoven On-site Visit Report- EU SCC1 Triangulum Smart City Replication Framework,” March 2016.

Schmidt, Alexander, Kai Tepe, Nikolay Tcholtchev, Nora Fanderl, and Sophie Mok. “Stavanger On-site Visit Report- EU SCC1 Triangulum Project Smart City Replication Framework,” March 2016.

Shetty, Nikita; Alexander, Schmidt; and Sonja, Stöffler. “EU SCC1 Triangulum Project WP 6 - Results 2nd On-site Stavanger - Module Description Electric Battery Bus Demostrator,” May 2017.

———. “EU SCC1 Triangulum Project WP 6 - Results 2nd On-site Stavanger - Module Description Electric Vehicle Charging Infrastructure,” May 2017.

Stavanger Kommune. “Roadmap for the Smart City Stavanger - Vision, Goals and Priority Areas,” 2016.

EU SCC1 Triangulum Project. “Grant Agreement-ANNEX 1 (Part A) Innovation Action, Number 646578,” November 14, 2014.

———. “Part B: Technical Periodic Reporting Version 2.0,” December 2017.

———. “Part B: Technical Periodic Reporting Version 2.0,” December 2017.

Winden, Willem van, Erik Braun, Alexander Otgaar, and Jan-Jelle Witte. Urban Innovation Systems: What Makes Them Tick? Routledge, 2014.

EU SCC1 Triangulum Project WP3, “D3.3 2nd Technical Implementation Report Manchester,” January 2017.

Panta Rhei? What about When Movements Come to a Halt?

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1 ABSTRACT

Panta rhei means 'everything in perpetual motion'. This may be true for the cosmos but on planet earth movement of people cohabits with staying put. Even nomads –historic and contemporary – alternative between movement and temporary station. Movement in cities is interdependent with arriving, staying put, or moving from one travel mode or one place to another. Normally, movements of people have a purpose of arriving. There exists therefore interdependence between flows and nodes to use Manuel Castells concepts. All types of movements of people on planet earth require man made infrastructure for the flows as well as for the nodes, regardless of mode of movement.

The paper concentrates on urban dynamics related to railway infrastructure and selected railway stations in London. It argues that railway privatisation shifted the emphasis from flows to nodes, as privatised railway land and stations had greater development potential than still quasi publically owned and run railway tracks. This shift could have provided an opportunity for greater integration between transportation and land use planning, long an aspiration but more rarely implemented in practice. The corporate separation between railtracks and other key rail functions like running trains and stations may well have constituted a hindrance to such integration, except at interchanges, where flows meet nodes. Since the revival of rail travel in the UK railway stations and their surroundings became the place for massive regeneration projects. In particular, stations were transformed from mere spaces of connection betweeen people travelling and using the city into places in their own right, parts of urban fabric with urban functions other than sheer interchanges between modes of movements. They were accommoding urban activities such as commerce and entertainment for people to linger, stay and use. They and their surroundings had become a destination in their own right. How do these destinations compare with other urban places?

Examples of station development are discussed by comparing their different approaches with special attention to their function as railway stations and their surroundings as public realm. The paper critically examines the impact of privatised railway strategies on station regeneration, the local environment surrounding them including land grab and, in particular, the sustainability or otherwise of the redesigned public realm, the 'relique pacificae' to 'panta rhei' as key to urbanity.

Keywords: railway station, regeneration, London, shrinkage, expansion

2 INTRODUCTION

Panta Rhei means 'everything in perpetual motion' according to Heraclitus. This may be the case of the cosmos, or of water, but on planet earth movement cohabits with standing still: 'reliqua pacificae' – 'peaceful rest'. Movement of people generally aims for destination. Even nomads - historic and contemporary – alternate between movement and temporary station. Movement, in cities which interest us here, is interdependent with arriving, staying put, or moving from one mode of transport or one place to another.

In the physical world movements of people and goods require infrastructure, regardless of mode of movement, be they controlled flight paths, rails, roads, cycle lanes, or walkways. Normally, movement does not take place for its own sake, it is interdependent with getting somewhere. Human flows are means to get from node to node. There exists therefore interdependence between flows and nodes, to use Manuel Castells concepts for whom all social processes are connected to physical space. In his theory interaction between space of flows and space of places (nodes) are leading to the transformation of the urban landscape.[1]

For planners and the professionals of the built environment that implies a linked approach between transportation and land use. Despite repeated pleas to integrate all types of planning in many countries land use planning was -and still is- often segregated from transportation planning. Such segregation can be explained by conflicting interests between the transportation and the development industry. One way forward

[1] Manuel Castells. Trilogy of The Information Age: economy, society and culture. Vol I The rise of the network society (1996, Whiley Blackwell); Vol II, The power of identity (1997, Wiley); Vol III, End of millennium (1998 Wiley).

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towards integration is to improve connections between flows and nodes. In the case of railway transportation railway stations act as connections, enabling people to pass through their multimodal links to other places or to remain in their built up surroundings.

The paper concentrates on urban dynamics related to railway infrastructure and selected railway stations in London. It critically examines the impact of railway strategies on station regeneration, the local environment surrounding them including land grab and, in particular, the sustainability - or otherwise - of the redesigned public realm as key to their urbanity.

3 SHORT BACKGROUND HISTORY

Great Britain has the oldest railway system in the world built for steam locomotives on cast iron rails. As part of the industrial revolution a national rail network was constructed, driven by the 1840s railway boom. It served London, then the largest city in the world with over one million population in 1801[2]. London extended vastly in space and demography due to the introduction of railways in 1836 which helped London's population double to 2.2 million by the mid 19th century. Capital of the largest Empire with the largest port in the world, London was accessed by star shaped rail connections from the country and beyond ending in a ring of rail termini around the edge of inner London. Railway development was a crass affair. The private sector built and owned interlaced radial routes to accommodate the movement of goods, passengers and to support general trade. Many railtracks and station buildings were carved into the existing urban fabric, severing usually poor communities.

Chronology of London railway station building
(often two adjacent stations were built by rival entrepreneurs in the same location)
London Bridge station, 1836, a rebuilt existing station and an added station for commuters, now an interchange with ThamesLink
Euston station, 1837, for goods from the industrial north, earmarked for the terminus of the planned HS2 line to the north west and Scotland
Fenchurch Street station, 1841, for City of London commuters, initially at the Minories
Waterloo station, 1848, with several additions by different developers, including the now redundant Eurostar terminal designed by Nicholas Grimshaw
King’s Cross station 1852, for goods and passenger services from the north-east and Scotland, totally regenerated with a new entrance, freeing the first façade showing the double railway arches designed by Lewis Cubitt
Paddington station, 1854, designed by Isambard Kingdom Brunel, linking up eastern and western counties, as well as more recently Heathrow airport
Victoria station, 1860, consisting of two stations serving south and south-east commuters, and also international trains from the continent across the channel by boat before the channel tunnel was built
Mooregate station 1865 as extension of west London ‘metroland’ and serving garden cities north of London
Cannon Street station, 1866, serving the City of London from the south east
Charing Cross station, 1864, an extension of London bridge station to the north of the Thames
Broad Street station, 1865, demolished and merged with Liverpool Street station in 1986 to give way to the first comprehensive high density station regeneration project, now being rebuilt
St Pancras station, 1866, with then the largest single span roof in the world designed by William Henry Barlow, but hidden behind the Victorian façade of the hotel designed by George Gilbert Scott, connections with the Midlands and Yorkshire, totally regenerated with in addition the Eurostar terminal of HS1
Liverpool Street station, 1875, replacing Shoreditch station, linking Essex and East Anglia, as well as Stansted airport
Blackfriars station, 1886, extended over the Thames forcommuters from the south to the City, regeneratedwith ‘solar’ bridge
Marylebone station, 1899, connecting Manchester and later Oxford and outer suburbs, boosting urban sprawl in the unplanned ‘metroland’ till 1933

Initial rail investment - akin to the tulip craze in 17th century Netherlands – cumulated in a railway mania towards the 1851 Universal Exhibition, although the Royal Commission on Metropolitan Railway Termini had tried to slow it down in 1846, for fear that the influx of passengers would bring the capital to a standstill. It prohibited rail through-routes in the central area of London. This led to an underground connection, the Circle Line, linking the head stations with a smaller gage, used subsequently for the whole underground railway system, built mainly on the north of the Thames, and preventing rail integration to this day. However, this separation preserves the role of the London (mainline) termini which are generating a great concentration of passenger movements and thus extensive commercial footfall in and around them.

[2]firstever UK census in 1801

Fig 1. London rail network and circle line 1889 (source: http://homepage.ntlworld.com/clive.billson/tubemaps/1889.html, accessed 0/03/14)

The myriad of small, often speculative rail companies were consolidated into four main consortia in 1923 and nationalised in 1948 into British Railways, later British Rail, which modernised the network with diesel and electrification.[3] Gradually passengers exceeded freight which had moved onto roads. Under the Thatcher governments in the 1980s railways were subjected to severe cuts and fares were hiked above inflation with the effect that rail journeys decreased. British rail was privatised from 1994-1997 into Railtrack, responsible for infrastructure and Network Rail in charge of operations. The latter was fragmented into many individual private lines run with concessions allocated by the central government.

After decline in the 1980s, rail passenger numbers on the underground, ‘overground’ and buses in London increased again, due to London’s population and economic growth. Modernisation of the transport networks and greater integration contributed also to greater use. Responsibility for an increasing number of ‘overground’ lines, as well as the Dockland Light Railway, new bus and tramlines were transferred to the Mayor of London, directly elected since the creation of the Greater London Authority in 2000. Responsibility for London transport management and operation remained entrusted in Transport for London, now answerable to the Mayor of London. Overall, the shifts toward greater integration facilitated travel for commuters also beyond London. Nevertheless, not all suburban lines were transferred to the control of the Mayor of London.[4] More over, rail fares remain among the highest among large cities worldwide.

Another important accelerator was the introduction of ICT aimed to ease the use of the transportation network in the London region. This included the introduction of the comprehensive 'electronic purse', the ‘Oyster card’ which can be used on all public transport modes across Greater London and increasingly beyond. Top-up facilities were reduced with the closure of ticket offices in all stations and the Oyster card was complemented by use of touch-less credit cards and mobile phones with appropriate apps. Passenger information remained patchy though. Electronic timetables at stops were scarce and supplemented by a system of phone numbers which passengers have to call up on their personal mobile phones to obtain travel information. Only recently were maps produced showing all these lines together, however they are hard to read on electronic devices.

[3] The last steam train was decommissioned in 1968

[4] Notoriously those which have been plighted by severe strikes over modernization in the eyes of the railway companies and job losses and pressures on security in the eyes of the trade unions. The strikes are ongoing but the conservative government did not want these lines to fall under the control of a socialist mayor of London.

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4 IMPACT OF RAIL PRIVATISATION

A major impact of rail privatisation was the monetisation of all assets, rail infrastructure as well as railway stations and railway land. To some extent this created a closer link between flows and nodes. Before privatisation the key objectives of railways were the flows, transporting people from origin to destination. Privatisation focused on all assets and especially the income they could generate. While Railtrack remained the quasi public owner of the tracks, railway land and railway stations had great real estate development potential and were regenerated accordingly by the private rail companies, often in cooperation with other developers. This meant that nodes had much greater commercial potential than flows. Various governments rewarded the usual pressures of developers with a host of new planning legislation, including two strategies of particular worth to railway land development. One is the general presumption in favour of development, the other densification of the urban fabric at transportation interchanges. Interestingly, Paul Cheshire[5] found that Iconic design, such as skyscrapers authored by 'trophy-architects' were not generating a higher yield than other office buildings and were often harder to let.

5 FROM SHRINKAGE TO EXPANSION

London's population of 8.6 million[6] was at its peak before the second world war. Population decline, due to the war was exacerbated by the London County Council's decongestion policy into eight new towns beyond the green belt proposed in the Abercrombie London Plans of 1944 and 1945. After the second world war population continued to decline in inner London, followed by outer London while small market towns were growing in the region and even beyond London's labour catchment area. Decline persisted until the late 1980s when London returned to growth, contrary to the then theories of urban change.[7]

London's infrastructure needed adjusting to its resurging population growth from 7.4 to 8.4 million between 2001 and 2011 and rising.[8] In the case of London this has led to speculative symbiosis between transportation and land use. It was also accompanied by a reversion of dispersion and the return of young families to the city centre.[9] The strategy to accommodate such population increase in London was to ease permission of high density, high rise development above and around transportation stations. This concern both railway and underground stations and those of the new Crossrail line.

Developments include the regeneration of the north-south Thameslink, the only rail-track crossing London. To be completed by 2018, this connection is linking Gatwick airport in the south with Luton airport in the north, interchanges with High Speed 1, the Eurostar connection between London and Europe at St Pancras station, was incorporated in the large railway station regeneration at London Bridge. A new east-west connection, Crossrail 1[10] is also under construction through inner London with a main railway gage. Crossrail 2 linking south-west to north-east London, eventually forking out into not yet determined new regional links is also foreseen to ease movement across the London conurbation.

HS2 high-speed rail is planned to link London to the north west of the country. Variations in London include a HS2 terminus at Euston station on the inner ring giving rise to a major development, a planned link to Heathrow airport,[11] and/or creating a new super-transport hub on railway land, at Old Oak Common in northwest London, again connected to a very large scale regeneration scheme on surrounding public land.

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[5] Cheshire, Paul, Iconic Design as Deadweight Loss, rent acquisition by design in the constrained London office market, LSE & SERC & Gerard Dericks III Oxford University & SERC, seminar at LSE, 3 February 2014. http://www.spatialeconomics.ac.uk/textonly/SERC/publications/download/sercdp0154.pdf

[6] 1939 estimates

[7] See for example: Peter Hall, 'London 2000', first published in 1963, where he maintains even in the 1971 edition that London will decline and its population will disperse continuously outwards well beyond the greenbelt into the homecounty market towns.

[8] The Mayor's London Plan 2011 and alternations forecast 10 million population by 2030.
For population forecasts, see also Bell, Sarah andPaskins, James (eds), Imagining the Future City: London 2062, UCL sustainable cities series.

[9] Mapping gentrification the great inversion, The Economist, 09092013. http://www.economist.com/blogs/blighty/2013/09/mapping-gentrification

[10] Now named Elizabeth II line

[11] Heathrow airport is expecting to build a third runway for which it has government go ahead, but no planning permission yet.

These to a large extent publicly funded projects, and many others amount to a massive transformation of London's privatised rail infrastructure, together with the renovation of the ancient 'overground' and underground rail networks to accommodate the growing increase in rail passengers. The regeneration of London's termini, including construction with air rights or on adjacent railway land are considered to be essential to co-finance these infrastructure projects.

Fig 2 Crossrail 1 & 2, London

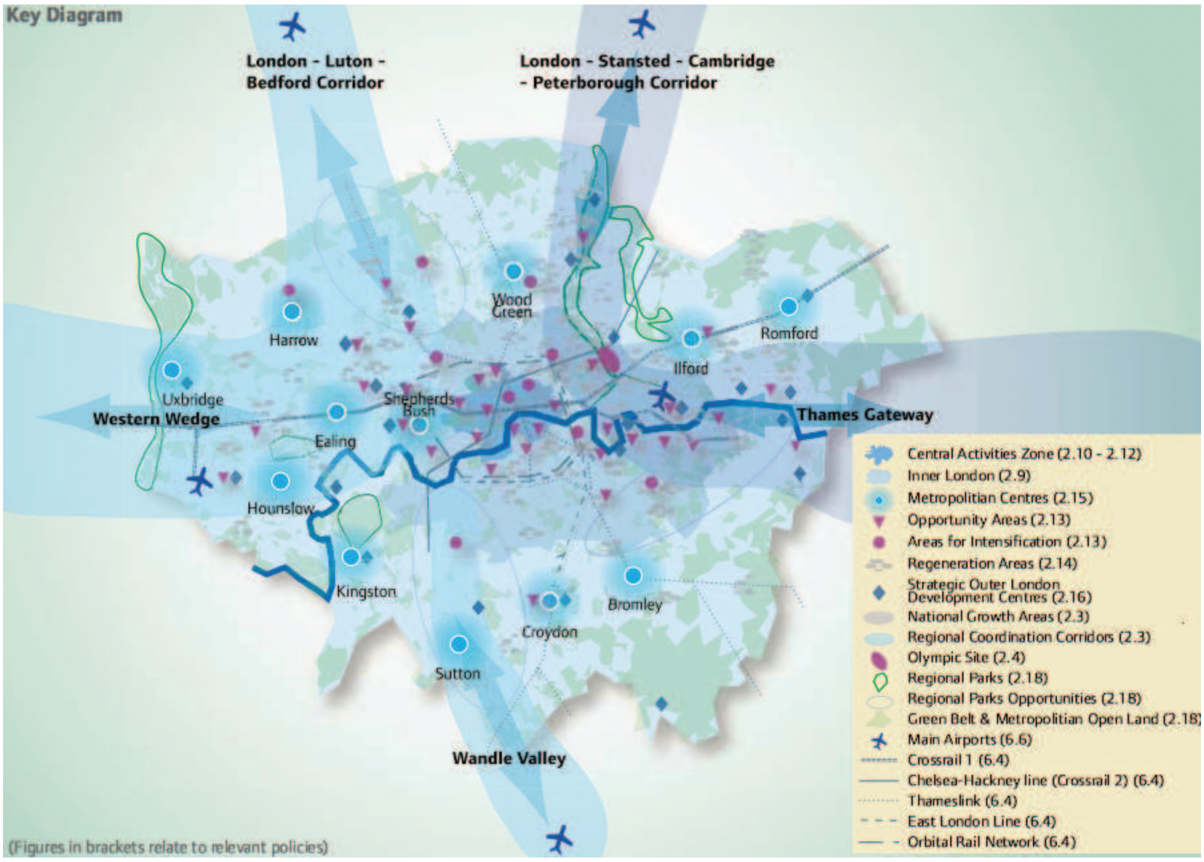

Fig 3. Key diagram for the development strategy of the 2011 London Plan, (Heathrow airport is in the west and Gatwick airport in the south), source: GLA (Greater London Authority)

6 REGENRATION STRATEGIES FOR LONDON'S RAILWAY STATIONS

Transformations of London's railway stations vary, owing to different heritage rulings over them, but the planning strategy laid down in the Mayor's London Plan postulates a general principle of increased densities for mixed use at and around transportation interchanges.

The stations are the most expensive part of the railway network regeneration programme. However they, together with their existing termini hotels, are potentially the most lucrative assets. Moreover, their regeneration is assisted by recent national planning legislation biased towards development[12] which is favouring investment into large scale, high density, new real estate around and, if possible, above railway stations which are driving up land and property prices in the surroundings.[13]

A detailed passenger survey comparing 2001 with 2011[14] shows the numbers of passengers arriving and departing in the main London stations and their on-journeys per mode of transport. Among the half million peak time passengers per day, 36% are going onward on foot from the central London termini, with potential pedestrian journeys on the increase. This means that these passengers are captive consumers in and around the railway stations. During modernisation railway stations rented out much space to retail outlets, while reducing public facilities, such as seats for waiting passengers and ticket and information offices. Many among the stations which were not constrained by listed building status underwent large scale regeneration programmes, attracting foreign inward investment, letting airspace for high rise, high density real estate above and around the stations, and/or using land of sidings and other redundant rail-land uses for new development. Together these developments helped finance station and railway modernisation and/or expansion to accommodate growing passenger numbers, notwithstanding substantial public subsidies.

Fig 4. Key Old Oak regeneration: transport node densification and real estate based financing

7 IMPACTS OF STATION REDEVELOPMENT ON THE PUBLIC REALM

The question remains how much these regeneration projects are contributing to the improvement of the environment in and around the railway stations for the benefit of those who use the stations and those who live, work and visit around them. This includes 'panta rhei', the ease – and better still attractiveness - of movement inside and around these nodes in the public realm. Station regeneration seems to create a chicken and egg situation. Extensions either above, alongside and/or below stations are increasing the commercial footfall, often with high density buildings and densification which, in turn, increase land values and make it difficult to keep open space free for public use. Planning is the only negotiation power of local authorities, the theoretical custodians of the public interest in their area, especially those which are only minority partners and/or without landholdings there. Increasingly strapped for cash, they are keen to obtain income from property taxation (business and residential rates), which are increasing with property values. The sites

[12] Defined in the 2012 National Planning Policy Framework as “presumption in favour of sustainable development”

[13] http://blogs.lse.ac.uk/politicsandpolicy/archives/32471 Accurate predictions of property price effects can help realise transport infrastructure projects. Gabriel Ahlfeldt, LSE, 2013.

[14]http://www.tfl.gov.uk/assets/downloads/corporate/central_london_rail_termini_report.pdf

around stations will thus accommodate lucrative real estate, including luxury flats which at present yield four times more rent (or sales value) than office space and tend to displace workplaces accordingly, even in the city centre. A few examples with diverse development strategies illustrate this trend below.

7.1 London Bridge Station, Shard and London Bridge City

The Shard, at the time of its construction the highest building in Europe is possibly the most famous example of property gain. Owned by Sellar Property and the State of Qatar, designed by Renzo Piano and inaugurated in 2013 it rises 310 m above London Bridge Station. The Shard is accompanied alongside by London Bridge City developed by St Martin's Property Corporation and Cushman & Wakefield and masterplanned by Twigg Brown Architects. The station regeneration by Nicolas Grimshaw followed, including vast refurbished spaces under the railway arches, an elegant roof over the platforms and tall buildings above. The entrance floor of the Shard accommodates a new open pedestrian area to access the station concourse and to reach the surrounding ground level by escalator or on walkways along vehicle access routes. The new elevated ThamesLink track[15] has triggered development but is also constraining the station forecourt which is not an inviting place to linger, not least owing to the wind turbulence created by the Shard.

7.2 Stations in the City of London

Part of the densification of the City of London is taking place with skyscrapers above and around railway stations. Cannon Street Station was the first to accommodate an air right building, a suspended structure by ARUP to leave the railtracks unimpeded, completed in 1965. Only the twin towers of the original station of 1910 overlooking the Thames remained during the various developments which followed. Foggo architects designed the latest air-right office building above the refurbished mainline and underground station, completed in 2012. Air-right buildings became widespread also above roads in the City of London.

In 1990, the remodelling of Charing Cross Station designed by Terry Farrell needed to guarantee complete flexibility for the future use of the railtracks and led to a building entirely suspended from an arch. No public realm was created and the new pedestrian bridges suspended either side of the railway bridge over the Thames end in narrow, convoluted passages leading to the station.

Broadgate was a massive development above and around Liverpool Street Stationin the mid 1980s by Rosehaugh Stanhope designed by SOM and ARUP. It involved the demolition of adjacent Broad Street station and the redirection of the tracks to Liverpool Street station, thereby liberating a large development site of 13 ha. At present - less than three decades later - Broadgate is undergoing a second phase of regeneration and densification by British Land and the Blackstone Group. For the first time a development company privatised the entire public realm, including Broadgate Circle with a temporary ice rink and Exchange Square above the station, although it includes public access to the railway station. Restructuring, densification and extension is proposed by the current owner-developer British Land on this site part of which has been incorporated into the jurisdiction of the City of London from the adjacent much poorer London Borough of Hackney.

7.3 King's Cross and St Pancras stations, Eurostar Terminal and Railway Land regeneration

A large scale development is still under construction after a lengthy planning process and strong local resistance on the site north of Kings Cross and St Pancras stations. In the mid-1980s four developers were invited to produce development plans for a 40 ha site, before the HS1[16] was rerouted to St Pancras. The current masterplan of Alies Morrison was granted planning permission in 2006. It concentrates on the southern 26 ha near the railway stations which contains a number of listed buildings, owned and regenerated by the King's Cross Central Limited Partnership.[17] King's Cross and St Pancras stations have been developed into a major transportation interchange with national railways to the north of the country, ThamesLink across London, the Eurostar to the European continent and six underground lines. This generated a large potential for developers and commerce but produced little convivial public realm. While

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[15] originally resisted by the wholesale market stall holders nearby a sit encroached on their land holdings

[16] HS1: First High Speed railway in the UK connecting London to Paris, Brussels and further afield through the Eurotunnel.

[17] consisting of Argent King's Cross Limited Partnership, London & Continental Railways Limited, and DHL Supply Chain.

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the forecourt between Euston Road[18] and St Pancras station serves mainly the refurbished listed station hotel and private condominiums the space in front of King's Cross station is being gradually liberated of its clutter, and offers a view on the façade, historically the first in which the railway arches are apparent. However a new entrance hall designed by John McAslan and Partners has been added on the side of the station, opposite the entrance to the Eurostar terminus situated on the lower St Pancras concourse. The only place which comprises a convivial public space toward Euston Road is the British Library designed by St John Wilson, built on land of the closed Midland railway station on the west of St Pancras station.

Although the bulk of the King's Cross railway land development north of the station is commercial, it includes historic buildings refurbished into new uses and provides public spaces. The 67 acre site is developed by the King's Cross Central Limited Partnership.[19] A large public space with fountains, sloping to Regent's canal has been designed in front of the historic Granary building converted into the Central St Martins University of the Arts London, the Lethaby Gallery and the Platform theatre. From there a boulevard leads to the railway stations. A number of international headquarters, including Google and Microsoft have chosen to relocate their headquarters to this site which also accommodates the Francis Crick Institute of biomedical research. On as yet not developed land, the developers had given permission to build three temporary theatre stages, two of which have already been demolished. How imaginative it would have been to keep the theatre activities on the ground level and confine the commercial building above. Such vast developments take generations to realise. Once completed this site is considered to become the third London centrality, besides the financial City and the commercial and cultural West End. The question remains whethr centrality means that a liveable balance exists between 'panta rhei', flows to central London, through it, or interchanging to other more localised movements and nodes - 'reliqua pacificae' - where people really wish to stay or linger?

7.4 Victoria station

Some London railway stations act as catalyst for the regeneration of the whole existing neighbourhood surrounding them. Victoria Station is the first example of a station redevelopment which has adopted a Business Improvement District (BID).[20] Although financed by commercial building users, this 'place-shaping' BID includes vast sways of demolitions and reconstructions around the station, together with privatisation of the public realm on the ground level which is shaped and will be managed by the BID company. Its declared priorities are safety and security, cleanliness and greening, a prosperous local economy, as well as a destination for, and showcasing Victoria. It operates on a five year plan under contract with the local authority, the City of Westminster. The BID area reaches far beyond the station eastwards along Victoria Street, a shopping high street with many government offices. It encompasses the redeveloped Stag Place, a nineteen sixties commercial development which is undergoing more refurbishment, transforming office blocks into condominiums, together with areas up to Buckingham Palace, the home of the Queen in the north and a national coach station in the south. Most of the blocks surrounding Victoria station have been demolished and are being rebuilt at much higher densities. Only the historic theatres are spared and will undergo substantial refurbishment as well. The forecourt spanning across what is in fact two station buildings remains problematic as it accommodates bus stops, thus not leaving any open space for urban encounters and mingling. Another BID project transforms spaces under elevated railtracks in Southwark with a new walkway along this new footfall for commerce complementing the South Bank cultural sites along the Thames.

Similar developments are taking place in and around a large number of London railway stations, including in the suburbs and the East End. There the regeneration of Stratford East and Stratford International stations have benefited from the development of the Olympic site for the 2012 Olympic games, constituting part of the lasting legacy project which includes a large park claimed to create a new centrality in the East End.

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[18] the inner ring road of London, delimiting the congestion charge zone

[19] comprised of Argent King's Cross Limited Partnership - Argentand Hermes investment Management -BT pension scheme and Australian Super – pension fund

[20] BIDs have originated in North America. In the UK they are partnerships between local authorities and local businesses willing to provide additional services and/or improvements to a specified area. Agreed by ballot they are financed from an additional levy of business taxes.

8 CONCLUSION

What these railway station and railway land regeneration schemes have in common is the very long timeline they necessitate for implementation. Often the size of the site and the public interest vested in these schemes require acts of parliament. Their investment is extremely large and can only be provided by complex consortia of stakeholders, but none of them would go ahead without considerable public subsidies. Their implementation tends to stretch over several business cycles and it is not uncommon that some of the stakeholders disappear into administration during this process.

Unsurprisingly there is opposition from residents and businesses displaced by these developments. Such schemes tend to be delayed also by protesting local activist groups, some with counterproposals which, however, stand little or no chance of fruition.[21] An example is the alternative designed by the local community for the whole site north of King's Cross station with lower densities, less offices, more communal services and a string of open spaces. The local community achieved to save Camley natural park which they had created on the derelict Kings Cross site. They even managed to achieve a compromise as the local authority, the London Borough of Camden, had prepared a brief for a community friendly alternative in the central part, inviting ideas from the local communities.[22]

All these schemes claim to improve the London economy, its environment and the quality of life of their users. Are they really doing this? So far, most of them have not contributed to a better, more liveable urban environment. Quite the reverse. Despite massive public investment and subsidies, the ownership of public land, most built spaces and also the public realm have been transferred into private hands. However, none of the open spaces either refurbished or created by the private sector around the stations involving international designers and global developers have the quality of a genuine public realm where passengers and other Londoners are at ease to congregate and dwell. It may be worthwhile reflecting that the much frequented open space in front of the British Library, right next to the massive King's Cross and St Pancras stations redevelopment was created by the public sector which owns and manages it: a genuine 'reliqua pacificae' to complement the very busy adjacent 'panta rhei'.

[21] http://www.kxrlg.org.uk/group/history.htm

[22] For one of many accounts of theKing's Cross railway land development process see Campkin. Ben, Remaking London: Decline and Regeneration in Urban Culture, IB Tauris, 2013. Also: Edwards, Michael, King's Cross; Renaissance for whom? in: Punter, John, ed, Urban Design, Urban Renaissance and British Cities, London, Routledge, 189-205, 2010.

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Photovoltaik für Elektromobilität – eine GIS-gestützte Analyse zur Identifizierung und Bewertung des Photovoltaikpotenzials auf städtischen Freiflächen zur Versorgung von Ladeinfrastrukturen für Elektrofahrzeuge

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1 ABSTRACT

Urbane Freiflächen wie Straßenräume, Großparkplätze oder Erholungsflächen bieten ein bislang wenig genutztes Potenzial für die Implementierung von Photovoltaikanlagen.Das Projekt Syn[En]ergy[1] (Zeitraum Februar 2016 bis Jänner 2018), durchgeführt vom Austrian Institute of Technology GmbH, der Universität für Bodenkultur Wien (BOKU) und Nikko Photovoltaik GmbH, verfolgt die Erforschung von Synergien zwischeneiner Photovoltaiknutzung auf horizontalen Stadtflächen und anderen Nutzungsansprüchen als Grundlage für eine nachhaltige Energieerzeugung. Dazuwurden Energieproduktionspotenziale unter Berücksichtigunglokaler Standortsspezifika für die Untersuchungsgebiete Wien und Korneuburg abgeschätzt und darauf aufbauend ökonomisch effiziente und sozial akzeptierte Anwendungsszenarien für einzelne Standorte entwickelt.

In dieser Arbeitwerden, als kleiner Teil von Syn[En]ergy, verschiedene Anwendungsszenarien für zukünftige Implementierungen von PV in Städten zur Unterstützung der E-Mobilität (E-Bikes) dargestellt undwesentliche Barrieren und Herausforderungenaufgezeigt, um diesesPV-Potenzial inurbanen Räumen nutzen zu können.Es wurde eine PV-Potenzial-Analyse für existierende Citybike-Stationen in Wien durchgeführt, die eine allgemeine ökonomische Analyse beinhaltet und für ausgewählte Stationen Szenarios vergleicht. Zusätzlich wird kurz erläutert, wie Standorte für zukünftige Stationen unter der Berücksichtigung des vorhandenen PV-Potenzialsgefunden werden könnten.

Keywords: E-Mobilität, GIS-Analyse, Photovoltaik, Stadtgestaltung, Solarpotenzial

2 EINLEITUNG

Die Verringerung vonKlima- und Umweltbelastungen durch den Verkehr sowie die Senkung der Abhängigkeit von fossilen Treibstoffen zählen zu den zentralen Herausforderungen der nächsten Jahre. Elektromobilität mit erneuerbarer Energie ist dabei ein wesentlicher Baustein zur Erfüllung nationaler und EU Vorgaben zur Luftqualität, Emissionsbegrenzung und Umsetzung des Weltklimavertrages von Paris. Österreich setzt sich zum Ziel, bis 2050 einen weitestgehend klimaneutralen Verkehrssektor zu schaffen, u.a. durch den Ausbau des öffentlichen Verkehrs, der Förderung der aktiven Mobilitätsformen und dem Umstieg auf Nullemissions-Fahrzeuge auf Basis von erneuerbarer Energien. Langfristig ist eine solche Elektrifizierung des Straßenverkehrsnur mit einer Stromversorgung durch erneuerbare Energiensinnvoll (BMVIT, 2017). PV-basierendeLösungen für öffentliche Verkehrsmittel können eine wichtige Rolle für den Übergang von fossilen Energieträgern zu erneuerbaren Energiequellen spielen.

Die Berücksichtigung der ökonomischen Komponente bei der Entwicklung innovativer Lösungen spielt hierbei eine große Rolle. Höhere Eigenstromverbrauchsraten erhöhen die Wirtschaftlichkeit von PV-Anlagen maßgeblich, da die PV-Stromerzeugungskosten niedriger sind als die Endverbraucherpreise. Eine vielversprechende Option zur Erhöhung des Eigenstromverbrauchs ist die Kombination von PV und E-Mobilität. Ladestationen mit PV-Strom könnendazu beitragen, die Nachhaltigkeit des künftigen Verkehrssystems zu fördern.

Ziel der vorliegenden Arbeit war es, eine erste grobe Bilanz-Analyse der aus dem lokalen Stromertrag von PV-Anlagenund derbenötigten lokalen Strom-Nachfragemenge zu erstellen, wobei hier exemplarisch ein Einsatz beibestehenden E-Bike-Ladestationenpräsentiert wird. Zunächst wurde in einer räumlichenAnalyse ermittelt, wo in Wien PV-Potenziale vorhanden sind, anschließendwurde das Potenzial für neue Ladestationen untersucht, bei denen PV einen erheblichen Teil der Stromversorgung liefern könnte. Die spezifischen Stromverteilungs- und Bedarfslastprofile wurden auch in der räumlichen Analyse

[1] http://synenergy.boku.ac.at/, letzter Zugriff am 12.06.2017

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berücksichtigt, um dadurch geeignete Standorte zu finden. Eine vereinfachte ökonomische Analyse der PV-Anlagen aufgrundverschiedenerFaktoren wie Größe, Ausrichtung, spezifische Installationskosten, Instandhaltungskosten, Eigenstromverbrauchsrate oder die Möglichkeit von Subventionen durchgeführt soll die wichtigsten Einflussfaktoren für einen hohen ökonomischen Ertrag aufzeigen.

3 PV-ANWENDUNGEN IM STADTRAUM UND IHRE SYNERGIEEFFEKTE

Die Nutzung urbaner Freiräume für Stromerzeugung beinhaltet zahlreiche Vorteile und Chancen, aber auch Nachteile bzw. Herausforderungen, die im Folgenden kurz aufgezeigt werden.

Vorteile bzw. Chancen,die sich durch die Installation von PV-Anlagen im Stadtraum ergeben, sind u.a.:

- Die Themen Sichtbarkeit & Bewusstsein: Werden die Anlagen im Gegensatz zu oft nicht einsehbaren Aufdach-Anlagen präsent im Stadtraum installiert, können diese von der Bevölkerung aktiv wahrgenommen werden, wodurch das Image von erneuerbaren Energieinfrastrukturen als innovative Lösungen gefördert werden kann.
- Photovoltaik kann zur Standortaufwertung beitragen und einem Gebiet durch die Sichtbarmachung technischer Innovationen eine neue Identität verschaffen (z.B. durch die Installation von PV-Kunstwerken oder auch mobilen PV-Lösungen)
- Durch die Installation diverser Multimedia-Stationen bzw. Solartankstellen (z.B. an Haltestellen des öffentlichen Personennahverkehrs, um Smartphones aufzuladen (Schrenk et al. 2010)) kann auch die Nutzbarkeit des Freiraums beeinflusst werden.

Nachteile bzw. Herausforderungen durch die Installation von PV-Anlagen im Stadtraum sind:

- Das Stadtbild kann durch die Errichtung wesentlich beeinflusst werden. Die Gestaltung muss mit der entsprechenden zuständigen Stelle[2] abgesprochen und diskutiert werden.
- Bei der Positionierung an speziell ausgewählten Orten (z.B. Citybike-Stationen oder Bushaltestellen oder auf Verkehrsflächen) im Stadtraum müssen die lokalen Gegebenheiten mitberücksichtigt werden. Sind beispielsweise nur geringe Variationsmöglichkeiten bezüglich Größe, Lage oder Ausrichtung gegeben, können verminderte Energieerträge im Vergleich zu herkömmlichen Aufdach- oder Freiflächen die Folge sein.
- Sicherheitstechnische Vorkehrungen müssen beachtet werden. Der Öffentlichkeit zugängliche Solaranlagen als Überdachung z.B. in Parks oder öffentlichen Grünanlagen dürfen in Österreich nicht direkt aus Standard-Solarmodulen bestehen, wenn diese ‚nur' Glas-Folien-Laminate benutzen und nicht als so genannte ‚Überkopfverglasung' zugelassen sind. Als Überdachung können z.B. Solarmodule aus Verbundsicherheitsglas (VSG), aus Kunststoff (Gefahr herabfallender Glasscheiben ist hier nicht gegeben) oder Standardmodule mit einer Unterkonstruktion aus unterschiedlichen Materialien (Draht, Blech, Holz, Metall) verwendet werden.
- Die Installation an belebten (frei zugänglichen) Orten erhöht die Gefahr von Vandalismus.
- Die Wartung und Überwachung der Anlagen erfordert zusätzliche, langfristige Investitionen.
- PV-Sondermodule, die v.a. durch ihre Sichtbarkeit zur Akzeptanz beitragen könnten, sind teilweise technisch noch nicht ausgereift und werden kommerziell noch nicht angeboten (z.B. PV auf Bodenbelägen).

3.1 Solarpotenzial für unterschiedliche Anwendungstypen

Innerhalb des Syn[En]ergy Projektes wurden verschiedene Nutzungskonzepte für die Photovoltaik in urbanen Freiräumen entwickelt. Diese Konzepte stellen eine Kombination aus 15 Freiraumtypen und mehreren Photovoltaikanwendungen dar, wobei diese in 6 Klassen eingeteilt wurden:Solarkraftwerke, Lineare Photovoltaik (entlang von Infrastrukturen – meist Brücken), Beläge, Überdachungen,

[2] In Wien MA19 Architektur und Stadtgestaltung

Freiraumausstattung und mobile Photovoltaik. Ausführliche Details dazu sind auf der Projekthomepage zu finden.[3]

Einer der 15 untersuchten Freiraumtypen charakterisiert Stellplätze, die mit verschiedenen PV-Anwendungen bestückt werden können, hierzu zählen u.a. überdachte Parkplätze. Die in diesem Beitrag näher betrachteten Citybike-Stationen finden sich in den Freiraumtypen Urbane Plätze oder Straßenräume. Für die verschiedenen Nutzungskonzepte wurden – sofern GIS-Daten zur Abgrenzung zur Verfügung standen – Potenziale ausgewiesen, die online zur Verfügung gestellt werden. Dafür wurde im Rahmen des Projektes eine Web-Applikation entwickelt, die diese Potenziale in der Form von Karten (mittels WMS[4]) darstellt.

4 RÄUMLICHE ANALYSE DES SOLARPOTENZIALS

Die räumliche PV-Potenzialbewertung wurde mittels ArcMap©durchgeführt, um eine effiziente Analyse des gesamten Untersuchungsgebiets (Stadt Wien und Gemeinde Korneuburg) zu ermöglichen.Mit Hilfe des ArcGIS-ToolsArea Solar Radiation (Esri, 2017)wurde die Sonneneinstrahlung flächendeckend berechnet(Paccagnel, K.,o.J.; Oßwald, M., 2013; Chow, A. et al. 2014).

Die Sonneneinstrahlung an einem bestimmten Ort ist abhängig von dessen Höhe, seiner Neigung und Ausrichtung sowie dem durch topografische Gegebenheiten (Bäume, Sträucher, Erhebungen,..) verursachten Schatten(vgl. Abbildung 1). Das ToolArea Solar Radiation berücksichtigt bei der Berechnung neben Breiten- und Höhengraden von Standorten ebenso die Neigung, Ausrichtung, tägliche Veränderungen des Sonnenstandes sowie Schattenwürfe aufgrund der umliegenden Topografie.

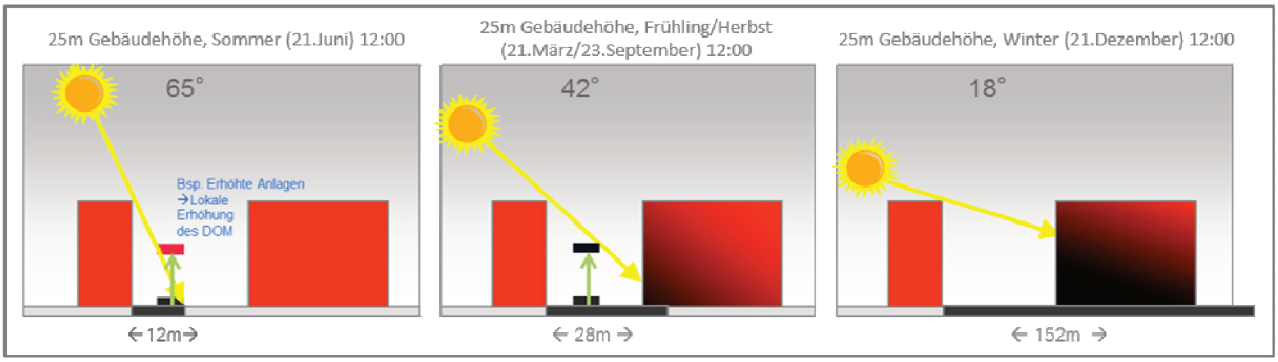

Abb. 1:schematische Darstellung eines Schattenwurfs in Abhängigkeit von Sonnenstand und Gebäudegröße bzw. –höhe (eigene Darstellung AIT)

Die einfallende Sonneneinstrahlungwurdedabei unter Einsatz des digitalen Oberflächenmodell (DOM)der Stadt Wien(Stadt Wien, 2017) - abgeleitet. Für eine Analyse für Gesamt Wien ergibt sich bei einer Auflösung von 1m² eine Rechenzeit von mehr als einem Monat. Durch eine Aufteilung der Daten in mehrere überlappende Teile, konnte mittels ArcPy-Script und multi-processing mehrere Teile parallel berechnet werden, wodurch sich die Rechendauer auf 6-7 Tage reduzierte und im Falle eines Systemabsturzes nur kleinere Mengen an Zeit und Daten verloren gehen. Im Folgenden werden einige wesentliche Punkte beschrieben, die bei der Datenaufbereitung zu berücksichtigen sind.

Die Höhe und Ausdehnung von Objekten beeinflussen den Schattenwurf maßgeblich. Die Verwendung eines DOM gestattet die Widergabe der Höhenstruktur der Stadt inklusive aller Gebäude und Vegetation und ist für eine flächendeckende Schattenanalyse und eine daraus abgeleitete PV-Potenzialabschätzung notwendig.Da die letzte Airborne Laserscan (ALS) – Befliegungder Stadt Wien im Jahr 2007 erfolgte, erschieneine Aktualisierung der Daten notwendig. Diese wurde hauptsächlichanhand des aktuellen Baukörpermodells (BKM) von Wien durchgeführt. In der Abbildung 2 ist die Überarbeitung des DOM exemplarisch anhand des Areals rund um den Wiener Hauptbahnhof dargestellt. Der dargestellte Schattenwurf entspricht jenem am 21. September um 11:00h.

[3] http://synenergy.boku.ac.at/index.php/projektphasen/ap3-entwicklung-von-nutzungskonzepten-fuer-photovoltaik-in-urbanen-freiraeumen/

[4] Web Map Service

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Abb. 2: DOM 2007 (links) und aktualisiertes DOM (rechts) (eigene Darstellung AIT)

Im Rahmen der Aktualisierung wurden zusätzlich „Störobjekte" im DOM, die die Schattenwurfberechnung beeinflussen (z.B. Abgasfahnen, Flugobjekte, Kräne oder Hochspannungsleitungen), bereinigt. Bei der Schattenberechnung würden diese Störobjekte als bis zum Boden reichende Barrieren mit Höhen bis zu 200m über dem Terrain modelliert werden.Die folgende Abbildung3 zeigt als Beispieleiner solchen Störung die Abgasfahne der Müllverbrennungsanlage Flötzersteig: Linksist das originale DOM dargestellt, in der Mitte der sich daraus ergebende Schattenwurf am 21.9 um 15:00h undrechts der Schattenwurf zum selben Zeitpunkt, nun aus dem aktualisierten (bzw. korrigierten) DOM.

Insgesamt wurden neben der Berücksichtigung des aktuellen BKM in ca. 300 unterschiedlich großen Gebieten semi-automatisch Areale korrigiert, sofern Störungen identifiziert werden konnten. Dies betraf v.a. Kräne sowie das gesamte Hochspannungsnetz, aber z.B. neben der oben dargestellten Bahnführung im Bereich des (neuen) Hauptbahnhofs auch die neue U2-Trasse nach Aspern, da Verkehrsinfrastruktur-Bauten nicht Teil des BKM sind. Zudem wurden auch zahlreiche, noch nicht im BKM enthaltene Gebäude manuell editiert und ebenfalls ins aktualisierte (korrigierte)DOM inkludiert, sofern deren Schattenwurf als bedeutend angesehen wurde. Auch signifikante Änderungen der Baumvegetation wurden im Rahmen der Aktualisierung berücksichtigt.

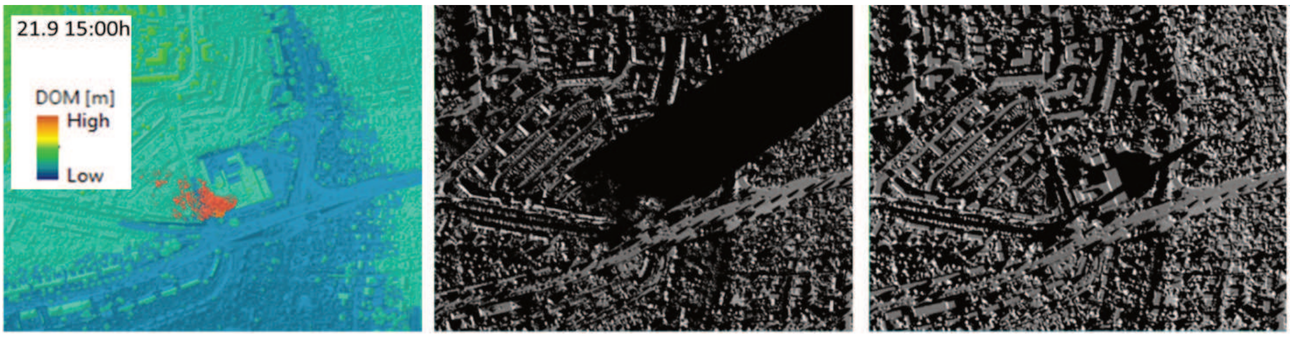

Abb. 3:Originales DOM, Schattenwurf im originalen DOM, Schattenwurf im korrigierten DOM(eigene Darstellung AIT)

5 ANWENDUNGSSZENARIO CITYBIKE WIEN

In diesem Abschnitt soll nun der Teil des ForschungsprojektesSyn[En]ergy vorgestellt werden, derdas Solarpotenzials bei Citybike-Stationender Stadt Wien behandelt. Zusätzlich werden die Herausforderungen, die sich einerseits bei der Analyse, andererseits bei der Implementierung selbst unter Berücksichtigung planerischer, räumlicher und ökonomischer Aspekte ergeben, dargestellt. Die durchgeführte Analyse ist nur als Grobanalyse zu verstehen, um Schlüsselelemente und Herausforderungen bei einer Implementierung von PV-Strom versorgten City-E-Bikes zu identifizieren.

5.1 (E)-Bike-Sharing-Systeme

Bike-Sharing Systeme zielen darauf ab, den Radverkehrsanteil Verkehrsaufkommen zu erhöhen, was nebenbei auch dazu führt, die aktive Mobilität der Bevölkerung im Alltag zu steigern. Neben der Verringerung von Treibhausgasemissionen durch die Wahl eines umweltfreundlichen Verkehrsmittels, wird dadurch zusätzlich die allgemeine Gesundheit gefördert. Weitere positive Effekte bei der Nutzung von Citybikes v.a. bei elektrischen Citybikes sind:

- Radfahren stellt auch für weniger mobile Personengruppen - wie z.B. ältere Personen - eine gute Alternative zum Motorisierten Individualverkehr dar.
- Die Verwendung von E-Bikes ermöglicht einfaches Fahren auch bei hügeliger Topografie, da durch die Zuschaltung von Energie die eigene Anstrengung reduziert wird, womit auch längere Fahrten im hügeligen Stadtgebiet erleichtert werden.
- Ein weiterer Ansporn für eine Stadt, ein (E)-Bike-Sharing System zu etablieren, stellt die Verbesserung des Images der Stadt dar.
- Neben der Positionierung als Smart City wird das Angebot an öffentlichen Verkehrsmitteln für die Stadtbewohner bzw. auch Touristen erhöht und die Lebensqualität dadurch gesteigert. (Leitgöb, 2016 und Fogelberg, 2014)

Weitere Fragestellungen, die sich in Hinblick auf die Implementierung von E-Citybikes stellen betreffen z.B. die Reichweite der Fahrräder, das Management des Aufladen der Akkus, um ausreichend geladene E-Bikes für die täglichen Entlehnungsdauer zu gewährleisten oder das Akkusystem selbst (austauschbarer Akku versus Akku, der direkt an der Station geladen wird).

5.2 Analysen &Ergebnisse

Die vorliegenden Analysen behandelt zum einen die Frage, welche der derzeit in Wien existierenden Citybike- Stationen prinzipiell ein hohes PV-Potenzial aufweisen und wie weit dadurch der Bedarf etwaiger E-Bikes gedeckt werden könnte. Zum anderen wurden auch Standorte für zukünftige PV-bestückte Citybike-Stationen abgeleitet, wobei es in beiden Fällen nicht darum ging, exakte Berechnungen anzustellen, da dies z.B. aufgrund der Datenlage nicht möglich ist. So mussten für die Berechnung oft Annahmen getroffen werden, die die Ergebnisse natürlich beeinflussen. Vielmehr stand im Vordergrund, einen Überblick über die Rahmenbedingungen und Schwerpunkte, die bei dem Thema beachtet werden müssen, zu geben. Zudem wurde die Sensitivität einzelner Annahmen überprüft und z.T. im Folgendenbeschrieben.

5.2.1 Potenzialberechnung und –analyse (Bedarfsdeckung) an vorhandenen Citybike-Stationen

Als Datengrundlage wurden vom Betreiber der Citybikes Wien, der Gewista Werbegesellschaft mbH (Gewista, 2017) ca. eine Million Entlehnungsvorgänge für die drei Monate März, Juni und August der Jahre 2014-2016 zur Verfügung gestellt. Für jeden Datensatz sind der Zeitpunkt der Entlehnung (Datum, Uhrzeit), die Entlehnungsstation (Nummer, Name), der Zeitpunkt der Rückgabe (Datum, Uhrzeit), die Rückgabestation (Nummer, Name) sowie die Radnummer erfasst. Angaben zum Nutzer sind aus Datenschutzgründen selbstverständlich in den Daten nicht enthalten.

Die räumlichen Informationen der Citybike-Stationen stehenim Rahmen der Open Government Data (OGD) Initiative der Stadt Wien kostenfrei als Punkt-Daten zur Verfügung. Als erster Schritt wurden aus allen 121 Stationen in Wien jene ausgewählt, bei denen die mittlere jährliche Solarstrahlung über 700 kWh/m² und Jahr im Umkreis von zwei Meter rund um den Stationspunkt beträgt. Die Auswahl dieser Stationen erfolgte aufgrund allgemeiner ökonomischen Betrachtungen (s.u.), da Standorte mit geringerer Solareinstrahlung aus verschiedenen Gründen nicht wirtschaftlich sind und es andere Standorte gäbe, die besser zur PV-Stromerzeugung geeignet wären.

Im nächsten Schritt wurde in einer detaillierten Berechnung das Solarpotenzial für die ausgewählten 33 Stationen (inkl. eines 100-m-Umkreises rund um die Station[5]) für den 21. März, 21. Juni und 21. August im Stundenintervall durchgeführt. Im Zuge des Projektes wurden aufbauend auf der Vorselektion der Stationen detaillierte Analysen für eine exemplarische Station mit hohem (Station Hauptbahnhof) und eine mit niedrigem Solarpotenzial (Station Sankt-Elisabeth-Platz) durchgeführt (vgl. Abb. 4). Der Grund für die detaillierte Untersuchung der PV-Potenziale mit stündlicher Auflösung liegt darin, dass ein wesentlicher Faktor für die Wirtschaftlichkeit der Anteil der Eigenstromnutzung ist. In einer jährlichen Bilanz können derartige Abschätzungen aber nicht gemacht werden, da nicht davon ausgegangen werden kann, dass der Strom, der nicht am jeweiligen Tag im Citybike-System verbraucht wird, längere Zeit bei den Stationen

[5] Dieser Umkreis von 100m ist deshalb notwendig um alle Objekte zu berücksichtigen, die einen Schatten werfen könnten, wobei hier ein Sicherheitsabstand gewählt wurde.

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gespeichert wird, sondern wohl ins Netz eingespeist werden müsste. Je feiner zeitlich aufgelöst die Bilanz durchgeführt werden kann, umso realistischer sind daher die Abschätzungen.

Abb. 4: ausgewählte Citybike-Stationen und Solarpotenziale am Standort (eigene Darstellung AIT)

Bei der Analyse des Solarpotenzials ist darauf zu achten, dass sowohl bei Stationen, die unter Unterführungen/Brücken liegen als auch bei Stationen unter Bäumen ein Solarpotenzial berechnet wird (z.B. bei der StationPraterstern und Hauptbahnhof West).In dieser Arbeit wurden solche Stationen nicht berücksichtigt, wodurch sich letztlich 29 analysierte Stationen ergaben.

Die folgende Abbildung 5 zeigt die mittleren stündlichen Solarpotenziale der dieser 29 Stationen, wobei die Stationen Hauptbahnhof und Sankt-Elisabeth-Platz farblich hervorgehoben sind. Für die meisten Stationen ergibt sich ein Tagesverlauf ähnlich jenem des Hauptbahnhofs, was einem ungestörten Solarpotenzialverlauf entspricht. Die Station Sankt-Elisabeth-Platz zeichnet sich durch eine Potenzialminderung am Vormittag aus, die durch Bäume und Gebäude im Osten der Station verursacht wird.[6]

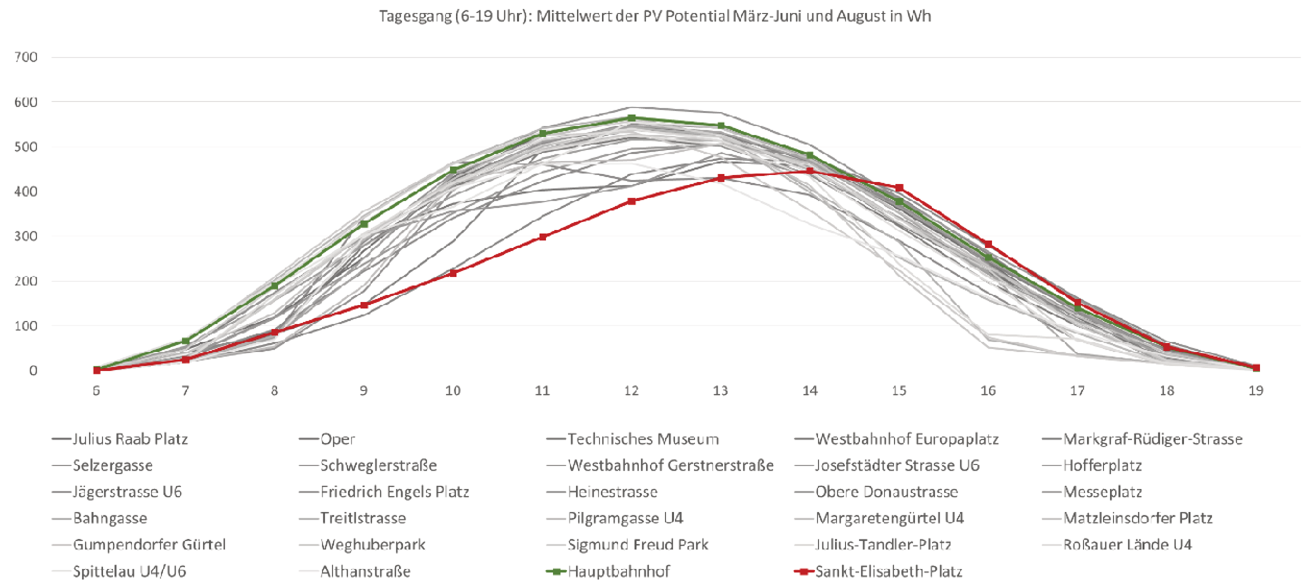

Abb. 5: mittleres Solarpotenzial der ausgewählten Stationen (Source: Berechnungen AIT); wobei der Wert um 6:00 Uhr den Solarenergieeintrag 6:00-7:00 und der Wert um 19:00 Uhr jenen zwischen 19:00-20:00 Uhr darstellt)

Abbildung 6 zeigt einen Vergleich der ausgewählten Stationen in Prozent zum Maximalwert der mittleren Summenwerte (21.3., 21.6., 21.8.) der Solarstrahlung in den Stunden zwischen 6:00 Uhr und 20:00 Uhr. Der

[6] https://www.google.at/maps/@48.1908095,16.375692,54m/data=!3m1!1e3

maximale mittlere Tageswert liegt dabei bei rund 4kWh/d für den guten Standort und ca. 3kWh/d für den schlechten Standort.

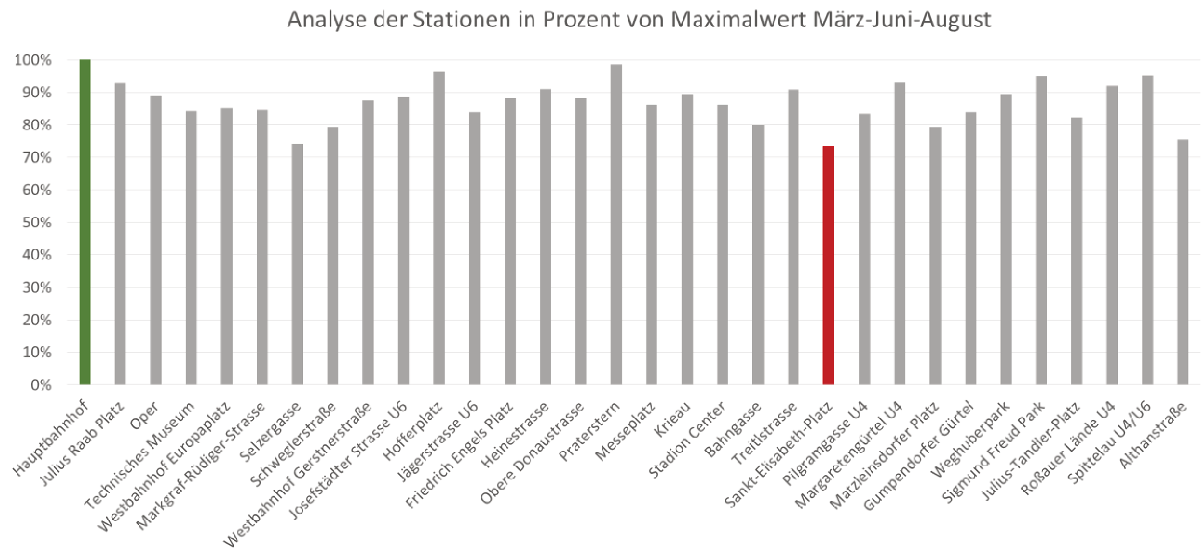

Abb. 6: Vergleich Solarpotenziale bezogen auf Stationsmaximum der ausgewählten Stationen (Source: Berechnungen AIT)

5.2.2 Allgemeine ökonomische Analyse

Eine ökonomische Analyse kann auf unterschiedliche Art und Weise durchgeführt werden.Eine oft verwendete Methode dabei ist die sogenannte Kapitalwertmethode, die wohl zu den wichtigsten Methoden der dynamischen Wirtschaftlichkeitsrechnung zählt. Der Kapitalwert einer Investition ist die Summe der Barwerte aller durch diese Investition verursachten Zahlungen. Dazu gehören sowohl Ein- als auch Auszahlungen. Der Barwert ist der Wert, den zukünftige Zahlungen in der Gegenwart besitzen.[7] Der Photovoltaik-Rechner der Österreichischen Energieagentur[8] nützt diese Methode und wurde im Rahmen der Analyse als Vergleichstool verwendet, wobei die folgenden Berechnungen mittels R-Statistik selbst durchgeführt wurden, da dadurch eine höhere Flexibilität in den Analysen möglich war. Die wesentlichen Parameter für die Berechnung sind:

- die solare Einstrahlung,
- die Investitionskosten und die laufenden Kosten (Wartungskosten),
- Wechselrichtertausch bei netzgekoppelten Anlagen (ca. im 13. Betriebsjahr)
- die Anlagengröße in kWp,
- die Förderung,
- der Strompreis und der Einspeisetarif (Überschusseinspeisung),
- der Anteil der Strom-Eigennutzung,
- die angenommene Strompreissteigerung und der
- angenommene kalkulatorische Zinssatz

Die verwendete Methode konzentrierte sich v.a.auf den Anteil der Strom-Eigennutzung und die Größe der Anlage, da diese Faktoren durch den Anlagenbetreiber verändert werden können. Abbildung 7zeigt einen Vergleich des Kapitalwertverlaufes einer Anlage mit der Größe 2kWp (links) und einer Anlage mit 3kWp (rechts). Beide Anlagen wurden unter der Annahme berechnet, dass es sich um einen guten Standort (jährliche solare Einstrahlung 1100kWh/m²) handelt.Die spezifischen Investitionskosten wurden mit 1500€ pro kWp angenommen. Dieser Vergleich soll zeigen, dass die Anlagengröße einen entscheidenden Einfluss hat.

[7] https://de.wikipedia.org/wiki/Barwert
[8] https://www.klimaaktiv.at/service/tools/erneuerbare/pv_rechner.html

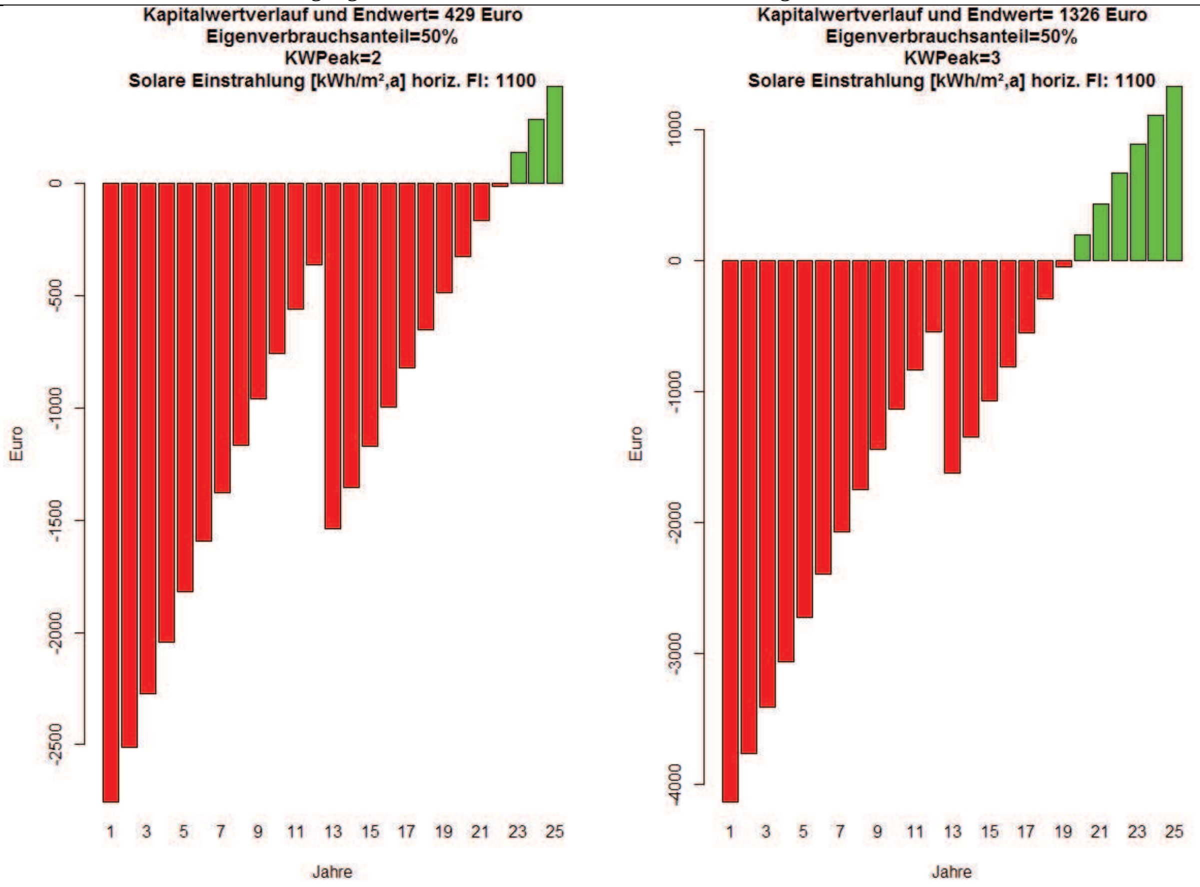

Abb. 7: Vergleich der Wirtschaftlichkeit verschiedenen Anlagengrößen (Source: Berechnungen AIT)

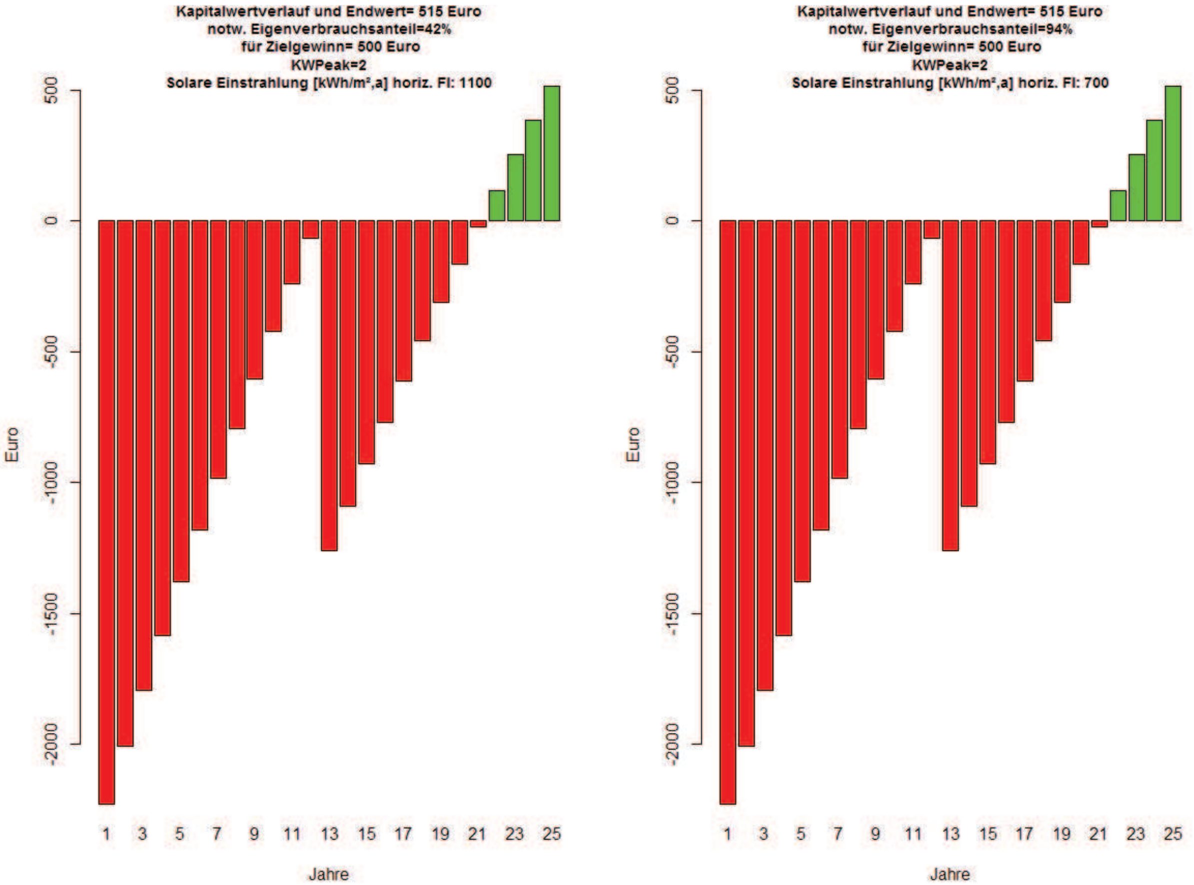

Abb. 8: Vergleich der Wirtschaftlichkeit verschiedener Strom-Eigennutzungsanteile (Source: Berechnungen AIT)

Handelt es sich um einen schlechten Standort, wie etwa bei der Station Sankt-Elisabeth-Platz, mit einem Ertrag von rund 700kWh/m² und Jahr, ist weder die 2kWp noch die 3kWp Anlagen ausreichend (ohne Förderung), wenn man von einer 50% Strom-Eigennutzung ausgeht. In diesem Fall sollte eine hohe Strom-Eigennutzung angestrebt werden. Bei der Berechnung (vgl. Abbildung 8) wurde angenommen, dass die Anlagen eine Förderung von 275 € pro kWp erhalten und analysiert, wie hoch die Strom-Eigennutzung sein müsste, um einen Gewinn von mindestens 500€ zu erzielen. Die Anlage am guten Standort erreicht schon mit rund 42% Eigennutzungden Zielertrag (links). Beim schlechten Standort müssten fast 95% des Stroms selbst genutzt werden (rechts). In der Berechnung wurde nicht berücksichtigt, dass bei der Anlage mit schlechtem PV-Potenzial wesentliche Kosten eingespart werden könnten, wenn auf einen Wechselrichter (der während der Lebensdauer zudem getauscht werden muss) verzichtet werden könnte. Dafür wäre aber entweder eine sehr gute Bedarfs- und Produktionsübereinstimmung notwendig, damit die hohe Strom-Eigennutzung möglich ist, oder es müssten Speicherakkus installiert sein, was zusätzliche Kosten mitsich bringen würde.

Die oben angeführten Berechnungsbeispiele stellen keine exakte Berechnung der Wirtschaftlichkeit dar, da auch Kosten durch notwendige Unterkonstruktionen anfallen können, um die Anlagen vor Glasbruch und daraus folgenden etwaigen Personenschäden abzusichern. Des Weiteren wurde keine mögliche Strompreiserhöhung in den nächsten 25 Jahren berücksichtigt,weil eine solche unserer Meinung nachmomentan nicht genau angegeben werden kann und die damit einhergehenden Auswirkungen derzeitnicht abgeschätzt werden können.

In der weiteren Folge wurden auf Stundenbasis Szenario-Berechnungen durchgeführt, inwieweit der Energiebedarf im Tagesverlauf und die Energieproduktion (für die zwei Standorte – gute und schlechte Solarpotenziale) zusammenpassen. Der Tagesverlauf der Entlehnungen wurde dabei aus den Gewista Daten abgeleitet und dazu verwendet, die Anzahl der Fahrten pro Rad und Tag auf die Stunden aufzuteilen.Die Tabelle 1 enthält die wichtigsten Annahmen und Kenngrößen für diese Szenario-Berechnungen.

Parameter	**Szenario 1**	**Szenario 2**	**Szenario 3**	**Szenario 4**
Anzahl der Fahrten pro Rad und Tag	2,3*	5	10.8**	5
Durchschnittliche Strecke pro Fahrt in [km]	4***	4	4	4
Anzahl der Räder pro Station in [Stück]	20	20	20	20
Energieverbrauch pro km in [Wh/km]	11*	11	11	11
Anlagengröße in kWp	2	2	2	1
Optimale Ausrichtung der Station****	nein	nein	nein	nein
Solarfläche pro Rad in [m²/Stellplatz]	0,68	0,68	0,68	0,34

Tabelle 1: Wichtige Annahmen und Kenngrößen für die Berechnung. *der Wert 2,3 wurde aus den Gewista Daten abgeleitet, 2014; **Wert für Barcelona ausTable 3 inFogelberg, 2014;*** Annahme der Verdoppelung der durchschnittlichen Fahrtlängen im Vergleich zu Leitgöb, 2016; ****bei optimaler Ausrichtung könnte ein erhöhter solarer Gewinn erzielt werden, ist aber nicht immer möglich v.a. bei schon existierenden Citybike-Stationen

Die folgende Abbildung 9stellt die Bilanz zu jeder Stunde im Tagesverlauf für die vier Szenarien dar. In den Nachtstunden liegt der Bedarf über dem solaren Angebot, wodurch sich eine negative Bilanz ergibt, die während den Tagesstunden (bei Sonnenschein) in eine positive Bilanz umschlägt.

Abb. 9:Szenariovergleich der Bilanz pro Stunde im Tagesverlauf der Solaren Stromproduktion minus Verbrauch durch E-Bikes (Source: Berechnungen AIT)

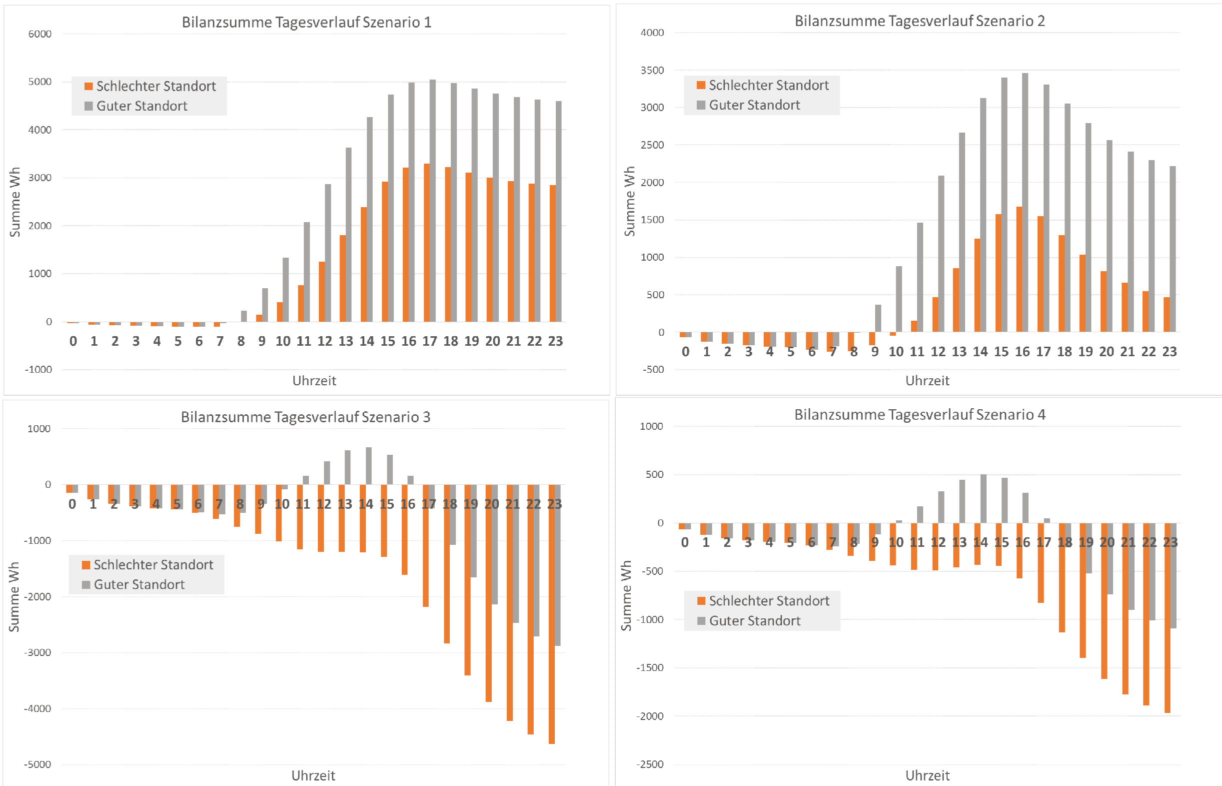

Abb. 10: Vergl. der Bilanz der Solaren Stromproduktion minusVerbr.von E-Bikes versch. Szenarien (Source: Berechnungen AIT)

Abbildung 10 stellt im Unterschied zu Abbildung 9 nicht die Bilanzen pro Stunde, sondern die Bilanzsumme bis zur jeweiligen Stunde dar. Dies bedeutet,solange ein positiver Wert vorliegt, ist Strom produziert aus Solarenergie, vorhanden. Der Wert am Ende eines Tages ist dann der Startwert für den nächsten Tag. Bei der Darstellung wurde von einem Startwert null um 0:00 Uhr ausgegangen, um die Darstellung zu vereinfachen. Wie der Szenariovergleich zeigt, ist bei Szenario 1 und 2 am Ende des Tages mehr Energie vorhanden, als benötigt wird und somit ein neuer Startwert um 0:00 vorhanden, der größer null ist. Dadurch könnte zumindest in Szenario 1 ein Tag ohne PV-Strom aus der Sonne am schlechten Standort und 2 Tage am guten Standort überdauert werden. Dabei sollte auch bedacht werden dass an bewölkten Tagen auch PV-Strom produziert wird und an regnerischen Tagen die Nachfrage nach E-Bikes reduziert sein wird. Diese Faktoren konnten aber in der durchgeführten ersten Analyse nicht berücksichtigt werden, sollten aber in einer detaillierteren Analyse betrachtet werden.

5.2.3 Neue Stationen – Analyse

Um geeignete Standorte für neue Stationen zu identifizieren wurden anhand der Stationsdichte – dem Abstand der Stationen zueinander – und dem Solarpotenzial entlang der ausgewiesenen Radwege mögliche Standorte ermittelt. Die Dichte des gesamten Bike-Sharing Netzes gibt Auskunft über die Versorgungsqualität. Um eine hochwertige Versorgung zur Verfügung zu stellen sollten eine fußläufige Erreichbarkeit der Stationen gewährleistet werden. Für ein ausreichend dichtes Netz gibt dasInstitut für Transportation & Development Policy einen Stationsabstand von durchschnittlich 300m an (Leitgöb, 2016, zitiert nach ITDP, 2013).

In Wien befinden sich ein Viertel aller Stationen in einem Abstand von etwa 300m zueinander, die Hälfte sind innerhalb von 400m zu erreichen. Jene Stationen, die mehr als 500m von der nächsten entfernt liegen, befinden sich im Randbereich des Stationsnetzes (Leitgöb, 2016). Die Distanz entscheidet u.a. darüber, welche Mobilitätsangebote im städtischen Raum wahrgenommen werden – sei es für Einkauf, Freizeitbeschäftigung oder Alltagswege. Dabei werden diese Entscheidungen davon bestimmt, den Energieverbrauch des Körpers möglichst gering zu halten, da der Fußgänger stark distanzempfindlich ist (Leitgöb, 2016, zitiert nach Knoflacher, 2012 und Knoflacher, 1985).

In Abbildung 11 wird die methodische Vorgehensweisezur Standortfindung für mögliche neue Stationen, die ein Solarpotenzial von über 700 kWh/m² und Jahr aufweisen, skizziert. Dabei werden in erster Linie nur die Bereiche betrachtet, die außerhalb der fußläufigen Reichweite (Distanz von 300m Luftlinie) von bestehenden Citybike-Stationen liegen. Exemplarisch wird hier die Sechshauser Straße im 15. Bezirk identifiziert, die ein gutes Solarpotenzial entlang des ausgewiesenen Radweges aufweist.

Abb. 11: Beispiel eines mögl.neuen Standorts in der Sechshauser Straße, 15. Bezirk, mit PV-Anlage (Quelle: eigene Analysen AIT)

Die oben erläuterte Analyse könnte durch die Berücksichtigung der Topografie (E-Bikes sind v.a. dort hilfreich, wo Steigungen zu überwinden sind) und Auslastung der Stationen in der Umgebung (müssen Räder der umliegenden Stationen oft umverteilt werden und würde eine neue Station helfen, die Nutzung der anderen auszugleichen) verfeinert werden.

6 ZUSAMMENFASSUNG UND AUSBLICK

Dermögliche Beitrag von PV in urbanen Freiräumen zur erneuerbaren Energiegewinnung ist unbestritten. Das Projekt Syn[En]ergy analysiert, welche Nutzungskonzepte besonders viele Vorteile und Synergieeffekte erwarten lassen. Im Zuge des Projektes wurden Potenziale für verschiedenen PV-Anwendungsarten untersucht. Die in dieser Arbeit dargestellte Nutzung des PV-Stroms zur Bedarfsdeckung für E-Citybikes zeigt, dass mehrere Faktoren wesentlich sind und v.a. Anlagen auf schlechten Standorten (<700kWh/m²,a) mit der Wirtschlaftlichkeit zu kämpfen haben werden.Sie zeigt aber auch, dass Szenarien möglich sind, bei denen eine Wirtschaftlichkeit gegeben ist. Diesebeinhaltenz.B. eine verstärkte Nutzung von E-Bikes (E-

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Citybikes) im Vergleich zu jener der derzeitigen Citybikes[9] um eine hohe PV-Strom Eigennutzung zu gewährleisten. Es kann aber angenommen werden, dass die Nutzung beim Einsatz von E-Bikes steigt, wobei dies stark vom Angebot bzw. der Stationsdichte abhängt. Die beschriebenen Analysen sollten noch verfeinert werden, wobei z. B. eine mehrtägige Bilanz, die auch typische Wetterveläufe und dessen Einfluss auf die PV-Strom Produktionund E-Bikenutzung berücksichtigt,analysiert werden sollte. Reale Feldversuche könnten diese Analyse zusätzlich verfeinern, um noch offene Fragen klären zu können.

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Diese Arbeit wurde im Rahmen desProjekts Syn[En]ergy durchgeführt. Syn[En]energy wird vom Bundesministerium für Verkehr, Innovation und Technologie (bmvit) im Rahmen der „Stadt der Zukunft“-Initiative gefördert (FFG). Wir möchten uns zudem noch bei Herrn Dechant und der Gewista Werbegesellschaft für die Daten bedanken.

8 LITERATUR

BMVIT: Elektromobilität, Bundesministerium für Verkehr, Innovation und Technologie, URL: https://www.bmvit.gv.at/verkehr/elektromobilitaet/index.html, 2017.

ESRI: Area Solar Radiation, URL: http://desktop.arcgis.com/de/arcmap/10.3/tools/spatial-analyst-toolbox/modeling-solar-radiation.htm, 2017.

CHOW,A.,FUNG, A. S.,LI, S.: GIS Modeling of Solar Neighborhood Potenzial at a Fine Spatiotemporal Resolution, Buildings 2014, 4, pp 195-206, 2014.

FOGELBERG, F.: Solar Powered Bike Sharing System with Electric Bikes, An Overview of the energy system and the technical system design, Master thesis within the Master´s Programme Industrial Ecology, Göteborg, Sweden, 2014.

GEWISTA: Entlehndaten Citybike Wien der Gewista Werbegesellschaft mbH, 2017.

ITDP: Seven World-Class Cities Are Riding Tall in the Bike-Share Boom; „The Last Mile” Can Be Solved Without Cars In More Places than Ever Before. Institute for Transportation & Development Policy. URL: https://www.eurekalert.org/pub_releases/2013-12/bc-swc120213.php,2013.

KNOFLACHER, H.: Katalysatoren für Nichtmotorisierte. Wien. 1985

KNOFLACHER, H.: Siedlungsplanung, Grundlagen der Verkehrs- und Siedlungsplanung, Wien. 2012

LEITGÖB, M.: Das Zu- und Abgangsverhalten bei Citybike-Wien-Verleihstationen, Diplomarbeit, Technische Universität Wien, 2016.

OßWALD, M.: Erstellung eines GIS-basierten landesweiten Solarkatasters für Freilandflächen in Baden-Württemberg und Durchführung einer Solarpotenzialanalyse, Bachelorthesis, Studiengang Kartographie und Geomatik, 2013.

PACCAGNEL, K.: Potenzialmodelle für Solarenergie, Seminararbeit, Naturwissenschaftliche Fakultät der Paris Lodron Universität Salzburg, Fachbereich Geographie und Geologie, o.J.

SCHRENK, M., BENEDIKT J., EGGER, T., EIZINGER, C., FARKAS, A.: Bus Stop 3.0–Bus Stop of the Future–Multifunctional Centers for Regional Development. http://www.geomultimedia.org/archive/CORP2010_219.pdf ,2010.

STADT WIEN: Digitales Oberflächenmodell, URL:https://www.wien.gv.at/stadtentwicklung/stadtvermessung/geodaten/als/, MA-41 Stadtvermessung.

[9] derzeit durchschnittlich 2,3 Nutzungen pro Rad und Tag mit einer durchschnittlichen Fahrtstrecke von rund 2 km, siehe dazu auch Leitgöb, 2016

🏆 *reviewed paper*

Playful Participation with Urban Complexity – Evaluation of the Co-Located Seriuos Game Mobility Safari in Vienna

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1 ABSTRACT

The issue of engaging citizens in urban development and planning has experienced a significant increase in recent years. Traditional planning, control and communication approaches are reaching their limits in a more complex stakeholder landscape and an increasing desire of citizens for engagement. Novel approaches to inform and involve citizens in a playful co-creation process are necessary. Serious games and gaming are increasingly considered as the magic bullet for elevated stakeholder involvement and citizen engagement in urban planning and governance. But they are also discussed as means to instigate learning and capacity building processes and to raise awareness for urban core topics. These learning processes can unfold in different formats, such as social or game-based learning. This paper investigates, if playing the serious game prototype 'Mobility Safari' instigates social and specific learning processes and motivates players for a playful public participation. The Mobility Safari is a serious game prototype that was developed for the City of Vienna, integrating Vienna's SMART city ambition to transition towards a more sustainable mobility system. The analysis illustrates that the serious game indeed instigates and evokes learning processes during the game play and in the debrief covering a broad range of different learning activities and social interaction. Incomplete rule-sets and un-governed situations triggered discussions where the players linked the game-with their real-world experience and were urged to confront those experiences and actual practises. On the other hand, the willingness for active participation, which indeed takes a lot of effort, could be observed less often. Our analysis suggests that Mobility Safari is indeed a suitable mean for learning processes and support in a moderate way the interest in participation processes. We learned that a careful design, facilitation and sufficient time for a debrief to reflect on the game experience is crucial for a deeper learning experience that is meaningful for real-world contexts.

Keywords: Fachkonzept Mobilität 2025, participation, mobility, civic learning, engagement

2 THE IMPACT OF SERIOUS GAMES ON LEARNING AND PARTICIPATION

Serious games, digital and gamified tools have recently experienced a strong proliferation, covering the fields of education, urban and community planning, transport or energy planning (e.g. Poplin 2014; Tan 2014). Games are considered valuable due to their capacity to mimic and represent complex real-world matters and allow players to explore and engage with these in an experiential way. In the game players can manipulate the system, see how the system responds and receive immediate feedback from the game on their decision making (Cumming et al. 2012). Thus, playing games triggers also different formats of learning, such as learning facts, finding common ground, conflict resolution, experimenting with rules or institutions and motivating goal achievement (Bluemink et al. 2010; Devisch et al. 2016; Hämäläinen 2011; Poplin 2014; Tan 2014) and are suitable a for playful public participation in urban planning (Poplin 2012).

Playing is a basic form of learning and the role of imaginative and social forms of play is crucial for conceiving and making-sense of the world (Huizinga 1999). Learning through playing was rediscovered with the rise of digital tools and the increasing popularity of (digital and serious) games. Serious games and gameful (rule-based) or playful (free-form) formats (Deterding et al. 2013) are considered beneficial because they provide immediate feedback to the players' actions, show immersive and entertaining aspects, foster the understanding of different perspectives through role-play, and support the understanding of complex systems by representing complex real world matters in an artificial game environment (e.g. Medema et al. 2016; Tan 2014). The safe game environment allows players to experiment, take risks, manipulate or explore different pathways without facing the real consequences or causing damages (e.g. Devisch et al. 2016; Juul 2011). They are pleasant and entertaining learning environments, because the game itself delivers balanced amount of progressing challenges, trigger social interactions, provide feedback loops and rewards, ideally encourage replay (Gee 2005; Juul 2011) and encourage public participation in urban planning (Poplin 2012). From a ‘serious learning perspective, games are praised to achieve learning objectives such as fact learning, problem solving, enhancing spatial sense and visual thinking, increasing literacy on selected topics, reflecting on complex problems, raising awareness, increasing media literacy, educating target audiences on specific skills, and building coalitions and networks (e.g. Erhel & Jamet 2013; Gee 2005). If such learning actions take place in group settings, where players interact with each other (i.e. in negotiating strategies, knowledge sharing, praising each other’s achievement), learning is associated with social learning. Multiplayer games, such as ‘Mobility Safari’, merge specific fact learning and social learning (Hämäläinen 2011). A returning criticism stresses that players might be so immersed that they fail to achieve the learning objectives; another point of critique is that ‘serious games’ are sometimes too serious. Hence, the challenge is to integrate learning and participating issues into the game without spoiling the enjoyment and fun (Ke 2016).

3 PICKING UP VIENNA`S MOBILITY STRATEGY AS A TOPIC FOR THE GAME

In our research, we addressed Vienna’s ambition to shift towards a sustainable mobility system and their interest to improve the general knowledge level and build up capacity of citizens by developing the serious game ‘Mobility Safari’. In this article, we discuss our research question if playing the serious game ‘Mobility Safari’ evokes fact-based and social learning associated with urban complexity. We also expect, that playing Mobility Safari unlocks gameful participation actions and make the strategic mobility planning processes more transparent for citizens.

Vienna is a growing city with 30.000 additional inhabitants per year, corresponding to a proportional increase in the number of trips. The current modal split shows a distribution of 39% public transport, 7% bicycles, 27% pedestrians and 27% motorized individual traffic (MA23 2016). The city’s main ambitions on mobility, as outlined in its SMART City Strategy, include strengthening CO_2 free modes such as walking and cycling and incrementally lowering the MIT to 15% by 2050, the introduction of new propulsion technologies for non-motorized types of PT by 2030 and MIT within municipal boundaries by 2050, the entire commercial traffic (source and destination traffic) should run CO_2 free and a total energy reduction of 10% produced by passenger traffic should be achieved by 2030 (City of Vienna 2016).

The city’s ambition is also characterized by urgency: the mobility and transport sector accounts for approximately 27% of the global energy consumption and CO_2 emissions and 1/3 in the European Union (IPCC 2014). Furthermore, mobility is a major cause of urban noise- and air pollution, it impacts the urban carbon footprint and poses major constraints to quality of life (Batty et al. 2015). Hence, novel policies and experimentation with original mobility practices, that could influence current social practices, are important tiers for urban sustainability transitions. Modal choice, in particular, is the consequence of a mix of values, attitudes and perceptions (e.g. Hunecke et al. 2010) or economic viability (e.g. Van Exel and Rietveld 2009). Thus, the transition towards a more sustainable urban mobility system takes place in the social, physical and institutional context and depends on the active involvement and engagement of many different actors and stakeholders whose daily practices and mobility choices contribute to policy performance.

For the game development, following policies and strategies are considered:

(i) awareness rising among various actor groups,

(ii) informing these actor groups which resources are needed for ‘green’ mobility and ‘sharing’ projects,

(iii) support networking and trust-building to set up sharing initiatives and citizen collectives,

(iv) inform citizens on existing initiatives and

(v) support and integrate underrepresented groups.

4 CO-CREATION GAME DESIGN

In an iterative co-creation process professional and administrative planners as well as interested citizens and urban initiatives (e.g. LA21 groups) jointly created the game prototype. The co-creation approach was crucial to produce a locally embedded prototype with a meaningful and recognizable game narrative (see also Gugerell & Zuidema, 2017). Important game components developed in the co-creation process were:

(i) Translation of complex guidelines, strategies, and vocabulary into common and practice-oriented game elements and mechanisms (e.g. linguistic adaptation of the project descriptions, order the quiz questions appropriate to difficulty-levels)

(ii) Complement and prioritization of social game components/mechanisms (e.g. gathering community points, team building processes) and sustainable work flows (e.g. different steps for realizing aproject e.g. you need partner, you need money, you need permission)

(iii) Create tokens of different transport users and integrate the topic accessibility (e.g. wheelchair as a piece)

Mobility Safari is a co-located board game for four to six players. The game narrative is embedded in the local mobility narrative and the city's ambition for a sustainable, urban mobility system (City of Vienna, 2014, 2016). The game board represents the city of Vienna with distinctive local conditions (e.g. planed subway lines and development areas, Danube), giving a strong spatial reference (see Fig. 1).

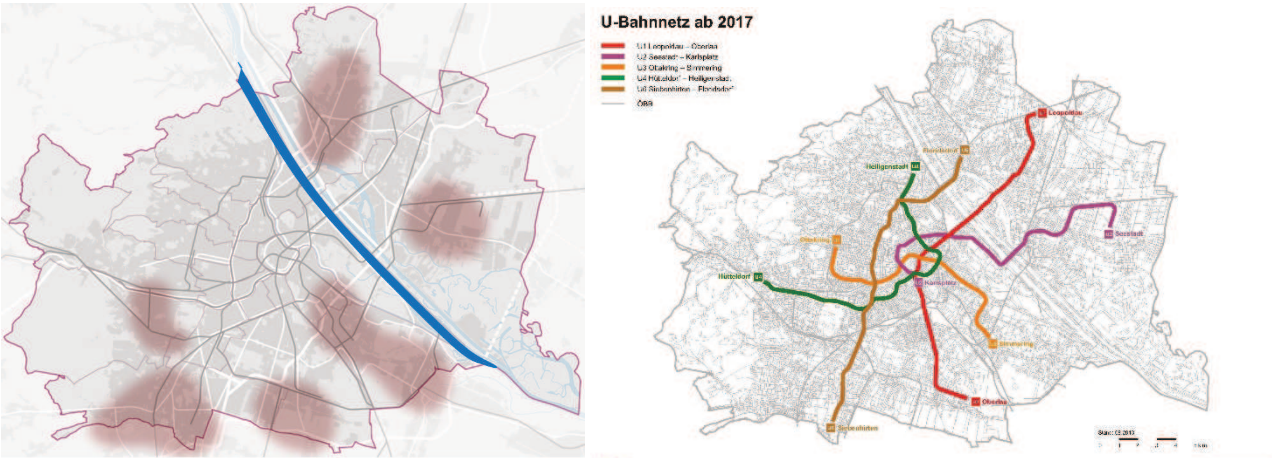

Figure 1: Development areas according to STEP 2025 (left) and planed subway network as of 2017

The game board is divided in differently coloured tiles that represent the main tiers of these policies (purple for 'innovation and learning', green for 'active and healthy', yellow for 'flexible and connected', red for 'fair and safe'). Players move their playing figure on the game board by rolling a dice and start or join mobility initiatives, develop new services and implement different projects. In doing so, they collect coins (financial aspect), community points (social aspect) and CO_2-reduction-points (environmental aspect).

Figure 2: Game board (left), different mobility initiatives (middle), counting board and tokens (right)

Arriving at a tile the player can decide on realizing the project, determined by the colour of the tile. The project cards are presented face-up, so the players can deliberately choose which project suits them most by checking and discussing different possible project types and required resources necessary for implementation. These requirements mirror a limited number of institutional, financial and social rules: (a) creating networks, (b) obtaining a permit (either by rolling a dice or answering a multiple-choice quiz question) and (c) funding the implementation and realization costs. Each implemented project provides the player network with a certain number of coins, community points or energy-reduction points. Players need to settle annually increasing mobility costs at the end of each game round, paying with the coins they collect when realizing projects. Additional quiz questions (e.g. number of bike-sharing providers, the average distance of a car trip in Vienna) and special action cards (e.g. elections, oil crisis, climate change) provide the players with factual, process and administrative knowledge to stimulate institutional and administrative capacity building process in a low threshold and entertaining fashion. Hence, the players are experiencing

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new perspectives, they are expected to learn about sustainable mobility initiatives and the game forces common learning between participants in multidisciplinary/multidimensional context (e.g. between planners, citizens, politicians etc.). At the end of the game there are three possible winning conditions: winners with the highest numbers of coins, community or CO_2-reduction-points.

5 METHODOLOGICAL APPROACH

The game 'Mobility Safari' was tested in spring 2017 with voluntary probands in Vienna. The research follows a mixed method approach, combining (a) a standardized questionnaire, (b) participatory observation during gameplay and (c) a debrief at the end of each playing session. Before and during the test phase various actions for recruiting voluntary players were utilized, including social media (e.g. Facebook, Twitter, Linked-in) and snowball sampling. The standardized questionnaire is literature based, querying (a) socio-demographic data, (b) knowledge and attitude towards environment, mobility, energy and participation, (c) player types and game preferences, (d) gaming experience and strategy, and (e) gaming/learning impact. The issues „specific fact-based learning", "social learning" and "participation" were sampled by inquiring the players' self-evaluation of their gaming experience. The completed questionnaires were coded with SPSS and analysed by descriptive statistics. The analysis was complemented by qualitative data on the playing processes, player interaction and decision-making processes in the game, collected through the participatory observation. Mapping player interaction is crucial to identify learning actions associated with social learning (Medema et al. 2016; Wendel & Konert 2016). The debrief was organized as a moderated focus group discussion, where the players jointly reflected on the game play, strategies and decisions taken and linked the gaming with their real-world experience. Serious gaming literature stresses the importance of debriefing to transform the gaming experience into a deeper learning experience (Lederman 1992; Crookall 2010).

In total 72 players tested Mobility Safari during 16 playing sessions. With an exploratory research focus we ignored a representative sample derivation. The sample shows a slight backlog of female participants and highly educated participants. Most players are between 19 and 30 years old, which represents the project's focus group of young adults. The sample is balanced regarding gaming abundance: 36% play games rarely to never, 25% occasionally and 39% play games frequently but with rather modest experience in serious games.

6 DESCRIPTIVE EVIDENCE AND RESULTS

The research illustrates that in general the players evaluate the urban game Mobility Safari as "fun-to-play": "It was great fun playing it" (77%), "the game is well constructed" (62%) and "The game is interesting and rich in diversity" (44%). Statistics also show a high willingness to replay the game (73 %). However, players who are active in community and participatory projects were slightly more positive about the game than the group of players who are not. Pursuing a sustainability transition by activating citizens would ideally cover all three types of learning: specific fact-based and social learning as well as learning for new social practises such as the willingness for active participation in mobility projects. While specific fact-based learning stands for an increase of technical-knowledge of urban mobility initiatives and projects, social learning considers the learning effects occurred by interactions with other players. The issue participation stands for increasing awareness and interest for participation possibilities and an active engagement in urban initiatives and development of new social practises. Figure 3 shows the self-reported answers of the standardized questionnaire:

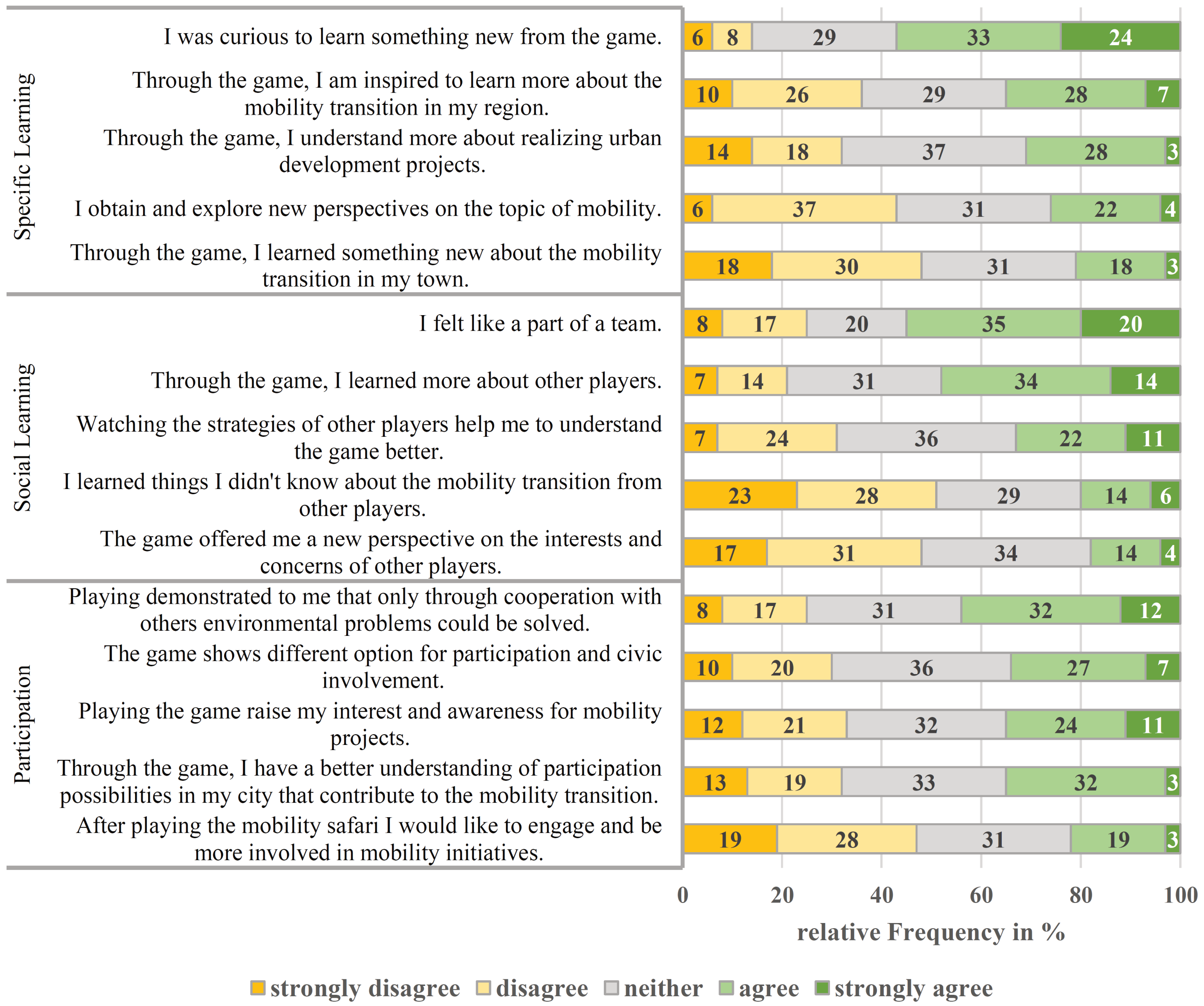

Figure 3: Results on the players' perceived learning outcomes (standardized questionnaire, n=72)

Specific fact-based learning actions occurred in the game besides the thematic action cards and the realization of mobility initiatives via the quiz questions. Two types of quiz questions were designed that correspond with the value (i.e. coins) of the chosen project card. The questions targeted schooling in the field of sustainable urban mobility such as providing information on bike-sharing, sustainable service providers, PT, CO_2 emissions and the urban carbon footprint. The wording of the multiple-choice quiz questions that included some smaller pieces of additional information, allowed the players to approximate the answers, by common sense and simple calculations, which was supported by the deviating choices.

More than half of the players stated that during the gameplay they learned something 'new'. More than 30% of the players indicated that they are inspired to learn more about the mobility transition in their region and gained a better understanding about urban development and mobility projects. About 25% of the players obtained new knowledge on urban initiatives and new perspectives on mobility which is crucial to consider new practises (see Fig. 3): "I learned about sustainable projects and ideas I had no idea about", and every fifth player stated that they have learned something new about the mobility transition in their town: "The game shows that every project has a sustainable influence on the environment". However, though learning occurred the players perceive their learning outcome rather moderate. That perception might be explained by the (a) slight overhang of well-educated people, who are already well informed in the sample and (b) given better education, that the set of quiz questions was probably too easy for that player group. Thus, the game indeed successfully delivers specific learning for information transfer and knowledge acquisition.

The quiz questions also delivered social learning, by triggering social interactions such as knowledge sharing and group discussions. In players compared their game experience with their real-world mobility practices and everyday life experiences. They expressed the value of the game regarding "Partnering up in a joint

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venture and not realizing projects on my own – and seeing the common benefit from realizing these projects". Such personal and professional experience also played an important role in the selection of game projects. The discussion around project selection reflects personal and professional values and preferences that are transferred into the game context: "No, electro-mobility-projects I do not support. That's not solving the traffic and mobility issue of the city" (G14). Debates about preferences and values are also put into spatial context: "No, for the Lobau (district in Vienna, N/A) a promenade does not fit – then I choose another tile and topic." (G12) and "(…) the most important strategy is, to choose for an urban development area, if possible a neighbourhood" (…) to enjoy the multiplier effects of neighbouring projects" (G15). The research aligns with prior research, e.g. Lozano (2014) or Medema et al. (2016) corroborating that playing the 'Mobility Safari' triggers social learning activities. By linking game world with real world practises, social values and norms shows that boundaries of the game world are permeable (see also Juul 2011)and that games indeed can be of value to better understand real-world complexities.

Next to the content specific group discussions institutional learning and capacity building occurred. Players indicated that they appreciated "Negotiating and cooperation with other players" and the "process of gathering a team of project members". The importance of building networks and collaborations to solve real-world environmental problems was agreed by 32% and strongly agreed by 12% of the players. The discussion strongly remained in the realm of daily practises and mobility choices and only rarely touched institutional and administrative questions, which indeed are less obvious or urgent in daily life.

The game activity instigated a positive team atmosphere. 82% of the players indicated that they actively considered them as a team member, and about half of the players stated that they have learned more about other players, such as different perceptions and interests, values and social practises, and watching other players elevated the understanding of the game (33%). Earlier we discussed the permeable boundary between game and real-world. Thus, watching and learning from other players in the game also transfers knowledge about real-world issues and delivers new insights for the development of new practises in it. To a lesser degree, they learned things about the mobility transition from other players and obtained a new perspective on the interests and concerns of other players (see Fig. 3).

Around 35% of the players stated that the game triggered their interest and increased their awareness about possibilities for participating in mobility initiatives. Still, only 22% would be interested to enter such initiatives and very few actively adapt and change mobility choices in their daily practices. Consequently, the game obviously works in terms of transfering information and rising awareness but falls short regarding triggering the players for active participation and behavioural change. Though the players are well educated with a comparatively high environmental friendly attitude, a game is likely not a format that works well for instigating active behavioural change.

In contrast to classic games, the gameplay of Mobility Safari based on incomplete rule-sets and un-governed situations. Thus it was necessary for the players to negotiate with each other and make decisions how to play in the specific unruled situation. Besides a cooperative teamplay and networking also "unsocial" or "unfair" decisions and practices occurred. To our curiosity, some players complained in the debriefing about the lack of predefined rules to govern such situations. Experimenting with new alternatives also included practices such as resource sharing, giving away resources as gifts to struggling players, but also included practices such as active bribery, corruption or usury. Addressing and discussing practices, institutional tensions, alternative institutional formats and the changeability of institutional designs are modest indications for a deeper and more complex learning process, in the sense to connect game experiences with real world matters.

7 CONCLUSION

In this article, we stress that playing the serious games 'Mobility Safari' indeed has the potential to increase the interest on urban development projects and reveals insights in their processes. The game delivered adequate results for schooling and transfer of specific mobility information to a broader audience. Hence, the game successfully supports the established goals of Vienna's SMART city strategy to raise awareness, inform actors on green mobility, sharing projects and existing initiatives, as well as support networking (City of Vienna 2016). The co-creation process during the game design process was crucial to develop the mobility safari and its components to actually deliver those positive effects. This participatory approach ensured the implementation of target-group specific desires and needs, new perspectives and subsequently leads to a deeper understanding.

Less promising were the results regarding consolidated active participation. Though the game play and the debrief show indications moderate willingness to engage stronger in urban projects, obviously the players do not actively perceive them as learning processes and learning results. Subsequently, also the results in the questionnaire were modest too. For future research ambitions developing and testing formats that are stronger focused on behavioural change and actionable knowledge, and how to make this learning effect more obvious and perceivable for players, would be valuable to explore to improve diffusion and impact of serious games.

During the testing period, we also learned that the incomplete rule-set created added value regarding social learning: fuzzy and ambiguous, ungoverned situations enabled the players to experience institutional tensions. Those situations urged the players to solve these situations through social interaction and eventually alter the institutional design of the game. Hence, when gameful, consolidated learning effects for sustainability transitions is the ambition, incomplete and ambiguous rule-sets might be a suitable option to trigger different modes of learning activities, such as exploring new rules and collaborative formats. This finding adds to the traditional gaming literature that outlines unambiguous, fixed and binding rule sets as fundamental conditions for games (Salen & Zimmerman 2004; Juul 2011).

We also learned that the debrief is the crucial moment to transform the gaming experience into a deeper learning experience by discussing and reflecting e.g. institutional questions, which are not obvious to the players in the game play. Thus the debrief and the design of the debrief should be already considered and sufficiently addressed in the serious game design. Hence, it is also crucial to plan and allocate enough time for this activity: without a considerate debriefing activity, the learning experience and learning outcomes are likely to be lost. However, for future studies a stronger deliberation on how to address complex forms of learning and implement them in the game play in an adequate fashion are crucial. To measure and observe these different leaning forms a diverse evaluation design (i.e. standardized survey, participating observation and reflexive focus groups) will be necessary.

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9 REFERENCES

BATTY, P., PALACIN, R. & GONZÁLEZ-GIL, A.: Challenges and opportunities in developing urban modal shift. Travel Behaviour and Society, 2(2), pp.109–123, 2015.

BLUEMINK, J., HÄMÄLÄINEN, R., MANNINEN, T., JÄRVELÄ, S: Group-level analysis on multiplayer game collaboration: how do the individuals shape the group interaction? Interactive Learning Environments, 18(November 2012), pp.365–383, 2010.

CITY OF VIENNA: Smart City Wien - Framework Strategy, Vienna 2016.

CITY OF VIENNA: STEP 2025 - Fachkonzept MOBILITÄT, Vienna 2014.

CROOKALL, D.: Serious Games, Debriefing, and Simulation / Gaming as a Discipline. Simulation & Gaming, 41(6), pp.898 –920, 2010.

CUMMING, G.S., OLSSON, P., CHAPIN, F.S., HOLLING, C.S.: Resilience, experimentation, and scale mismatches in social-ecological landscapes. Landsc. Ecol. 28, 1139–1150. doi:10.1007/s10980-012-9725-4, 2012.

DETERDING, S.; BJÖRK, ST.; NACKE, L.; DIXON, D.; LAWLEY, E.: Designing Gamification: creating gameful and playful experiences. CHI ’13 Extended Abstracts on Human Factors in Computing Systems on - CHI EA ’13, p.3263, 2013.

DEVISCH, O., POPLIN, A. & SOFRONIE, S.: The Gamification of Civic Participation: Two Experiments in Improving the Skills of Citizens to Reflect Collectively on Spatial Issues. Journal of Urban Technology, 732, pp.1–22, 2016.

ERHEL, S. & JAMET, E.: Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness. Computers and Education, 67, pp.156–167, 2013.

Van EXEL, N.J.A. & RIETVELD, P.: Could you also have made this trip by another mode? An investigation of perceived travel possibilities of car and train travellers on the main travel corridors to the city of Amsterdam, The Netherlands. Transportation Research Part A: Policy and Practice, 43(4), pp.374–385, 2009. Available at: http://dx.doi.org/10.1016/j.tra.2008.11.004.

FRANTZESKAKI, N., WITTMAYER, J. & LOORBACH, D.: The role of partnerships in “realising” urban sustainability in Rotterdam’s City Ports Area, the Netherlands. Journal of Cleaner Production, 65, pp. 406–417, 2014.

GEE, J.P.: Why are videogames good for learning? Spectrum, 32, pp. 25–32, 2005.

GUGERELL, K.; ZUIDEMA, CH.: Gaming for the energy transition. Experimenting and learning in co-designing a serious game prototype. In Journal of Cleaner Production, 2017.

HÄMÄLÄINEN, R.: Using a game environment to foster collaborative learning: a design-based study. Technology, Pedagogy and Education, 20(March 2015), pp. 61–78, 2011.

HUIZINGA, J.: Homo Ludens: A Study of the Play-Element in Culture, Routledge Chapman & Hall, 1999.

HUNECKE, M.; HAUSTEIN, S. BÖHLER, S.; GRISCHKAT, S.: Attitude-Based Target Groups to Reduce the Ecological Impact of Daily Mobility Behavior. Environment and Behavior, 42, pp.3–43, 2010.

IPCC: Climate Change 2014 - Synthesis Report, 2014.

JUUL, J.: Half Real: Video Games between Real Rules and Fictional Worlds, MIT University Press Group Ltd., 2011.

KE, F.: Designing and integrating purposeful learning in game play: a systematic review. Educational Technology Research and Development, 64(2), pp.219–244, 2016.

KIILI, K.: Digital game-based learning: Towards an experiential gaming model. Internet and Higher Education, 8(1), pp.13–24, 2005.

LEDERMAN, L.: Debriefing: Toward a Systematic Assessment of Theory and Practice. Simulation & Gaming, 23(2), pp.145–160, 1992.

VIENNA CITY ADMINISTRATION MUNICIPAL DEPARTMENT 23 (MA 23). Economic Affairs, Labour and Statistics. Vienna in Figures, Vienna 2016. Article at: https://www.wien.gv.at/statistik/pdf/viennainfigures-2016.pdf

MAYRING, P.: Qualitative Inhaltsanalyse: Grundlagen und Techniken, Beltz, 2015.

MEDEMA, W.; FURBER, A.; ADAMOWSKI, J.; ZHOU, Q.; MAYER, I.: Exploring the Potential Impact of Serious Games on Social Learning and Stakeholder Collaborations for Transboundary Watershed Management of the St. Lawrence River Basin. Water, 8(5), p.175, 2016. Available at: http://www.mdpi.com/2073-4441/8/5/175.

NEVENS, F.; FRANTZESKAKI, N.; GORISSEN, L.; LOORBACH, D.: Urban Transition Labs: Co-creating transformative action for sustainable cities. Journal of Cleaner Production, 50, pp.111–122, 2013.

POPLIN, A.: Playful public participation in urban planning: A case study for online serious games. In Computers, Environment and Urban Systems, Volume 36, Issue 3, pp. 195–206, 2012.

POPLIN, A.: Digital serious game for urban planning: "B3-Design your Marketplace!" Environment and Planning B: Planning and Design, 41(3), pp.493–511, 2014.

PRENSKY, M.: "Don't bother me Mom, I'm learning!": how computer and video games are preparing your kids for twenty-first century success and how you can help! Minnesota Paragon House, pp.27–51, 2006.

SALEN, K. & ZIMMERMAN, E.: Rules of Play. Game Design Fundamentals, Cambridge, Massachusetts, London, England: MIT Press, 2004.

TAN, E.: Negotiation and Design for the Self-Organizing City. TU Delft, 2014.

WENDEL, V. & KONERT, J.: Multiplayer Serious Games. In R. Dörner et al., eds. Serious Games. Foundations, Concepts and Practise. Springer International Publishing Switzerland, pp. 211–242, 2016.

reviewed paper

Public Choices and Decision-Making Processes: a Case Study on Sustainable Mobility

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1 ABSTRACT

The definition of a decision process, which implies the capacity to implement and realize an action involving all the actors interested, is crucial not only for taking adequate political decisions but even mainly for getting a democratic control of the decisions themselves.

From a strategic planning point of view, decision process on public issues should be essentially considered as a process of participation, which involves political decision-makers as well as all the administrative organizations which have to realize the decisions taken and citizens and more generally all the stakeholders who will be impacted in a positive or negative way by such decisions. If this is the case, important issues arise: which is the methodology that should be followed to assess all the alternative solutions to adopt? How are analyzed the effects and the impacts of political decisions? How are evaluated the consequences of a set of actions?

To answer to all these questions, Decision Support Systems (DSSs) have been developed. They include measurement tools such as cost-benefit analysis as well as relational methods of "rational analysis" such as multicriteria analysis. DSSs' allow decision makers to implement the best choices and decisions with the aim of reaching a Pareto improvement for the territory considered. Though these tools may be implemented to any socio-political decisions, in these last years the democratic and, therefore, political pressure has led to adopt DSSs' mainly for two specific themes: the environment and the sustainable mobility.

Moreover, in the agenda of European institutions and local and national administrative governments, sustainable mobility is become a high priority. In this framework, the methodology[1] proposed combines two different approaches. On the one hand, the "classic" or top-down approach based on statistical data analysis is considered where the main target is the definition of some synthetic indicators, while on the other hand, the bottom-up approach is adopted, which is based on the Strategic Environment Assessment (SEA) framework and on citizens' participation. This decision process as defined, should be followed for implementing specific and appropriate solutions at local level and for taking into consideration the peculiarities of the territory considered. Finally, a case-study regarding the ex-13th District of the Municipality of Rome is presented.

Keywords: decision making process, sustainable mobility, participative approaches, public choices, decision support system

2 LITERATURE BACKGROUND

2.1 Policy cycle

In the post-World War II period, the ever-increasing gap between political prescriptive theory and the political practice of modern states prompted many scholars to research methods and approaches to achieve social, economic and political development, reconciling theory and practice that can be observed in the actual institutions.

Among these methods, it is worth to note what is based on the definition of public policy goals, called „policy science". From the seminal work of Harold Lasswell, the main topic of policy science regards government activities especially in describing their design and implementation, with a multidisciplinary, problem-solving and normative approach. Despite the criticism on the scientific feature of this approach, the principles developed are still valid and accurate, and continue to provide the basis for public policy study. Among them, one of the most generally known and widespread concept is the policy cycle theory, that is, the decomposition of the process of public policy formation in a number of distinct steps and phases. Among various advanced proposals (Lasswell, 1956; Brewer, 1974; Jones, 1984; Anderson, 1984) of particular

[1] The methodology has been developed within the Interreg III B Medocc project "Ville emission zero – Villemizero"

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importance, it should be recall those of Howlett and Ramesh (1995). They define five phases (corresponding to the problem solving mechanism): Agenda Setting, Formulation, Decision making, Implementation, and Evaluation.

In this vein, a decision process starts when there is a need for a change or when an action should be implemented (Sutton, 1999): for example it could be an answer to a uneasiness situation or to the feeling that the current state is inadequate in respect to the new needs of a specific community. The initiative of starting a decision process may be related to the action of a person or of a group interested in changing, because new data or research results highlight the need of new policies.

The rising of changing needs leads to the formulation of a problem that requires a solution. Sometimes the problem will be well defined and will be easily subdivided in targets and constraints, but more often it will be confused with general and many targets (or even only aspirations) that is difficult to analyse.

Starting from these considerations, analysing the relative constraints, the active and passive involved actors, the relationship among interests, it will be possible to define more precisely the problem, to analyze a set of different actions (scenarios) to solve it and finally to realize the chosen solution.

Even if this approach facilitates the understanding of the decision-making process by subdividing it into various subprocesses, it should be taken into account that actually the process is not structured so sequentially or aimed at the goal but is influenced by several factors such as actors, institutions, prevailing ideologies, tools available (Hilgartner and Bosck, 1981; Holzner and Marx, 1979) according to non-linear schemes. This empirical evidence has led to the development of different models of decision-making, including the most well-known as: the rational model (Simon, 1955), the incremental model (Lindblom, 1959), the garbage can model (Cohen, March and Olsen, 1972). These models point out that, depending on different conditions (number of agents, environment in which decision is taken, completeness of information, time available) (Forester, 1984, Howlett and Ramesh, 1995) the decisional process can assume different styles, anyway oriented to the best possible result.

2.2 Decision making

In this framework the decision making, the process embracing the steps leading to a choice, assumes a central role and for this reason is studied in several academic disciplines: psicology, sociology, political theory, economy and managerial sciences. Among them, the one aiming more specifically at the study of the decision process and to the development of methodologies to reach rational (or optimal) choices, is known as Operations Research, Management Science[2] or Decision Theory. However, there is a large overlap, and the issue has been deepen from the variety of methods that researchers with different backgrounds have applied to the same or similar problems.

Mental and formal models play a fundamental role in decision making. On the one hand it is through our mental models that we interpret the world and give a meaning to it (Forrester, 1975), while on the other hand, the formal models are the instruments to improve and strengthen our mental models but also they represent the way we communicate them to the others. The formalization can be more or less in depth, but a minimum level is necessary to face the complexity of many problems.

Particularly interesting are the models called policy narratives (Sutton, 1999). Such a narrative is a story with a beginning, a course and a conclusion, in which are represented a specific events sequence that reaches the status of “common sense” or “shared truth” within a community or a cultural, scientific or political circle.

In some cases they are stories deriving from specific experiences but interpreted as general meaning in all of the cases that reproduce similar circumstances. In other cases they are only artificial realities built in order to highlight or demonstrate the damages or the benefits that some behaviours or actions can imply. A typical example is the story called “The tragedy of the commons”.

These particular models aim to comparing and studying the effects of cooperative and competitive behaviours. In a decision making process, where there are actors with different targets, interests and preferences, the problem is how to choice among the possible alternatives.

[2] The two terms, used today as synonymous, have a different meaning: the first one underlines the operative decisions, the second one highlights the strategic and political choices.

Decision makers will seek to serve the "public good". But how are the decisions that serve the public good actually identified and distinguished from publicly the bad ones? Traditional planning theories propose that good public decisions are "rational" in the sense that social benefits will exceed social costs. The idea is that collective choice can and should mirror "rationality" as it applies to individual choice-making behaviour. Individuals do not freely make choices whose costs to them exceed the forecast benefits. By the same token, traditionalists argue that social groups in a democratic society should be presented with public choices whose collective benefits exceed the collective costs of achieving them.

In the same vein, traditional neo-classical economics teaches that good public choice requires decisions that yield "Pareto improvements" whereby change leaves some individuals better off without leaving others worse off.

There are theories of choice, however, that do not hold to the traditional model outlined above. James Buchanan, founder of the "public choice" school of economics, and other non-traditionalists such as political scientists David Braybrook and Charles Lindblom (1961), reject the fundamental premise that "rational" decision making, as it applies to individuals, can logically and reasonably be transferred to a collection of individuals (namely, the public) as a basis for public decision making. Buchanan puts it thus:

"Rationality or irrationality as an attribute of the social group implies the imputation to that group of an organic existence apart from that of its individual components. If the social group is so considered, questions may be raised relative to the wisdom or "unwisdom" of this organic being. But does not the very attempt to examine such rationality in terms of individual values introduce logical inconsistency at the outset? Can the rationality of the social organism be evaluated in accordance with any value ordering other than its own?" (Buchanan, 1954)

Each one of the decision makers will rank the alternatives on the base of his own preferences: how to get a common ranking? A typical way is to vote. Through the voting the preferred alternative should be chosen, if not from all at least from the majority of the decision makers.

Buchanan and others of the public choice school argue that it is simply majority decision making in the context of democratic institutions that yields sound social choices. They view majority decision and coalition formation as the key mechanisms through which a social group makes "correct" choices among alternatives.

Definitively the choices will be correct but not completely democratic. In fact, as proved from the impossibility theorem (Arrow, 1951), in trying to obtain an integrated social preference (a social welfare function) from diverse individual preferences, it is not in general possible to satisfy simultaneously even mild-looking conditions that would meet the most elementary standards of reasonableness for public choice in a democratic society while still preserving some basic axioms of rationality (transitivity, completeness, reflexivity). These conditions are:

- create a rank ordering of public priorities for every possible combination of individual preferences ("universal domain");
- ranking any pair of social states (alternatives) with no dependence on how others, unrelated alternatives, are ranked ("independence");
- permit no individual or group of individuals to prevail over the social ordering regardless of what others prefer ("nondictatorship");
- all the group of all individuals, taken together, to prevail over the social ordering (Pareto optimality).

Does this mean that group choices are inherently antidemocratic, or elitist, or irrational?

Buchanan argues that decisions reached through the approval of a majority has never been, and should never be, correctly interpreted as anything other than a provisional choice of the social group. As a tentative choice, the majority-determined policy is held to be preferred to inaction, but it is not to be considered irrevocable. In other words, if the result of a majority decision is ultimately seen by a majority to yield net negative outcomes, the decision will ultimately be reversed.

According with this point of view a decisional process cannot be reduced to a linear process aimed to choice the best alternative in a predefined set. On the contrary it can be represented as a "chaos of purposes and accidents" (Sutton, 1999) and if the target is to get choices related to the original needs, has to be characterized from three fundamental elements: learning, participation and assessment.

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The analysis of a problem becomes a learning process where the reality (the system) in which the problem has born is understood gradually and where the knowledges of the various actors are shared. This process implies that the problem and the possible solutions are defined more than one time.

The study of decision processes, the capacity to analyze the mechanism and highlight the actors, is crucial not only to lead to good political decisions (in the meaning previously defined), but mainly to get to a democratic control of the decisions.

So the decision process has to be also a process of participation that has to involve, not only the decision-makers, but also all those who put into practice the decisions taken and those who will suffer in their lives (in a positive or negative) the effects of such decisions.

Without these features it will be difficult the success of the decisional process, both for the lack of cooperation or little motivation of those who have to make the decisions, and for the resistance of those who, even suffering the effects of decisions, have not been involved (Healey, 1997).

2.3 Decision Support Systems and SEA

Whitin the decision making and consequently referring to the attempt to define the most efficient choices in order to catch up the policy targets, two questions assume a central role: which methods have to be used in order to assess alternative decisions, analyzing the effects and the impacts? How to evaluate effects that a set of actions will imply?

In order to answer to these questions the so called Decision Support Systems – DSSs have been developed: they include measurement tools as costs-benefit analysis and related methods of “rational analysis” (for instance based on multicriteria analysis), that have been devised in order to help decision makers to make good choices (Pareto improvements) and avoid bad ones.

Although this kind of analysis is known to be used for any problem, in the last years the democratic and, therefore, political pressure has led to develop decision support systems aimed at specific themes, notably the environment. A reference point, from this perspective, is the Strategic Environmental Assessment (SEA).

Conceptually born at the end of the 80s, the SEA is a systematic process to assess the environmental consequences of planning proposals, having as main goal to consider these at the same level of the economic and social impacts. The SEA concerns the elaboration process of the plan rather than the plan themselves. In that way the SEA has to be inserted from the very beginning of the decisional process and has to be applied along the path leading to the plan.

A central point of the SEA is the consideration of alternative choices, including the “zero option”. Often a planning process doesn’t include this option, i.e. to don’t act, that on the contrary sometimes can be more efficient compared with the other alternatives. The main steps of a SEA are:

- Screening (determining whether or not SEA is required);
- Scoping (determining the range of environmental issues to be covered by the SEA);
- The preparation of an Environmental Report;
- The carrying out of consultations;
- The integration of environmental considerations into the Plan or Programme;
- The publication of information on the decision (SEA Statement).
- In a operative way the SEA has to be based on:
- Simple methods oriented specifically on the strategic levels;
- Organized databases, without which it’s impossible any assessment.

Moreover since the 2004, with the adoption by UE Council of the directive 2001/42/CE, SEA has a compulsory character.

3 THE METHODOLOGICAL APPROACH

Starting from the framework depicted above, a decision making has been defined in order to identify a cohesive process able to assist the policy makers in finding solutions that best respond to local needs, in order to support, reinforce and best utilize the various territorial stakeholders.

In general terms this decision making has the following characteristics:

- interactive – various territorial actors work closely with the authorities responsible for planning, facilitating a continuous exchange of information;
- iterative – the choices, subjected to constant refining, are considered as alternative hypotheses;
- participatory – the request of the resident population affect the corpus of judgment criteria and project choices;
- systemic – the various components are analyzed according to their mutual interactions in relation to the established objectives;
- evaluative – the alternative scenarios are assessed in comparison with four different situations (ideal status, actual status, preferred status by institution, preferred status by local community).

The resulting conceptual framework has as core the concept of assessment that implies to define: the assessment target (the theme), the assessment object (the territorial context), the assessment criteria (the benchmark to be caught or the threshold not to be overcome) and the impacting actions (the alternative scenarios).

By applying this definition to the operational sphere, a logical outline of the process has been defined (Fig. 1) that foresees four main groups of action that operate according to a non-sequential dynamic and mutual relationship.

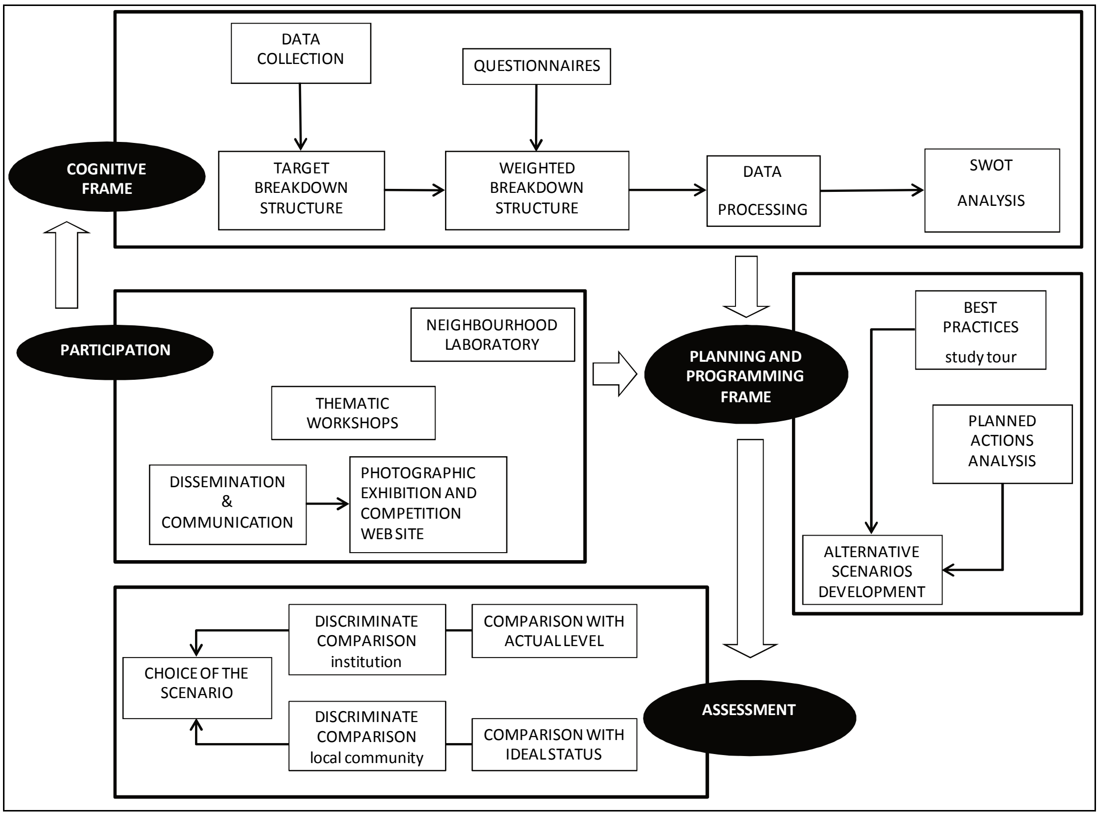

Fig. 1 – Logical outline of the methodology (our elaboration)

The components of this logical outline have been then recomposed into five steps to assure its operability: building the Target Breakdown Structure; measuring the Status quo, defining the alternative scenarios, assessment and choice. In the following table (Tab. 1), the correspondence among these lasts and the ones of SEA and of Policy cycle has shown.

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Decision making (our proposal)	Policy cycle	SEA
Target Breakdown Structure	Ageda setting	Screening
Measuring the status quo	Formulation	Scoping
Defining the alternative scenarios	Decision	Environmental report
	Implementation	Consultations
Assessment	Assessment	

Tab. 1: correspondence between Decision Making proposed, SEA and Policy Cycle

4 DECISION MAKING ON SUSTAINABLE MOBILITY

Due to the fact that sustainable mobility is today a focus point in the agenda of development policies, the procedure above mentioned has been concretized in a model which allows for the adoption of common strategies to reduce emissions caused by traffic, such as the development of intermodality, improvement of infrastructure and existent transportation services, also through improved relations among the various institutional levels.

The conclusions of the Johannesburg Earth Summit (2002) and the Aalborg "Charter of European Cities & Towns Towards Sustainability" (June 2004) highlight on the commitments that have to be assumed by the local authorities to develop their territories according to the principles of the sustainability. One of the themes is that one of the mobility:

"We, cities & towns, shall strive to improve accessibility and sustain social welfare and urban lifestyles with less transport. We know that it is imperative for a sustainable city to reduce en-forced mobility and stop promoting and supporting the unnecessary use of motorised vehicles. We shall give priority to ecologically sound means of transport (in particular walking, cycling, public transport) and make a combination of these means the centre of our planning efforts. Motorised individual means of urban transport ought to have the subsidiary function of facilitating access to local services and maintaining the economic activity of the city."

The concept of mobility therefore covers more than merely transportation or traffic (Mataix González 2010).

The European Commission establishes different guidelines in this regard: alternatives to private car, the increase efficient travel through the links between the different modes of transport and the smart control management to reduce traffic congestion. The objective of European sustainable transportation policy is to provide a transport system that addresses economic, social and environmental needs of a society trough an efficient transport systems that account for the strong impact that transportation has on economic growth on social development and on the environment.

The importance of mobility reflects even on the so called Smart City paradigm and on its different axes make this a vital issue for residents and local governments. The difference between mobility and smart mobility is public accessibility to real-time information; this improves services by saving time, enhancing the journey, saving money and reducing CO_2 emissions (Manville et al. 2014). Smart mobility is key to the smart transformation of cities (Van Audenhove et al. 2014).

Even if the target is clear, there is no shared definition of sustainable and smart mobility. So among the different definitions, it has been chosen the one advanced by the Sustainable Mobility Working Group of the World Business Council for Sustainable Development (http://www.wbcsd.org/): Sustainable Mobility is the ability to meet the needs of society to move freely, gain access, communicate, trade, and establish relationships without sacrificing other essential human or ecological values today or in the future.

According with this definition four major challenges have been identified:

- reduce carbon emission (CO, CO_2);
- build institutional capacity;
- address the problem of traffic congestion;
- reinvent current processes of planning, development and management of mobility infrastructures.

Coherently with these issues the subsequent phase has been the definition of an indicator set in order to describe the phenomenon and able to give a quantitative measure of its value.

4.1 Building the Target Breakdown Structure

To define the indicator set we have choosen to use a hierarchical framework typical of the Project Management theory (usually known as Work Breakdown Structure - WBS) recalling it Target Breakdown Structure (TBS). It's articulated in themes, subthemes and indicators describing the phenomenon with a „tree structure".

The starting point for choosing the indicators was the "scorecards" in Mobility 2001 by WBCSD. We modified the items listed in the scorecards through a combination of studies of existing literature, availability of data and consultations with stakeholders.

The result was a set of 25 indicators grouped in 16 themes and 4 main policies that in our view constitutes the most important dimensions of sustainable mobility.

Two issues have influenced the choice of indicators. One regards the need for indicators that reflect all three pillars (environmental, social, and economic) commonly thought necessary for sustainability. The other regards the importance of "people-centered" factors. In this perspective the four main policies identified are:

- accessibility, meaning a transport system that protects and guarantees the right of movement, its accessibility and safety;
- economic development, meaning a transport system mainly oriented to the economic development in respect for environmental laws;
- territory, meaning a transport system that favours "soft" mobility;
- innovation, meaning a transport system oriented towards new research findings and opportunities.

To characterize each element of the TBS in a clear and unambiguous manner have been defined the related metadata (Fig. 3).

The TBS has to be thus specified according to the available statistical data concerning the specific context object of evaluation. Whereas elementary data are not available (what especially happened when the study is conducted at local or sub-local level) specific estimation models could be used to find the value of the indicator (in particular for air pollution and noise pollution) or, alternatively, appropriate proxies have to be found.

To add a dynamic dimension to the TBS, finally mutual relationships (i.e. vertical relations) among all the indicators in order to capture the complexity of the phenomenon have to be defined. Such evaluation, performed with classical criteria or with statistical independence tests, allows for the creation of a correlation matrix.

4.2 Measuring the "status quo"

In order to get a not purely quantitative measure of the phenomenon the TBS has to be more specified in terms of relative performance.

In fact if the process would stop at the previous step, it would be a simple top-down analysis. Considering that different territorial contexts have different priorities, the methodology, coherently with a bottom-up approach, foresees to use a Weighted Model Evaluation, introducing a weight to each indicator depending on the impact to the citizens or the experts' opinion (Delphi method) by means of questionnaires on the relevance perceived of the indicators above defined. That adds a subjective and qualitative component to the previous objective and quantitative measure.

It must be underlined that to capture better the perceptions of the different stakeholders, the weighting process can consider separately the answers of differente stakeholders (for instance politicians and citizens).

Another point that helps to get relative results, concerns the data collection process that has not to be restricted to the target area, but it has to be extended to a set of close local administrative units, standardizing the results of the data collection.

This process leads to the definition of a spatial matrix Xnpr, with n indicators and p territories and r weight vectors representing the priorities of the interviewed subjects (r is the number of the stakeholder groups choosen).

This step ends with a SWOT analysis (Strengths, Weakness, Opportunities and Threats) in order to summarize the main issues of the target area in order to be presented in an interactive and iterative way to the main territorial stakeholders enriching thus their informative background.

4.3 Definition of the alternative scenarios

An impact assessment requires two fundamental elements: the object of impact and the impacting agent. The first element are the indicators of the TBS.

The second element are the several actions that could be implemented in the focus area, the so called „alternatives“, which definition starts from the SWOT analysis previously defined. Main actors in this activity are local governance authorities, as well as citizens who can express their priorities in several way: neighbourhood laboratories, forum, working group and all the possible means of participations. To better inform the citizens it is possible to support the participation activities with workshops of experts, reports of specific literature and of similiar experiences in other contexts (benchmark analysis), and the visiting of other contexts (study tours).

The different scenarios, as subset of hypotized actions, are created by using a quali-quantitative logic. Firstly, the impact of a determined action, when implemented, can impact on one or more indicators (and consequently on more determinants) of the TBS, so as many impact matrices (n x m, where n is the number of the indicators and m is the number of impacting actions) derive as many weighting vectors has been defined.

Each scenario, impacting the indicators that define the initial state of the sustainable mobility system, transforms them into receptors, altering their status and defining a new status of the system. (Eq. 1):

(1) $R_i = f(A_{j\ (j= 1\ to\ m)}; W_{i,k\ (k= 1\ to\ n)} * I_i)$

where

R= receptor, value of the indicators after the impact of the action

A= action

I= value of the indicator before the impact

W = weight attributed by the stakeholders (for instance politicians k=1, citizens k=2, etc.) to the i-indicator

i = number of indicator/receptor

j = number of impacting action

k = number of stakeholder groups

The specification of function (1) depends on the impacting action and has to be defined for each case.

The impact of the scenarios on the entire system depends finally on the correlations (vertical relations) among the indicators, as previously defined. To have the syntetic value of the sustainable mobility, hypotizing that stakeholders are two (politicians and citizens), the decision making process produces four different scenarios of the focus area:

- status quo (zero hypothesis or status quo);
- ideal scenario (where the receptors assume their maximum value);
- planned scenario (top-down hypothesis or scenario imagined by local administrators);
- wished scenario (bottom-up hypothesis or scenario imagined by citizens).

4.4 The assessment

Comparing the four scenarios, concise quantitative judgment could be elaborated with regard to:

- Citizens’ perceptions of the current states of their district in comparison with several other areas;
- policy makers' perceptions on the current state of their territory of competency in comparison with several other territories;
- effective performance of the sustainable mobility system related to its maximum potential;
- potential improvements and new states of the sustainable mobility system.

We choose to aggregate the indicators so that the maximum value for the sinthetic index is 4, representing the benchmark of the ideal situation.

Moreover the model allows for a focus on each component of the TBS, so that the local/regional authorities could acquire the information for making, as much as possible, an informed choice about the actions to be implemented.

Policy	Definition	Themes	Definition	Variables/Indicators	Definition
Accessibility	A transport system that protects and guarantees the right of movement, its accessibility and safety	Security	Safety level of the passengers	Street accidents deaths	Number of road accidents deaths per year
				Street accidents woundeds	Number of road accidents injuries per year
				Infraction to the street code	Number of Code violations per year
		Capacity	Capital stock of the public transport means	Passengers	Average of passengers per years/ resident population at 31-12
		Capillarity	Territorial distribution of the access points to the public transports	Public transport stops	Number of local public transport/ total area in square Km
				Taxi stock	Number of taxi/resident population at 31-12
		Quali-quantity	Total efficency of the qualitative and quantitative stock of the public and private vehicles	Circulant vehicles stock (Npc)	(n. of private vehicles+ n. of taxi + n. of bus+n. of tram and metro)/resident population at 31-12
				Age of circulant vehicles	Average of the age for the Npc variables/ years of useful life for the Npc variables
				Energetic consuption of the circulant vehicles	Average consumption per Kwh for the Npc variables
				Use of Public Transport	Average Km travelled from the public transport means
Economic Development	A transport system mainly oriented to the economic development in respect for environmental laws	National level of wealth	Specialization level of the mobility sector with regard to the entire economy	Sectoral specialization in the field of transport	Year added value of the transport system / Year added value of the entire economy
		Worker competitiveness	Addedd value produced from a worker in a year in the traansport sector compared with the added value of the entire economy per worker	Average productivity employer	Year added value of the transport system for worker unit / Year added value of the entire economy for worker unit
		National level of occupation	Contribution of the transport system to the employment level	Transport occupation sectoral specialization	Number of employers in the transport sector / Number of employers in the entire economy
		Pollution	Negative exttemalities cased by pollution	Air pollution	Yearly average in mg per cube meter of Pm10
				Acustic pollution	Yearly average of the noise pollution in decibel in the night hours
Territory	A transport system that favours "soft" mobility	Green areas	Capital stock intensity for the urban green areas	Urban green stock	Urban green areas (mq)/ total area (mq)
				Urban green closed stock	Urban green closed (mq)/total area (mq)
				Garden stock	Garden area (mq)/total area (mq)
		Urban area with "zero" traffic	Capital stock intensity for the urban areas with zero traffic	Walkways areas	Walkways areas (mq)/total area (mq)
		Urban area with controlled traffic	Capital stock intensity for the urban area eith controlled traffic	ZTL	ZTL (mq)/total area (mq)
		Protected routes for alternative mobility	Capital stock intensity for the alternative mobility	Cycling routes	Cycling routes (Km)/total area (mq)
Innovation	A transport system oriented towards new research findings and opportunities	Management systems	Research and Development expenditure	Research and development	R&d expenditure for the public firms in the transport sector / totale budget
		Means of transport	Public capital stock intensity eco-sustainable	Eco-friendly transport	Transport means with zero emissions/ total number of public transport means
		Information on the street	Virtual accessibility on the streeet to the informations on the mobility system	External hot spot	number of hot spot points/total area (mq)
		Information by home	Virtual accessibility by home to the informations on the mobility system	Internet access	Number of internet contacts to the public transport sites/ number of inhabitants

Fig. 3: The target breakdown structure (our elaboration)

5 EVIDENCES FROM A STUDY CASE: THE XIII DISTRICT OF ROME MUNICIPALITY

The decision making process described above has been tested on the territory of the XIII District of Rome. To evaluate the citizen opinions on sustainable mobility as previously defined, a questionnaire was submitted to a sample of 400 individuals: 200 of them were interviewed face to face at stops along the Roma-Lido train line, while the other 200 were interviewed by phone. Sample quotas for gender and age group were calculated on the basis of census data for the 13th Municipal district. Moreover, a questionnaire was designed for and submitted to a chosen panel of decision makers and technical experts, to assess the gap between the institutional wishes and the citizens' perspectives. Given the importance of evaluating the mobility desiderata and opinions on challenges land potential solutions to sustainable mobility, has been used

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a categorization of the citizens interviewed (unsustainable, intermodal, sustainable) on the basis of their mobility orientation choosing as criterion (specifically stated during the interview) the main means of transport utilized. The results highlight the guarantee of accessibility as the main priority, followed by the implementation of innovative systems. The right to movement (accessibility) is interpreted essentially as greater frequency of public transportation, followed by request for greater security, as it pertains to cleanliness, decorum and public order. In the use of innovative systems, the preferred choice is the investment in eco-sustainable means of transportation and the management of traffic to avoid delays; third is the option of investing in informative panels on the streets and on train and metro platforms; and far behind there was the possibility of receiving information through the most advanced systems. As far as foot and bicycle traffic, the first priority for citizens of the 13th district was the construction of green areas, then the construction of foot paths and finally there was the construction of bicycle paths. The organization of traffic in ZTL - Limited Traffic Zones, was the least preferred option in the sample interviewed, as it was seen as a mere limitation rather than a solution.

Among the many other findings of the study, it’s interesting to note that the satisfaction about the transport system in the 13th District is considerably higher in those with sustainable behaviors, probably because them tend to use mostly public transportation and non-polluting vehicles and therefore they make their evaluation on the basis of their own life experience.

To strenght the implementation of the decision making two other activities has been performed to broaden. the knowledge of the issues and help the definition of the solutions. Firstly, study tours was carried out in the European cities partener of the project with the aim to inspirations and potentially adopt successful solutions to local contexts. Secondly, neighbourhood laboratories (in this case called Villemizero Lab) was created, to discuss and define policies and activities to be implemented. The main results of decision making implemented in the 13th district of Rome can be summarized in the following points:

(1) The overall evaluation of the status quo, as perceived by its residents (Fig. 4) and determined by algorithms of the model, is 2.14, in seventh place among the 19 other Rome districts, where values range from 2.28 in the 19th district and 1.57 in the 9th district;

(2) The evaluation of the status quo, as perceived by political actors (Fig. 5), varies only slightly from the evaluation made by the citizens. The overall evaluation of the state of the sustainable mobility system is equal to 2.04, just below the citizens' evaluation, which puts the 13th district in eighth position among the 19 Rome districts;

(3) The evaluation of the scenario related to the impact of the activities desired by the citizens (the wished scenario) earns a value of 2.46. This value moves the 13th district from seventh to first place in the ideal scale of the positions among all Rome districts (Fig. 6);

(4) The evaluation of the scenario relative to the impacts of the activities planned by local policy makers (the planned scenario) shows a value of 2.11. This value takes the 13th district from eighth to seventh place on the ideal scale of the positions of all Roman Municipal districts, representing only a relative unitary increment greatly inferior, in absolute value and in relative comparison, with residents' perceptions of the new state of the system in relation to their specific requests (Fig. 7).

The last evaluation has been performed about the value of each determinant (accessibility, territory, innovation, economic development) and of each indicator of the TBS, thus allowing to better understand on what elements to focus on the activities to maximize the final result.

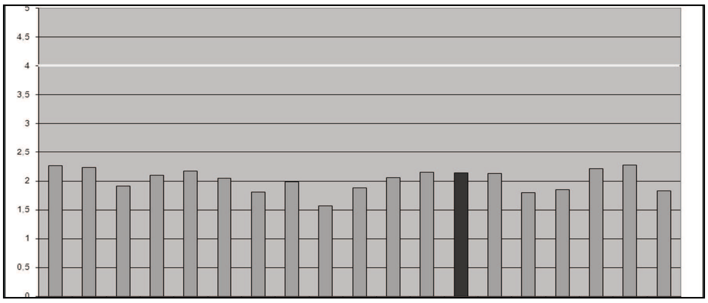

Fig. 4: Status quo of the mobility system in the citizen perception (our elaboration)

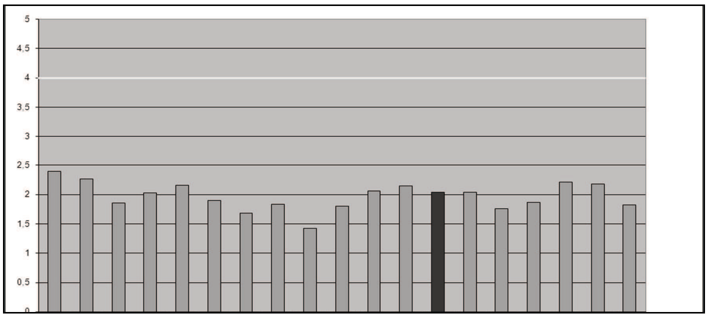

Fig. 5: Status quo of the mobility system in the policy makers perception (our elaboration)

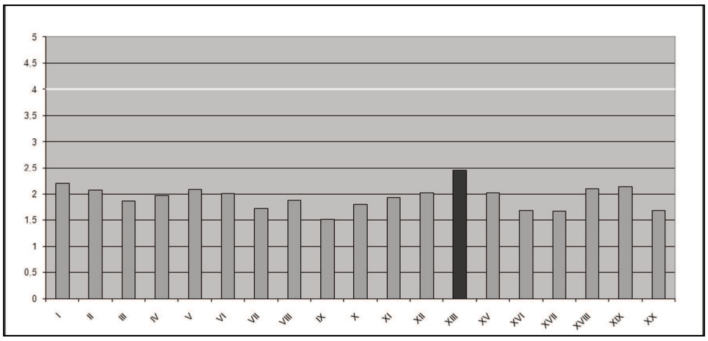

Fig. 6: Effects of the wished scenario on the Rome districts performance (our elaboration)

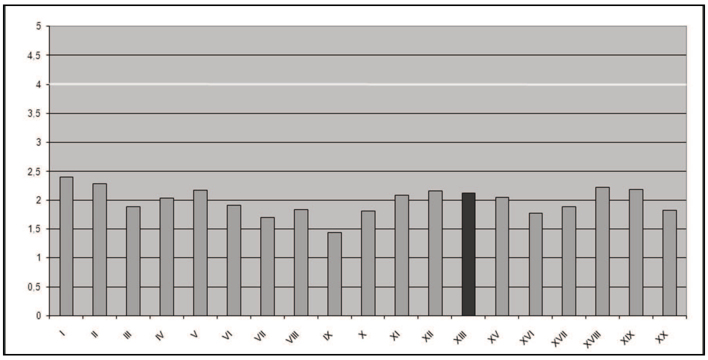

Fig. 7: Effects of the planned scenario on the Rome districts performance (our elaboration)

6 CONCLUSION

The proposed decision making does not provide a set of predefined actions in order to solve the sustainable mobility issue and to be used indifferently in various contexts, but rather it defines a general procedure, applicable to different cases, that, recognizing the particularities of different territorial contexts, allows yielding specific (thus each time different) solutions.

From this point of view the main characteristics of the process developed are:

- the capacity to integrate the desk informations with field investigation. Past experience demonstrates the importance of analyses founded on informal inputs from several entities (for instance interviews with local agencies and "field experts");
- a cohesive approach able to assist policy makers in finding solutions responding to local needs through the involvement of the various territorial stakeholders;
- the creation of a framework of qualitative and quantitative indicators to ensure the maximum coverage of the several aspects of mobility (indicators of stock, use, negative externalities and measures of the innovative character of the initiatives);
- the collection of data on contiguous territories that allows for a relative measure of the scenarios and thus it highlights more clearly the potential strengths and weaknesses in the focus area;
- the involvement of the stakeholders in the different step of the process that highlights not only the planned activities by the politicians, but also of the desiderata of the citizens;

- a composite evaluation based on different sources of information (statistical data, questionnaires, etc.) and on the horizontal and vertical correlation among the indicators, that reflects the complexity of a decisional process;
- the dynamic character of the procedure, that allows for continuos monitoring and adaptation of the strategies, provided that info points (or neighbourhood laboratories) remain operational; these facilities thus become vital points of encounter between territorial actors, of information updating and territorial observation.

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8 REFERENCES

ANDERSON J.E., Public policy making: an introduction, Boston, MA, Houghton Mifflin 1984.
ARROW, K. J., Individual Values and Social Choice, Wiley, New York, 1951 (2d ed., 1963).
BRAYBROOKE, DAVID AND LINDBLOM, CHARLES E., A Strategy of Decision, Free Press, New York, 1961.
BREWER G.D., The policy sciences emerge: tonurture and structure a discipline, in Policy Science, 5, pp. 239-244, 1974.
BUCHANAN J., "Social Choice, Democracy, and Free Markets", Journal of Political Economy, University of Chicago Press, vol. 62, 1954.
COHEN M., MARCH J. AND OLSEN J., A garbage can model of organizational choice, in Administrative Science Quarterly, 17, pp. 1-25, 1972.
EUROPEAN COMMISSION, Aalborg Charter "Charter of European Cities & Towns Towards Sustainability", 2004, (http://ec.europa.eu/environment/urban/pdf/aalborg_charter.pdf).
FORESTER J., Bounded rationality and the politics of muddling trough, in Public Administration Review, 44, pp. 22-30, 1984.
FORRESTER J. W., Collected Papers of Jay W. Forrester. Waltham, MA: Pegasus Communications, 1975.
HEALEY P., Collaborative Planning: Shaping Places in Fragmented Societies, Vancouver: University of British Columbia Press. John Forester, 1997.
HILGARTNER S., BOSCK C.L., The rise and fall of social problems: a public arenas model, in American Journal of Sociology, 94, pp. 53-78, 1981.
HOLZNER B., MARX J.H., Knowledge application: the knowledge system in society, Boston, MA, Allyn and Bacon, 1979.
HOWLETT M., RAMESH M., Studying public policy: policy cycles and policy subsystems, Oxford, Oxford University press, 1995.
http://www.wbcsd.org/Projects/smp2/Resources/world-mobility-at-the-end-of-the-twentieth-century-and-its-sustainability
JONES C. O, An introduction to the study of public policy, Monterey, CA, Brooks/Cole, 1984.
LASSWELL H.D., The decision process, seven categories of functional analysis, College Park, Md, Bureau of Governmental research, 1956.
LINDBLOM C., The science of muddling trough, in Public Administration Review, 19, pp. 79-88 1959.
MANVILLE, C., COCHRANE G., CAVE J., MILLARD J., PDERSON J. K., THAARUP R. K., LIEBE A., WISSNER M., MASSINK R., KOTTERINK B., "Mapping Smart Cities in the EU." Industry, Research and Energy, European Parliament, 2014.
MATAIX GONZÁLEZ, C. Movilidad Urbana Sostenible: Un Reto Energético Y Ambiental, in Argumentos Para La Cultura, Obra Social Caja Madrid, 2010.
SIMON H.A. A behaviorhal model of rational choice, in Quarterly Journal of Economics, 69 pp. 99-118, 1955.
SIMON H.A., The Sciences of the Artificial (2nd ed.), MIT Press, 1981.
SUTTON R., The policy process: an overview, Overseas Development Institute, Working Paper 118, Chameleon Press Ltd, London, 1999.
Van Audenhove, F-J., Oleksii Korniichuk, L. D., Pourbai J., The Future of Urban Mobility 2.0, Arthur D. Little and UITP. 2014.
WBCSM, Mobility 2001: world mobility at the end of the twentieth century and its sustainability,
WBCSM, Mobility 2030: Meeting the Challenges to Sustainability, The Sustainable Mobility Project, World Business Council for Sustainable Mobility, 2004 (www.wbcsd.org).

reviewed paper

Quantifying the Potential of Photonic Cooling to Improve Urban Microclimate

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1 ABSTRACT

The observed warming trend in regional climate is expected to continue in the future, aggravating urban heat load as extreme temperatures are amplified in cities due to the urban heat island (UHI) effect. Beside causing negative health effects and reducing human comfort, this development results in an increase in urban air conditioning (AC) usage, again negatively influencing the outdoor urban microclimate due to AC waste heat emission. As cities are continiously growing (the population of e.g. Vienna increased more than 10% over the past 10 years), more and more people are affected by this additional anthropogenic heating of the urban canyon. The Viennese trend away from individual motorized traffic such as cars and towards the use of public transport, walking and cycling further leaves increased numbers of inhabitants directly exposed to excessive heat loads, highlighting the need for innovative solutions to counteract this problem. The exploratory project ‘Photonic Cooling’, funded by the Austrian Research Promotion Agency through the ‘City of the Future’ program, aims at evaluating the potential of practical and cost-effective photonic cooling techniques for the cooling of buildings. The use of the photonic cooling technology instead of conventional AC systems minimizes anthropogenic heat emissions resulting from building cooling, hence minimizing the UHI development due to AC heat release and improving the quality of life of the urban population as a result.

This paper focusses on the quantification of the potential of photonic cooling to improve the urban microclimate using Vienna as a case study. To estimate the future development of the UHI, the resulting changes in cooling demand and its effect on urban temperatures, a modelling approach is used. Simulations with the MUKLIMO_3 urban climate model are performed for the city of Vienna to determine changes in urban temperature for the 2021-2050 period relative to the 1971-2000 period. These results are then used as input for an empirical model to determine future cooling demand in terms of AC electricity use in buildings. Based on existing studies for other cities a relation between AC heat release and city temperature increase is established. Combining this with the modelled future cooling demand quantifies the influence from conventional AC systems on the urban microclimate, illustrating the benefit of using passive photonic cooling techniques to cover cooling demands instead.

Keywords: Cooling Load Modelling, Commuter Comfort, Urban Heat Island, Urban Climate, Photonic Cooling

2 INTRODUCTION

As a result of climate change, extreme heat events are occurring more frequently over large parts of Europe including Austria, and this trend is expected to continue in the future (Fischer and Schär, 2010; IPCC, 2013; ACCP, 2014). The excess in heat is further amplified in cities due to the urban heat island (UHI) effect caused by modifications in land use through urbanization and respective changes in the surface energy balance (e.g. Landsberg, 1981; Oke, 1987). The UHI effect is generally evident as a temperature increase in urban areas compared to the nearby rural environments and is superposed on the regional warming trend. This increase in heat load not only results in a decrease in thermal comfort for the urban population, but has in recent years been recognized as a severe threat to the environment and society. Increase in frequency, intensity and duration of heat events with reduced nocturnal cooling, decreased ventilation and consequent air pollution can have significant impacts on morbidity and mortality (e.g. Souch and Grimmond 2004; Son et al. 2012).

Beside causing negative health effects and reducing human comfort, these changes likely also result in an increase in urban air conditioning (AC) usage. Although improving indoor conditions, AC systems can negatively influence the outdoor urban microclimate due to their emission of waste heat in the urban canyon and thereby increasing the already high temperatures in the city. Continued city growth over the next decades (e.g. Referat für Statistik, 2012) together with the Viennese trend away from individual motorized traffic such as cars and towards the use of public transport, walking and cycling (Referat für Statistik, 2016) leaves more and more people exposed to this additional anthropogenic heating.

These developments highlight the need for innovative solutions to counteract this problem. One such innovative solution is the use of photonic cooling to cool buildings, as the use of this technology instead of conventional AC systems would minimize the anthropogenic heat emission resulting from building cooling. Photonic cooling is based on the concept of materials having a high reflectivity in the visible and near infrared wavelength range (0.35-2 µm) as well as a high emissivity in the atmospheric window wavelength range (8-13 µm). These properties allow for a direct radiative cooling to space, and by using this technique surfaces can be cooled to temperatures below the ambient temperature. A recent study by Raman et al. (2014) has shown that, even for a surface under direct solar radiation during daytime, a cooling of up to 7°C can be reached when suitable photonic materials are used. However, the materials used in the Raman et al. (2014) study are too expensive to be used for the cooling of buildings. The exploratory project 'Photonic Cooling', funded by the Austrian Research Promotion Agency through the 'City of the Future' program, aims at evaluating the potential of practical and cost-effective photonic cooling techniques for the cooling of buildings. As can be seen in Fig 1, first results are very promising for a photonic device comprising mainly of polymer foils. In particular, the investigated photonic device has a very high reflectance (>95 %) for solar radiation (0.35 – 2 µm) and a decent emission coefficient in a wavelength range between 8 to 13 µm. Consequently, almost no solar radiation is absorbed, while thermal radiation is emitted into the clear sky. The temperature difference between ambient and device temperature was found to be in the range between 3 to 7°C. In order to check the impact of the photonic cooling effect, a polycarbonate cover was put on the device, blocking the thermal emission into the sky, while sun light in the visible and near-infrared can surpass the cover. As it is shown in Fig. 1, cooling beyond ambience is clearly related to that effect.

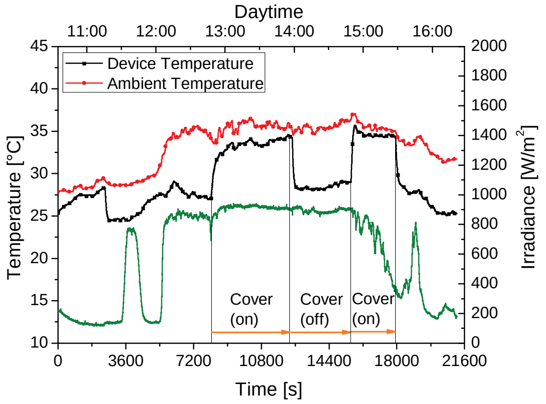

Fig. 1: First results on outdoor measurements of cost efficient photonic cooling devices. In particular the ambient temperature, the device temperature and the global irradiance is plotted over the course of a day (30th May 2017, Weiz / Austria). Due to photonic cooling effects the device was measured to have a temperature of 3-7 °C below the ambience. For cross-checking a transparent polycarbonate cover was put on the device in order to maintain the solar irradiation and block the thermal emission into the sky

Another part of the project focusses on the development of these materials and their implementation in the cooling of buildings. The focus of this paper is on the final project part where the potential of photonic cooling to improve urban microclimate is evaluated.

A method to estimate the potential of photonic cooling to improve urban microclimate, using Vienna as a case study, is presented. This approach consists of three steps. The projected increase in urban heat load as a result of climate change and UHI effect are determined in the first step based on existing simulations with the urban climate model MUKLIMO_3. Based on these simulations, the future urban climate for Vienna can be estimated, and serve as an input to determine the resulting changes in AC cooling demand in step 2. Finally, a linear model describing maximum urban outdoor temperature increase as a result of AC cooling demand (if covered by conventional AC systems) is developed in step 3. This then provides an estimate of the advantage of the use of photonic cooling techniques for the cooling of buildings over that of conventional AC systems in terms of urban microclimate. These steps as well as their results are outlined in detail in Section 3.1, 3.2 and 3.3. A discussion and summary are found in Section 4.

3 METHODS AND RESULTS

3.1 Urban Climate Change in Vienna

Observations have shown that the urban heat load in Vienna has been increasing over the past decades. This positive trend could be assigned to both the observed warming in the regional climate (Auer et al., 2007) and changes in urban environment (Böhm, 1998). Global and regional climate projections show this warming trend will likely continue in the future. According to IPCC climate projections (IPCC, 2013), the maximum temperature in the summer period in South and Central Europe is very likely to increase by the end of the 21st century. Furthermore, the analysis of climate scenarios from regional multi-model ensembles (Schär et al., 2004; Fischer and Schär, 2010) shows an increase in both intensity and frequency of heat waves.

Although global and regional models provide key information on the climate in the 21st century, they are limited in their capacity to represent the relatively small scales such as urban areas. Therefore, it is necessary to apply further downscaling methods to provide information on the local level. In this study, the urban climate model MUKLIMO_3 (Sievers and Zdunkowski, 1983) and the dynamical-statistical cuboid method (Früh et al., 2011) are used for the downscaling of 15 EURO-CORDEX (Coordinated Regional Climate Downscaling Experiment, European domain; Jacob et al., 2014) regional climate model simulations. These simulations are driven by three Representative Concentration Pathways (RCPs) defined in the International Panel on Climate Change (IPCC) Fifth Assessment Report (Moss et al., 2010; IPCC, 2013). RCPs are not based on socioeconomic scenarios, but rather prescribe the development of the radiative forcing, and are named according to their 2100 forcing levels. The simulations used in this study consider the RCP scenarios corresponding to a stabilization of radiative forcing at 4.5 W/m2 in 2100 (RCP4.5), a rising radiative forcing crossing 8.5 W/m2 in 2100 (RCP8.5), and peaking radiative forcing within the 21st century at 3.0 W/m² and declining afterwards (RCP2.6; van Vuuren et al., 2007).

In order to calculate climatic indices, such as the mean annual number of summer days (SU, defined as days with maximum temperatures over 25°C) which are used in order to assess the heat load, the dynamical modeling approach is combined with the cuboid method (Früh et al. 2011; Žuvela-Aloise et al. 2014). The cuboid method refers to a tri-linear interpolation of meteorological fields derived by single-day simulations from an urban climate model. The simulations are performed for a set of idealized weather patterns for potential situations where extreme heat load in the urban center could occur. Eight simulations with a duration of 24 hours for two prevailing wind directions are calculated, representing the cuboid corners. The calculation of climatic indices for 30-year climatic periods is based on the maximum temperature fields from the eight single-day simulations using daily time series of the mean air temperature, relative humidity and wind speed, including hourly wind direction. The climatological data driving the model are obtained from the EURO-CORDEX regional climate model simulations, and reference simulations are performed for the periods 1971-2000 and 1981-2010 using observations as well as climate model runs.

3.1.1 Results

Fig. 2 shows simulations based on observational data for the time periods 1971-2000 and 1981-2010 (top left and right panel, respectively) and future climate scenarios (bottom panels) for Vienna for the time period 2021-2050. The reference simulations show a typical spatial distribution with the maximum heat load in densely built-up areas in the city center and in residential areas in the flat terrain to the north and east of the Danube. Both orography and land use distribution influence the thermal characteristics. Due to the orography and prevailing winds from the northwest and southeast, the heat load in the residential areas located on the hill slopes in the west is lower than the heat load in the same type of built-up terrain in the flat areas located southward and eastward of the city center. Although the spatial pattern in the simulations for the periods 1971-2000 and 1981-2010 based on observational data is similar, an increase in SU can be seen between 1971-2000 and 1981-2010, in line with observational time series (Žuvela-Aloise et al., 2014). Furthermore,

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in order to check the performance of the regional climate model simulations used as an input, the simulations for the time period 1971-2000 driven by observational data and climate model data were compared (not shown) and it was found that both simulations show similar results.

The model results for the time period 2021-2050 (Fig. 2, bottom panels) show a moderate increase in SU compared to the reference simulation (Fig. 2, top left panel). The intensity of warming and the spatial pattern do not vary much between different climate scenarios for this period. However, as shown by Bokwa et al. (2015), the increase in number of summer days is substantially different for each RCP scenario for the end of the century (2071-2100). This behavior is not surprising, as the spread in radiative forcing for the different RCP scenarios is largest towards the end of the century (Moss et al., 2010).

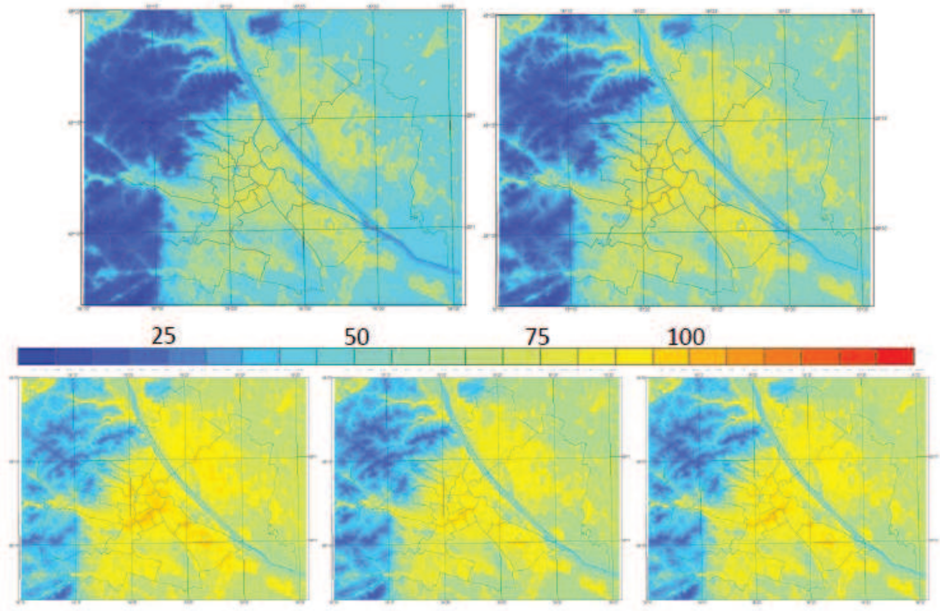

Fig. 2: Mean annual number of SU in Vienna determined with the MUKLIMO_3 model combined with the cuboid method based on the observational time series for 1971-2000 (top left) and 1981-2010 (top right), and IPCC scenarios RCP2.6 (bottom left), RCP4.5 (bottom middle) and RCP8.5 (bottom right) for 2021-2050 using ensembles of EURO-CORDEX RCM model simulations as input. Adapted from Bokwa et al. (2015).

In Table 1, the evaluation of the heat load is expressed as mean annual number of SU for different IPCC scenarios. The analysis is performed for the stations Hohe Warte (HW, in a residential area to the northwest of the city center) and Innere Stadt (IS, located in the city center). The results show a difference in heat load in the city center (IS) compared to the residential districts (HW), with higher heat loads in the city center. Furhtermore, the future climate projections show an increase in heat load of about 20 SU in annual mean in both the city center and residential area when comparing the time period 2021-2050 to the reference period 1971-2000. The variation between different IPCC scenarios is relatively small (less than 5 SU in the annual mean).

SU (days)	Time period	Observations	Reference simulation	RCP2.6	RCP4.5	RCP8.5
HW	1971-2000	56.4	53.1			
	1981-2010	64.1	-			
	2021-2050	-	-	75.0	70.7	72.4
IS	1971-2000	67.6	71.0			
	1981-2010	72.3	-			
	2021-2050	-	-	91.7	87.8	90.0

Table 1: Mean annual summer days (SU) for the climatic periods 1971-2000; 1981-2010; and 2021-2050 based on observations and climate projections for Hohe Warte (residential area) and Innere Stadt (city center). The results shown for RCP2.6 are based on a single run with EUR-11_ICHEC-EC-EARTH_rcp26_SMHI-RCA4, the other model results are based on ensemble averages.

Based on this analysis, it is to be expected that Vienna will experience an increase in SU. How this temperature change might influence the market penetration rate of AC systems and AC electricity use is explored in Section 3.2.

3.2 Estimating the Potential Increase in AC Demand

3.2.1 Data, Methods and Results

To translate the projected change in urban climate for the middle of the 21st century to AC cooling demand, a model was developed to estimate the AC market penetration rate based on the projected temperature changes. The model is based on daily average temperatures in 2015 and 2016 (NOAA, 2017) for 55 cities in 16 european countries from NOAA online database (NOAA, 2017). These are combined to create an population weighted average temperature for each country which is compared to the daily national electricity consumption (ENTSO-E, 2017).

Damm et al. (2016) showed that a country's electricity consumption in the course of a year is dependent on outdoor air temperature, as illustrated in Fig. 3 . Two regimes can be distinguished. For temperatures below about 18-20°C in the first regime, electricity consumption can be seen to increase with decreasing temperatures as a result of heating. Above 18-20°C (this minimum will be denoted by T0) a linear increase of electricity consumption is present, which can be explained by the use of AC systems above these temperatures. The remainder of this paper will focus on this second regime.

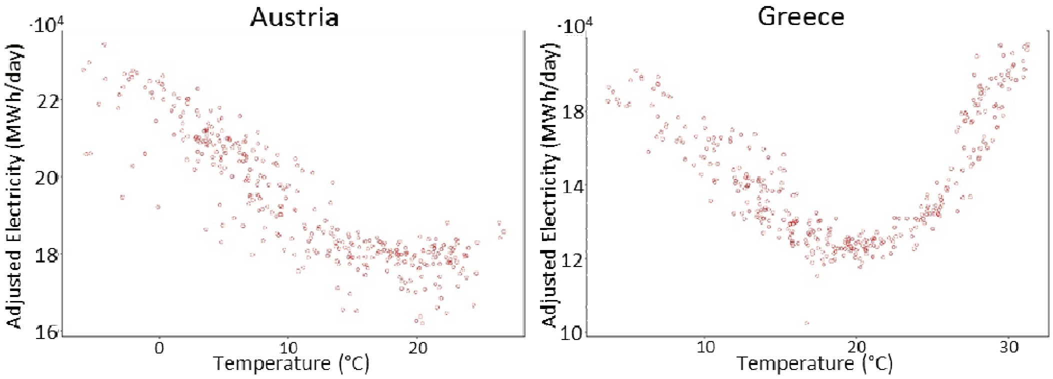

Fig. 3: Daily population weighted electricity consumption versus average temperature for Austria and Greece in 2016. The electricity data are normalised for day of week and national holidays and weekends have been excluded.

The slope of the line in the second regime (ΔE/ΔT) divided by floor area of housing and commercial buildings, calculated from the floor area per capita (ENTRANZE, 2017) and population, is roughly linearly dependent on the market penetration rate of AC systems, as can be seen from Fig. 4. Disregarding the outlier Spain, it is clear that ΔE/ΔT/Afloor (with Afloor denoting floor area) increases for increasing AC market penetration rates, meaning that the electricity consumption in countries where more people have AC systems increases more per 1°C temperature increase than in countries where less households have AC systems.

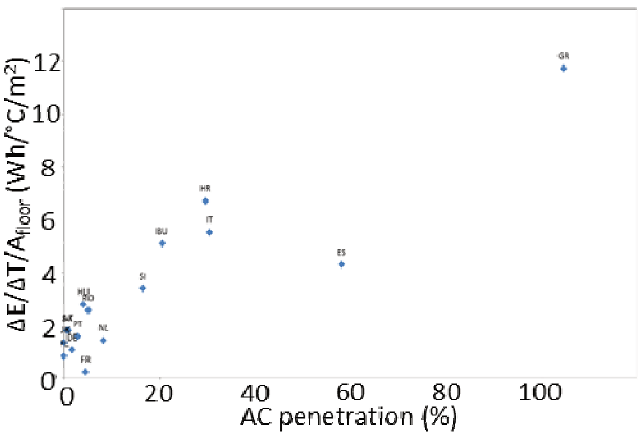

Fig. 4: $\Delta E/\Delta T/A_{floor}$ (Wh/°C/m2) as a function of AC penetration rate (%) in 2010 for several European countries. AC penetration rate is from Odyssee (2017).

We assume that the total electricity consumption for the second regime can be expressed as:

$$E_{tot} = a_0 + A_{floor} \cdot P_{AC} \cdot a_1 \cdot (T - T_o) \qquad \text{Eq. 1}$$

Here, E_{tot} and T are the daily electricity consumption and mean temperature, respectively. a_0 denotes that part of the electricity consumption not related to building cooling (e.g. lighting), P_{AC} is the AC market penetration rate, and a_1 is a coefficient related to the thermal properties of buildings such as their insolation, design and floor area. Eq. 1 can be rewritten to focus on the increase in cooling demand per °C temperature change ($\Delta E/\Delta T$) related to AC market penetration (P_{AC}), resulting in:

$$\Delta E/\Delta T = A_{floor} \cdot P_{AC} \cdot a_1. \qquad \text{Eq. 2}$$

Hence, if the future AC market penetration rate and floor area are known, the future AC cooling demand for a certain outdoor temperature can be determined.

To estimate the market penetration rate of AC systems, cooling degree days are often used. Cooling degree days (CDD) are a measure of how much the outdoor temperature is above a certain threshold (T_o, taken to be 18.3°C in this study) and for how long (in days), with CDD defined as CDD = $\Sigma(T-T_o)$ over all days in a single year on which $T>T_o$. Several relationships between CDD and P_{AC} have been suggested (e.g. Sailor and Pavlova, 2003; Jakubcions and Carlsson, 2017). However, these cannot be applied to the current analysis, as the study by Sailor and Pavolova (2003) is representative of the situation in the USA and cannot directly be applied to the European case, and the relation in Jakubcions and Carlsson (2017) suggests a decline in P_{AC} when CDD decreases. The latter situation seems unlikely, as it suggests already installed AC systems are removed again in years with colder summers. Therefore, we introduce the term CDD_{max}, where the last maximum of CDD as a function of time is taken as the current CDD value. Hence, CDD_{max} is a step function, which never decreases.

The current situation in Europe is used to derive a relationship between market penetration rate and CDD_{max}. If it is assumed that the relation between $\Delta E/\Delta T$ and market penetration rate remains valid, even under a warmer climate, and assuming factor a_1 remains constant (i.e.: no significant changes in building design or insolation) this relationship can then be used to estimate AC cooling demand based on the projected future CDD_{max}. By assuming a_1 to largely remain constant, a change in cooling demand is therefore only caused by a change in AC market penetration rate.

To this end, $\Delta E/\Delta T/A_{floor}$ (which is directly related to the market penetration rate, see Eq. 2) as shown in Fig. 3 was determined for the second regime for all European countries separately. In addition, the CDD_{max} per country was determined. $\Delta E/\Delta T/A_{floor}$ as a function of CDD_{max} per country is shown in Fig. 5 for current climatic conditions. Based on a linear regression, the following relation is found:

$$\Delta E/\Delta T/A_{floor}\ (\text{Wh/d/°C/m}^2) = -1.206 + 0.00868\ CDD_{max}. \qquad \text{Eq. 3}$$

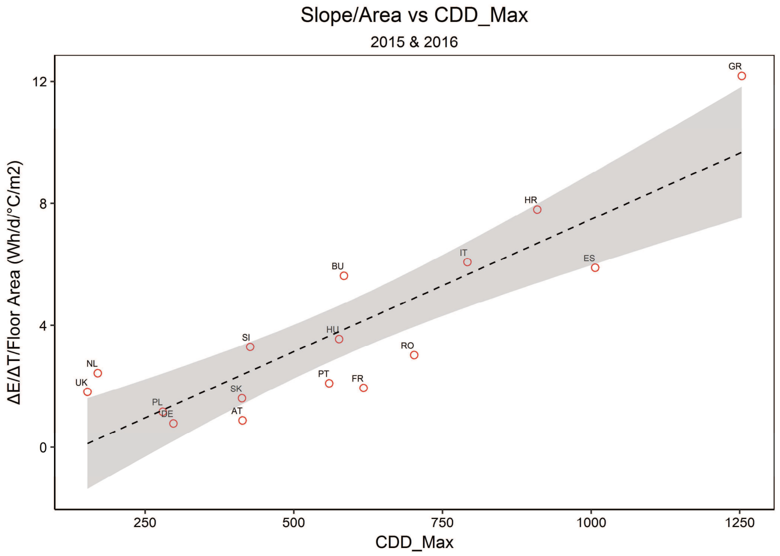

Fig. 5: Slope ($\Delta E/\Delta T/A_{floor}$, which is directly related to AC market penetration rate) as a function of CDD_{max} for current climatic conditions in Europe.

It should be noted that although the market penetration rate is no longer visible in Eq. 3, it is still present as it determines the slope of the daily AC electricity consumption as a function of daily outdoor temperature. For larger CDD_{max}, AC penetration rates will be larger and as a result the increase in AC electricity consumption for a 1°C increase in temperature will be larger.

Combining Eq. 1 and Eq. 3, it is now possible to determine the future AC energy consumption for a given outdoor temperature based on the projected CDD_{max}, illustrating the possibility to determine AC energy consumption based on climate projections:

$$E_{AC} = (-1.206 + 0.00868\ CDD_{max}) \cdot A_{floor} \cdot (T\text{-}T_o). \qquad \text{Eq. 4}$$

3.3 Estimating the Effect of AC Heat Release on Urban Climate

3.3.1 Data and Methods

In this section, the effect of AC heat release, which is directly related to AC energy consumption, on urban climate is investigated based on literature research. In the studies examined, the influence of building structure and anthropogenic heat emissions on the atmospheric circulation was studied using urban parameterizations coupled to regional climate and weather models. Common urban parameterizatino schemes are the Town Energy Balance (TEB) model (Masson, 2000) and the Building Effect Parameterization (BEP; Martilli et al., 2002). The BEP scheme has been integrated in the Weather & Forecasting (WRF) model together with the Building Energy Model (BEM; Salamanca et al., 2010), and is widely used. The TEB scheme is combined with a soil and vegetation scheme and is integrated in the ALADIN model group. These models enable the estimation of the change of urban air temperature caused by additional heat release through AC systems.

The modelling studies considered here investigated the effect of AC heat release on urban temperatures for European (de Munck et al., 2013; Salamanca et al., 2012), American (Salamanca et al., 2011; Salamanca et al., 2014) and Asian (Kikegawa et al., 2003; Ohashi et al., 2007) cities, all showing maximum temperature increases between 1.0°C and 3.0°C. The temperature effect of anthropogenic heat emissions from AC systems in Paris (France) during the 2003 heat wave using actual AC system data and the TEB model was studied by de Munck et al. (2013). This time period was chosen, as global climate model projections suggest these heat wave temperatures to be representative of mean summer temperatures during the second half of the 21st century. Under currently present AC cooling loads, with a total heat release power of 5.16 GW and AC heat being released as both sensible and latent heat, maximum local temperature increases between 0.25°C and 1°C were found, and the UHI was increased by +0.3°C. Keeping the heat release the same as in the previous case, but converting all latent heat releases to sensible heat, maximum local temperature impacts range from 0.25°C to 2°C and an increase in UHI effect of 0.8°C. The future scenario, in which the heat release is doubled and solely emitted as dry (sensible) heat, results in maximum local temperature increases of 0.25°C to 3°C. In terms of UHI, it was observed that the future scenario would result in an UHI increase of almost 2°C. Another European case was studied by Salamanca et al. (2012), who simulated the increase in air temperature due to AC heat fluxes for Madrid, Spain. Using the BEP-BEM scheme integrated in the WRF model and assuming an internal building target temperature of 25±1°C and coefficient of performance (COP) of 3.5 of the AC systems, the effect of anthropogenic heat release due to AC heat fluxes was found to be 1.5°C-2°C in the densest urban areas. Studies for the US have shown similar results, with local maximum temperature increases up to 1°C (Houston, TX) to 2°C (Phoenix, AZ) in the densest urban areas during the nighttime (Salamanca et al., 2011; 2014). Simulations for Tokyo (Japan), are in line with these results, and show an increase in air temperature of 1.0°C to 2.0°C due to AC heat release (Kikegawa et al, 2003; Ohashi et al., 2007).

Due to the wide range of meteorological conditions as well as urban structures represented in these studies, generalizing these results for other cities is not trivial. Here, the relation between peak AC heat emission per unit urban area and maximum local temperature effect is derived in an attempt to generalize the impact of AC use on urban temperature. For consistency, only the results determined where waste heat was solely emitted as sensible heat (as opposed to a combination of sensible and latent heat) are taken into account. Anthropogenic heat emissions were either mentioned in the studies or determined using the COP and energy or electricity consumption (EC) through

$$Q_{ant} = EC + CL \qquad \text{Eq. 4}$$

and

$$EC = CL / COP \qquad \text{Eq. 5}$$

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with Q_{ant} the anthropogenic heat emission, EC the AC energy consumption and CL the cooling load (Ohashi et al., 2007). Using the COPs reported in the studies, energy consumption can now be converted to anthropogenic heat emission and vice versa.

3.3.2 Results

Based on the studies that not only reported temperature effects but also gave information related to the AC energy consumption or heat release, a relation between the maximum local temperature effect and the peak AC heat release can be derived (Fig. 6). As expected, the temperature effect increases with increasing AC heat release, and although hard to estimate based on the limited amount of data, the two parameters appear to be linearly related. The linear best-fit forced through the origin, as for a non-existent AC heat flux the temperature effect has to be zero as well, is indicated with a dotted line. The relation between maximum local temperature (MLT) and peak AC heat release (Q_p) is:

$$MLT = 0.08 \cdot Q_p. \qquad \text{Eq. 6}$$

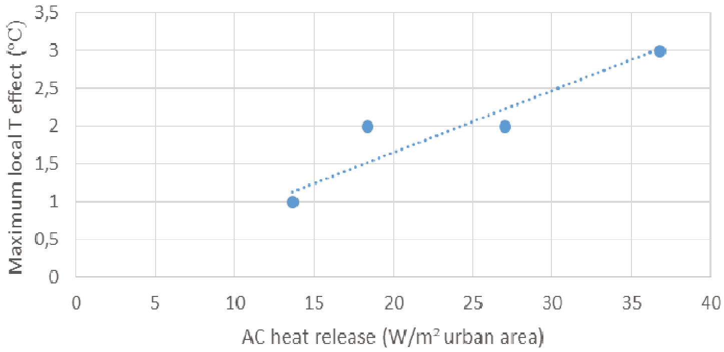

Fig. 6: The maximum local temperature effect as a function of peak AC heat release for the studies by de Munck et al. (2013) and Salamanca et al. (2011; 2014) (dots), and the linear best-fit going through the origin.

It should be noted, however, that this result is based on the assumption that anthropogenic heat is only released as sensible heat. Based on the results from de Munck et al. (2013), this relation might therefore be viewed as an upper limit. Another caveat is that the peak AC heat release, which occur during daytime, are compared to the maximum temperature increases, which are found during nighttime when the boundary layer is shallower. Ideally, the two nighttime values would be compared to obtain a more direct relationship. However, the nighttime AC heat release could not be determined for all studies. Therefore, a more comprehensive analysis is not feasible at this time.

4 DISCUSSION AND SUMMARY

In the framework of the exploratory project ‘Photonic Cooling’, funded by the Austrian Research Promotion Agency through the ‘City of the Future’ program, the potential for the use of photonic cooling over conventional AC systems in terms of urban microclimate was investigated. In this study, relations allowing for a quantitative estimate of the maximum local temperature increase as a result of increased future AC cooling demand were derived. As the approach is based on several steps, all associated with uncertainties and assumptions, it was chosen to focus on the methodology rather than the numerical result.

Based on urban climate projections for the city of Vienna it was shown that the observed trend of warmer summers is expected to continue in the future. An increase of about 20 SU for the 2021-2050 time period relative to the reference period 1971-2000 is expected, both for dense urban areas as well as residential areas. In these projections, the effect of AC systems on urban climate is not incorporated, and the projected changes are solely due to climate change. In Section 3.2, a model to estimate the relation between CCDs and AC market penetration rate was developed, which showed that AC market penetration and hence AC energy consumption increases for increasing temperatures. If this increased cooling demand is covered by conventional AC systems, AC anthropogenic heat release will increase as a result. From results shown in recent studies, the maximum local temperature effect was shown to be lineraly related to anthropogenic AC heat release, suggesting increased urban temperatures as a result of increased AC market penetration.

In summary, a feedback cycle, where increased temperatures lead to an increase in AC market penetration resulting in – if conventional AC systems are used – increased anthropogenic heat release and hence temperatures, develops. If the increased cooling demand under a changing climate, however, could (partially) be covered by the photonic cooling technology, the increase in anthropogenic heat release would be limited. As such, photonic cooling has the potential to keep further urban temperature increase as a result of anthropogenic heat emissions at bay.

5 ACKNOWLEDGEMENTS

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6 REFERENCES

ACCP: Österreichischer Sachstandsbericht Klimawandel 2014 (AAR14). Austrian Panel on Climate Change (APCC). ISBN 978-3-7001-7699-2. Verlag der Österreichischen Akademie der Wissenschaften, Vienna, 2014.

AUER, I., R. Böhm, A. Jurkovic, W. Lipa, A. Orlik, R. Potzmann, W. Schöner, M. Ungersböck, C. Matulla, K. Briffa, P.D. Jones, D. Efthymiadis, M. Brunetti, T. Nanni, M. Maugeri, L. Mercalli, O. Mestre, J.-M. Moiselling, M. Begert, G. Müller-Westermeier, V. Kveton, O. Bochnicek, P. Stastny, M. Lapin, S. Szalai, T. Szentimrey, T. Cegnar, M. Dolinar, M. Gajic-Capka, K. Zaninovic, Y. Majstorovic, E. Nieplova: HISTALP – historical instrumental climatological surface time series of the greater Alpine region 1760-2003. In: International Journal of Climatology, Vol. 27, pp 17-46. 2007.

BÖHM, R: Urban bias in temperature time series: a case study for the city of Vienna, Austria. In: Clim. Change, Vol. 38, pp 113-128. 1998.

BOKWA, A., P. Dobrovolny, T. Gal, J. Geletic, A. Gulyas, M. J. Hajto, B. Hollosi, R. Kielar, M. Lehnert, N. Skarbit, P. Stastny, M. Svec, J. Unger, M. Vysoudil, J.P. Walawender, M. Zuvela-Aloise, L. Burian: Urban climate in Central European cities and global climate change. International Visegrad Fund, Standard Grant No. 21410222. 10.2014-09.2015. Final Report. 2015.

DAMM, A., J. Köbler, F. Prettenthaler, N. Rogler, C. Töglhofer: Impacts of +2°C global warming on electricity demand in Europe. In: Climate Services. 2016, in press.

DE MUNCK, C. G. Pigeo, V. Masson, F. Meunier, P. Bousquet, B. Tréméac, M. Merchat, P. Poef, C. Marchadier: How much can cair conditioning increase air temperatures for a city like Paris, France? In: Int J Climatol, Vol. 33, pp 210-227. 2013.

ENTRANZE: Average floor area per capita. 2017. http://www.entranze.enerdata.eu/average-floor-area-per-capita.html. Accessed 2017-06-08.

EUROPEAN NETWORK OF TRANSMISSION SYSTEM OPERATORS (ENTSO-E): Data Portal. 2017. https://www.entsoe.eu/data/data-portal/Pages/default.aspx. Accessed 2017-06-08.

FISCHER, E.M. and C. Schär: Consistent geographical patterns of changes in high-impact European heatwaves. In: Nature Geoscience Letters, Vol. 3, pp 398-403. 2010.

FRUH, B., P. Becker, T. Deutschländer, J.-D. Hessel, M. Kossmann, I. Mieskes, J. Namyslo, M. Roos, U. Sievers, T. Steigerwald, H. Turau, and U. Wienert: Estimation of climate change impacts on the urban heat load using an urban climate model and regional climate projections. In: Journal of Applied Meteorology and Climatology. Vol. 50, pp 167-184. 2011.

IPCC: Climate Change 2013: The physical science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and O.M. Midgley (eds.)]. Cambridge University Press, Cambredge, United Kingdom and New York, NY, USA. 2013.

JACOB, D., Petersen, J., Eggert, B. et al.: EURO-CORDEX: new high-resolution climate change projections for European impact research. In: Reg Environ Change, Vol. 14, Issue 563. 2014.

JAKUBCIONIS, M., J. Carlsson: Estimation of European Union residential sector space cooling potential. In: Energy Policy, Issue 101, pp225-253. 2017.

KIKEGAWA, Y., Y. Chenchi, H. Yoshikado, H. Kondo: Development of a numverical simulation system toward comprehensive assessments of urban warming countermeasures including their impacts upon the urban buildings’ energy-demans. In: Applied Energy, Vol. 76, pp 449-466. 2003.

LANDSBERG, H.E.: The Urban Climate. Academic Press, New York, USA. 1981.

MASSON, V.: A physically-based scheme for the urban energy budget in atmospheric models. In: Boundary-Layer Meteorology, Issue 94, pp357-397. 2000.

MARTILLI, A. A. Clappier, M.W. Rotach: An urban surface exchange parameterization for mesoscale models. In: Boundary-Layer Meteorology, Issue 104, pp 261-304. 2002.

MOSS, R.H., et al.: The next generation of scenarios for climate change research and assessment. In: Nature, 463, pp. 747-756. 2010.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), Climate Data Online. 2017. https://www.ncdc.noaa.gov/cdo-web/, Accessed 2017-06-08.

ODYSSEE: Online database. 2017. http://www.indicators.odyssee-mure.eu/online-indicators.html. Accessed 2017-06-09.

OHASHI, Y. Y. Genchi, H. Kondo, Y. Kikegawa, H. Yoshikado, Y. Hirano: Influence of air conditioning waste heat on air temperature in Tokyo during summer: numerical experiments using an urban canopy model coupled with a building energy model. In: Journal of Applied Meteorology and Climatology, Vol. 46, pp 66-81. 2006.

OKE, T.R.: Boundary Layer Climates. Routledge, New York, USA. 1987.

RAMAN, A.P., M. Abou Anoma, L. Zhu, E. Rephaeli, S. Fan.: Passive radiative cooling below ambient air temperature under direct sunlight. In: Nature, Issue 515, pp 540-544. 2014.

REFERAT FÜR STATISTIK: Vienna in Figures. ISSN 1028-0723, Vienna, 2012.

ISBN 978-3-9504173-2-6 (CD), 978-3-9504173-3-3 (print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

REFERAT FÜR STATISTIK: Vienna in Figures. ISSN 1028-0723, Vienna, 2016.
SAILOR, D.J., A. Pavlova: Air conditioning market penetration and long-term response of residential cooling energy demand to climate change. In: Energy, Vol. 28, pp941-951. 2003
SALAMANCA, F., A. Martilli (2010): A new building energy model coupled with an urban canopy parameterization for urban climate simulations – Part II. Validation with one dimension off-line simulations. In: Theor Appl Climatol., Issue 99, pp 345-356. 2010.
SALAMANCA, F., A. Martilli, M. Tewari, F. Chen: A study oft he urban boundary layer using different urban parameterizations and high-resolution urban canopy parameters with WARF. In: Journal of Applied Meteorology and Climatology, Vol. 50, pp 1107-1128. 2011.
SALAMANCA, F. A. Martilli, C. Yagüe: A numerical study of the urban heat island over Madrid during the DESIREX (2008) campaign with WRF and an evaluation of simple mitigation strategies. In: Int J Climatol, Vol. 32, pp 2372-2386. 2012.
SALAMANCA, F. M. Georgescu, A. Mahalov, M. Moustaoui, M. Wang: Anthropogenic heating of the urban environment due to air conditioning. In: J Geophys Res Atmos, Vol. 119, pp 5949-5965. 2014.
SCHÄR, C., P.L. Vidale, D. Lüthi, C. Frei, C. Häberli, M.A. Liniger, C. Appenzeller: The role of increasing temperature variability in European summer heatwaves. In: Nature, Vol. 427, pp 332-336. 2004.
SIEVERS, U., W. Zdunkowski: A microscale urban climate model. In: Beitr Phys Atmosph, Vol. 59, pp 13-40. 1986
SON, J., J. Lee, G. B. Anderson, M. L. Bell: The impact of heat waves on mortality in seven major cties in Korea. In: Environ Health Perspect. Vol. 120, pp 566-571. 2012.
SOUCH, C. and C.S.B. Grimmond: Applied climatology: heatwaves. In: Prog Phys Geog, Vol. 28, Issue 4, pp 599-606. 2004.
VAN VUUREN, D.P., J. Edmonds, M. Kainuma, K. Riahi, A. Thomson, L. Hibbard, G.C. Hurtt, T. Kram, V. Krey, J.-F. Lamarque, T. Masui, M. Meinshausen, N. Nakicenovic, S.J. Smith, S.K. Rose: The representative concentration pathways: an overview. In: Climate Change, Issue 109, pp 5-31. 2011.
ZUVELA-ALOISE, M., R. Koch, A. Neureiter, R. Böhm, S. Buchholz: Reconstructing urban climate of Vienna based on historical maps dating tot he early insturmental period. In: Urban Climate, Vol. 10. 2014.

reviewed paper

Räumliche Modellierung der Tagesbevölkerung in Wien

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1 EINLEITUNG

Mit fortschreitender Urbanisierung weltweit kommt es zu einer immer stärkeren Konzentration der Bevölkerung in Städten. Im Jahr 2014 lebten bereits mehr als die Hälfte (54%) der Menschen in urbanen Räumen. Hochrechnungen zufolge wird sich dieser Anteil bis zum Jahr 2050 auf 66% erhöhen. Mega-Cities mit mehr als 10 Millionen Einwohnern werden häufiger, während kleinere Städte schnell wachsen (United Nations 2014). Somit ist es für Anwendungsgebiete wie Stadtplanung und Risikomanagement immer wichtiger, genaue und aktuelle Daten über die kleinräumige Verteilung der Bevölkerung in urbanen Räumen zur Verfügung zu haben. Diese sind allerdings, sofern überhaupt verfügbar, in der Regel veraltet oder in zu geringer Auflösung vorhanden. Im Falle einer Katastrophe, wie beispielsweise einem Erdbeben, ist es für Behörden und Hilfsorganisationen aber von großer Bedeutung, die Zahl der potentiell Betroffenen abschätzen zu können. Die Anzahl der Personen ist dabei nicht nur abhängig von der Bebauungsdichte des Gebietes sondern auch von der Tageszeit. So wird sich nachts der Großteil der Bevölkerung zu Hause, also in Wohngebäuden aufhalten, während sie sich tagsüber am Arbeitsplatz befindet.

Ziel dieser Studie ist die Entwicklung einer konsistenten und nachvollziehbaren Methode zur Abschätzung der Tagesbevölkerung in einem Stadtgebiet und die Anwendung dieser Methode zur Modellierung der Tagesbevölkerung von Wien.

Keywords: Vienna, daytime population, spatial disaggregation, population modelling, urbanisation

2 AKTUELLER STAND DER BEVÖLKERUNGSMODELLIERUNG

Es gibt bereist zahlreiche Studien, die sich mit der Bevölkerungsmodellierung beschäftigen und dazu auf unterschiedliche Methoden sowie Datensätze zurückgreifen. Neben statistisch erhobenen Daten über die Bevölkerung – Zensus, Pendlerdaten – sind hier vor allem Daten zu nennen, die Informationen zur Landnutzung, Bebauungsdichte sowie zu einzelnen Gebäuden und Gebäudehöhen liefern. Solche Datensätze werden zumeist aus Fernerkundungsbildern abgeleitet und stehen vor allem auf Europäischer Ebene frei zur Verfügung. Beispiele dafür sind CORINE Landcover, Urban Atlas, der Imperviousness Layer des Copernicus Land Cover Services oder im Fall der Stadt Wien die Realnutzungskartierung. Neben Fernerkundungsdaten können auch Hilfsdaten wie Adresspunkte oder sozioökonomische Daten in die Modellierung einfließen.

Ein Ansatz von Aubrecht et al. (2009) beschreibt eine objekt-basierte Analyse von verschiedenen Fernerkundungsdaten zur Modellierung von Bodenbedeckung und urbanen Strukturen, wobei letztere in einem semi-automatischen Prozess generalisiert werden. Anschließend wird die Verteilung der Wohnbevölkerung berechnet mittels Disaggregation auf die Gebäude gewichtet nach deren Volumen. Die Gebäude werden dabei nach ihrer Nutzung bewertet, die durch Geokodierung von Firmendaten modelliert wird.

Unter Bevölkerungsdisaggregation versteht man dabei das Verteilen der Bevölkerung, die meist auf einer gröberen Raumeinheit (z.B. pro Bezirk oder Zählbezirk) vorliegt, auf eine höher aufgelöste Einheit wie Rasterzellen oder Gebäude, wobei die Verteilung auf einem Gewichtungsfaktor basiert. Dieser kann z.B. die Gebäudefläche oder das Volumen sein, sofern Höhendaten verfügbar sind. Danach erhalten also größere Gebäude anteilsmäßig mehr Bevölkerung als kleinere Gebäude.

Eine andere Methode wählten Steinnocher et al. (2015), die die Bevölkerung auf europäischer Ebene disaggregierten basierend auf der Bebauungsdichte. Die Bevölkerungszahlen lagen auf NUTS-3-Ebene vor, die Bebauungsdichte wurde vom Versiegelungsgrad (Copernicus Imperviousness Layer) abgeleitet. Dies geschah unter Ausmaskierung all jener versiegelter Flächen, die keine Wohngebäude enthielten, wie Straßen oder Industriegebäude. Identifiziert wurden diese Flächen mithilfe von CORINE-Landcover-Daten. Zieleinheit der Disaggregation waren 500-m-Rasterzellen.

Martin et al. (2014) schlägt eine raum-zeitliche Bevölkerungsmodellierung vor, welche die Bevölkerung zu vier verschiedenen Zeitpunkten über einen typischen Arbeitstag verteilt berechnet. Zieleinheit der

Disaggregation sind 200m Rasterzellen. Die Einteilung der Bevölkerung erfolgt in drei Kategorien: Wohnbevölkerung, Nicht-Wohnbevölkerung und Pendler. Diese Gruppen können weiter unterteilt werden in Untergruppen je nach Alter oder ökonomischer Aktivität, wobei sich die Subgruppen über die Zeit in konstanter Bewegung zwischen den drei Hauptgruppen und verschiedenen Orten befinden. Die zeitliche Modellierung basiert auf Zeit-Profilen, welche für verschiedene Orte (z.B. Schulen) vorliegen und die Aktivitätsmuster der Bevölkerung repräsentieren. Diese können ausgewechselt werden um etwa Feiertage zu simulieren.

Eine weitere Methode zur dynamischen Kartierung der Bevölkerung kommt von Deville et al. (2014), die Daten von Mobiltelefonen heranziehen, um Bevölkerungsdichten zu berechnen. Dies ist nicht nur sinnvoll, um im Falle von Katastrophen kurzfristige Bevölkerungsschätzungen bereitzustellen, sondern erleichtert auch Berechnungen für ärmere Länder, wo oftmals keine genauen Zensusdaten existieren, die man für eine Disaggregation benötigt. Weitere Vorteile liegen in der hohen Penetrationsrate von Mobiltelefonen weltweit, die Bevölkerungsmodellierungen über Ländergrenzen hinweg ermöglichen, sowie in der Kosteneffizienz der Methode. Analysiert wurden mehr als 1 Milliarde Aufzeichnungen über getätigte Anrufe aus Portugal und Frankreich, die von Mobilfunkanbietern anonymisiert bereitgestellt wurden. Die Lokalisierung erfolgte über die Bestimmung der geographischen Koordinaten der Mobilfunkmasten und den dazugehörigen Mobiltelefonen. Diese Netzwerk-basierte Methode ist einfach zu implementieren, wobei ihre Genauigkeit von der Netzwerkstruktur abhängt. Je höher die Dichte der Masten, desto höher ist auch die Präzision der Lokalisierung.

3 DATEN

Für die Modellierung der Tagesbevölkerung für Wien wird eine Disaggregation auf Gebäudeebene gewählt. Die Bevölkerungszahlen liegen einerseits pro Zählbezirk vor, andererseits kommen sie aus verschiedenen Registern. Die Verteilung auf die Gebäude erfolgt gewichtet nach Volumen. Insgesamt fließen 24 Datensätze in die Berechnungen ein, die gruppiert werden können in Landnutzungsdaten, Gebäudedaten, räumliche Daten und sozioökonomische Daten (siehe Tabelle 1).

Das digitale Baukörpermodell ist einer der Hauptbestandteile für die Modellierung, da die Bevölkerung auf die einzelnen Gebäude verteilt werden soll. Der originale Datensatz beinhaltet 200.000 Gebäude und 650.000 Baukörper, wobei ein Gebäude aus mehreren Baukörpern bestehen kann. Jeder Baukörper beinhaltet eine Gebäude-ID sowie seine Höhe. Um die Volumina der Gebäude einfacher berechnen zu können, wird ein generalisiertes Baukörpermodell verwendet (siehe Abb. 1). Dieses wurde mit der Realnutzungskartierung von Wien verschnitten, sodass die einzelnen Gebäude generalisierte Nutzungsinformationen (Wohngebäude, Industrie, soziale Infrastruktur etc.) beinhalten.

Die nächste Gruppe der Input-Datensätze, die räumlichen Daten, bestehen vorwiegend aus geokodierten Adressen von ausgewählten Institutionen (Schulen, Universitäten, Krankenhäuser, Firmen). Diese werden mit dem Gebäudemodell verschnitten und ermöglichen etwa die Verteilung von Schülern auf die einzelnen Schulen. Ein Problem bei den Adresspunkten ist, dass für manche Adressen mehrere Punkte existieren, die in verschiedenen Gebäuden liegen, sodass es bei der Verteilung der Beschäftigten aus dem Firmenregister zu mehrfachen Eintragungen ins Baukörpermodell kommen kann. Eine manuelle Bereinigung der Adresspunkte wäre zu aufwendig, daher wurden die entsprechenden Einträge aus dem Firmenregister entfernt.

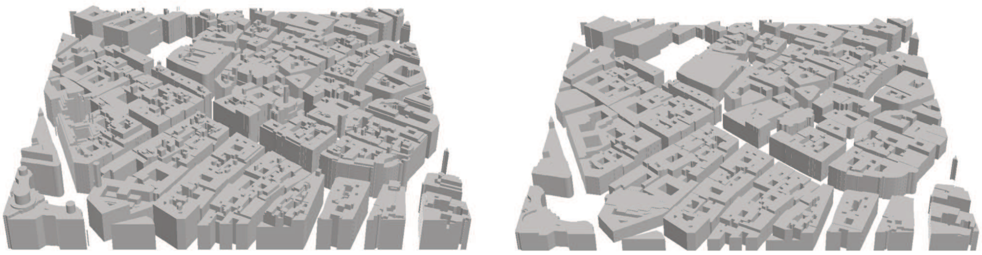

Abb. 1: Digitales Baukörpermodell (Ausschnitt). Links: Original, rechts: generalisiert.

Weiters enthalten manche Gebäude mehrere Punkte mit gleicher Adresse bzw. vor allem Eck-Gebäude mehrere Punkte mit unterschiedlichen Adressen. Dies muss bei der Modellierung berücksichtigt werden, indem die Adresspunkte mit den selben Adressen zusammengeführt werden (dissolve) und jene mit mehreren unterschiedlichen Adresspunkten so mit dem Gebäudemodell verschnitten werden, dass aus den Beschäftigten unterschiedlicher Firmen die Summe gebildet wird

Datensatz	***Quelle***	***Jahr***	***Typ***
Landnutzungsdaten			
Realnutzung Wien	Stadt Wien (OGD)	2012	polygon-shp
Gebäudedaten			
Digitales Baukörpermodell	Stadt Wien (OGD)/AIT	2015	polygon-shp
Räumliche Daten			
Adresspunkte	BEV/AIT	2015	point-shp
Standorte Krankenhäuser	Stadt Wien (OGD)	2017	point-shp
Standorte Schulen	Stadt Wien (OGD)	2017	point-shp
Standorte Universitäten	Stadt Wien (OGD)	2017	point-shp
Standorte Volkshochschulen	Stadt Wien (OGD)	2017	point-shp
Standorte Kindergärten	Stadt Wien (OGD)	2017	point-shp
Standorte Pflegeheime	Stadt Wien (OGD)	2017	point-shp
Öffentliche Verkehrslinien	Stadt Wien (OGD)	2014	line-shp
Sozioökonomische Daten			
Bezirks- und Zählbezirksgrenzen von Wien	Stadt Wien (OGD)	2014	polygon-shp
Wohnbevölkerung von Wien pro Zählbezirk in 5-Jahres-Altersklassen	Wiener Bevölkerungsregister	2013	table
Pendlersaldo	Statistik Austria	2012	table
Beschäftigte pro Krankenhaus (aus Firmenregister)	Bisnode Austria/AIT	2015	table
Beschäftigte pro Universität und VHS (aus Firmenregister)	Bisnode Austria/AIT	2015	table
Firmenregister (Beschäftigte pro Firma)	Bisnode Austria/AIT	2015	table
Beschäftigte Wiener Linien	Wiener Linien	2013	single value
Gesamtzahl der Beschäftigten pro Bezirk	Statistik Austria	2013	table
Gesamtzahl der Arbeitslosen	Job Center Wien	2013	single value
Schüler pro Schultyp	Statistik Austria	2012/13	table
Studenten pro Universität	Statistik Austria	2013/14	table
Rentner in Pflegeheimen (abgeleitet aus dem Anteil der Pflegebedürftigen pro Altersgruppe und dem Anteil jener, die in Pflegeheimen wohnen)	Statistisches Bundesamt (Deutschland)	2013	table
Patientenzahlen (abgeleitet aus der Bettenzahl pro Krankenhaus und der durchschnittlichen Belegungsrate)	Ministerium für Gesundheit und Frauen	2013	table

Tabelle 1: Input-Daten für Wien.

Der Datensatz mit den öffentlichen Verkehrsmitteln bildet eine Ausnahme unter den räumlichen Daten, da dieser keine Punkte sondern Linien enthält. Er wird dazu genutzt, die Beschäftigten der Wiener Linien, die nicht stationär in einem Gebäude arbeiten, auf die Verkehrslinien in der ganzen Stadt zu verteilen.

Die abschließende Gruppe bilden die sozioökonomischen Daten, die Informationen enthalten über administrative Grenzen, die Wohnbevölkerung pro Zählbezirk, Pendler, Beschäftigte, Arbeitslose, Schüler, Studenten, Rentner und Patienten. Beim Firmenregister besteht allerdings das Problem, dass sich die Beschäftigtenzahlen pro Firma nicht immer auf die tatsächliche Adresse beziehen, sondern dass vor allem bei großen und/oder im Ausland tätigen Firmen sämtliche in- und ausländischen Mitarbeiterinnen und Mitarbeitern am Firmensitz in Wien verortet werden. Ein Beispiel hierfür ist die Raiffeisen-Landesbanken-Holding GmbH, welche 60.356 Mitarbeiterinnen und Mitarbeiter an einer Adresse zählt. Zur Vermeidung dieser Fälle wurden alle Einträge mit mehr als 1.000 Mitarbeitern ausgeschlossen. Dieser Schwellwert wurde geschätzt und liefert keine Garantie, dass die Mitarbeiterzahlen der verbleibenden Firmen bezogen auf deren Standort richtig sind.

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4 MODELLIERUNG

Zur Berechnung der Tagesbevölkerung wurde ein Python-Skript programmiert, welches vorwiegend ArcPy-Funktionen ausführt. Bei ArcPy handelt es sich um ein Modul der Geoinformations-Software ArcGIS, das mit der Programmiersprache Python arbeitet und eine effiziente Durchführung der Analyse ermöglicht. Das Prinzip der Disaggregation und Aggregation von Bevölkerungsdaten, wie sie in dieser Studie verwendet wurden, zeigt Abbildung 2. Bei der Disaggregation wird eine Bevölkerung, z.B. pro Zählsprengel, verteilt auf jene Gebäude, die innerhalb dieser Raumeinheit liegen. Die Gewichtung erfolgt über das Volumen, sodass größere Gebäude einen größeren Bevölkerungsanteil als kleinere Gebäude zugewiesen bekommen. Anschließend wird die Bevölkerung von den Gebäuden hochaggregiert auf einen 100x100m Raster, hier gewichtet nach den Flächenanteilen der Gebäude, die innerhalb der Rasterzellen liegen. Die Aggregierung auf den Raster ermöglicht einen besseren Vergleich der Ergebnisse sowie eine übersichtlichere Darstellung, da jede Rasterzelle im Gegensatz zu den Gebäuden dieselbe Fläche besitzt.

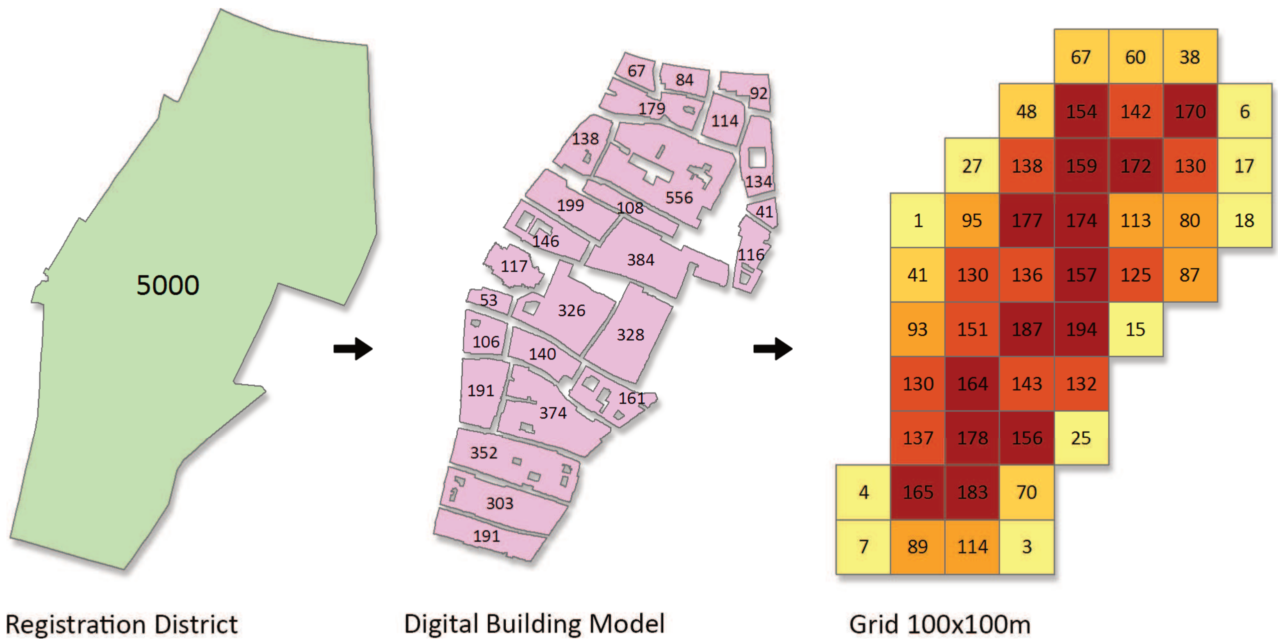

Abb. 2: Disaggregation und Aggregation von Bevölkerungsdaten (Schema).

Insgesamt wurden im Zuge der Studie fünf verschiedene Modelle entwickelt, welche unterschiedliche Genauigkeitsgrade repräsentieren. Modell 01 ist das genaueste – es beinhaltet alle Daten, die zur Verfügung stehen und disaggregiert die Bevölkerung gewichtet nach den Gebäudevolumina. Modell 02 enthält ebenfalls alle Daten, gewichtet aber nur nach Fläche. So soll untersucht werden, wie sich die Ergebnisse verändern, wenn keine Höhendaten von Gebäuden zur Verfügung stehen. Modell 03 schließt das Firmenregister aus und verteilt die arbeitende Bevölkerung auf die Firmengebäude ausschließlich nach Gewichtung und Gebäudevolumen. Modell 04 verwendet keine Hilfsdaten (außer die Pendler, damit die verteilte Gesamtbevölkerung aller Modelle übereinstimmt) und gewichtet die Verteilung nach Volumen. Das letzte Modell (05) verwendet ebenfalls keine Hilfsdaten und verteilt die Bevölkerung statt auf das Gebäudemodell auf den Realnutzungs-Layer, gewichtet nach Fläche, da hier keine Gebäudehöhen mehr existieren. Die Ergebnisse werden am Schluss mit Modell 01 verglichen, um herauszufinden, wie sich die Verteilungen und Genauigkeitsgrade verändern, wenn davon ausgegangen wird, dass Modell 01 das genaueste ist.

Die Verteilung der Bevölkerung in Modell 01 lässt sich anhand der verwendeten Datensätze und den Altersgruppen wie folgt zusammenfassen:

- *Kleinkinder (0-4J.):* diese liegen pro Zählbezirk vor. 50% der Kleinkinder werden verteilt auf die Kindergärten pro Bezirk (wenn davon ausgegangen wird, dass Kinder nicht zwangsläufig im selben Zählbezirk in den Kindergarten gehen), gewichtet nach deren Volumina. Die andere Hälfte wird verteilt auf die Wohngebäude pro Zählbezirk, da diese Altersgruppe auch Kleinkinder enthält, die zu Hause sind.

- *Schüler (5-19J.):* die Schülerzahlen existieren pro Schultyp. Diese lassen sich einteilen in Pflichtschule, Gymnasium, andere höhere Schule und Berufsschule. So lassen sich die jeweiligen Schülerzahlen pro Schultyp über ganz Wien auf die jeweiligen Schulgebäude verteilen. Berufsschüler werden aufgrund ihrer Ausbildung aufgeteilt, wobei 20% in der Berufsschule erwartet werden und 80% im Betrieb (WKO 2006).
- *Studenten (20-29J.):* die Studenten pro Universität werden zu 50% auf Wohngebäude verteilt (nachdem vor allem höhere Semester nicht ganztags an der Universität sind) und zu 50% auf die Universitäten (Anteile geschätzt). Diese haben im Gegensatz zu Schulen oder Kindergärten mehrere Institute, die Verteilung wird somit gewichtet nach dem Volumen der Institutsgebäude einer Universität.
- *Beschäftigte Universitäten & VHS (15-64J.):* diese werden wie die Studenten auf die Universitätsinstitute bzw. auf die Volkshochschulen über ganz Wien verteilt.
- *Beschäftigte Krankenhäuser (15-64J.):* Verteilung zu 50% auf Krankenhäuser (wie Universitäten meist mehrere Gebäude pro Krankenhaus) und zu 50% auf Wohngebäude (aufgrund des Schichtbetriebes).
- *Beschäftigte Wiener Linien (15-64J.):* Verteilung zu 50% auf öffentliche Verkehrslinien und zu 50% auf Wohngebäude (Schichtbetrieb).
- *Beschäftigte aus Firmenregister (15-64J.):* Verteilung pro Firma, wo eine Übereinstimmung mit den Adresspunkten gefunden wird. Diese wird nicht gewichtet, da sich die Beschäftigtenzahlen bereits auf das jeweilige Gebäude beziehen.
- *Gesamtzahl der Beschäftigten (15-64J.):* liegt pro Bezirk vor. Diese Werte werden benötigt, da das Firmenregister nicht alle Beschäftigten in Wien enthält. Somit wird die bereits verteilte arbeitende Bevölkerung pro Bezirk subtrahiert von der Gesamtzahl der Beschäftigten und die Differenz auf alle Firmengebäude und Krankenhäuser verteilt (wo noch keine Beschäftigten verteilt wurden), ebenfalls nach Volumengewichtung.
- *Arbeitslose (15-64J.):* Verteilung auf die Wohngebäude über ganz Wien.
- *Rentner (65+):* Rentner werden sowohl auf Wohngebäude als auch auf Pflegeheime verteilt. Die Anteile errechnen sich aus dem Anteil der Pflegebedürftigen (zusätzlich unterteilt in 6 Altersklassen der über 65-Jährigen) multipliziert mit dem Anteil der Pflegebedürftigen, die in Pflegeheimen wohnen (im Gegensatz zu jenen, die zu Hause gepflegt werden).
- *Restbevölkerung (alle Altersklassen):* Ähnlich wie bei den Beschäftigten enthalten die bisher besprochenen Datensätze nicht alle Personen, die sich in Wien aufhalten (so erfasst z.B. die Arbeitslosenstatistik nicht alle Arbeitslosen). Deshalb muss die Summe der Tagesbevölkerung aus der Wohnbevölkerung von Wien (1.758.888) und dem Pendlersaldo (207.662) errechnet werden. Von dieser wird die bereits verteilte Bevölkerung abgezogen und der Rest auf die Wohngebäude verteilt.
- *Patienten (alle Altersklassen):* Abschließend werden die Patienten pro Krankenhaus über ganz Wien verteilt. Die Zahlen errechnen sich aus der Bettenzahl pro Krankenhaus multipliziert mit der durchschnittlichen Belegungsrate. Da sich die Patienten der Krankenhäuser aus allen Bevölkerungsgruppen von Wien zusammensetzen und diese somit an ihrem „Ursprungsort" fehlen, müssen diese von dort in einem letzten Schritt abgezogen werden. Dies erfolgt über alle Gebäude gewichtet nach deren Bevölkerungszahl, sodass von Gebäuden mit vielen Einwohnern mehr Personen abgezogen werden als von Gebäuden mit weniger Einwohnern. Zusätzlich werden auf diese Weise negative Einwohnerzahlen vermieden.

Die Nachtbevölkerung wurde im Zuge der Studie ebenfalls berechnet, indem die Wohnbevölkerung auf die Wohngebäude verteilt wurde, mit Ausnahme der Beschäftigten der Krankenhäuser und der Rentner, die sich in Pflegeheimen aufhalten.

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5 ERGEBNISSE

Ergebnis der Studie ist die Tagesbevölkerung von Wien für das Jahr 2013 auf Gebäudeebene (siehe Abb. 3) sowie pro 100m Rasterzelle (siehe Abb. 4). In Abbildung 3 treten deutlich die in der Innenstadt zahlreichen Gewerbegebäude hervor, die eine größere Bevölkerung aufweisen (orange), im Gegensatz zu den Wohngebäuden, in denen sich zumeist nur wenige Personen aufhalten (dunkelgrün/hellgrün). So sind auch Einkaufsstraßen wie die Mariahilfer Straße oder Kärntnerstraße deutlich zu erkennen. Besonders hohe Einwohnerzahlen von über 3.000 haben etwa das Hauptgebäude der Universität Wien (5.597), das Hauptgebäude der TU Wien (3.544) oder das AKH (12.138), was auf die großen Volumina relativ zur Verteilungsgruppe der jeweiligen Gebäudetypen zurückzuführen ist. Beim AKH kommt hinzu, dass nicht nur Beschäftigte und Patienten verteilt werden, sondern auch Studenten, da die Medizinische Universität Wien auch im AKH Räumlichkeiten besitzt. Der Gebäudekomplex mit der höchsten Einwohnerzahl (21.189) beinhaltet sowohl die WU Wien als auch das Biozentrum Althahnstraße der Universität Wien (nicht zu sehen in Abb. 3). Dies ergibt sich ebenfalls aus dem hohen Volumen im Vergleich zu den anderen Gebäuden in der Verteilungsgruppe und aus der großen Studentenzahl, die verteilt wird. Wie Tabelle 2 jedoch zeigt, sind diese Extremfälle selten – nur 0.2% haben eine Belegung von über 1.000 Personen, während 83.4% der Gebäude zwischen einem und 25 Einwohner haben. Abbildung 4 zeigt den aggregierten Bevölkerungsraster von Wien sowohl für die Tages- als auch für die Nachtbevölkerung. Besonders gut zu erkennen ist tagsüber die hohe Dichte in der Innenstadt mit vielen Spitzen während die Nachtbevölkerung eher gleichmäßig auf die Wohngebäude verteilt ist.

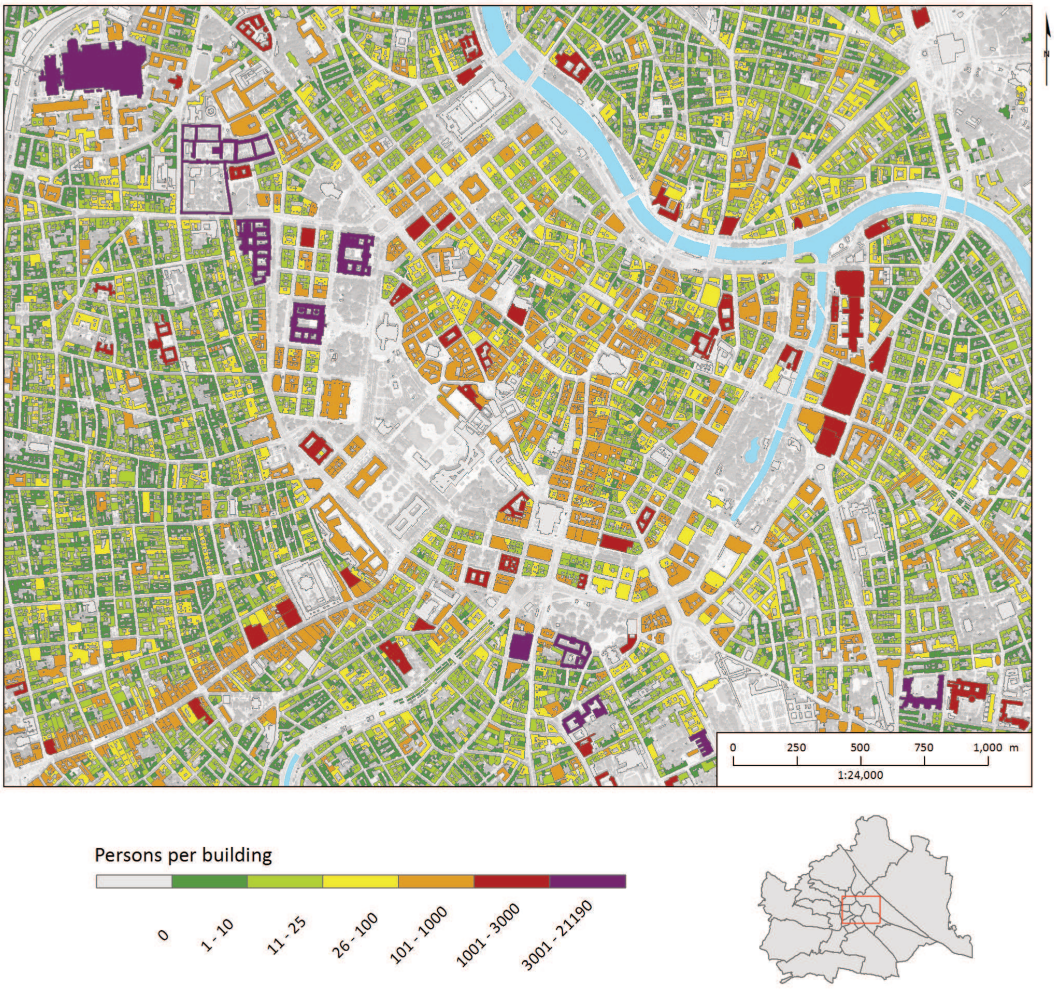

Abb. 3: Tagesbevölkerung Wien 2013, Digitales Baukörpermodell. Ausschnitt aus der Innenstadt.

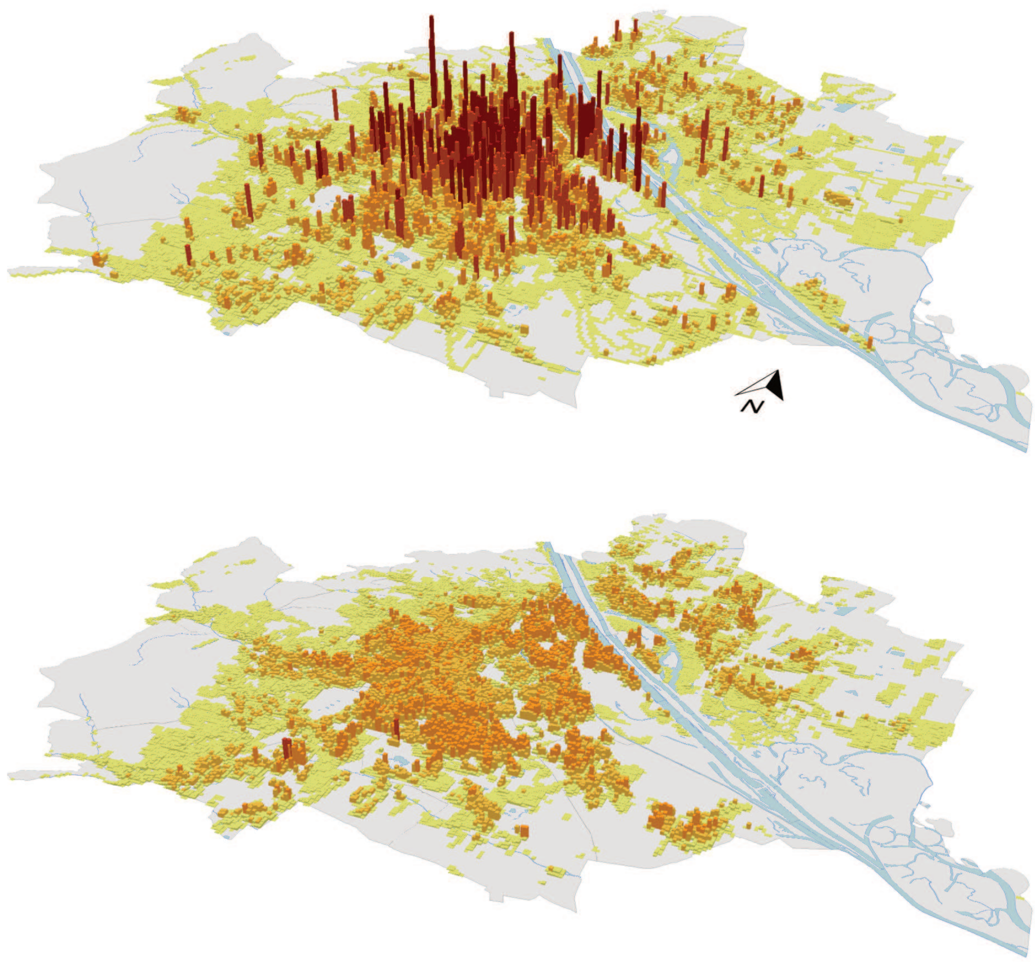

Abb. 4: Tages- und Nachtbevölkerung Wien 2013, 100m Raster. Oben: Tag. unten: Nacht.

Um die Ergebnisse der Modelle miteinander vergleichen und eine Aussage über die relative Genauigkeit im Vergleich zu Modell 01 treffen zu können, wurden die Abweichungen zwischen den Rastern berechnet (siehe Abb. 5). Dies geschah jeweils durch Subtraktion der Bevölkerungszahl pro Rasterzelle (Modell 02-05) von jener aus Modell 01. Negative Werte (blau) bedeuten, dass das jeweilige Modell im Vergleich zu Modell 01 weniger Bevölkerung aufweist, positive Werte (rot) bedeuten mehr Bevölkerung. Die gelbe Farbgebung weist auf eine sehr geringe Abweichung von +/- 20 Einwohnern hin.

Einwohner	*Häufigkeit*	*Prozent*	*Kumulierte Häufigkeit*
0	5747	6.8	6.8
1 - 10	55275	65.9	72.7
11 - 25	14705	17.5	90.2
26 - 100	5432	6.5	96.7
101 - 1000	2561	3.1	99.7
1001 - 3000	182	.2	100.0
3001 - 21190	31	.0	100.0
Total	83933	100.0	

Tabelle 2: Einwohner pro Gebäude - Tagesbevölkerung. Die Häufigkeit repräsentiert die Anzahl der Gebäude. Ausgeschlossen wurden alle Baukörper mit einer Höhe <=5m und einer Fläche <=30m², da diese höchstwahrscheinlich keine Bevölkerung beinhalten.

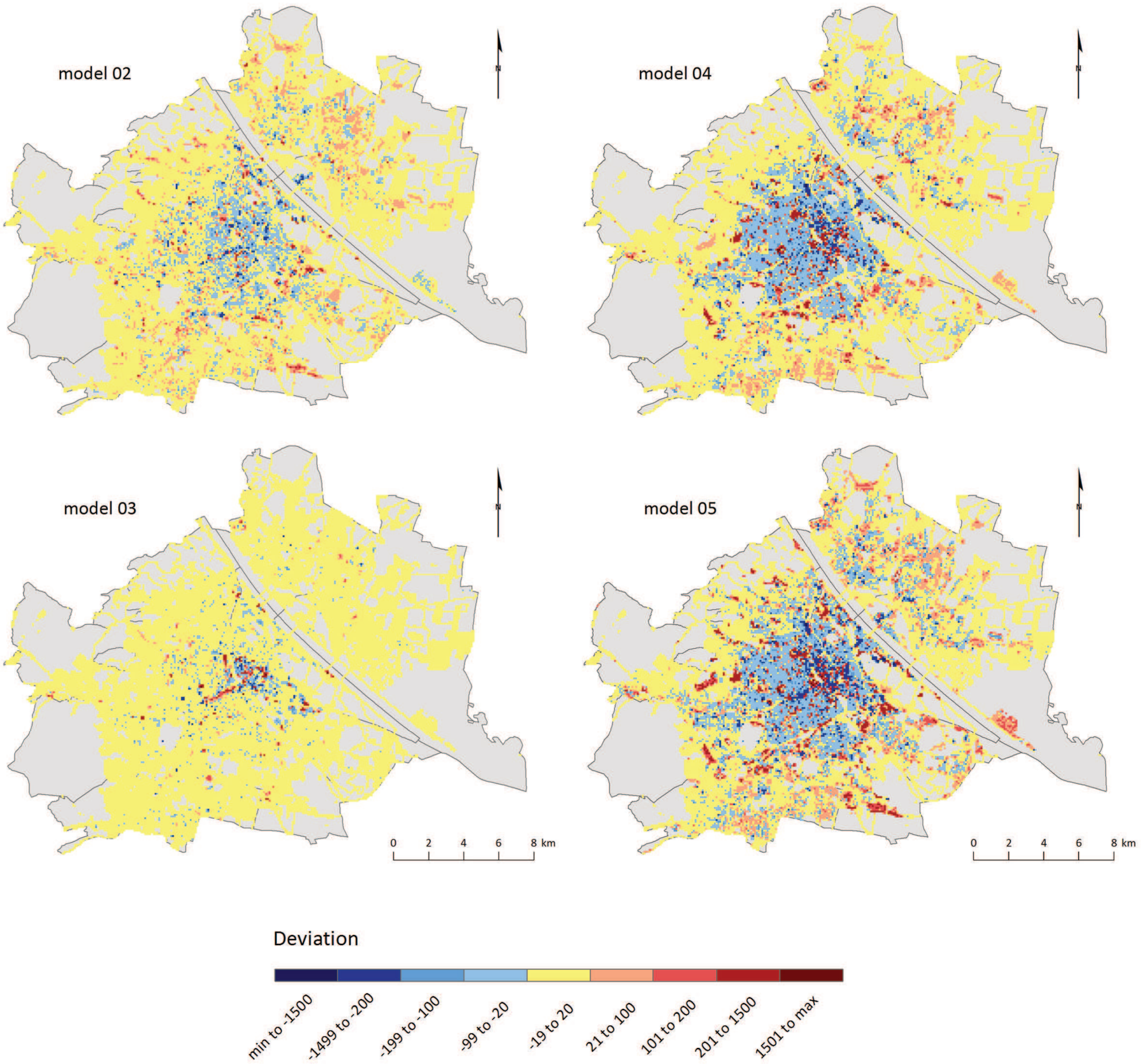

Abb. 5: Abweichungen der Modelle 02-05 von Modell 01.

Bei Betrachtung von Modell 02 (alle Hilfsdaten, Gewichtung nach Fläche) zeigt sich, dass negative Abweichungen vor allem um das Stadtzentrum auftreten, wo auch die durchschnittliche Gebäudehöhe am höchsten ist. Positive Abweichungen liegen hingegen verstreut über die gesamte Stadt. Das bedeutet starke Unterschätzung in den Bereichen mit hohen Gebäuden (Stadtzentrum) und Kompensation dieser Abweichung in allen anderen Bereichen.

Bei Modell 03 ist zu sehen, dass die Bevölkerungszahl von Firmengebäuden (Nutzungsklasse Industrie + Betriebsgebäude) ohne Zuhilfenahme eines Firmenregisters eher überschätzt wird. Besonders deutlich in Abbildung 5 zu erkennen sind die Mariahilfer Straße und der 1. Bezirk, welche besonders viele Geschäftszonen besitzen. Unterschätzt werden dagegen vor allem Wohngebäude. Dies mag daran liegen, dass durch das Firmenregister auch Beschäftigte in Wohngebäuden verteilt werden (diese Nutzungskategorie ist definiert als Wohn- und Mischnutzung mit Schwerpunkt Wohnen und kann ebenfalls Geschäfte beinhalten). Insgesamt sind die Abweichungen zwischen Modell 01 und 03 aber eher gering.

Im Gegensatz dazu sind die Abweichungen bei Modell 04 stärker ausgeprägt, welches keine Hilfsdaten verwendet und nach Volumen gewichtet. Zu Überschätzungen (positiven Abweichungen) kommt es vor allem bei Gebäuden mit der Nutzungsklasse Soziale Infrastruktur (=Schulen, Universitäten, Krankenhäuser, Theater) sowie Betriebs- und Industriegebäuden, während Wohngebäude fast ausschließlich unterschätzt werden. Die Überschätzung der Industriegebäude bei gleichzeitiger Unterschätzung der Wohngebäude könnte auf die gleichen Effekte wie in Modell 03 zurückzuführen sein, da auch hier kein Firmenregister verwendet wird. Auffallend ist, dass ein relativ hoher Anteil an Betriebsgebäuden unterschätzt wird. Grund dafür könnte sein, dass in Modell 04 aufgrund der fehlenden Hilfsdaten die Altersgruppe der arbeitenden Bevölkerung um Schüler ab 10 Jahren erweitert werden musste. Diese erweiterte Altersgruppe musste anschließend nicht nur auf Firmengebäude sondern auch auf Gebäude sozialer Infrastruktur (welche auch Schulen beinhaltet) verteilt werden. Damit wird auch ein Teil der arbeitenden Bevölkerung diesen Gebäuden zugewiesen und fehlt somit in den Firmengebäuden. Der Grund, warum dies vor allem Betriebsgebäude und nicht Industriegebäude betrifft ist, dass die Verteilung pro Bezirk erfolgt und die Industriegebäude eher am Rand von Wien lokalisiert sind, wo weniger Gebäude sozialer Infrastruktur vorhanden sind. Die Betriebsgebäude hingegen sind oft in den inneren Bezirken konzentriert, wo auch die Dichte der sozialen Infrastrukturgebäude höher ist. Diese haben zusätzlich meist ein höheres Volumen als Betriebsgebäude und bekommen somit einen größeren Bevölkerungsanteil zugewiesen. Damit erklärt sich auch, warum Gebäude sozialer Infrastruktur in Modell 04 stark überschätzt werden – sie erhalten nicht nur zusätzliche Bevölkerung von den Beschäftigten sondern diese Bevölkerung wird auch aufgrund der fehlenden Standortdaten auf alle Gebäude mit sozialer Infrastruktur verteilt. Im Gegensatz dazu bekommen in Modell 01 nur jene Gebäude sozialer Infrastruktur Einwohner zugewiesen, die mithilfe eines Punktdatensatzes als Schule oder Universität identifiziert werden konnten. Alle anderen (Theater, Opernhäuser, Museen etc.) erhalten keine Bevölkerung, da diese Gebäude in der Regel sehr groß sind und gleichzeitig tagsüber im Vergleich dazu eher wenig Einwohner besitzen.

Modell 05 weist ein ähnliches Verteilungsmuster wie Modell 04 auf, mit dem Unterschied, dass die Abweichungen noch etwas größer sind. Dies liegt daran, dass hier ebenfalls keine Hilfsdaten verwendet wurden und die Bevölkerung statt auf das Gebäudemodell auf die Realnutzungskartierung (welcher die Nutzungsklassen für das Gebäudemodell lieferte) gewichtet nach der Fläche verteilt wird.

6 CONCLUSIO

Die Studie konnte eine Methode aufzeigen, wie die Tagesbevölkerung einer Stadt modelliert werden kann. Durch die Implementierung der Modellierung in einem Python-Skript konnte zudem die Durchführung der Analyse automatisiert werden, was eine Wiederholung der Berechnung für andere Städte, einen anderen Zeitpunkt oder die Anpassung bestimmter Parameter für eine erneute Berechnung erleichtert. Im Bereich der Raumplanung können die Ergebnisse der kleinräumigen Bevölkerungsmodellierung dazu beitragen, die richtigen Maßnahmen zu ergreifen, um der wachsenden Bevölkerungskonzentration in den Städten zu begegnen während Behörden vor allem in gefährdeten Gebieten auf Basis der Ergebnisse Notfallpläne im Falle einer Katastrophe entwickeln können.

Die Herausforderung in der Bevölkerungsmodellierung liegt vor allem in der Beschaffung und Aufbereitung der Datensätze, die für eine genaue Modellierung notwendig sind. Aussagen über die Genauigkeit der Modellierungsergebnisse zu treffen ist schwierig, da diese nicht mit den realen Bevölkerungszahlen pro Gebäude abgeglichen werden können, denn diese Daten existieren nicht. Vielmehr muss versucht werden, die Ergebnisse mithilfe von anderen Studien oder Behörden zu validieren. Eine weitere Möglichkeit wäre die Abschätzung der Resultate auf Plausibilität sowie stichprobenartige Überprüfungen einzelner Gebäude.

7 LITERATUR

AUBRECHT C. et al. (2009): Integrating earth observation and GIScience for high resolution spatial and functional modeling of urban land use. – In: Computers, Environment and Urban Systems 33, 15-25

DEVILLE P. et al. (2014): Dynamic population mapping using mobile phone data. – Proceedings of the National Academy of Sciences; doi: 10.1073/pnas.1408439111

MARTIN D. et al. (2014): Developing a flexible framework for spatiotemporal population modeling. – Annals of the Association of American Geographers; doi: 10.1080/00045608.2015.1022089

STEINNOCHER K., KÖSTL M. and WEICHSELBAUM J. (2015): Grid-based population and land take trend indicators. New approaches introduced by the geoland2 Core Information Service for Spatial Planning. – Vienna; https://www.researchgate.net/publication/266285682_Grid-based_population_and_land_take_trend_indicators_-_New_approaches_introduced_by_the_geoland2_Core_Information_Service_for_Spatial_Planning (30.03.2017)

UNITED NATIONS (2014): World’s population increasingly urban with more than half living in urban areas; http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html (02.09.2016)

WKO (ed.) (2006): Ausbilden zahlt sich aus! Moderne Lehrberufe im Dienstleistungsbereich – Wirtschaftskammer Österreich, Vienna

🏆 *reviewed paper*

Räumliche und zeitliche Visualisierung als Smart-City-Planungswerkzeug

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1 ABSTRACT

Die steigende Bevölkerung und der starke Zuzug in die urbanen Ballungsräume ist eine große Herausforderung für die Akteure der Planungswelt. Um ressourcenschonende Planungen voranzutreiben, ist eine innere Entwicklung der urbanen Systeme zielführend. Dabei ist neben der Aufspürung und Nutzung von Flächenreserven, die Nutzung und der Ausbau bestehender Versorgungsinfrastruktursysteme eine Möglichkeit für nachhaltige Entwicklungen. Dies stellt eine komplexe Planungsaufgabe für Planer und Entscheidungsträger dar, die das Zusammenwirken von Planungsakteuren unterschiedlichster Domänen erfordert. Innerhalb des interdisziplinären Forschungsprojektes URBEM (Urbanes Energie- und Mobilitätssystem) wurde ein visuelles Planungs- und Entscheidungsunterstützungswerkzeug, die URBEM-Visualisierung, entwickelt. Diese webbasierte Umgebung bietet eine Arbeits- und Kommunikationsplattform für Domänenexperten und Stakeholder zur Unterstützung komplexer Planungsprozesse. Die URBEM-Visualisierung erlaubt domänenspezifische Simulationsergebnisse räumlich zu verorten, visuelle Übersichten zu generieren und ein urbanes Gesamtsystem mit Hilfe der räumlichen Überlagerung von Informationen unterschiedlichster Versorgungsträgerstrukturen im Bereich Energie und Mobilität zu untersuchen. Dies bietet den Planern eine Grundlage um Probleme im Raum und in der Zeit fest zu machen und gezielte Maßnahmen zur Entwicklung smarter Lebensräume aufzuzeigen. Die Möglichkeiten der URBEM Visualisierung werden im folgenden Beitrag anhand von Modellergebnissen aus der Domäne Mobilität illustriert.

Keywords: Kooperativer Planungsprozess, interaktiv, multiskalar, Simulation, Planungsunterstützungswerkzeug

2 EINLEITUNG

2.1 Motivation

Der digitale Fortschritt unserer Kommunikationstechnologien hat ermöglicht, dass Daten urbaner Ballungsräume aus unterschiedlichsten Disziplinen einfach gesammelt und verarbeitet werden können. Diese Daten können Planenden Grundlagen bieten um Lösungswege für komplexe Planungsaufgaben aufzuzeigen, die durch die steigende Bevölkerung und die vielerorts ambitionierte Klimaschutzpolitik in den urbanen Ballungsräumen, entstehen. Die Daten speisen dabei Berechnungs- und Simulationsmodelle unterschiedlichster Domänen. Um die daraus resultierenden Ergebnisse Planenden und Entscheidungstragenden zur Unterstützung bereitstellen zu können, ist es zielführend durch räumliche Verortung der Ergebnisdaten visuelle Übersichten zu entwickeln. Mit Hilfe digitaler Technologien erlauben diese Raumübersichten interaktiv und multiskalar Planungsmaßnahmen festzulegen und deren Auswirkungen abzuschätzen. Zur ressourcenschonenden inneren Entwicklung unserer urbanen Ballungsräume entstehen so neue domänenübergreifende Möglichkeiten zur ressourcenschonenden Planung und holistischen Systembetrachtung. Die räumliche Datenvisualisierung ist damit ein wichtiges Analysewerkzeug.

Das vorliegende Paper zeigt anhand des Beispiels eines neuen Stadtenwicklungsgebiets, wie domänenübergreifende Planung und visuelle Verortung räumlicher Informationen zur Planungsunterstützung herangezogen werden können.

2.2 Stand der Technik

Für die ressourcenschonende Entwicklung urbaner Ballungsräume stellt die Innenentwicklung, die Entwicklung innerhalb definierter Grenzen, eine zielführende Möglichkeit dar. Die Innenentwicklung ist als ganzheitlicher Ansatz zu verstehen, der neben der Nutzung von bestehenden Flächenreserven auch die

Nutzung bestehender Ver- und Entsorgungsinfrastrukturen mit einschließt. Zur praktischen Umsetzung des Ansatzes der Innenentwicklung schlägt Scholl einen strukturierten Planungsprozess vor, die sogenannte Testplanung (vgl. SCHOLL 2011). Die Testplanung bildet Rahmenbedingungen für kooperative domänenübergreifende Planungsaufgaben und erlaubt dabei Ent- und Verwurf von Maßnahmen zur Planungs- und Entscheidungsunterstützung.

Zur visuellen Datenaufbereitung in Planungsprozessen und als Analysegrundlage werden CAD basierte Softwaresysteme (GIS, BIM) eingesetzt. Diese erlauben die Entwicklung multidimensionaler Modelle. Basierend auf digitalen Modellen können raumbezogene Daten interaktiv dargestellt werden. Web basiert kann visuelle Entscheidungs- und Planungsunterstützung domänenübergreifend und plattformunabhängig agieren (vgl. FORSTER, KAUFMANN et al. 2017). Die Grundlage für einen dynamischen Datenaustausch von Ergebnissen zwischen domänenspezifischen Berechnungsmodellen und der Visualisierung kann eine digitale Arbeitsplattform bilden, in die sowohl Berechnungsmodelle als auch die räumliche Darstellung deren Ergebnisse eingebettet sind (vgl. SCHLEICHER, VÖGLER et al. 2016). Die digital gestützte Arbeitsumgebung erlaubt neben Datensicherheitsaspekten auch eine dynamische Aggregation zwischen unterschiedlichen Betrachtungsebenen (Baublock, Bezirk). Dadurch wird auch der Austausch von Daten zwischen domänenspezifischen Berechnungsmodellen vereinfacht.

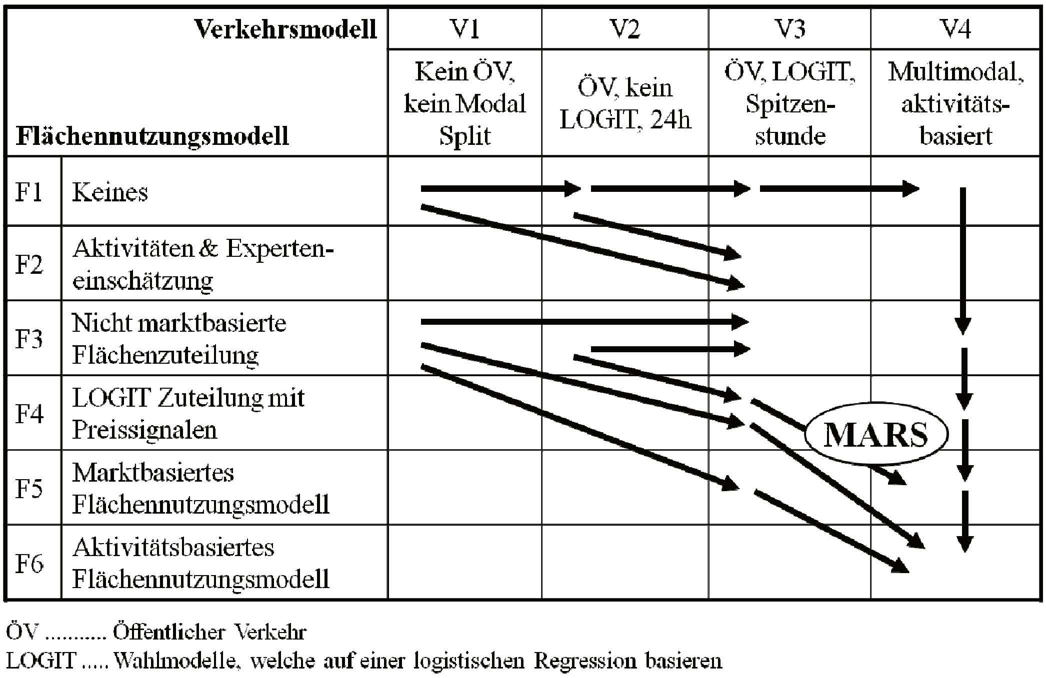

Abb. 1: Evolution der Modellierung des urbanen Verkehrs- und Flächennutzungssystems nach (WEGENER 2003).

Im vorliegenden Beitrag werden die Möglichkeiten raum-zeitlicher Visualisierungswerkzeuge anhand von Modellergebnissen aus der Domäne Mobilität illustriert. Ausgehend von bereits Mitte des 19. Jahrhunderts formulierten qualitativen Analogien zum Gravitationsgesetz der Physik hat sich die modellhafte Beschreibung des urbanen Verkehrsgeschehens kontinuierlich weiter entwickelt (PFAFFENBICHLER 2008). Die Entwicklung immer leistungsfähigerer elektronischer Rechenanlagen ermöglichte eine zunehmend detailliertere quantitative Modellierung des urbanen Verkehrssystems. Ausgehend von monomodalen, am Pkw orientierten Verkehrsmodellen verlief die Entwicklung über multimodale Modelle hin zu aktivitätsbasierten (Mikrosimulations-)Modellen (vgl. EMBERGER, PFAFFENBICHLER 2015). Ab Anfang der 1970er Jahre setzte sich in der Fachwelt die Erkenntnis durch, dass eine isolierte Betrachtung der beiden Teilbereiche Flächennutzung und Verkehr nicht zielführend ist. Abbildung 1 illustriert die daraufhin einsetzende Entwicklung der isolierten Verkehrs- und Flächennutzungsmodelle hin zu integrierten Flächennutzungs- und Verkehrsmodellen. Abbildung 2 illustriert mögliche Strategien zur modellhaften Bewältigung der Komplexität urbaner Systeme. Ein möglicher Pfad ist die Erhöhung der räumlichen Detailliertheit, während ein anderer auf der Erhöhung der Zahl der berücksichtigten (Sub-)Systeme beruht. Bislang wurde die exponentiell steigende Verfügbarkeit von Rechnerleistung in der Planungsrealität vor allem in eine stärkere räumliche Disaggregierung isolierter Verkehrsmodelle investiert. Der derzeitige Stand der Technik sind sogenannte Vier-Stufen-Modelle, bestehend aus den Stufen Erzeugung, Verteilung, Aufteilung und Umlegung. Zunehmend werden auch Mikrosimulationsmodelle eingesetzt. Erste operative rechnergestütze integrierte Flächennutzungs- und Verkehrsmodelle existieren seit Mitte der 1980er Jahre (SIMMONDS 1999). In der Planungspraxis werden derartige Modelle aufgrund ihrer hohen Komplexität bis heute allerdings nach wie vor selten eingesetzt.

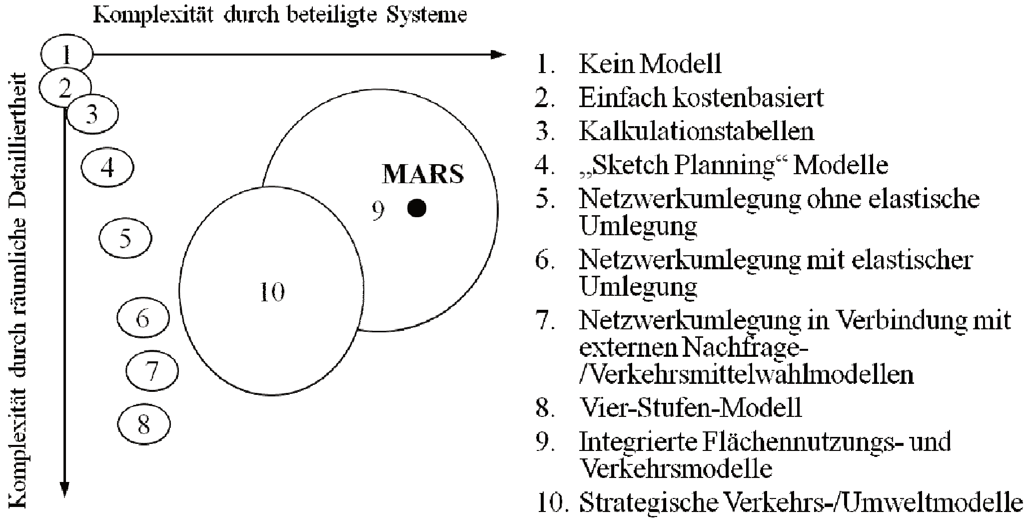

Abb. 2: Strategien zur Berücksichtigung der Komplexität urbaner Systeme.

2.3 Übersicht

Als Kooperationsprojekt zwischen der Technischen Universität Wien und Wiens größtem Energie und Mobilitätsversorgungsunternehmen, den Wiener Stadtwerken, wurde das Doktoratskolleg URBEM (Urbanes Energie und Mobilitätssystem[1]) von 2013-2016 durchgeführt. Das darin involvierte interdisziplinäre Expertenteam entwickelte ein ganzheitliches Konzept zur Abbildung der Versorgungsbereiche Energie und Mobilität am Beispiel der Stadt Wien. Für die Abbildung der unterschiedlichen Domänen innerhalb urbaner Ballungsräume wurden Berechnungs- und Simulationsmodelle entwickelt und miteinander verknüpft. Die aus diesen Modellen für festgelegte Szenarien erarbeiteten Ergebnisse können dynamisch in eine räumliche Visualisierungsumgebung, die URBEM-Visualisierung, gespeist werden (vgl. FORSTER 2016). Die URBEM-Visualisierung erlaubt domänenübergreifende Systemübersichten zu generieren und gezielt Systemeinblick für detaillierte Betrachtungen in Planungsprozessen zu gewährleisten. Durch einen in die URBEM-Visualisierung implementierten Planungsmodus kann die Planung neuer Stadtentwicklungsgebiete im Bestand unterstützt werden. So können Auswirkungen von Planungsmaßnahmen in unterschiedlichsten Trägersystemen der Stadt aufgezeigt und abgeschätzt werden.

2.4 Beispielregion

In Wien bilden die Planungen entlang der Bahnhöfe große Flächenpotentiale für neue Stadtentwicklungsgebiete. Durch die Entwicklung und den Ausbau des Wiener Südbahnhofs zu Wiens Hauptbahnhof entstanden bei Wiens Westbahnhof große Potentialflächen für neue bauliche Entwicklungen, die bisher noch nicht umgesetzt wurden. Dies ist einerseits durch einen möglichen Rückbau ungenützter Gleistrassen als auch durch Abbruch und Neubau von Infrastrukturgebäuden der Bahn und Logistikbetrieben möglich. Abbildung 3 zeigt die Lage der Flächenreserven entlang der Gleistrassen im Areal des Wiener Westbahnhofs.

[1] Siehe auch https://urbem.tuwien.ac.at

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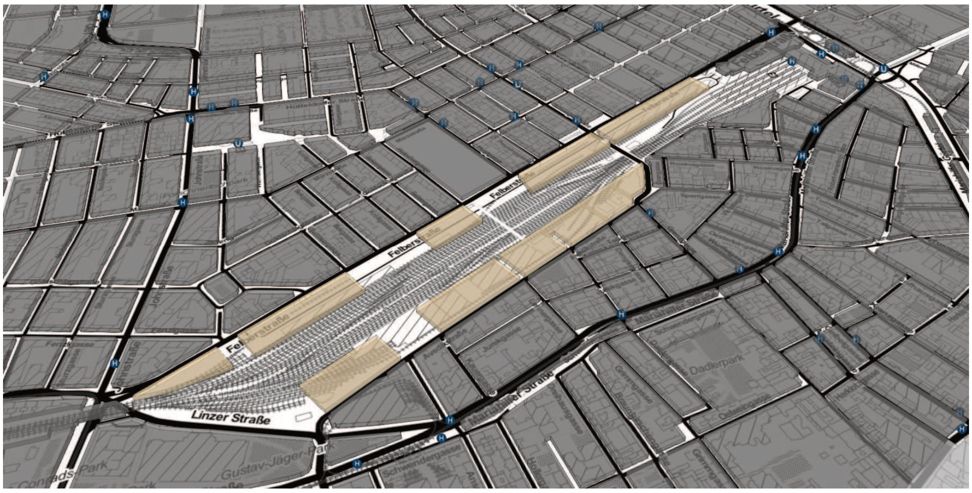

Abb. 3: Stadtentwicklungsgebiet Wien Westbahnhof – ein Gebiet mit großem Potential für die innere Entwicklung der Stadt

Das Planungsgebiet Westbahnhof liegt im 15. Wiener Gemeindebezirk und verfügt über eine sehr gute Anbindung an das Netz des öffentlichen Verkehrs. Im Umkreis von 300 Metern stehen 2 U-Bahn-Linien, 7 Bus- und Straßenbahnlinien sowie mehrere Fernbusse, Regional- und Schnellzüge zur Verfügung. Um mögliche bauliche Entwicklungen in diesem Gebiet an das bestehende Netz des öffentlichen Verkehrs, sowie an das Rad- und Fußwegnetz ressourcenschonend und effizient anzubinden, sind frühzeitige Analysen und ein Ausloten von Maßnahmen zielführend. Nachführende Kapitel zeigen wie diesbezüglich Analysen erarbeitet werden können, um dadurch frühzeitig Maßnahmen für die ressourcenschonende Erreichbarkeit des Planungsareals festzulegen.

3 METHODE

Zur strategischen Analyse des Stadtentwicklungsgebietes Wien Westbahnhof und dort durchführbarer baulicher Maßnahmen werden einerseits Berechnungen zur Abbildung der Ist-Situation und anderseits Simulationen für zukünftige szenarioabhängige Prognosen mittels des integrierten Flächennutzungs- und Verkehrsmodells MARS (Metropolitan Activity Relocation Simulator) durchgeführt. Das Flächennutzungs- und Verkehrsmodell ist dabei in eine dynamische Arbeitsumgebung gebettet, die einen Datenaustausch von Berechnungsdaten zu anderen Domänenmodellen, sowie zu der URBEM-Visualisierung ermöglicht. Insgesamt bildet die Arbeitsumgebung mit den beinhalteten Domänenmodellen und der daraus gespeisten Visualisierung eine visuelle Planungs- und Entscheidungsgrundlage für kooperative Planungsprozesse.

3.1 Systemstruktur und Systemsetup

Für die Analyse des Stadtentwicklungsgebietes Wien Westbahnhof wurde als Grundlage ein Masterplan für die Evaluierung möglicher Bebauungen erstellt. Unter Berücksichtigung der angrenzenden Bestandsbebauungen und in der Umgebung bestehender sozialer Infrastruktureinrichtungen konnten Annahmen für die Gebäudehöhen und die damit verbundene Bebauungsdichte festgelegt werden. Die Annahmen zu Bebauung und Nutzung bilden die Grundlage zur Abschätzung des zu erwartenden Mobilitätsbedarfs der durch die Umsetzung der Planungen entsteht. Diese Abschätzung und die räumlichen Informationen (GIS basiert) zu den bestehenden Ver- und Entsorgungsinfrastrukturen des Areals speisen domänenspezifische Modelle (vgl. Abbildung 4). Zur Erreichbarkeits- und Verkehrsanalyse wird in diesem Zusammenhang ein Mobilitätsmodell verwendet (siehe Kap. 3.2), welches über eine digitale Arbeitsplattform mit Simulationsmodellen zur Untersuchung von Auslastungen in den elektrischen Versorgungsinfrastrukturen verknüpft ist.

Die Domänenmodelle speisen Ergebnisse auf unterschiedlichsten Aggregationsgraden der Stadt Wien (Bezirk, Zählbezirk und Baublock) in ein webbasiertes visuelles Analysewerkzeug, die URBEM-Visualisierung. Die URBEM-Visualisierung bildet ein Interface für die Abfrage und Anzeige der domänenspezifischen Ergebnisse. Basierend auf den Berechnungsmodellen wird so visuelle Planungs- und Entscheidungsunterstützung für kooperative Planungsprozesse zur Verfügung gestellt.

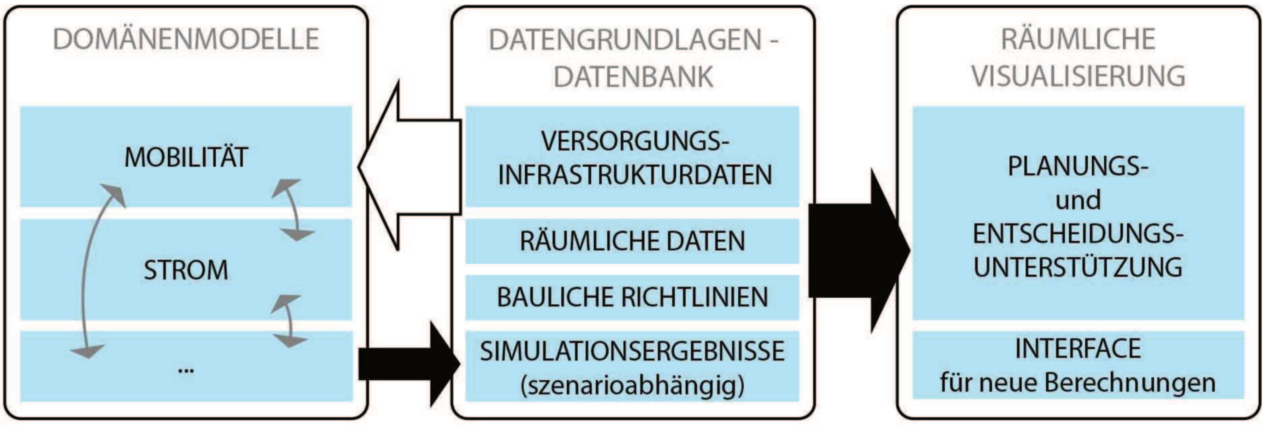

Abb.4: Darstellung des Ablaufs der räumlichen Visualisierung als Planungswerkzeug

3.2 Mobilitätsmodell

Die in dem vorliegenden Paper präsentierten Ergebnisse beruhen auf einer Fallstudie des dynamischen, integrierten Flächennutzungs- und Verkehrsmodells MARS (Metropolitan Activity Relocation Simulator). Mit diesem verfolgt das Institut für Verkehrswissenschaften die Strategie der Integration der verkehrsrelevanten Subsysteme urbaner Agglomerationen (siehe Abbildung 2). Methodisch basiert MARS auf Systems Dynamics, einer in den 1960er Jahren am MIT entwickelten Methodik zur Beschreibung komplexer dynamischer Systeme. MARS wurde als strategisches Modell konzipiert. Das heißt um die für eine Untersuchung einer großen Zahl möglicher Kombinationen aus verkehrs- und raumplanerischen Maßnahmen notwendigen kurzen Laufzeiten zu erreichen, wurde bewusst auf eine hohe räumliche Differenziertheit verzichtet. Das Modell MARS wurde in der System Dynamics Software Vensim® (www.vensim.com) programmiert. Der Zeithorizont der Prognose ist frei wählbar und reicht zumeist 30-40 Jahre in die Zukunft. Änderungen im Personenverkehrsmodell werden bis zum Erreichen des Zeithorizonts in vierteljährlichen Zeitschritten abgebildet, Änderung im Flächennutzungsmodell dagegen in Jahresschritten. Detaillierte Dokumentationen und eine Beschreibung der für diesen Artikel verwendeten Modellversion finden sich in (PFAFFENBICHLER 2008) und (PFAFFENBICHLER 2017).

3.3 Räumliche Visualisierung als Planungswerkzeug

Die URBEM-Visualisierung bietet in kooperativen Planungsprozessen visuelle Planungs- und Entscheidungsunterstützung (vgl. FORSTER 2016). Die digitale Planungsunterstützung dabei erlaubt szenarioabhängige Informationsinhalte auf unterschiedlichen Maßstabsebenen darzustellen. Dadurch können Raumübersichten schrittweise untersucht werden. Fragestellungen in Bezug auf ressourcenschonende Handlungsweisen können so unter Miteinbeziehung unterschiedlichster Stakeholder gestellt werden. Dadurch lassen sich nicht nur Auswirkungen von Maßnahmen abschätzen, sondern vielmehr auch Ort und Zeit für die Handlungsmaßnahmen festmachen. Die domänenübergreifende Visualisierungsmöglichkeit innerhalb des URBEM-Visualisierungswerkzeugs erlaubt es Planenden sichtbare und unsichtbare Systemzusammenhänge zu analysieren und holistische Systemübersichten zu generieren. Die Trägersysteme einer städtischen Struktur und ihre gegenseitigen Abhängigkeiten können dargestellt und Planungsmaßnahmen domänenübergreifend in Relation gestellt werden.

Holistische Systemübersicht und detaillierter Systemeinblick ermöglichen es in Planungsprozessen mit interdisziplinären Beteiligten die bestehenden Planungsprozessabläufe für ressourcenschonende bauliche Entwicklungen aufzubrechen. Die bisher an eine bauliche Planungsvorstellung hintangestellte Planung der Versorgungsinfrastrukturen für Mobilität und Energie kann schon frühzeitig in alle Überlegungen der baulichen Entwicklung mit einbezogen werden. Dadurch lassen sich Schnittstellen zwischen Infrastrukturen räumlich erkennen und neue Synergien für Energieeinsparungen finden.

In der Domäne Mobilität können mit Hilfe der URBEM-Visualisierung verschiedene mobilitätsrelevante Daten und Modellergebnisse räumlich und zeitlich analysiert werden. Mit Hilfe der Visualisierung können einerseits Hintergrunddaten, welche Szenarien des Angebots im Verkehrssystem (z.B. Haltestellen als Punktinformation, Motorisierungsgrad als Choroplethenkarte) und des Siedlungssystems (z.B.

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Einwohnerdichte als Choroplethenkarte) beschreiben, in den Ebenen Raum und Zeit dargestellt werden. Andererseits können die sich aus den verschiedenen prognostizierten Szenarien ergebenden Modellergebnisse (Quell- und Ziel-Modal Split als Tortendiagramm oder Choroplethenkarte, Quell-Ziel-Matrizen nach Verkehrsmittel als Spinne) räumlich und zeitlich dargestellt werden.

4 ERGEBNISSE

Im Rahmen des interdisziplinären Forschungsprojektes URBEM wurde u.a. mit Hilfe des Modells MARS die Entwicklung des Verkehrs- und Siedlungssystems von 2011 bis 2050 iterativ in Vierteljahresschritten simuliert. Neben einem Referenz-Szenario wurden ein „Stagnations-Szenario“ und ein „Klimaschutz-Szenario“ betrachtet.[2] Für die Maßnahmenbildung wurden dabei neben den Annahmen der URBEM-Szenarien die verkehrspolitischen Rahmenbedingungen und Förderungen auf Basis des Stadtentwicklungsplans 2025 berücksichtigt (vgl. MAGISTRATSABTEILUNG 18 2014a, 2014b, 2015). Beispiele dafür sind die Entwicklung des Verkehrssystems durch den Ausbau der U-Bahn-Linie U2/U5, sowie der Förderung von Elektromobilität oder die Ausweitung der Parkraumbewirtschaftung.

Die Ergebnisse der Modellrechnungen zeigen die Verteilung des Quell-Ziel-Verkehrs über die Zeit sowie die Entwicklung der Verkehrsmittelwahl der Bevölkerung. Dabei werden die Einflüsse von Nutzerverhalten, Mobilitätsmustern, Infrastrukturangebot und Verteilung von Arbeits- und Wohnstandorte auf den Modal Split quantifiziert.

Im Folgenden wird ein im Projekt URBEM anhand des möglichen Stadterweiterungsgebiets Westbahnhof durchgeführter Planungstestlauf[3] anhand der Ergebnisse der Domäne Mobilität erläutert. Der Anteil des Umweltverbunds aus zu Fuß Gehen, Radfahren und öffentlichem Verkehr ist im 15. Bezirk mit über 80% bereits im Bestand 2015 sehr hoch. Unter allen Bezirken außerhalb des Gürtels weist der 15. Bezirk im Jahr 2015 den niedrigsten Anteil an Pkw-Verkehr auf. Nur innerhalb des Gürtels wird der Pkw teilweise noch weniger genutzt. Gründe dafür sind neben der guten Anbindung an das ÖV-Netz die hohe Dichte und der niedrige Motorisierungsgrad (Abbildung 5).

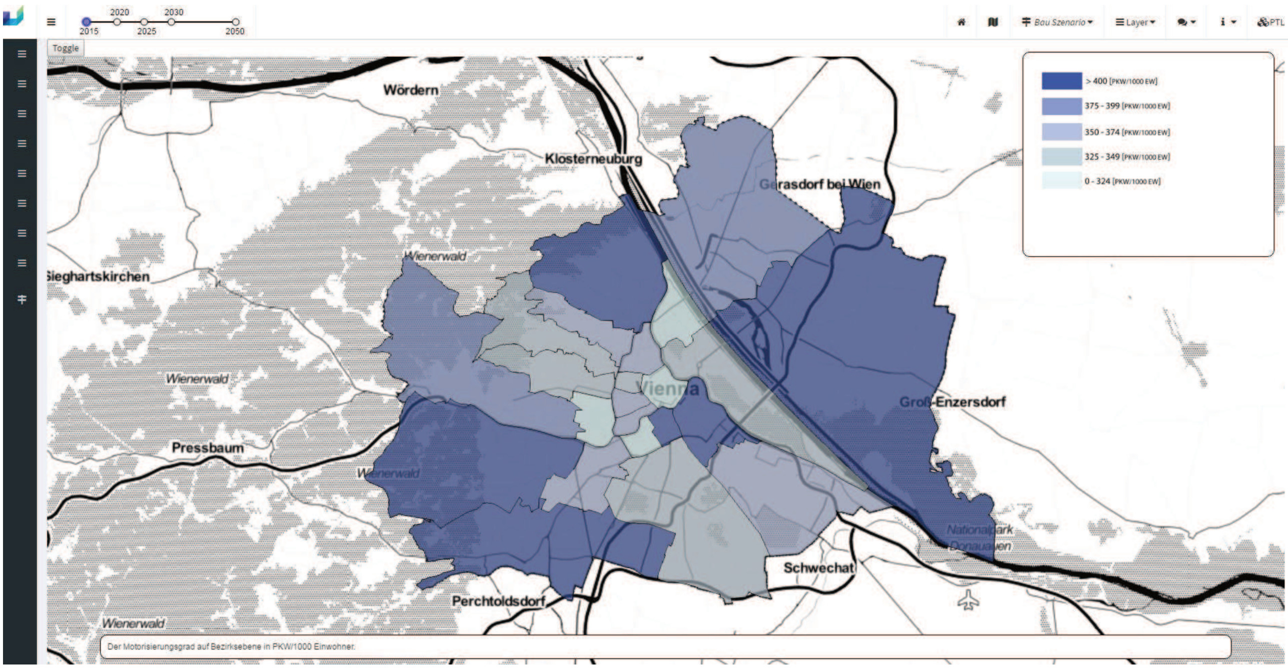

Abb. 5: URBEM Visualisierung Motorisierungsgrad 2015 auf Bezirksebene. © URBEM/TU Wien

[2] Innerhalb des Forschungsprojektes URBEM wurden ein Stagnations-, ein Business as Usual und ein Klimaschutzszenario als Rahmenbedingungen betrachtet. Während das Szenario Stagnation stagnierende wirtschaftliche Entwicklung mit einer Nivellierung klimapolitischer Bestrebungen nach unten beschreibt, bildet das Business as Usual Szenario ein Referenzszenario der Klimaschutzpolitik. Das Szenario Klimaschutz betrachtet dagegen ambitioniertere politische Maßnahmen im Sinne der Ressourcenschonung und des Klimaschutzes.

[3] Eine Erläuterung des Projekts URBEM, der Visualisierung und des Planungstestlaufs findet sich in folgendem Video: https://www.youtube.com/watch?v=bw6aPeVwmlw

Prognosen des Verkehrsmodells MARS zeigen, dass bei einer Fortsetzung der heutigen Verkehrspolitik die Bedeutung des Umweltverbunds bis 2045 weiter zunehmen wird. Abbildung 6 zeigt die URBEM-Visualisierung des Modal Split im Planungsgebiet der Prognose des Szenarios Klimaschutz im Jahr 2045. Bezogen auf das Jahr 2015 erhöhen sich die Anteile des zu Fuß Gehens (rund 35% auf rund 38%) und des öffentlichen Verkehrs (rund 41% auf rund 43%). Der Anteil des Radverkehrs bleibt ungefähr konstant bei rund 7 Prozent. Der Anteil des Pkw-Verkehrs reduziert sich von rund 16% auf rund 12%. Während im Jahr 2015 der Anteil des E-Pkws an den Pkw-Wegen des 15. Bezirks bei rund 0,1% liegt, steigt dieser im Szenario Klimaschutz bis 2045 auf immerhin rund 17% an.

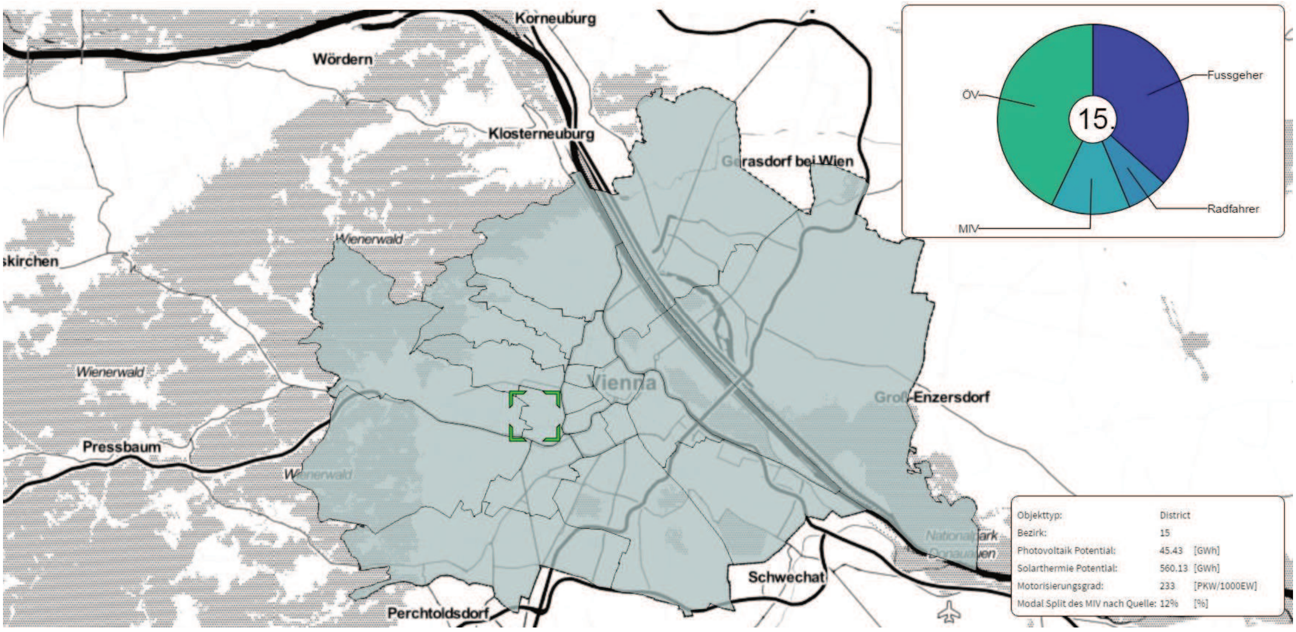

Abb. 6: URBEM Visualisierung Modal Split auf Bezirksebene – 15. Wiener Gemeindebezirk 2045. © URBEM/TU Wien

Für genauere Aussagen zur verkehrstechnischen Erschließung eines Planungsgebiets ist es zudem hilfreich, die Verkehrsströme ausgehend von diesem zu kennen und räumlich darzustellen. Abbildung 7 zeigt mit Hilfe der URBEM-Visualisierung die werktäglichen Verkehrsflüsse des öffentlichen Verkehrs aus dem 15. Bezirk in alle anderen Wiener Gemeindebezirke. Durchmesser und steigender Rotanteil der Bewegungskurven sind dabei Indikatoren für höhere Verkehrsmengen. Wichtige Ziele für die Einwohnerinnen und Einwohner des 15. Bezirks sind unter anderem die Innenstadtbezirke 1 bis 3. Mehr als 70% der Wege dorthin werden mit dem öffentlichen Verkehr zurückgelegt.

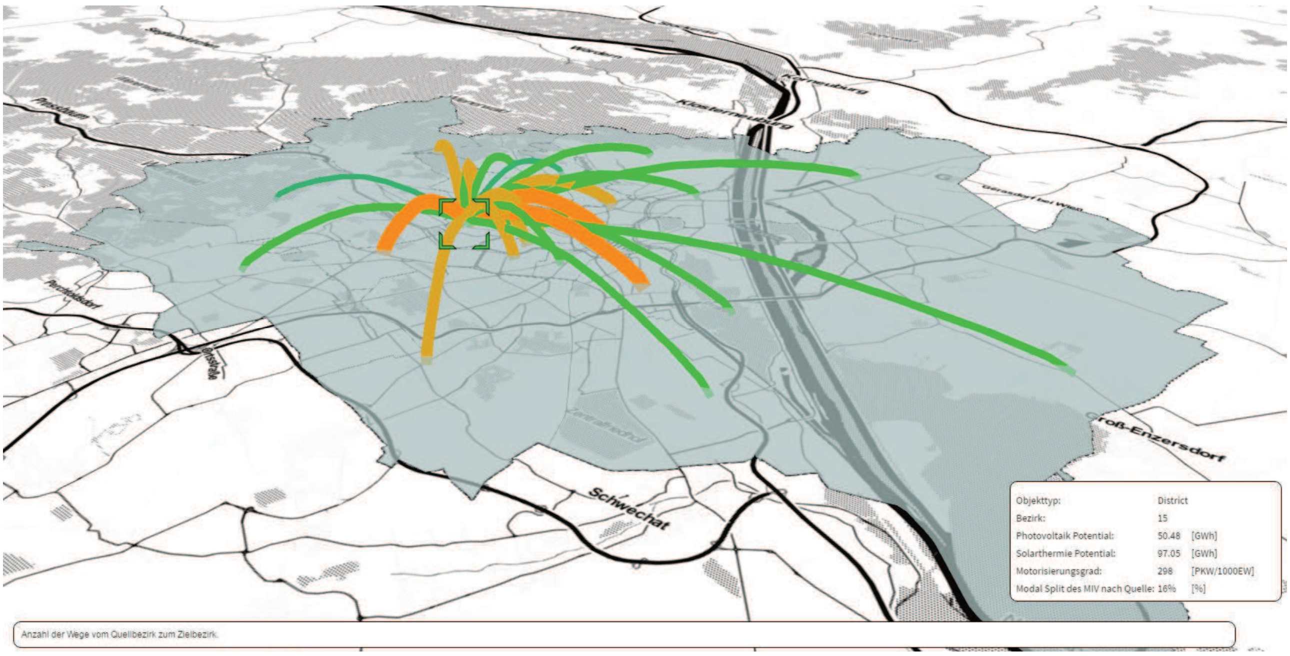

Abb. 7: Werktäglicher Zielverkehr öffentlicher Verkehr – Quelle 15. Wiener Gemeindebezirk 2045. © URBEM/TU Wien

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5 SCHLUSSFOLGERUNGEN

Das im Rahmen des Projekts URBEM entwickelte Visualisierungswerkzeug vereinfacht die Kommunikation in Planungsprozessen, ermöglicht Informationsverortung und detaillierte Informationszuweisung (BEDNAR et. al. 2016). Dadurch können Informationen in unterschiedlichen Kontexten betrachtet, analysiert und modifiziert werden. Zahlreiche Fragestellungen, welche das zukünftige urbane Energiesystem betreffen, können aufgrund ihrer hohen Komplexität nicht von individuellen Experten und Expertinnen alleine beantwortet werden. Darüber hinaus ergeben sich im Laufe der Fragebeantwortung neue Fragestellungen. Durch die Überlagerung der Ergebnisse verschiedener Domänen (z.B. Mobilität, Stromnetze, etc.) können komplexe Planungsaufgaben gemeinschaftlich in interdisziplinären Teams bearbeitet werden. Dies wurde im Projekt URBEM exemplarisch anhand eines Planungstestlaufs für das Stadtentwicklungsgebiet Westbahnhof demonstriert (BEDNAR et. al. 2016).

In der Domäne Mobilität können mit Hilfe der URBEM-Visualisierung verschiedene mobilitätsrelevante Daten und Modellergebnisse räumlich und zeitlich analysiert werden. Dabei können mit Hilfe der Visualisierung Hintergrunddaten, welche Szenarien des Angebots im Verkehrssystem (z.B. Haltestellen als Punktinformation, Motorisierungsgrad als Choroplethenkarte) und des Siedlungssystems (z.B. Einwohnerdichte als Choroplethenkarte) beschreiben, in den Ebenen Raum und Zeit dargestellt werden. Zusätzlich erlaubt die interaktive Visualisierung auch die sich aus den verschiedenen prognostizierten Szenarien ergebenden Modellergebnisse (Quell- und Ziel-Modal Split als Tortendiagramm oder Choroplethenkarte, Quell-Ziel-Matrizen nach Verkehrsmittel als Spinne) mit den Siedlungssystemdaten zu überlagern und Systemverbindungen räumlich zu erkennen.

Die Ergebnisse der Domäne Mobilität können wie folgt zusammengefasst werden. Im Szenario Stagnation2 bleiben die Anteile des zu Fuß Gehens, des Fahrrads, des öffentlichen Verkehrs und des motorisierten Individualverkehrs mehr oder weniger konstant auf dem Niveau des Jahres 2015. Die Entwicklung der E-Mobilität kommt fast vollständig zum Erliegen. Aus einer für 2050 prognostizierten mittleren Fahrleistung von rund 70 Millionen E-Pkw-km/a ergibt sich eine Nachfrage nach Ladestrom von rund 16 GWh/a.

Im Szenario Business as Usual2 geht der Anteil des motorisierten Individualverkehrs leicht zurück. Ab etwa 2035 liegt der Anteil des motorisierten Individualverkehrs unter 25 Prozent, im Jahr 2050 bei rund 24 Prozent. Die Anteile des zu Fuß Gehens und des öffentlichen Verkehrs steigen kontinuierlich an. Der Anteil des öffentlichen Verkehrs liegt ab etwa 2040 über 40 Prozent und steigt bis zum Jahr 2050 nur mehr geringfügig an. Die E-Mobilität entwickelt sich etwas dynamischer. Aus einer für 2050 prognostizierten mittleren Fahrleistung von rund 330 Millionen E-Pkw-km/a ergibt sich eine Nachfrage nach Ladestrom von rund 70 GWh/a.

Im Szenario Klimaschutz2 nimmt der Anteil des motorisierten Individualverkehrs deutlich stärker ab als in den beiden anderen Szenarien. Bereits etwa 2020 wird die 25 Prozent Marke erreicht, im Jahr 2050 liegt der Anteil des motorisierten Individualverkehrs bei rund 22 Prozent. Die Anteile des zu Fuß Gehens und des öffentlichen Verkehrs steigen an. Der Anteil des öffentlichen Verkehrs liegt ab etwa 2030 über 40 Prozent und erreicht im Jahr 2050 rund 42 Prozent. Der Anteil des zu Fuß Gehens steigt bis zum Ende der 2020er Jahre auf etwas über 30 Prozent an. Danach geht der Anteil des zu Fuß Gehens auf Kosten des öffentlichen Verkehrs wieder leicht zurück und liegt im Jahr 2050 knapp unter 30 Prozent. Die E-Mobilität entwickelt sich nochmals deutlich dynamischer. Aus einer für 2050 prognostizierten mittleren Fahrleistung von rund 1.600 Millionen E-Pkw-km/a ergibt sich eine Nachfrage nach Ladestrom von rund 350 GWh/a. Je nach Bezirk werden rund 24 bis 26 Prozent der Pkw-Wege elektrisch zurückgelegt.

Das Ziel eines Anteils des motorisierten Individualverkehrs im Jahr 2025 von weniger als 20 Prozent wird in keinem der drei URBEM-Szenarien erreicht (MAGISTRATSABTEILUNG 18 2014). Um dieses zu erreichen, scheint eine weitere Intensivierung der verkehrspolitischen Maßnahmen unbedingt notwendig.

6 LITERATURVERZEICHNIS

BEDNAR, T., BOTHE, D., Forster, J., FRITZ, S., HAUFE, N., KAUFMANN, T., EDER-NEUHAUSER, P., PFAFFENBICHLER, P., RAB, N., SCHLEICHER, J., WEINWURM, G., WINKLER, C. und ZIEGLER, M.: urbemDK ergebnisbericht, Doktoratskolleg Urbanes Energie- und Mobilitätsmanagement, TU Wien, Wiener Stadtwerke Holding AG. Wien. 2016. http://urbem.tuwien.ac.at/fileadmin/t/urbem/files/urbem_Ergebnisbericht_web.pdf

EMBERGER, Günter, PFAFFENBICHLER Paul: Von monomodalen Verkehrsmodellen hin zu einer dynamischen, multimodalen Betrachtung der Wechselwirkungen zwischen Flächennutzung und Verkehr, in „Der Lehrer Knoflacher und die nächste

Generation – Festschrift“, Beiträge zu einer ökologisch und sozial verträglichen Verkehrsplanung, Institut für Verkehrswissenschaften, TU Wien, S. 175-188, Wien, 2015.

FORSTER, Julia: Strategische räumbezogene Visualisierung im Kontext der Innenentwicklung urbaner Siedlungs-, Energie- und Mobilitätssysteme am Beispiel der Stadt Wien, Dissertation, TU Wien, Wien, 2016.

FORSTER, Julia, KAUFMANN, Thomas, BOTHE, Dominik, VOIGT, Andreas: Visual interactive support for cross-domain simulation and new information flows in early stage planning processes, AESOP Conference – Spaces of Dialog for Places of Dignity, Lissabon, 2017.

MAGISTRATSABTEILUNG 18: STEP 2025 - Stadtentwicklungsplan Wien, Stadtentwicklung Wien Magistratsabteilung 18 – Stadtentwicklung und Stadtplanung. Wien, 2014a.

MAGISTRATSABTEILUNG 18: STEP 2025 - Fachkonzept Mobilität, Stadtentwicklung Wien Magistratsabteilung 18 – Stadtentwicklung und Stadtplanung. Wien, 2014b.

MAGISTRATSABTEILUNG 18: STEP 2025 - Detailkonzept E-Mobilitätsstrategie, Stadtentwicklung Wien Magistratsabteilung 18 – Stadtentwicklung und Stadtplanung. Wien, 2015.

PFAFFENBICHLER, Paul: MARS - Metropolitan Activity Relocation Simulator - A Systems Dynamics based Land Use and Transport Interaction Model, Verlag Dr. Mueller, Saarbruecken, 2008.

PFAFFENBICHLER, Paul: Anwendungskapitel Thema 8: “Strategische Modellbildung des Wiener Personenverkehrssystems in einer wachsenden Stadt – Folgen ausgewählter Maßnahmenbündel für Modal Split, Stadtentwicklung und Energiesysteme”, Urbanes Energie- und Mobilitätssystem Doktoratskolleg. Technische Universität Wien, Wiener Stadtwerke, Wien, 2017.

SCHLEICHER, J., VÖGLER, M., FRITZ, S, ZIEGLER, M., KAUFMANN, T., BOTHE, D., FORSTER, J., DUSTDAR, S.: A Holistic , Interdisciplinary Decision Support System for Sustainable Smart City Design, International Conference on Smart Cities (SMART-CT 2016), Switzerland, 2016.

SCHOLL, Bernd: Die Methode der Testplanung. Exemplarische Veranschaulichung für die Auswahl und den Einsatz von Methoden in Klärungsprozessen. In: Grundriss der Raumordung und Raumentwicklung, 330-345. Hannover: Akademie für Raumforschung und Landesplanung, 2011.

SIMMONDS David: Review of Land-Use/Transport Interaction Models, David Simmonds Consultancy in collaboration with Marcial Echenique and Partners Limited, Reports to The Standing Advisory Committee on Trunk Road Assessment, Department of the Environment, Transport and the Regions, London, 1999

WEGENER, Michael: Overview of land-use and transport models, CUPUM03 - The 8th International Conference on Computers in Urban Planning and Urban Management, Sendai, Japan, 2003.

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reviewed paper

Raum- und standortökonomische Optimierungsmodelle in Open-Source-Umgebungen – Implementation und Anwendungsmöglichkeiten im Kontext der Einzelhandels- und Versorgungsforschung

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1 ABSTRACT

Bei raum- und standortökonomischen Problemen können Optimierungsalgorithmen eingesetzt werden, z.B. zur Anpassung von Modellen an Echtdaten oder zur Optimierung von Standortstrukturen. Im Kontext von Handels- und Dienstleistungsstandorten steht hierbei das räumliche Nachfragerverhalten im Vordergrund. Mit dem in der Handelsforschung populären Marktgebietsmodell von Huff ist es möglich, räumliche Kunden- bzw. Kaufkraftströme anhand der Attraktivität und Erreichbarkeit von Standorten abzuschätzen. Einsatzbereiche des Modells sind u.a. die betriebliche Standortplanung und die Verträglichkeitsbeurteilung von Einzelhandelsansiedlungen in der Raumordnung. Um die Aussagekraft des Modells zu erhöhen, sollte es allerdings anhand von Echtdaten an die Realität angepasst werden, was besonders problematisch ist, wenn nur Gesamtumsätze von Standorten (und nicht etwa Kundenbefragungen) vorliegen. Um in diesem Fall eine gute Modellanpassung zu erreichen, wurde ein Optimierungsalgorithmus entwickelt, der die Modellvariable der Standortattraktivitäten iterativ an die realen Daten anpasst. Wie an einem Beispiel aus dem Einzelhandel gezeigt wird, ist hiermit eine sehr gute Anpassung des Huff-Modells zu erreichen. Der Algorithmus wurde dahingehend weiterentwickelt, auch normative Aussagen zu einer optimalen Standortgröße treffen zu können. Ausgehend von Randbedingungen zur Mindestnachfrage und Erreichbarkeit von Anbietern lässt sich hiermit die Verteilung von Einrichtungen in einem Standortsystem optimieren, was am Beispiel der kleinräumigen Arztversorgung demonstriert wird. Das Huff-Modell sowie die Optimierungsalgorithmen wurden in der freien Programmiersprache R umgesetzt und in einem R-Erweiterungspaket veröffentlicht.

Keywords: Einzelhandel, Marktgebietsmodell, Optimierung, Standortanalyse, Gesundheitsversorgung

2 HINTERGRUND

In vielen wirtschaftlichen Fragestellungen bilden mathematische Optimierungsmodelle ein notwendiges Werkzeug als Entscheidungsgrundlage. Mit Hilfe dieser Modelle wird ein *Optimierungsproblem* gelöst, was bedeutet, dass eine *Zielfunktion* maximiert (z.B. maximale Produktionsmenge einer Produktionsanlage) oder minimiert (z.B. minimale Stückkosten einer Produktionsanlage) wird. Die mathematische Formalisierung besteht hierbei aus mehreren linearen und/oder nicht-linearen Gleichungen und enthält einschränkende *Nebenbedingungen* (z.B. maximale Kapazität einer Produktionsanlage). Die Lösung des Problems erfolgt in Form von *Algorithmen* (Domschke et al., 2015). Auch bei raumökonomischen bzw. standortbezogenen Problemen werden Optimierungsmodelle eingesetzt, z.B. in der Logistik (Minimierung der Transportkosten) oder der Standortplanung (Haase/Hoppe, 2008; Rodrigue et al., 2006).

In raumökonomischen Optimierungsmodellen mit Bezug zu Handels- und Dienstleistungsstandorten ist die räumliche Verteilung der Nachfrager – z.B. in Form von Kunden- oder Kaufkraftflüssen – unter der Bedingung konkurrierender Angebotsstandorte im Fokus. In Bezug auf die Modellierung der Nachfrageseite unterscheiden Haase/Hoppe (2008) hier Modelle, in denen die Nachfrager den Standorten zugeteilt werden (*Location-Allocation-Modelle*) und jene Modelle, in denen die Nachfrager selbst die *Wahl* der von ihnen aufgesuchten Einrichtung(en) treffen (*Location-Choice-Modelle*). Zu erstgenannter Modellfamilie werden die Ansätze gezählt, in denen transportkostenminimierende Standortstrukturen (ggf. unter Bedingung einer Maximaldistanz) ermittelt werden, etwa zur *optimalen Verteilung* von Notdiensten. Im zweiten Fall erfolgt eine wahrscheinlichkeitsbasierte Modellierung der *Auswahl* durch die Nachfrager anhand der Erreichbarkeit sowie weiterer Eigenschaften der Angebotsstandorte; darauf aufbauend wird eine *optimale Standortstruktur* und/oder die *Tragfähigkeit* neuer Standorte durch die Maximierung einer Umsatzfunktion ermittelt.

Die räumliche Verteilung der Nachfrage von Angebotsstandorten und die damit verbundene Abgrenzung und Segmentierung von Marktgebieten ist der Gegenstand von *Marktgebietsmodellen* (Löffler, 1998), die selbst keine Optimierungsmodelle darstellen, sehr wohl aber in diese integriert werden können (Haase/Hoppe, 2008). Der erste Modellansatz, der Marktgebiete von Standorten anhand von Auswahlwahrscheinlichkeiten ermittelte und zugleich den Ursprung für viele weitere Modelle darstellt, ist das *Huff-Modell* (Huff 1962; 1963; 1964), das auch zum Methodenportfolio der Standortanalyse gehört, insb. in der Expansionsplanung von Handelsunternehmen (Berman/Evans, 2013). Das Modell ist außerdem häufig Bestandteil von Verträglichkeitsgutachten, in denen im Rahmen planerischer Genehmigungsverfahren die Auswirkungen von Einzelhandelsvorhaben geprüft werden (Wolf, 2012). Mittlerweile wurde das Betätigungsfeld des Modells z.B. auch auf Gesundheitsstandorte ausgeweitet (z.B. Bauer/Groneberg, 2016; Fülop et al., 2011).

Dieser Beitrag stellt zwei auf dem Huff-Modell basierende Optimierungsansätze vor: Zunächst wird ein Algorithmus gezeigt, mit dem es möglich ist, das Huff-Modell an Echtdaten anzupassen, wenn lediglich Gesamtumsätze der betrachteten Angebotsstandorte vorhanden sind. Im zweiten Schritt wird dieser Algorithmus dahingehend weiterentwickelt, dass auch normative Aussagen zur optimalen Standortgröße daraus abzuleiten sind, was am Beispiel der kleinräumigen Arztversorgung dargestellt wird. Die Entwicklung und technische Umsetzung des Huff-Modells und der Optimierungsalgorithmen sowie die Beispielanwendungen sind in der auf wissenschaftliches Rechnen und statistische Datenanalyse spezialisierten Open-Source-Programmiersprache *R* (R Core Team, 2016) vorgenommen worden und teilweise in Form des *R*-Erweiterungspaketes *MCI* (Wieland, 2017) öffentlich verfügbar.

3 DAS HUFF-MODELL

3.1 Theoretische Grundlagen und formaler Aufbau

Marktgebiete von Angebotsstandorten sind Teilbereiche der Erdoberfläche, aus denen die tatsächlichen (oder potenziellen) Nachfrager eines Angebotsstandortes stammen. Sie resultieren aus *räumlichen Interaktionen* zwischen den Herkunftsorten der Kunden (Nachfrageorte) und den Angebotsstandorten, d.h. aus *räumlichen Kunden- bzw. Kaufkraftströmen*, die aus den Teilgebieten des gesamten Marktgebietes zu den Anbietern fließen (Löffler, 1998). Es handelt sich in dieser modellhaften Vorstellung also um einen *räumlichen Markt*, der anhand verschiedener Aspekte (z.B. Transportkosten) geographisch segmentiert werden kann. Es ist hierbei realistisch anzunehmen, dass sich die Marktgebiete einzelner Angebotsstandorte überschneiden, d.h. dass *räumlicher Wettbewerb* besteht (Berman/Evans, 2013; Rodrigue et al., 2006).

Das Marktgebietsmodell von Huff (1962; 1963; 1964) ist ursprünglich für Einzelhandelsstandorte (z.B. Shopping-Center) konzipiert und bildet einen solchen räumlichen Markt ab; dieser ist räumlich segmentiert in Nachfrageorte i ($i = 1, \ldots, m$) und wird bedient von den Angebotsstandorten j ($j = 1, \ldots, n$). Die Grundlage des mikroökonomisch und verhaltenswissenschaftlich fundierten Modells bildet eine multiplikative *Nutzenfunktion* mit zwei erklärenden Variablen der Einkaufsstättenwahl (Huff, 1962; Huff/Batsell 1975):

$$U_{ij} = A_j^{\gamma} d_{ij}^{-\lambda} \quad (1)$$

Der Nutzen des Angebotsstandortes j für die Nachfrager im Teilbereich i des Marktgebietes, U_{ij}, setzt sich aus der *Attraktivität* des Angebotsstandortes, A_j, und den *Transportkosten* zwischen i und j, d_{ij}, zusammen. Die „Attraktivität" von Standorten wird anhand ihrer Größe operationalisiert (z.B. Verkaufsfläche von Einzelhandelsstandorten): Da *unvollständige Information* angenommen wird, können die Nachfrager niemals genau wissen, ob sie die von ihnen nachgefragten Güter auch tatsächlich am jeweiligen Angebotsstandort bekommen. Je größer der Standort ist, desto höher ist aber die Wahrscheinlichkeit eines „erfolgreichen" Einkaufs. Gleichzeitig steigen mit der Größe der Standorte aber auch die *Such-* und *Entscheidungskosten* der Nachfrager, weswegen der Nutzen nicht proportional, sondern degressiv mit der Größe steigt (*Abnehmender Grenznutzen*, daher: $0 < \gamma < 1$). Die Wirkung der Transportkosten – i.d.R. dargestellt in Form von Fahrtzeit – ist überlinear negativ ($|\lambda| > 1$), was die *Opportunitätskosten* der Raumüberwindung (z.B. Einkaufsfahrt) und die damit verbundene überproportionale Wahrnehmung der Wegezeit ausdrückt (Huff, 1962).

Die konsumentenseitige Entscheidung für den Angebotsstandort wird im Sinne des Wahlaxioms von Luce (1959) als probabilistisch angesehen, d.h. die „Zuordnung" des Nachfrageortes i zu einem Angebotsstandort j wird in Form einer Wahrscheinlichkeit ermittelt, die von der Ausprägung des Nutzens abhängt. Diese *Auswahl-* oder *Interaktionswahrscheinlichkeit*, p_{ij}, ist der Quotient des Nutzens der Alternative j für die Nachfrager aus Ort i und der Summe der Nutzen aller n Angebotsstandorte (Huff, 1962):

$$p_{ij} = \frac{U_{ij}}{\sum_{j=1}^{n} U_{ij}} = \frac{A_j^{\gamma} d_{ij}^{-\lambda}}{\sum_{j=1}^{n} A_j^{\gamma} d_{ij}^{-\lambda}} \quad (2)$$

Die Basis einer Huff-Modellrechnung ist eine *Interaktionsmatrix* mit $m*n$ Einträgen. Die ermittelten Wahrscheinlichkeiten lassen sich auch als *lokale Marktanteile* interpretieren, wobei gilt: 1.) $0 < p_{ij} < 1$ und 2.) $\Sigma\ p_{ij} = 1$. Es gibt demnach keine Überhänge oder Defizite des Angebots und alle Kunden bzw. die gesamte Kaufkraft werden auf die Angebotsstandorte verteilt; das Modell beschreibt also einen Zustand im *(Konsumenten-)Gleichgewicht* (Güssefeldt, 2002; Huff/Batsell, 1975).

Werden die lokalen Marktanteile mit dem Nachfragepotenzial im Ort i (z.B. Kundenzahl, Kaufkraft), C_i, multipliziert, ergeben sich die zu erwartenden Kunden- oder Kaufkraftströme von i nach j, E_{ij}:

$$E_{ij} = p_{ij} C_i \quad (3)$$

Das gesamte Marktgebiet eines Angebotsstandortes j, T_j, entspricht der Summe der Kunden- bzw. Kaufkraftzuflüsse aus allen m Nachfrageorten (Huff, 1964):

$$T_j = \sum_{i=1}^{m} E_{ij} \quad (4)$$

3.2 Anpassung des Modells an Echtdaten

Aufgrund der exponentiellen Gewichtungsvorschrift haben die Parameter γ und λ einen sehr großen Einfluss auf das Modellergebnis: Die Aussagekraft des Modells wird durch die Exponenten entscheidend bestimmt (Löffler, 1998). Im ursprünglichen Huff-Modell wurde die Größengewichtung zunächst unbeachtet gelassen ($\gamma = 1$) und der Gewichtungsparameter der Fahrtzeit, λ, anhand von empirisch erhobenen Marktgebieten (Haushaltsbefragung zur Einkaufsorientierung) branchenspezifisch durch einen iterativen Schätzalgorithmus ermittelt (Huff, 1962). Abgesehen von einer Potenzfunktion sind aber auch andere Typen nicht-linearer Gewichtungsfunktionen denkbar, z.B. eine Exponentialfunktion oder eine Sigmoid-Funktion. Der Parameter λ lässt sich in jedem Fall ebenso mittels (linearer und nicht-linearer) Regressionsanalyse schätzen, wenn empirische Marktgebiete einzelner Betriebe erfasst wurden (Kanhäußer, 2007).

Durch eine mehrstufige Transformation ist es außerdem möglich, Formel (2) zu linearisieren und somit in ein ökonometrisches Modell umzuwandeln, das empirisch durch lineare Regression parametrisiert werden kann (Nakanishi/Cooper, 1974). Die Anwendung dieses Ansatzes erfordert eine empirische Erfassung der Kunden- bzw. Kaufkraftströme, p_{ij}, sowie der erklärenden Variablen. Es ist dann nicht nur möglich, die Parameter der erklärenden Variablen Größe und Fahrtzeit empirisch zu schätzen und einem Signifikanztest zu unterziehen, sondern auch das Modell um andere erklärende Variablen zu erweitern (z.B. Baviera-Puig et al., 2016; Tihi/Oruc, 2012; Suárez-Vega et al., 2015; Wieland, 2015a).

Die repräsentative Erhebung von Einkaufsinteraktionen ist aber aufwendig, so dass empirische Marktgebiete meist nicht vorliegen, was die Anpassung des Modells an Echtdaten natürlich erschwert und der o.g. ökonometrische Ansatz nicht anwendbar ist. In den meisten Fällen sind lediglich jährliche Gesamtumsätze oder Gesamtkundenzahlen von Angebotsstandorten (d.h. die Summe aller Kunden-/Kaufkraftzuflüsse, T_j, siehe Formel 4) verfügbar. Daher wurden verschiedene nicht-lineare Optimierungsmethoden entwickelt, um das Modell an diese Gesamtwerte anzupassen (z.B. Baecker-Neuchl/Wagenseil, 2015; De Beule et al., 2014; Güssefeldt, 2002; Klein, 1988; Marinov/Czamanski, 2012; Orpana/Lampinen, 2003; Yingru/Lin, 2012).

Im Folgenden wird ein neu entwickelter Optimierungsalgorithmus für diesen Fall der Anwendung des Huff-Modells diskutiert. Die Grundlage bildet hierbei das Konzept der *lokalen Optimierung der Attraktivität* von Güssefeldt (2002), dessen Ziel es ist, *unvollkommene Märkte* im Huff-Modell abzubilden; diese Optimierung ist zugleich der einzige der genannten Modellansätze, der nicht nur methodisch, sondern auch theoretisch-inhaltlich fundiert ist. Zugleich werden aber auch Aspekte anderer Ansätze aufgegriffen.

4 EIN NEUER OPTIMIERUNGSALGORITHMUS FÜR DAS HUFF-MODELL

4.1 Theoretische Grundlagen und Ablauf

Es wird davon ausgegangen, dass eine bestimmte Anzahl an j Angebotsstandorten (j = 1, …, n) sowie die zugehörigen Informationen – Größenindikatoren (A_j) und empirisch erfasste Gesamtumsätze (T_j) – vorliegen. Gemäß Huff-Modell hängt der Umsatz (= Output) eines Standortes j (T_j) von seiner Größe (= Input) bzw. „Attraktivität" (A_j), aber auch dem ökonomischen Verhalten aller seiner Konkurrenten – wozu auch die Standortwahl bzw. die Erreichbarkeit und die (ggf. kontinuierliche) Standortanpassung zählen –, ab.

Nach Güssefeldt (2002) kann die Größenvariable die „wirkliche" Attraktivität des Angebotsstandortes nicht widerspiegeln, da jeder Mitbewerber seine Produktionsfaktoren unterschiedlich einsetzt und seinen Marktauftritt regelmäßig anpasst (z.B. durch Sortimentsveränderungen, Marketing), ohne dass sich dies in der Größenvariable (z.B. Verkaufsfläche, Anzahl Mitarbeiter) niederschlägt. Gleichzeitig sind auch *sinkende Grenzerträge* (z.B. mit der Größe sinkende *Flächenproduktivität* im Einzelhandel) möglich, die allerdings nicht an jedem Standort gleichermaßen ausgeprägt sein müssen. Jeder Angebotsstandort hat also *seine eigene* Umsatzfunktion. Zwischen dem in der Huff-Modellrechnung erwarteten Umsatz eines Standortes ($T_{j\ erw}$) und dem tatsächlichen, d.h. empirisch ermittelten, Umsatz ($T_{j\ emp}$) bestehen dementsprechend *lokale* (d.h. den individuellen Standort betreffende) Abweichungen, die bei Güssefeldt (2002) minimiert werden sollen. Allerdings sind in diesem Ansatz keine *globalen* Gütekriterien vorgesehen, die die Anpassung des Modells in Bezug auf das *gesamte* Standortsystem evaluieren. Diese müssen allerdings einbezogen werden, wie z.B. in Form des *Mean Absolute Percentage Error* oder *Pseudo-*R^2 (De Beule et al., 2014).

Nach Güssefeldt (2002) kann die tatsächliche „Attraktivität" jedes einzelnen Angebotsstandortes j (A_j) als (lineare) Funktion seines Gesamtumsatzes (T_j) beschrieben werden, deren Parameter (Achsenabschnitt a_j, Steigung b_j) allerdings für jeden Standort *individuell* bestimmt werden müssen. Anders als in diesem Ansatz muss diese Funktion aber proportional sein: Die Nutzenfunktion im Huff-Modell ist multiplikativ (Formeln 1 und 2), so dass eine Attraktivität von null gleichermaßen in Marktanteilen und Gesamtumsätzen von null resultieren *muss* ($A_j = 0 \Leftrightarrow T_j = 0$). Die Funktion zum Zusammenhang zwischen A_j und T_j muss demnach eine Funktion durch den Ursprung sein ($a_j = 0$), so dass nur die anbieterindividuelle Steigung (b_j) bestimmt werden muss, um danach die Attraktivität ($A_{j\ gesch}$) aus dem empirischen Umsatz ($T_{j\ emp}$) zu ermitteln:

$$A_{j_{gesch}} = b_j T_{j_{emp}} \qquad (5)$$

Wie bei Güssefeldt (2002) wird die Steigung b_j mit Hilfe des Differenzquotienten bestimmt. Hierzu ist, anders als in diesem genannten Optimierungsansatz, der mehrere Modellrechnungen benötigt, nur die einmalige Berechnung der Gesamtumsätze ($T_{j\ erw}$) mit Hilfe der Formeln (2) bis (4) unter Nutzung der bekannten Größenindikatoren A_j (z.B. Verkaufsfläche) notwendig. Da mit dem Ursprung (0, 0) ein weiterer Koordinatenpunkt bekannt ist ($T_j = 0$, $A_j = 0$), besteht das notwendige Intervall zur Berechnung von b_j:

$$b_j = \frac{\Delta A_j}{\Delta T_j} = \frac{A_j - A_{j_0}}{T_{j_{erw}} - T_{j_0}} = \frac{A_j}{T_{j_{erw}}} \qquad (6)$$

Da allerdings der Umsatz nicht nur von der Eigenattraktivität, sondern auch von allen konkurrierenden Angebotsstandorten abhängt, muss die Parametrisierung der Umsatzfunktion und die darauf aufbauende Ermittlung der Attraktivitätswerte iterativ erfolgen. Parallel werden sowohl auf der lokalen als auch der globalen Ebene Gütemaße errechnet, wobei vorher Abbruchkriterien definiert werden. Der Ablauf des Algorithmus lässt sich grob wie folgt zusammenfassen (Wieland, 2017):

(1) Definiere einen Wert für die tolerierte Abweichung zwischen $T_{j\ erw}$ und $T_{j\ emp}$ (*tol*) sowie eine Distanzgewichtung.

(2) Berechne die Gesamtumsätze $T_{j\ erw}$ aller n Angebotsstandorte mit den Formeln (2) bis (4)

(3) Berechne die Abweichung zwischen $T_{j\ erw}$ und $T_{j\ emp}$. Ist diese Abweichung absolut kleiner als *tol*, ist keine lokale Optimierung notwendig und Schritt 3 wird mit Angebotsstandort j+1 wiederholt. Ist die Abweichung größer als *tol*, gehe zu Schritt 4.

(4) Berechne die geschätzte Attraktivität von j, $A_{j\ gesch}$, mit den Formeln (5) und (6).

(5) Setze die neu geschätzte Attraktivität von j, $A_{j\ gesch}$, in die Huff-Interaktionsmatrix ein und führe Schritt 2 für den nächsten Angebotsstandort, j+1, aus.

(6) Wiederhole die Schritte 2 bis 5 für alle Angebotsstandorte (j = 1, …, n).

(7) Berechne ein oder mehrere globale Gütemaße für die Anpassung des Modells an die Echtdaten (z.B. *Pseudo-*R^2).

(8) Wiederhole die Schritte 2 bis 7, bis das definierte Abbruchkriterium (im Hinblick auf eine lokale und/oder globale Anpassung des Modells) erfüllt ist.

4.2 Anwendungsbeispiel: Lebensmittelmärkte in Freiburg

Die Funktionsweise des Optimierungsalgorithmus soll an einem Beispiel demonstriert werden, nämlich der Anpassung des Huff-Modells für die Marktgebiete der Lebensmittelmärkte in der deutschen Stadt Freiburg im Breisgau (rd. 220.000 Einwohner). Im Jahr 2015 wurden in Freiburg 63 Lebensmittelmärkte (32 Super- und Verbrauchermärkte, 27 LM-Discounter und 4 SB-Warenhäuser) mit einer Gesamtverkaufsfläche von 79.093 qm erfasst. Ihre Erreichbarkeit in Metern und PKW-Fahrtzeit (in Minuten) wurde mittels GIS-Netzwerkanalyse in *GRASS GIS* unter Nutzung von *OpenStreetMap*-Daten ermittelt (Wieland, 2015b). Abb. 1 gibt einen Überblick zur Standortverteilung der Betriebe sowie zur damit verbundenen kleinräumigen Ausstattungs- und Erreichbarkeitssituation auf der Ebene der 42 Stadtbezirke bzw. 28 Stadtteile Freiburgs.

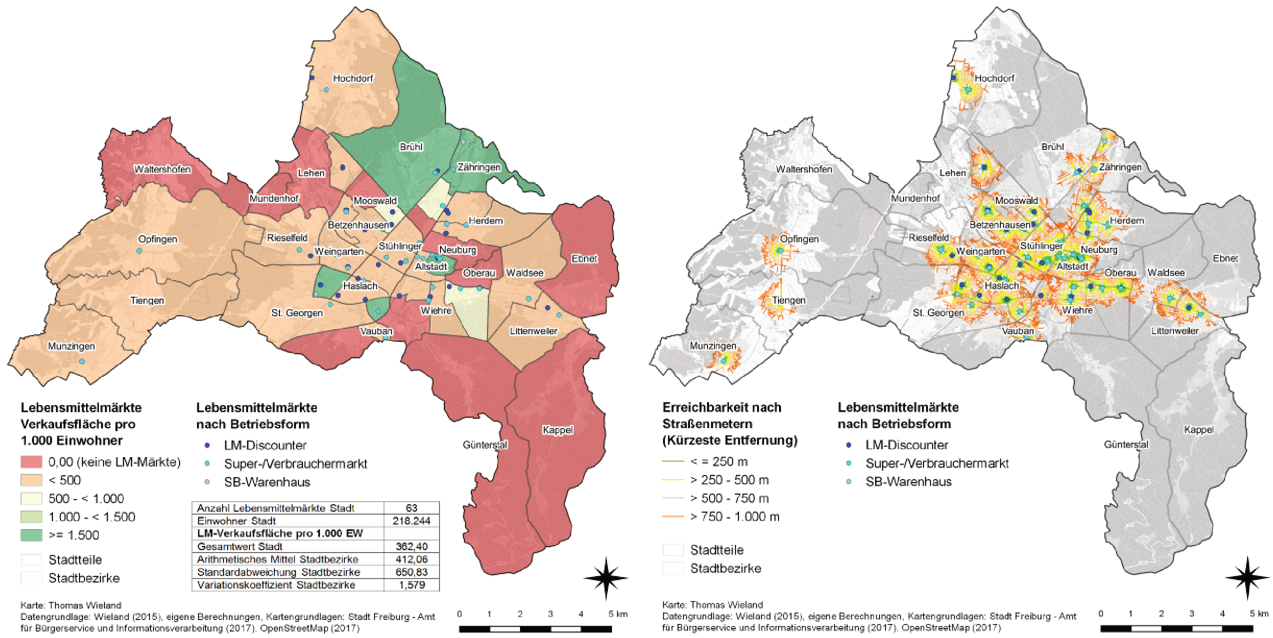

Abb. 1: Lebensmittelmärkte in Freiburg – Standorte, Betriebsformen, Versorgungsgrade und Erreichbarkeit

Ausgehend von betriebsformen- und kettenspezifischen Flächenproduktivitäten wurden die Umsätze der Märkte geschätzt, die sich auf rd. 377 Mio. € jährlich aufsummieren. Wenn nun eine einfache Huff-Modellrechnung mit den Standard-Gewichtungsparametern (γ = 1 und λ = 2) durchgeführt wird, ergeben sich im Vergleich der realen und der im Huff-Modell erwarteten Umsätze mitunter sehr große Abweichungen (Abb. 2, 1.v.l.). Das *Pseudo-*R^2, das die Varianzaufklärung in einem Wertebereich von null bis eins (bzw. 100 %) darstellt, liegt bei 0,513.

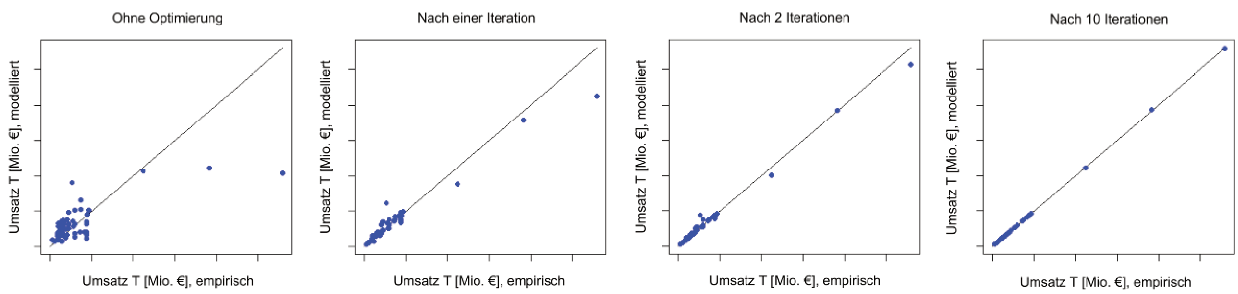

Abb. 2: Schrittweise Anpassung des Huff-Modells

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Wird der in Kap. 4.1 besprochene Optimierungsalgorithmus einmalig auf die Interaktionsmatrix angewendet, ist bereits eine deutliche Verbesserung des Anpassungsgüte zu erkennen (Abb. 2, 2.v.l.); das Gütemaß *Pseudo-*R^2 steigt auf 0,933. Nach zwei Iterationen (Abb. 2, 2.v.r.) sind die Abweichungen bereits so stark reduziert, dass der *Pseudo-*R^2-Wert bei 0,988 liegt. Ab der vierten Iteration liegt das Gütemaß bei über 0,999 und verändert sich nur noch ab der vierten Nachkommastelle. Nach zehn Iterationen (Abb. 2, 1.v.r.) sind die vom Huff-Modell geschätzten Umsätze der Betriebe mit den empirisch ermittelten Werten nahezu identisch.

5 WEITERENTWICKLUNG DES ALGORITHMUS FÜR NORMATIVE PLANUNGSZWECKE

5.1 Übergeordneter Zusammenhang und theoretische Grundlagen

Im Fokus des o.g. Optimierungsalgorithmus steht die Angebotsseite des Huff-Modells in Form der Attraktivitäts- bzw. Größenindikatoren von Standorten, die, ausgehend von der ihnen *real* zufließenden Gesamtnachfrage, iterativ angepasst werden. Daran schließt sich der Grundgedanke an, diesen Algorithmus dahingehend weiterzuentwickeln, dass auch *normative* Aussagen zur *optimalen Größe von Angebotsstandorten* möglich ist, die aus (Ideal-)Annahmen zur Erreichbarkeit und der daraus resultierenden räumlichen Nachfrageverteilung hergeleitet werden. Die Fragestellung wird also dahingehend modifiziert, dass nicht die „echte“ Attraktivität von Standorten als Ergebnis der ihnen zufließenden Nachfrage modelliert wird, sondern die „Größe“, die sie aufweisen *sollen*, um eine bestimmte Gebietsnachfrage zu bedienen.

Um den Sinn und die Funktionsweise des Optimierungsmodells und gleichzeitig die Implementation als Planungsinstrument deutlich zu machen, wird das Konzept anhand des Anwendungsbeispiels der kleinräumigen Gesundheitsversorgung illustriert. In Deutschland wird die Versorgung mit Ärzten durch die *kassenärztliche Bedarfsplanung* gesteuert: Hierbei werden Versorgungskennziffern (Einwohner je Arzt) auf der Ebene von Teilgebieten (z.B. Landkreise) definiert. Die Kennziffern sollen einerseits die *Tragfähigkeit* (Mindestzahl potenzieller Nachfrager) einer Arztpraxis abbilden, andererseits wird daraus die Zahl *freier Arztsitze* berechnet, die für eine Abrechnung mit den Krankenkassen freigegeben werden (KBV, 2013). Die normative Bedarfsplanung macht die Niederlassung also von einer lokal verorteten Nachfrage abhängig.

Die Erreichbarkeit der Einrichtungen spielt in diesem Planungssystem keine Rolle, ist aber in der geographischen Versorgungsforschung in den Vordergrund gerückt (z.B. Augustin et al., 2015). Allerdings ist die Erreichbarkeit des jeweils *nächstgelegenen* Arztes ebenso wenig aussagekräftig wie regionalisierte Versorgungskennziffern: Das Erreichbarkeitsmodell berücksichtigt zwar, dass sich die Nachfrager nicht an administrativen Grenzen orientieren, es wird jedoch implizit unterstellt, dass eine gute Versorgung durch die Nähe zu *einer* Einrichtung hergestellt wird. Wegen der *freien Arztwahl* sind Nachfrager von Arztpraxen aber nicht an einen Standort gebunden: *Persönliche Präferenzen* oder eine mögliche *Mehrfachorientierung* (z.B. Einholen einer Zweitmeinung) machen deutlich, dass das Nachfragerverhalten im Gesundheitssektor *probabilistisch* gesehen werden sollte. Gleichzeitig zeigen die Ergebnisse zum Arztwahlverhalten von Fülop et al. (2011) eine hohe Distanz- bzw. Fahrtzeitsensibilität der Nachfrager: Der Anteil von Patienten, die jeweils den nächstgelegenen Arzt aufsuchen, liegt bei den meisten Facharztbereichen zwischen 55 und 75 %.

Ebenso wie in der Bedarfsplanung soll hier eine normative Verteilung von Einrichtungen (Ärzte) auf der Grundlage der gebietsspezifischen Nachfrage vorgenommen werden. Allerdings wird diese nicht als lokal verortet (Kunden vor Ort) verstanden, sondern als Ergebnis von räumlichen Interaktionen *zwischen* den Teilgebieten. Hierbei wird ein probabilistisches Auswahlverhalten angenommen, d.h. die Nachfrage wird nicht eindeutig einem Angebotsstandort zugeteilt und es existieren überlappende Marktgebiete. Gleichzeitig wird eine hohe Entfernungssensibilität angenommen, die sich aus dem normativen Anspruch des Modells herleitet: Arztpraxen *sollen*, im Sinne einer Versorgungsplanung, schnell erreicht werden können.

Anstatt der Potenzfunktion im ursprünglichen Huff-Modell können z.B. auch Exponentialfunktionen (Fülop et al., 2011) oder S-förmige Funktionen (Bauer/Groneberg, 2016) genutzt werden. Hier fällt die Wahl auf die zweite Alternative, da der S-förmige Funktionsverlauf eine relativ strikte Segmentierung der Marktgebiete ermöglicht: Zwar sinkt die Auswahlwahrscheinlichkeit mit steigender Fahrtzeit, jedoch bis zu einer gewissen Grenze nur gering (Hauptmarktgebiet), darüber hinaus beginnt sie in einer Übergangsphase stark zu sinken, bis sie ab einer weiteren Grenze auf sehr niedrigem Niveau bleibt, jedoch niemals gleich null ist. Die – trotz näherer Alternativen vorgenommene – Auswahl eines weit entfernt gelegenen Arztes (z.B. wegen persönlicher Motive) ist im Modell also *möglich*, jedoch *unwahrscheinlich* bzw. *selten*.

5.2 Ablauf des Optimierungsalgorithmus

Die Sensibilität der Nachfrager im Hinblick auf die Erreichbarkeit der Anbieter muss normativ anhand von zumutbaren Erreichbarkeitsgrenzen definiert werden. Dies wird durch die Konstruktion einer logistischen Wachstumsfunktion mit S-förmigem Verlauf zur Gewichtung der Fahrtzeit erreicht:

$$y = \frac{Y}{1+e^{-a+bx}} \quad (7)$$

Die von der Distanz oder Fahrtzeit, *x*, abhängige Auswahlwahrscheinlichkeit ist die abhängige Variable in der Funktion, *y*. Da Wahrscheinlichkeiten bzw. Marktanteile auf den Wertebereich zwischen null und eins beschränkt sind, ist das Maximum bzw. die Sättigungsgrenze, *Y*, bekannt: $Y = 1$ (bzw. 100 %). Daher lässt sich die Sigmoid-Funktion zwecks Parametrisierung linear darstellen:

$$\ln\left(\frac{Y-y}{y}\right) = a + bx \quad (8)$$

Die strikten, aber eben nicht „trennscharfen“, Erreichbarkeitsgrenzen werden in diesem Beispiel wie folgt definiert: 1) Die Arztbesuche spielen sich *im Wesentlichen* innerhalb einer Wegezeit von *10 Minuten* ab. 2) Eine Wegezeit von *20 Minuten* ist die Obergrenze, ab der nur noch *seltene* bzw. irreguläre Konsultationen stattfinden. Der erste Parameter wird daher auf $a = -10$ gesetzt, d.h. die Auswahlwahrscheinlichkeit fällt ab dieser Zeitgrenze deutlich ab. Der Parameter *b* berechnet sich aus dem bereits definierten Parameter *a* und einem Koordinatenpunkt, der aus den genannten Annahmen resultiert (Die Auswahlwahrscheinlichkeit soll bei einer Fahrtzeit von 20 Minuten nur noch bei 1 % bzw. 0,01 liegen):

$$b = \frac{\ln(y) - a}{x} = \frac{\ln(0{,}01) - 10}{20} \approx -0{,}7302 \quad (9)$$

Anhand dieser Annahmen zur Erreichbarkeitssensibilität wird nun zunächst mit den Huff-Formeln (2) bis (4) geschätzt, wie sich die Nachfrage aus den Nachfrageorten ($i = 1, \ldots, m$) auf die Angebotsstandorte ($j = 1, \ldots, n$) verteilt, wenn *ausschließlich* die Erreichbarkeit maßgeblich ist; der Attraktivitätsindikator ist hierbei zunächst konstant ($A_1 = A_2 = , \ldots, = A_n$), hat also keine Auswirkungen. Um die Modellierung realistischer zu machen, ist auch eine innerörtliche Mindestfahrtzeit (z.B. 5 Minuten) sinnvoll. Für alle *n* Angebotsstandorte wird also die ihnen unter den genannten Bedingungen zufließende Gesamtnachfrage T_j berechnet.

Im nächsten Schritt werden die Angebotsstandorte absteigend nach der Größe von T_j geordnet, so dass der Standort mit der höchsten Nachfrage als erstes bearbeitet wird. Die Definition der Tragfähigkeitsgrenze einer Einrichtung, *V*, kann in diesem Beispiel (Arztpraxen) anhand der Kennziffern der Bedarfsplanung ermittelt werden. Im Fall von Hausärzten werden z.B. 1.671 Einwohner angesetzt (KBV, 2013), d.h. eine Gebietsnachfrage von 3.342 Personen würde exakt zwei Hausarztpraxen „tragen“. Die optimale Größe des Angebotsstandortes, $A_{j\,opt}$, berechnet sich nun aus dem Quotienten der zu erwartenden Nachfrage in Ort *j*, T_j, und der Mindestnachfrage *V*. Im – meist realistischen – Fall einer diskreten Größe erfolgt eine Rundung:

$$A_{j_{opt}} \approx \frac{T_j}{V} \quad (10)$$

Dieser optimierte Attraktivitätsindikator für den ersten Angebotsstandort *j*, $A_{j\,opt}$, wird nun wieder in die Huff-Interaktionsmatrix eingesetzt. Die Berechnung beginnt wieder von vorne mit dem nächsten Standort *j+1*, wobei ein Teil der Gesamtnachfrage bereits an den ersten behandelten Angebotsstandort *j* gebunden ist und die übrige Nachfrage auf die weiteren *n-1* Standorte verteilt wird, sofern dort 1) die Mindestnachfrage gegeben ist und 2) die absolute Gesamtzahl der zu verteilenden Einrichtungen noch nicht erreicht ist. Um sicherzustellen, dass das Gesamtgebiet nicht unterversorgt ist, kann auch nach der Optimierung jedes einzelnen Standortes eine Prüfung erfolgen, ob die maximale Anzahl der Anbieter (d.h. die Summe aller einzelnen Attraktivitätswerte) bereits erreicht ist; wenn dies nicht der Fall ist, kann das betreffende Teilgebiet auch trotz einer geringeren Gebietsnachfrage mit zumindest einer Einrichtung ausgestattet werden.

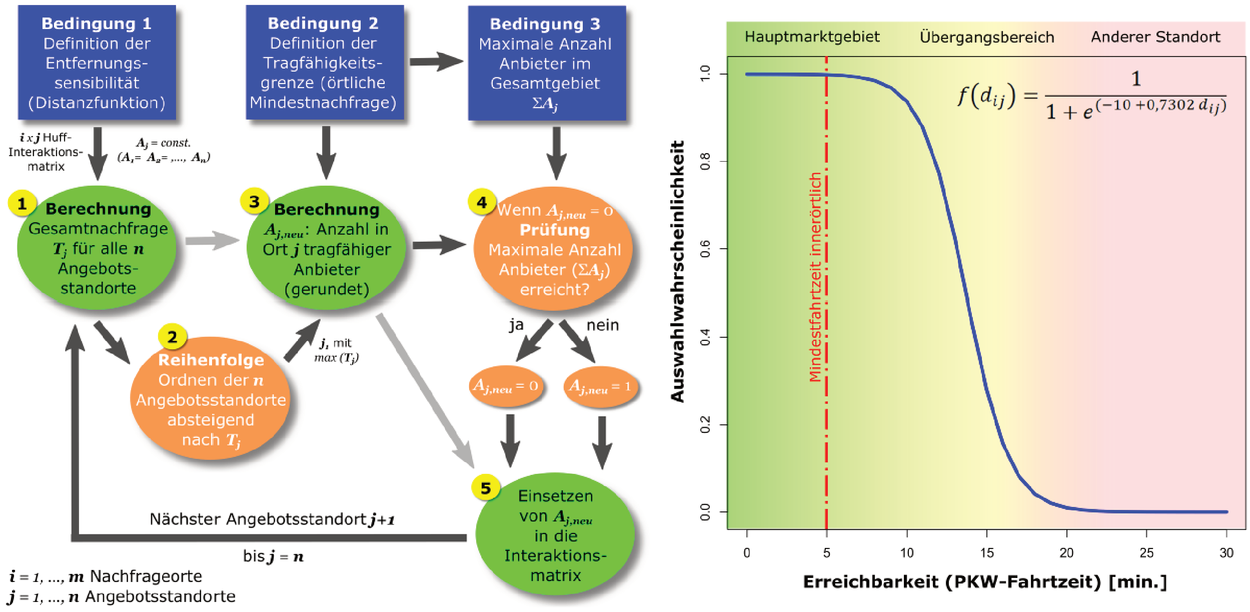

Abb. 3: Algorithmus zur optimalen Standortverteilung und Distanzgewichtung

Das Ergebnis des Algorithmus (Abb. 3, links) ist eine optimale Standortverteilung einzelner Einrichtungen, wobei gleichzeitig gewährleistet wird, dass das Gesamtgebiet nicht über- oder unterversorgt ist und – unter Berücksichtigung einer realen Siedlungsstruktur (z.B. Ortsteile, Stadtbezirke) – Erreichbarkeitsgrenzen eingehalten werden, was durch die S-förmige Distanzfunktion (Abb. 3, rechts) gewährleistet wird.

5.3 Anwendungsbeispiel: Standortverteilung von Kinder- und Jugendärzten in Freiburg

Der skizzierte Algorithmus zur optimierten Standortverteilung soll wiederum am regionalen Fallbeispiel der Stadt Freiburg dargestellt werden, und zwar im Hinblick auf die kleinräumige Versorgung mit Kinderärzten. Für den Stadtkreis Freiburg ist eine Versorgungskennziffer von 2.405 Einwohnern unter 18 Jahren je Facharzt für Kinder- und Jugendmedizin vorgesehen, was in Anbetracht der Einwohnerzahl eine Ausstattung mit 15 Kinderärzten bedeuten würde. Real sind allerdings 21 Kinderärzte in Freiburg angesiedelt, was nach Maßgabe der Bedarfsplanung eine Überversorgung bedeutet (KVBW, 2017). Abbildung 4 zeigt die aktuellen Bedarfs- und Versorgungsstrukturen im Hinblick auf die Kinderärzte in Freiburg (Stand: Mai 2017).

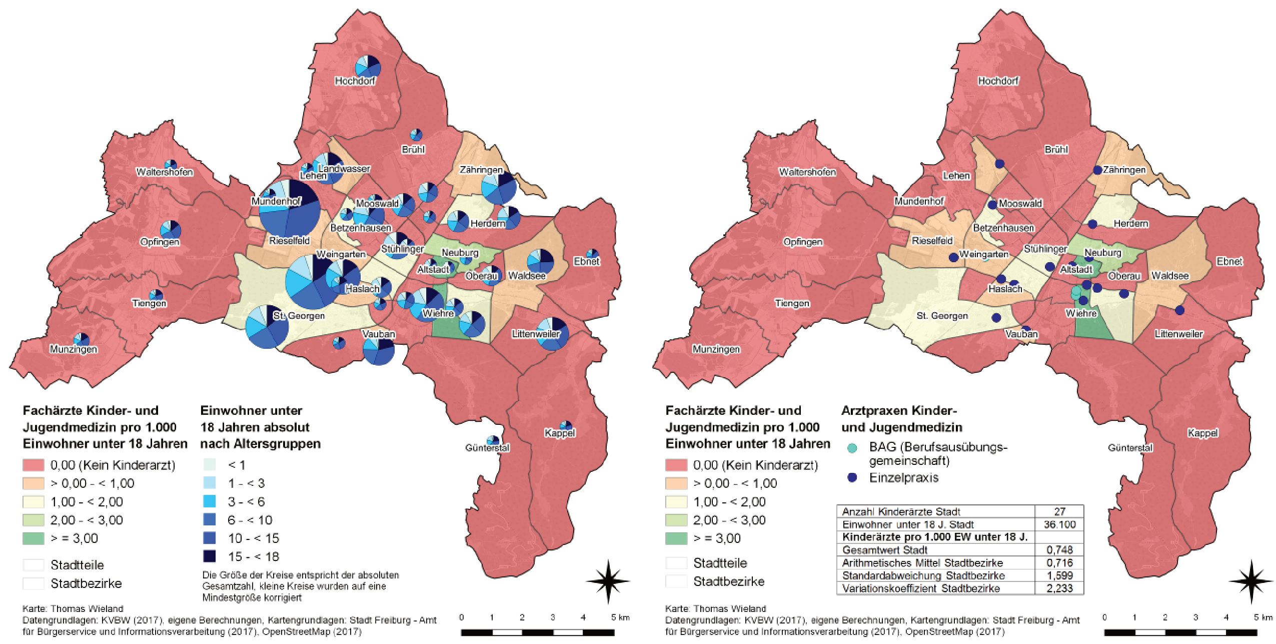

Abb. 4: Kinderärzte in Freiburg – Bedarf, Standorte, Praxistypen und Versorgungsgrade

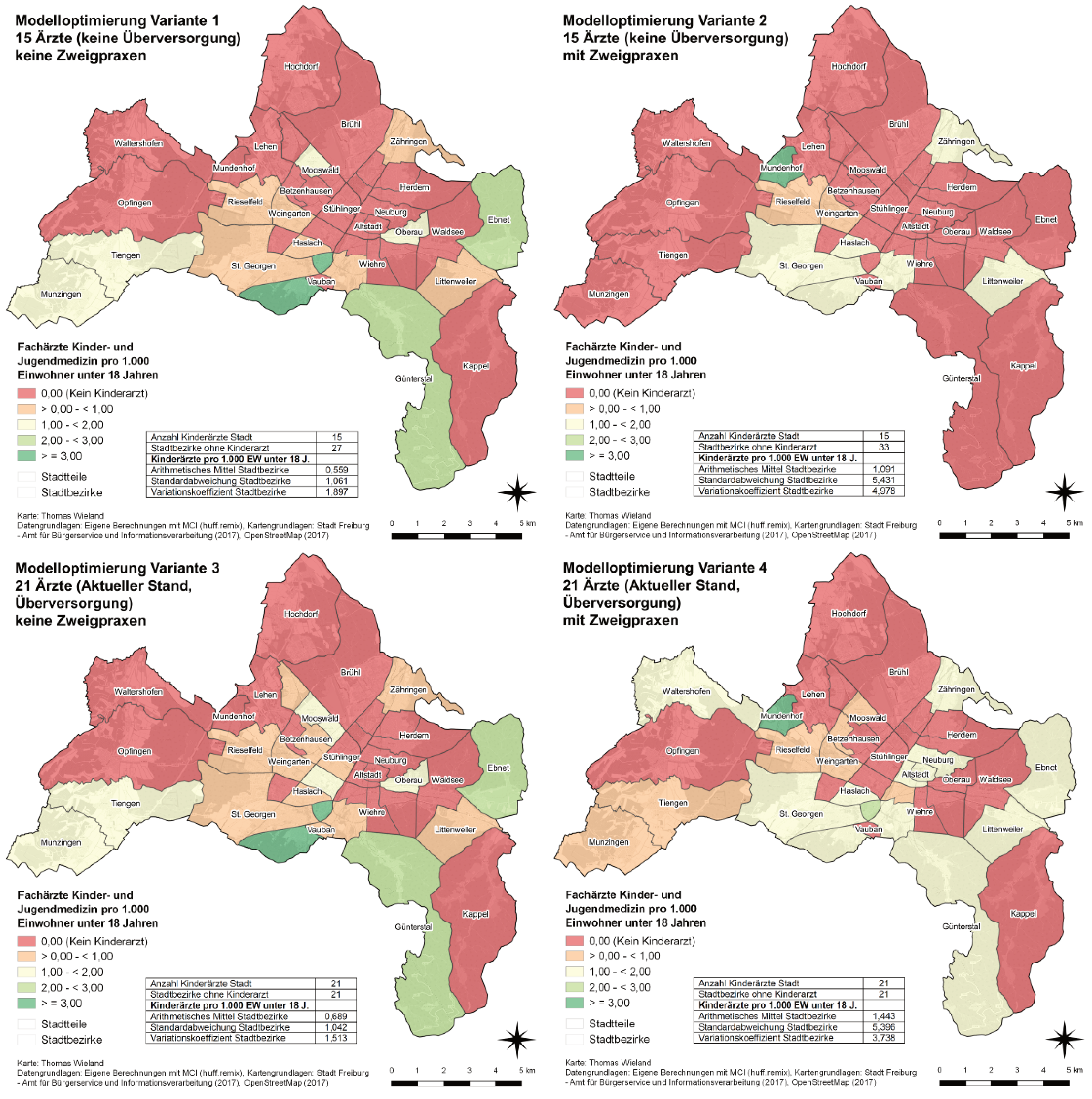

Abb. 5: Optimierte Standortverteilung von Kinderärzten in Freiburg – 4 Varianten

Es wurden vier Varianten der Standortoptimierung für die Freiburger Kinderärzte berechnet (Abb. 5), wobei die räumliche Aggregationsebene die 42 Stadtbezirke sind. Die Erreichbarkeit zwischen den Stadtbezirken wurde als PKW-Fahrtzeit operationalisiert und in *R* mit Hilfe des Pakets *osrm* (Giraud, 2016) ermittelt, das über eine Programmierschnittstelle auf den *OpenStreetMap*-basierten Routendienst *OSRM* (*Open Source Routing Machine*) zugreift. Die Stadtbezirke sind hierbei sowohl Nachfrageorte als auch Angebotsstandorte. Als Mindestfahrtzeit wurden fünf Minuten angenommen. Die Varianten 1 und 2 enthalten eine Optimierung auf der Grundlage der in der Bedarfsplanung vorgesehenen 15 Ärzte, in den Varianten 3 und 4 wurden die realen Arztzahlen (21 Ärzte) genutzt, jeweils einmal unter der Bedingung „voller" Arztpraxen und einmal unter der Bedingung, dass Zweigpraxen bzw. geteilte Arztsitze an unterschiedlichen Standorten (0,5 Ärzte) möglich sind.

Vergleicht man die optimierten mit den realen Standortstrukturen – kartografisch sowie anhand der Streuungsindikatoren (Standardabweichung, Variationskoeffizient; jeweils auf den Karten verzeichnet) –, so zeigen sich große Unterschiede: Offensichtlich müssen unter Optimalbedingungen auch die westlichen und östlichen Stadtbezirke zumindest teilweise versorgt werden. Werden die 15 vorgesehenen Kinderärzte in diesem Sinne verteilt, sinkt der Variationskoeffizient der Versorgungsgrade (Kinderärzte pro 1.000 Einwohner unter 18 Jahren) von aktuell 2,233 auf 1,897. Die geringste Streuung der Versorgungsgrade und

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zugleich die (mit) geringste Zahl an Stadtbezirken ohne kinderärztliche Versorgung wird dann erreicht, wenn die aktuell bestehenden 21 Kinderärzte neu verteilt werden (Abb. 5, links unten). Die Teilung der Arztsitze bzw. Praxen, die in der Realität durchaus möglich ist und auch vom System der Bedarfsplanung akzeptiert wird, führt aber entgegen der Erwartungen *nicht* zu einer geringeren Streuung der Versorgungsgrade, wie an den hohen Variationskoeffizienten (4,978 bzw. 3,738) zu sehen ist (Abb. 5, rechts oben und unten).

6 SCHLUSSFOLGERUNGEN

Es wurde gezeigt, wie das in der Handelsforschung populäre Marktgebietsmodell von Huff mit Hilfe eines Optimierungsalgorithmus iterativ an Echtdaten angepasst werden kann. Die Anpassung zeigt sich als sehr gut, wobei eine Schwachstelle darin liegt, dass der Gewichtungsparameter der Distanz bzw. Fahrtzeit (λ) vorgegeben werden muss. Um Distanzfunktionen empirisch zu schätzen, auch wenn keine repräsentativen Haushaltsbefragungen zum Einkaufsverhalten, sondern nur Gesamtumsätze vorliegen, existieren aber bereits Möglichkeiten (z.B. Klein, 1988), die ggf. vor Anwendung der o.g. Optimierung genutzt werden können.

Der Algorithmus lässt sich dahingehend modifizieren, dass auch normative Aussagen zur optimalen Größe von Angebotsstandorten möglich sind. Der Einsatz dieses Modells hat dieselbe Funktion wie ein Location-Allocation-Modell (Standortstruktur mit optimaler Versorgung), berücksichtigt aber, wie ein Location-Choice-Modell, probabilistisches Auswahlverhalten der Nachfrager. Das Optimierungskriterium ist hierbei eine Erreichbarkeitsvorgabe. Natürlich wird die Auswahl von z.B. Ärzten nicht nur nach diesem Kriterium getroffen, sondern insbesondere persönliche Motive (z.B. Vertrauen) spielen eine große Rolle, die im Modell nicht als solche vergegenständlicht sind. Diese Fälle finden sich aber bereits – indirekt – im Ansatz des probabilistischen Nachfragerverhaltens wieder. Andererseits erscheint die Berücksichtigung individueller Wahlmotive in großräumigen Prozessen der Versorgungsplanung ohnehin schwer realisierbar.

Die Modelle sind in einer Open-Source-Umgebung umgesetzt worden; auch die zusätzlichen Analyseschritte (z.B. Berechnung von Fahrtzeiten) sind, wie im vorliegenden Beispiel, mit freier Software möglich. Die Anwendungen sind prinzipiell auf alle Formen anbieterbasierter Dienstleistungen übertragbar. Grundsätzlich empfiehlt sich aus Gründen der inhaltlichen Plausibilität aber immer ein Vergleich mehrerer Szenarien.

7 LITERATUR

AUGUSTIN, Jobst/ERASMI, Stefan/REUSCH, Michael/AUGUSTIN, Matthias: Methoden zur Analyse der regionalen dermatologischen Versorgung am Beispiel Hamburgs. In: Journal der Deutschen Dermatologischen Gesellschaft, Bd. 13, Nr. 7, S. 661-673. 2015.

BAECKER-NEUCHL, Simone/WAGENSEIL, Hendrik: Das Ganze sehen: räumliche Analysen zur Ermittlung des Zusammenhangs zwischen Umsatz- und Nachfragepotenzial. In: GANSSER, Oliver A./KROL, Bianca (Hrsg.): Markt- und Absatzprognosen : Modelle, Methoden, Anwendung. S. 263-281. Wiesbaden, 2015.

BAUER, Jan/GRONEBERG, David: Measuring Spatial Accessibility of Health Care Providers – Introduction of a Variable Distance Decay Function within the Floating Catchment Area (FCA) Method. In: PLoS One, Bd. 11, Nr. 7, e0159148. 2016.

BAVIERA-PUIG, Amparo/BUITRAGO-VERA, Juan/ESCRIBA-PEREZ, Carmen: Geomarketing models in supermarket location strategies. In: Journal of Business Economics and Management, Bd. 17, Nr. 6, S. 1205-1221. 2016.

BERMAN, Barry R./EVANS, Joel R.: Retail management: a strategic approach. 12. Auflage. Boston, 2013.

DE BEULE, Matthias/VAN DEN POEL, Dirk/VAN DE WEGHE, Nico: An extended Huff-model for robustly benchmarking and predicting retail network performance. In: Applied Geography, Bd. 46, Nr. 1, S. 80-89. 2014.

DOMSCHKE, Wolfgang/DREXL, Andreas/KLEIN, Robert/SCHOLL, Armin: Einführung in Operations Research. 9., überarbeitete und verbesserte Auflage. Berlin (u.a.), 2015.

FÜLOP, Gerhard/KOPETSCH, Thomas/SCHÖPE, Pascal: Catchment areas of medical practices and the role played by geographical distance in the patient's choice of doctor. In: The Annals of Regional Science, Bd. 46, Nr. 3, S. 691-706. 2011.

GIRAUD, Timothée: osrm: Interface Between R and the OpenStreetMap-Based Routing Service OSRM. R package version 3.0.0. https://CRAN.R-project.org/package=osrm. 2016.

GÜSSEFELDT, Jörg: Zur Modellierung von räumlichen Kaufkraftströmen in unvollkommenen Märkten. In: Erdkunde, Bd. 56, Nr. 4, S. 351-370. 2002.

HAASE, Knut/HOPPE, Mirko: Standortplanung unter Wettbewerb. Teil 1: Grundlagen. Diskussionsbeiträge aus dem Institut für Wirtschaft und Verkehr, Bd. 2/2008. Dresden, 2008.

HUFF, David/BATSELL, Richard: Conceptual and operational problems with market share models of consumer spatial behaviour. In: Advances in Consumer Research, Bd. 2, Nr. 1, S. 165-172. 1975.

HUFF, David: A Probabilistic Analysis of Shopping Center Trade Areas. In: Land Economics, Bd. 39, Nr. 1, S. 81-90. 1963.

HUFF, David: Defining and Estimating a Trading Area. In: Journal of Marketing, Bd. 28, Nr. 3, S. 34-38. 1964.

HUFF, David: Determination of Intra-Urban Retail Trade Areas. Los Angeles, 1962.

KANHÄUSSER, Christian: Modellierung und Prognose von Marktgebieten am Beispiel des Möbeleinzelhandels. In: KLEIN, Ralf/RAUH, Jürgen (Hrsg.): Analysemethodik und Modellierung in der geographischen Handelsforschung. Geographische Handelsforschung, Bd. 13. S. 75-110. Passau, 2007.

KBV [=KASSENÄRZTLICHE BUNDESVEREINIGUNG]: Die neue Bedarfsplanung. Berlin, 2013.

KLEIN, Ralf: Der Lebensmittel-Einzelhandel im Raum Verden – Räumliches Einkaufsverhalten unter sich wandelnden Rahmenbedingungen. Flensburger Arbeitspapiere zur Landeskunde und Raumordnung, Bd. 6. Flensburg, 1988.
KVBW [= KASSENÄRZTLICHE VEREINIGUNG BADEN-WÜRTTEMBERG]: Stand der Bedarfsplanung, 15. Februar 2017.
LÖFFLER, Günter: Market areas – a methodological reflection on their boundaries. In: GeoJournal, Bd. 45, Nr. 4, S. 265-272. 1998.
LUCE, Robert D.: Individual choice behavior: a theoretical analysis. New York, 1959.
MARINOV, Maria/CZAMANSKI, Daniel: Normative issues in the organization of modern retailers in Israel. In: GeoJournal, Bd. 77, Nr. 3, S. 383-398. 2012.
NAKANISHI, Masao/COOPER, Lee G.: Parameter Estimation for a Multiplicative Competitive Interaction Model – Least Squares Approach. In: Journal of Marketing Research, Bd. 11, Nr. 3, S. 303-311. 1974.
ORPANA, Tommi/LAMPINEN, Jouko: Building spatial choice models from aggregate data. In: Journal of Regional Science, Bd. 43, Nr. 2, S. 319-347. 2003.
R CORE TEAM: R: A Language and Environment for Statistical Computing. Wien, 2016. https://www.R-project.org/.
RODRIGUE, Jean-Paul/COMTOIS, Claude/SLACK, Brian: The Geography of Transport Systems. New York, 2006.
SUÁREZ-VEGA, Rafael/GUTIÉRREZ-ACUNA, José L./RODRÍGUEZ-DÍAZ, Manuel: Locating a supermarket using a locally calibrated Huff model. In: International Journal of Geographical Information Science, Bd. 29, Nr. 2. 2015.
TIHI, Boris/ORUC, Nermin: Competitive Location Assessment – the MCI Approach. In: South East European Journal of Economics and Business, Bd. 7, Nr. 2, S. 35-49. 2012.
WIELAND, Thomas: Market Area Analysis for Retail and Service Locations with MCI. In: The R Journal, Bd. 9, Nr. 1, S. 298-323. 2017.
WIELAND, Thomas: Räumliches Einkaufsverhalten und Standortpolitik im Einzelhandel unter Berücksichtigung von Agglomerationseffekten. Theoretische Erklärungsansätze, modellanalytische Zugänge und eine empirisch-ökonometrische Marktgebietsanalyse anhand eines Fallbeispiels aus dem ländlichen Raum Ostwestfalens/ Südniedersachsens. Geographische Handelsforschung, Bd. 23. Mannheim, 2015a.
WIELAND, Thomas: Nahversorgung im Kontext raumökonomischer Entwicklungen im Lebensmitteleinzelhandel. Konzeption und Durchführung einer GIS-gestützten Analyse der Strukturen des Lebensmitteleinzelhandels und der Nahversorgung in Freiburg im Breisgau. Projektbericht. Göttingen, 2015b.
WOLF, Michael: Anforderungen an Einzelhandelsgutachten. In: KONZE, Heinz/WOLF, Michael (Hrsg.): Einzelhandel in Nordrhein-Westfalen planvoll steuern! Arbeitsberichte der ARL, Bd. 2, S. 114-134. Hannover, 2012.
YINGRU, Li/LIN, Liu: Assessing the impact of retail location on store performance: A comparison of Wal-Mart and Kmart stores in Cincinnati. In: Applied Geography, Bd. 32, Nr. 2, S. 591-600. 2012.

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Reaktionen einer angewandten und planungsorientierten Stadtklimatologie auf die rezenten Veränderungen urbaner Strukturen

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1 ABSTRACT

Den Verantwortlichen der Stadt- und Umweltplanung ist es mehr denn je gelegen, dass sie fachbezogene Antworten zu klimatisch-lufthygienischen Fragestellungen im urbanen Raum erhalten. Die angewandte, planungsorientierte Stadtklimatologie stellt das Bindeglied zwischen Klimatologie und Stadtplanung dar. In diesem Zusammenhang gilt es aktuell Fragen nachzugehen, wie z. B. die durch „Schrumpfende Städte" offerierten, frei werdenden Flächen stadtklimatologisch sinnvoll in neue Nutzungsstrukturen integriert werden können, damit diese als potenzielle Areale (z. B. Kaltluftproduktionsflächen) einer klimaangepassten Planung zur Verfügung stehen können. Ebenso werden weitestgehend vergessene urbane Reserveflächen (z. B. Dachbegrünung) in Bezug auf die Schaffung eines verbesserten Mikroklimas v. a. in Städten arider und semiarider Räume immer stärker in den Fokus gerückt. Aus lufthygienischer Sicht ist es an der Zeit Datenbanken zu entwickeln, die sich mit dem Kronendach respektive der Auswahl des Straßenbegleitgrüns befassen, da ein dichter Bestand einen verminderten Luftaustausch bedingt, was zu Schadstoffanreicherungen führen kann, die vergleichbar sind mit einer urbanen Straßenschlucht.

Das Wissen und die Kenntnis bezüglich des lokalen Klimas und der daraus resultierenden lufthygienischen Situation sowie deren klimatische Funktionszusammenhänge stellen wichtige Aspekte der Umweltvorsorge und Stadtentwicklung dar. Die beiden Schutzgüter Klima und Luft sind wichtige Bestandteile räumlicher Planung im Abwägungsprozess der Bauleitplanung, Umweltverträglichkeitsprüfungen und entsprechenden Standortuntersuchungen. Ziel einer angewandten und planungsorientierten Stadtklimatologie ist aus klimatischer Sicht die Identifizierung von urbanen Problemfeldern und über die Berücksichtigung flächen- und objektbezogener Handlungsfelder, die Sicherung, Entwicklung und Wiederherstellung immissionsklimatisch relevanter Flächennutzungsstrukturen.

Keywords: Klimaanpassung, Grüne Räume, Smart City, Stadtklima, Flächennutzung

2 EINLEITUNG

Die angewandte Stadtklimaforschung wird in Anbetracht des rezenten globalen Klimawandels in der Zukunft eine immer größere Rolle spielen. Die Stadt als Wohnort für viele Menschen kann mitunter als klimatologischer „Hot-Spot" bezeichnet werden. Aufgrund der Beeinflussung des natürlichen Ökosystems durch den urbanen Siedlungsraum und die daraus hervorgehenden Problemfelder, wird ein Handeln aus Sicht der Stadtplanung unausweichlich. Dabei gilt es sowohl die klimatischen als auch die lufthygienischen urbanen Belastungsräume zu lokalisieren und zu typisieren, sowie basierend auf den Erkenntnissen mittels geeigneter Klimafunktions- und Planungshinweiskarten entsprechende Gegenmaßnahmen vorzuschlagen. Eine Schwerpunkt bildet sich Frage wie die u. a. durch „schrumpfende Städte" offerierten, frei werdenden Flächen stadtklimatologisch sinnvoll in neue Nutzungsstrukturen zu integrieren sind, damit sie als potenzielle Areale (z. B. Kalt- und Frischluftproduktionsflächen) in die klimaorientierte Planung aufgenommen werden können. Des Weiteren liegt ein Hauptaugenmerk auf weitestgehend vergessenen urbanen Reserveflächen wie z. B. Dachbegrünungen in Bezug auf die Schaffung eines verbesserten Mikroklimas, hier v. a. in urbanen Räumen der ariden und semiariden Klimazonen. Aus lufthygienischer Sicht muss eine Datenbank entwickelt, die sich mit dem Kronendach respektive der Auswahl des Straßenbegleitgrüns befasst, da ein dichter Bestand einen verminderten Luftaustausch bedingt, was zu Schadstoffanreicherungen führen kann, die vergleichbar sind mit einer Straßenschlucht. Und es wird der Tatsache Rechnung getragen, dass diverse Baumarten unterschiedliche Mengen an biogenen flüchtigen organischen Kohlenwasserstoffen emittieren. Diese wiederum können als Vorläufersubstanzen zur Bildung von bodennahmen Ozon beitragen und sind nicht als Bestand innerhalb eines Erholungs- bzw. Rückzugsraumes (z. B. innerstädtische Grün- und Parkfläche) geeignet.

Das Wissen und die Kenntnis bezüglich des lokalen Klimas und der daraus resultierenden lufthygienischen Situation sowie deren klimatische Funktionszusammenhänge stellen wichtige Aspekte der Umweltvorsorge und Stadtentwicklung dar. Die beiden Schutzgüter Klima und Luft sind wichtige Bestandteile räumlicher Planung im Abwägungsprozess der Bauleitplanung, Umweltverträglichkeitsprüfungen und entsprechenden Standortuntersuchungen. Ziel einer angewandten und planungsorientierten Stadtklimatologie ist aus klimatischer Sicht die Identifizierung von urbanen Problemfeldern und über die Berücksichtigung flächen- und objektbezogener Handlungsfelder, die Sicherung, Entwicklung und Wiederherstellung immissionsklimatisch relevanter Flächennutzungsstrukturen [Henninger, 2013a].

3 FORSCHUNG- UND ARBEITSFELD ANGEWANDTE STADTKLIMATOLOGIE

Das lokalklimatische Phänomen des Stadtklimas wird hervorgerufen durch anthropogene Eingriffe in das natürliche Ökosystem. Der dicht bebaute und versiegelte urbane Bereich verursacht im Vergleich zu seiner ruralen Umgebung sowohl lokalklimatische Veränderungen als auch Modifikationen der atmosphärischen Spurenstoffe. Grundsätzlich können folgende Entstehungsursachen für das Stadtklima festgestellt werden:

- Großräumige Versiegelung der ehemals natürlichen Oberflächen
- Reduzierung der Vegetations- und Wasserflächen
- Dreidimensionale Überhöhung der Erdoberfläche durch die Bebauung
- Eintrag anthropogener Emission durch Wärme und Spurenstoffe

Diese Einflussfaktoren sorgen schließlich für ein eingeschränktes Evaporationsvermögen, eine deutliche Erhöhung der Oberflächenrauigkeit und im Zusammenhang mit der anthropogen modifizierten Stadtatmosphäre zu Veränderungen des Strahlungs- und Energiehaushaltes [Henninger, 2011a; Kuttler, 2013].

Die angewandte Stadtklimatologie wird gegenwärtig stark von der Bearbeitung klimatischer und lufthygienischer Fragestellungen geprägt. Ein Sachverhalt, der in den letzten Jahren zunehmend in den Fokus der Stadtklimatolgie gelangt, ist nicht nur die Betrachtung und Bewertung von Klima und Lufthygiene, sondern auch die Analyse der daraus resultierenden negativen Auswirkungen sowohl auf das biotische als auch auf das abiotische urbane Ökosystem [Henninger, 2011b]. Ebenso stellt die angewandte, planungsorientierte Stadtklimatologie das Bindeglied zwischen Klimatologie und Stadtplanung dar. Die Stadtklimatologie vermag so eine große Fülle an Lösungsmöglichkeiten anzubieten, die sowohl in klimatologischen als auch lufthygienischen Problemfeldern auftauchen. Stadtklimaanalysen bzw. die daraus zu erstellenden synthetischen Klimafunktions- und Planungshinweiskarten erlauben es der Planung auf kommunaler Ebene wichtige klimatische Aspekte innerhalb des kommunalen Handlungsrahmens aufzugreifen [Overbeck et al., 2008; VDI, 2015; Henninger, 2013a].

4 HANDLUNGSFELDER DER ANGEWANDTEN, PLANUNGSORIENTIERTEN STADTKLIMATOLOGIE

Das primäre Ziel einer angewandten und planungsorientierten Stadtklimatologie muss sein, dass sowohl die klimatischen als auch die lufthygienischen Bedingungen eine nachweisbare Verbesserung erfahren. Daher öffnet sich für die Stadtklimatologie ein breiter Fächer an möglichen Handlungsfeldern, die sich aus den stadtklimatologischen Charakteristika und Problemfeldern ableiten [Henninger, 2013a]. Einige dieser Handlungsfelder werden von der Lehr- und Forschungseinheit Physische Geographie aufgegriffen und auf eine angewandte, planungsorientierte stadtklimatische Forschung übertragen.

4.1 Tolerierbares Stadtklima

Ein Hemmnis für die planungsorientierte Stadtklimatologie ist der Tatsache geschuldet, dass Städte einen über einen langen Zeitraum gewachsenen Körper darstellen, der nicht ohne weiteres nach klimatischen und lufthygienischen Interessen umgestaltet werden kann. Wie aus klimatischer Sicht dennoch positiv auf den Städtebau eingewirkt werden kann, wird ersichtlich, wenn man die Bebauungsstruktur in anderen Klimazonen betrachtet und als Vorbild heranzieht. Zum Beispiel sorgen enge Gassen für eine Verschattung der Hauswände. Eine solche Passivkühlung kann den Energieverbrauch konventioneller Klimaanlagen reduzieren. Neben der Hauswandverschattung bietet sich der Einsatz von Verschattungselementen bzw. eine klimaorientierte Ausrichtung der Gebäude an. Eine optimierte Wärmedämmung trägt ebenfalls zu einem klimaangepassten Bauen bei und vermindert den sommerlichen Hitzestress. Mithilfe einer optimalen Wärmedämmung entsteht ein Synergieeffekt. Der Schutz vor übermäßiger Aufheizung der Räume im Sommer sorgt gleichzeitig für einen Schutz vor Energieverlust im Winter [Henninger, 2010]. Ein für den Stadtbewohner optimales Umfeld wurde von Mayer (1989) mit dem Begriff des „idealen Stadtklimas“ umschrieben. Basierend auf gezielten planerischen Eingriffen wird eine urbane Atmosphäre geschaffen, die möglichst keine anthropogenen Luftschadstoffe enthält und den Bewohnern eine große Vielfalt an urbanen Mikroklimaten zur Verfügung stellt. Dieses ideale Stadtklima lässt sich streng genommen aber nur dort annähernd realisieren, wo Stadtneugründungen geplant sind und bereits zu Beginn der Planungsphase die Belange des Klimas und der Luftqualität mit in die Entscheidungsphase aufgenommen wurden. Für bereits bestehende urbane Räume ist dies nicht durchzuführen. Hier muss es die Aufgabe der Stadtplanung sein, dem idealen Stadtklima durch gezielte Maßnahmen sehr nahe zu kommen. Auf diese Weise kann durch eine Minimierung der Belastung und der Umfeldverbesserung ein „tolerierbares Stadtklima“ geschaffen werden [Mayer, 1989; Hartz, 2011]. Als Folge der Anpassungsstrategien an den Klimawandel muss eine Verminderung der zu erwartenden steigenden thermischen Belastung im urbanen Raum angestrebt werden. Dabei geht es zum einen um eine Reduzierung des direkten Hitzeeintrages, zum anderen um die Sicherstellung einer guten Durchlüftung und verbesserter Austauschbedingungen innerhalb der bodennahen Stadtatmosphäre. Bereits der Einsatz geeigneter Baummaterialien kann zu einer Verringerung des Wärmeinseleffektes beitragen. Helle Materialien mit einem entsprechend hohen Albedowert reduzieren das Aufheizen der Hauswand, da auf der Oberfläche mehr kurzwellige Sonnenstrahlung reflektiert wird. Ein großflächiger Einsatz unter Berücksichtigung planerischer Aspekte kann durchaus den sommerlichen Überwärmungseffekt der Stadt minimieren [Henninger 2010; Henninger, 2011a].

4.2 Urbane Kühleinseln

Dem demographischen Wandel und der in einigen deutschen Großstädten noch immer zu verzeichnenden Stadtflucht ist es gegenwärtig zu verdanken, dass verstärkt stadtklimatische Kenntnisse mit in die zukünftige Stadtplanung einfließen können. Das Phänomen der „Shrinking Cities“ offeriert eine große Zahl frei werdender Flächen, deren Raum stadtklimatologisch sinnvoll in die neu entstehende Nutzungsstruktur zu integrieren ist [Oswalt & Rieniets, 2006]. In diesem Zusammenhang sind unterschiedliche Handlungsfelder für die angewandte, planungsorientierte Stadtklimatologie hervorzuheben. Im urbanen Bereich bietet sich vor allem die Schaffung von Frei-, Grün- und Wasserflächen an. Vor allem Frei- und Grünflächen im Bestand sind der Ansatzpunkt unterschiedlicher Forschungsthemen im Bereich der angewandten, planungsorientierten Stadtklimatologie.

Von allen urbanen Grünflächen geht ein mehr oder minder starker Kühlungseffekt aus. Während der Tagstunden kommt es aufgrund der Evapotranspiration zu einem Energieverbrauch und dementsprechend zu einer Abkühlung der Lufttemperaturen. Verstärkt wird dieser Effekt durch den Schattenwurf der Bäume. In der Nacht bildet sich über den Grünflächen Kaltluft. Durch die so genannte „park breeze“, eine Luftströmung aus dem Park heraus gerichtet, wird die Luft ausgetauscht und wirkt sich ebenfalls kühlend aus. Innerstädtische Grünflächen können in Abhängigkeit ihrer Größe und Gestaltung einen erheblichen Einfluss auf ihre Umgebung ausüben. Hierbei gilt es jedoch zu beachten, dass nicht jede Grünfläche die gleiche Wirkung auf sein Umfeld besitzt [Errel et al., 2011]. Um einen deutlichen klimawirksamen Effekt zu haben, müssen solche Flächen jedoch mindestens eine Fläche von 50 ha aufweisen [Horbert, 2000]. Kleinere Park- und Grünflächen, dies konnte von Bongardt (2006) nachgewiesen werden, besitzen allerdings ebenfalls eine kühlende Wirkung und sorgen so für eine Verringerung der thermischen Belastung. Jedoch bleibt dies auf direkt angrenzende Bereich beschränkt. Die Frage, die man sich im Vorfeld einer sinnvollen Nutzung dieser „urbanen Kühleinsel“ („urban cool island“) stellen muss ist, welcher Effekt soll für die Nutzer bzw. die angrenzende Bebauung erreicht werden. In Abhängigkeit der Nutzungsfunktion einer solchen Grünfläche können zwei tageszeitenabhängige Arten der „urbanen Kühleinsel“ unterschieden werden, die sich letztendlich für eine unterschiedliche Intention anbieten [Henninger, 2015]. Wie aus Tabelle 1 zu ersehen ist, verändert sich in Abhängigkeit des Wasserdargebotes und des Vegetationsbestandes die Wirkung der „Park Cool Island“ zu unterschiedlichen Tageszeiten, wie es u. a. Tel Aviv am Beispiel einer küstennahen urbanen Parkfläche nachgewiesen werden konnte [Henninger & Saaroni, 2014].

	Tagstunden ***„park cool island"***	**Nachtstunden** ***„park cool island"***
Art der innerstädtischen Grünfläche	- bewässerte Parkflächen - dichter Baumbestand	- unregelmäßig bis nicht gewässerte Parkflächen - geringer Baumbestand
Entstehung	- geringere Oberflächen-temperatur durch Verschattung der Bäume - bei guter Bewässerung höhere Verdunstungsleistung über den Grasflächen	- hohe kurzwellige Einstrahlung am Tage - hohe langwellige Ausstrahlung nach Sonnenuntergang
Zeit der maximalen Intensität	- Nachmittag bzw. früher Abend	- mehrere Stunden nach Sonnenuntergang
Besonderheiten		- während der Tagstunden vielfach wärmer im Vergleich zu benachbarten Flächen

Tabelle 1: Unterschiedliche Charakteristika einer „park cool island" in Abhängigkeit der Tageszeit und Bewirtschaftung [verändert nach Errel et al., 2011; Cohen et al., 2012; Henninger, 2015].

4.3 Luftleit- und Ventilationsbahnen

Möglichst naturbelassene Freiflächen bzw. deren Aufwertung ermöglichen einen besseren Luftaustausch mit dem Umland. Als Luftleit- bzw. Ventilationsbahnen sind diese in der Lage kühlere Luftmassen in bebautes Gebiet zu leiten. In Verbindung mit dem bereits angesprochenen Phänomen der schrumpfenden Städte sind es weiterhin nicht mehr für die direkte Verwendung vorgesehene Flächen, die einer Nutzungsänderung unterliegen und sich für die Anlage von Grün- und Freiflächen eignen. Industrie- und Gewerbebrachen, stillgelegte Bahntrassen oder auch Bebauungslücken können in diesem Fall als potenzielle Areale in die klimaorientierte Planung aufgenommen werden.

An dieser Stelle gilt es eine genaue Prüfung der Situation aus klimaorientierter Sicht vorzunehmen, um die Relevanz eines funktionierenden Stadtbelüftungssystems zu gewährleisten oder es möglicherweise durch diese neue Sachlage entstehen zu lassen. Gegebenenfalls sollten solche Areale nicht mehr für eine neue Bebauung frei gegeben werden. Potentielle Ventilationsbahnen sind aus klimatologischer Sicht als sehr sensible Flächen zu betrachten. Bereits kleinste Hindernisse können den Kaltlufttransport zum Erliegen bringen. Zur Sicherstellung einer adäquaten Stadtbelüftung über intraurbane Grünflächen und Frischluftschneisen muss über Bebauungsgrenzen dafür Sorge getragen werden, dass diese Bereiche auch tatsächlich frei gehalten werden [Henninger, 2011a].

4.4 Urbane Dach- und Fassadenbegrünung

Eine weitestgehend vergessene Reservefläche in Bezug auf die Schaffung eines verbesserten Lokal- bzw. Mikroklimas ist die Möglichkeit der Dach- und Fassadenbegrünung. Im Besonderen bietet die intensive bzw. extensive Dachbegrünung in der Stadt eine Möglichkeit nicht nur punktuell den stadtklimatischen Effekt zu verringern. Ein positiver thermischer Effekt der Dachbegrünung ist die Minderung von Temperaturextremen. Während sich Kiesdächer und schwarze Bitumenpappe auf bis zu 80°C aufheizen, weisen begrünte Dächer Oberflächentemperaturen von lediglich 20°C bis 25°C auf [Henninger, 2010]. Dieser positive thermische Effekt zeigt sich nicht nur im Sommer, sondern ist auch im Winter nachweisbar. Nicht zuletzt kommt es in den Wintermonaten aufgrund der Vegetation und des Dachsubstrates zu einer Verminderung des Wärmedurchganges und somit zu einer erhöhten Wärmedämmung. Ein weiterer positiver Effekt der Dachbegrünung wird abermals durch die Verdunstung von Wasser hervorgerufen. Auch die Überflutungsgefahr, hervorgerufen durch Starkniederschlagsereignisse, wird deutlich reduziert. Vergleichbar mit offenen Vegetationsflächen, die in der Lage sind Oberflächenwasser zu speichern, wird, je nach Art der Dachbegrünung, das Niederschlagswasser dort unterschiedlich lange gehalten und fließt so, abzüglich von Verdunstung und Transpiration, zeitverzögert ab. Der sog. Abflussbeiwert wird durch die Dachbegrünung, erheblich verbessert. Werden von einem ≥ 15° geneigten Dach 80 % bis 100 % des Niederschlages direkt in die Kanalisation geleitet, beträgt der direkte Abfluss eines begrünten Daches lediglich 30 %. Das restliche Wasser wird über die Verdunstung wieder an die Atmosphäre abgegeben. Somit trägt das zwischengespeicherte Niederschlagswasser zur Verbesserung des Feuchtegehaltes der Luft bei. Die Zeitverzögerung entlastet die Stadtentwässerung erheblich und die Überflutungsgefahr wird gemindert [Chifflard, 2011]. Die Erkenntnisse aus dem gemäßigten Klimabereich können jedoch auch in anderen Klimazonen transferiert werden, um vor allem in ariden und semiariden Räumen lokalklimatisch zu einer Entlastung der thermischen Situation beizutragen.

Diese Kenntnisse bilden u. a. die Grundlage für zwei Forschungsprojekte in ariden bzw. semiariden Gebieten im Iran und Bahrain [Henninger et al., 2015]. Die Projekte haben das Ziel die Grundidee der urbanen Nachhaltigkeitsstrategie beispielhaft in die Städte Bahrain (Bahrain) und Karadsch (Iran) zu transferieren. Vor allem die kommunalen Entscheidungsträger sollen für den Nachhaltigkeitsgedanken sensibilisiert werden. Im Sinne des Nachaltigkeitsdreiecks (Ökonomie, Ökologie, Gesellschaft) werden unterschiedliche Ziele aufgezeigt, die offenlegen, dass eine gezielte urbane Dachbegrünung in den drei o. g. Bereichen Vorteile für das Wohnumfeld und vor allem die Wohnqualität in urbanen Räumen bereitstellen können.

Ökonomische Vorteile: Natürlich muss in der initialen Projektphase investiert werden, um die entsprechenden Vorbereitungen und Installationen durchzuführen. Allerdings soll dargelegt werden, dass mit der Dauer der Laufzeit wiederum Kosten eingespart werden können. Der Schwerpunkt liegt hierbei darauf, dass

- eine Dachbegrünung zu einer Reduktion der Oberflächentemperaturen führt, was wiederum einen positiven Effekt auf die Effizienz von Photovoltaikanlagen haben kann.
- eine Dachbegrünung zu einer Reduktion der Oberflächentemperatur führt, was wiederum eine geringere Erwärmung der darunterliegenden Räumlichkeiten mit sich bringt und so in einem nächsten Schritt einen geringen Energieaufwand zur Kühlung ebendieser bedingt.
- eine Dachbegrünung in Abhängigkeit von intensiver oder extensiver Nutzung zu einer Reduktion der lokalen urbanen Lärmbelästigung führen kann, aufgrund der erhöhten Schallabsorption [Henninger, 2010].

Ökologische Vorteile: Neben einer Verbesserung der lokalklimatischen Verhältnisse aufgrund der Reduktion der Umgebungstemperatur zeigt sich durch die Begrünung der Dachflächen ebenfalls eine positive Aufwertung der urbanen Luftqualität. Vor allem für den Bereich der Feinstaubproblematik, aber auch für weitere urbane Luftinhaltsstoffe leistet eine durch Dachbegrünung zusätzlich geschaffene Depositions- und Filterflächen positive Effekte. Weiterführend kann im Rahmen eines gezielten Siedlungswassermanagements durch eine aufgrund der Begrünung hervorgerufene Erhöhung der Abflusszeiten, v. a. bei Starkniederschlagsereignissen, eine zusätzliche Möglichkeit der temporären Zwischenspeicherung des abfließenden Oberflächenwassers bewirken. Dies wiederum entlastet die Kanalisation deutlich [Henninger, 2013b]. Ebenfalls nicht zu vergessen ist, aus ökologischer Sicht, der Nutzen, v. a. extensiv genutzter Grünflächen auf Dächern, als Habitat sowohl für Flora als auch Fauna.

Soziale/ Gesellschaftliche Vorteile: Neben den ökonomischen und ökologischen Aspekten einer urbanen Nachhaltigkeit darf jedoch nicht die gesellschaftliche Wirkung außer Acht gelassen werden. Hier ist es insbesondere der ästhetische Eindruck, der durch eine gezielt betriebene Landschaftsgärtnerei bei der urbanen Bevölkerung durch eine Vielzahl von „grünen Oasen" eine Steigerung und Akzeptanz der Wohnqualität hervorruft.

Mit diesem Wissen werden sowohl in Bahrain als auch in Karadsch interdisziplinäre Arbeiten angestoßen, die wie u. a. das Projekt „Bahrain Regains Greenery – Green Roofs in Private & Public Buildings" das Ziel verfolgen den „öffentlichen Dienst" in Form von Leuchtturmprojekten in die Pflicht zu nehmen. Dabei wird gezielt auf das immense Dachflächenpotential öffentlicher Gebäude zurückgegriffen und an diesen Standorten offensiv die positive Wirkung von Dachbegrünungsmaßnahmen analysiert, angepasst und letztendlich beworben [Henninger et al., 2015].

Weiterführend wird neben der Möglichkeit der intensiven und extensiven Begrünung von Dachflächen sowie der Nutzung der Solarenergie mittels Photovoltaik auch dem Thema des „urban gardening/ farming" auf sonnenexponierten Dachversuchsflächen Rechnung getragen. Ebensolche offenbaren zusätzlich lokal landwirtschaftlich nutzbare Reserveflächen mit einem entsprechenden Erntebeitrag, v. a. in entsprechend klimatisch begünstigten Räumen [Henninger, 2012a].

4.5 Blattwendende (Stadt)Bäume

Auch die Begrünung innerhalb des vorhandenen Bestandes bietet aufgrund sowohl der Verschattung als auch der Verdunstungsleistung von Pflanzen ein kühlendes Potential. Daher beschäftigt sich die Lehr- und Forschungseinheit Physische Geographie u. a. mit der Frage, wie urbanes Grün die negativen lokalklimatischen Modifikationen der urbanen Überwärmung abmildern kann. Dazu werden lokalklimatische Untersuchungen an Silberlinden (Tilia Tomentosa) durchgeführt. Ziel des Forschungsprojektes ist es der Frage nachzugehen, ob diese Baumart in der Lage ist ihre nähere Umgebung abzukühlen und somit in den Sommermonaten positiv zu beeinflussen. Hierbei liegt der Fokus jedoch nicht auf bereits bekannten Effekten wie Evapotranspiration und Verschattung. Vielmehr wird die Wirkung einer veränderten Albedo am Blattwerk der Bäume analysiert. Die Tilia tomentosa ist für diese Untersuchung besonders geeignet, da initiale Beobachtungen gezeigt haben, dass vor allem die Blätter des Kronenbereiches junger Silberlinden in der Lage sind sich selbstständig gegen eine intensive solare Einstrahlung zu schützen. Kommt es im Verlauf des Tages zu erhöhten Temperaturen im Kronenraum, wendet sich die dunkelgrüne, kurzwellige Strahlung absorbierende Blattoberseite ab und die silberne, reflektierende Blattunterseite wird zur Sonne hin ausgerichtet. Aufgrund der hierdurch hervorgerufenen Veränderung der Albedo kommt es zu einer Reduktion der Oberflächentemperatur am Kronendach und einer Verringerung der Lufttemperatur innerhalb des Kronen- bzw. Stammraums. Zur Verifizierung dieser Aussage werden Analysen an Silberlinden unterschiedlichen Alters durchgeführt (drei Altersklassen: 0 – 10 Jahre, 11 – 25 Jahre, älter als 26 Jahre). Die Ergebnisse werden im Anschluss auf das lokale Klima übertragen und der Effekt der Abkühlung auf die räumliche Planung angewendet [Wundsam & Henninger, 2015]. Im Rahmen des Projektes werden in-situ-Messungen mithilfe von Messstationen innerhalb und außerhalb des Baumbestandes vorgenommen. Hinzu kommen Foto- und Filmaufnahmen von Hitzestresspunkte auf den Kronenblättern, die mithilfe von Wärmebildkameras punktgenau lokalisiert werden, um entsprechende Veränderungen innerhalb des Kronendachs bei der späteren Analyse visualisieren zu können. Mithilfe dieser Methodik wird ermittelt, ab welchem Temperaturbereich die Blattoberflächen beginnen auf den Hitzestress zu reagieren und mit einer Blattdrehung antworten. Des Weiteren wird durch die Positionierung von Messgeräten sowohl im Stammbereich der Silberlinden als auch im nahen Umfeld aufgezeigt, welche Wirkung die Drehung der Blätter auf die Baum- und Umgebungstemperatur hat. Weiterführend wird es Untersuchungen mit anderen Stadtbäumen geben, die ebenso dem urbanen Hitzestress und Luftverunreinigungen ausgesetzt sind. Mittels dieser Analyse soll eine Vergleichbarkeit zwischen der Silberlinde und weiteren urbanen Baumarten hergestellt werden, um die erzielten Ergebnisse mit der Tilia tomentosa zu verdeutlichen. Sollten die blattwendenden Baumarten verifizierbare lokalklimatische Auswirkungen auf ihre nähere Umgebung haben, besteht darüber hinaus die Aufgabe darin, diese Erkenntnisse für zukünftige Stadtplanung aufzuarbeiten und in Stadtentwicklungskonzepten bzw. landschaftsplanerische Maßnahmen aufzugreifen, um somit dem Trend der zunehmenden urbanen Überwärmung gezielt entgegenzuwirken.

4.6 „Grüne“ Straßenschluchten

Grundsätzlich gilt für straßenbegleitendes Grün, dass es zur Verbesserung des lokalen Klimas beiträgt und eine luftfilternde Funktion einnimmt [Litschke & Kuttler, 2008]. Aus lufthygienischer Sicht sollte jedoch bei der Auswahl des Straßenbegleitgrüns auf das Kronendach geachtet werden. Ist dieses dicht und geschlossen, erhält man aufgrund des verminderten Luftaustausches ähnliche Schadstoffanreicherungen wie innerhalb einer Straßenschlucht [Errel et al., 2011; Henninger, 2015]. Dies gilt jedoch nur entlang solcher Verkehrswege, die durch ein hohes Verkehrsaufkommen gekennzeichnet sind. Das Projekt „Gefahren am Schulort“ untersucht die Luftqualität im Bereich von Grundschulen. Dabei liegt der Fokus vor allem auf den Standorten, die augenscheinlich aufgrund ihrer Lage nicht als lufthygienisch belastete Räume klassifiziert werden (z. B. Stadtrandbereiche). Dennoch hat sich aufgrund der vor allem morgendlichen Verkehrssituation gezeigt, dass mitunter die suburbanen Grundschulstandorte und deren nähere Umgebung als potenziell lufthygienisch belastet betrachtet werden müssen [Henninger, 2013c].

In vielen Fällen offenbart sich die Kombination aus hohem Verkehrsaufkommen und einem schlechten Austausch innerhalb der bodennahen Luftschicht als dominant-negativer Einflussfaktor. Dies ist wiederum für urbane Schulstandorte im Innenstadtbereich aufgrund der meist engen Straßenschluchten nicht weiter verwunderlich. Jedoch kann dieser Effekt auch an Standorten am Stadtrand oder außerhalb gelegener Stadtteile „im Grünen“ mittels unbefriedigender lufthygienischer Werte nachgewiesen werden. Neben den meteorologischen Parametern werden auch diverse Luftinhaltsstoffe zeitgleich und parallel erfasst, sowohl an urbanen/ suburbanen als auch an ruralen Grundschulstandorten. Dabei haben erste Ergebnisse offen gelegt, dass einige Standorte in den Morgenstunden eine deutliche Erhöhung der Luftschadstoffsituation aufweisen und diese sich auch nur äußerst langsam im Bereich der der bodennahen Luftschicht verdünnt/ verbessert. Besonders auffällig und über mehrere Stunden anhaltend, waren die erhöhten Schadstoffbelastungen an suburbanen Grundschulstandorten, die im Zufahrtsbereich durch Straßenbegleitgrün mit dominant ausgeprägter Kronenfläche der Bäume einen aus Sicht der bodennahen Luftaustauschverhältnisse „grünen" Straßenschlucht-Charakter entstehen lassen. Hierbei zeigt sich, dass diese Verschlechterung der lokalen Austauschverhältnisse vor allem in den Sommermonaten deutlich stärker wirkt als dies an als typische Innenstadtstandorte mit ausgeprägter Straßenschlucht klassifizierte „Hot Spots" der Fall ist [Henninger, 2013c].

4.7 Bodennahes Ozon innerhalb von Grünflächen

Auch wenn die lokalklimatischen Vorteile urbaner Grünflächen hinlänglich bekannt sind besteht durchaus in Bezug auf die Betrachtung solcher Räume ein gewisser Nachholbedarf [Henninger, 2015]. Diverse Baumarten sind in der Lage unterschiedliche Mengen an biogenen flüchtigen organischen Verbindungen zu emittieren [Henninger, 2012b, 2013a, 2014a/b]. Eine dieser Stoffgruppen sind die Isoprenoide. Einige der von der Vegetation produzierten organischen Substanzen dienen u. a. der Abwehr von Herbivoren und Pathogenen oder sie locken Bestäuber an. Des Weiteren wird vermutet, dass das Isopren die Pflanze vor Hitze- bzw. oxidativem Stress schützt [Henninger, 2013a; 2015]. Die Höhe der Emissionsrate der biogenen Kohlenwasserstoffe ist abhängig von den meteorologischen Bedingungen (Blatttemperatur, Strahlungsintensität bzw. Intensität der photosynthetisch aktiven Strahlung (PAR)) und wie diese letztendlich auf den Vegetationsbestand wirken. Demnach sind es vor allem autochthone Wetterlagen, gekennzeichnet durch eine hohe Strahlungsintensität und damit einhergehend hohen Lufttemperaturen, die am besten dazu geeignet sind Isopren an den Pflanzenblättern zu emittieren [Henninger, 2014b; 2015]. Dies bedeutet in einem ersten Umkehrschluss, dass genau an diesen Tagen, an denen ohnehin mit erhöhten Ozonkonzentrationen zu rechnen ist, das biogene Isopren zusätzlich zu einer weiteren Produktion des bodennahen Ozons beiträgt. Und dies innerhalb potentieller urbaner Rückzugs- und Erholungsräume.

Zu den einschlägigen Isopren emittierenden Arten zählen vor allem die Laubbäume (z. B. Eiche (Quercus), Pappel (Populus), Platane (Platanus), Robinien (Robinia), Weiden (Salix)). Nadelbäume wie z. B. die Gemeine Fichte (Picea abies) spielen lediglich eine untergeordnete Rolle. Problematisch ist, dass viele der oben genannten Baumarten als charakteristische Stadtvegetation anzusehen sind. Somit sind meist einige wenige Arten für die Gesamtheit der Isoprenemissionen verantwortlich. Gegenwärtig kann festgehalten werden, dass große Mengen an biogenem Isopren im urbanen Raum trotz einer vergleichsweise eher geringen Vegetationsdichte freigesetzt werden. Dies liegt darin begründet, dass innerstädtische Grünflächen oftmals eine Artenzusammensetzung aufweisen, die nicht zwingend der potenziell natürlichen Vegetation des Standortes entspricht. Ein weit verbreitetes Beispiel ist die Isopren emittierende Baumart der ahornblättrigen Platane (Platanus acerifolia). Sie zählt ursprünglich nicht zu den heimischen Baumarten [Henninger, 2015]. Dennoch wird sie aufgrund ihrer Widerstandsfähigkeit gegenüber Luftverschmutzung sowie einer gewissen Unempfindlichkeit gegenüber verdichtetem Boden vielfach als Straßenbaum sowie in Parkanlagen angepflanzt (Wagner, 2014).

Biogenes Isopren weist gegenüber den anthropogenen Kohlenwasserstoffen ein verhältnismäßig hohes Ozonbildungspotenzial auf. Grund dafür ist die Reaktionsgeschwindigkeitskonstante der Reaktion mit OH-Radikalen. Dies bedeutet, dass Isopren selbst bei geringen Konzentrationen als durchaus ernst zu nehmende Vorläufersubstanz für die Produktion von Ozon angesehen werden kann [Henninger, 2015]. Seit Mitte der 1990er Jahre setzen sich in der planungsorientierten angewandten Stadtökologie bzw. Stadtklimatologie verstärkt die Begriffe der „low-emitter" und „high-emitter"-Pflanzen durch. Für die innerstädtische Grünplanung kann die Berücksichtigung dieser Bäume einen nachhaltigen Einfluss auf die biogene Kohlenwasserstoffemissionsrate und damit auch auf die Ozonbildungspotenziale haben [Henninger, 2013a; 2015]. Dass dieses Thema bisher in vielen Fällen eher stiefmütterlich behandelt wurde ist der Tatsache geschuldet, dass es an einer allgemein gültigen Analysemethodik mangelt und so vor allem eine Übertragbarkeit an andere Standorte nur schwer möglich ist. Sicherlich gibt es mittlerweile eine große Zahl an fachwissenschaftlichen Publikationen, die sich der Thematik widemt (Analysen der

Ozonbildungspotenziale von Stadtbäumen, Straßenbegleitgrün, in innerstädtischer Parkvegetation). Allerdings offenbart sich immer wieder das Defizit, dass die publizierten Emissionspotenziale der Baumarten extreme Schwankungen aufweisen. Die entsprechende notwendige Vergleichbarkeit wird somit erschwert, was letztlich auf zahlreiche standortbedingte Einflussfaktoren zurückzuführen ist (u. a. genetische Unterschiede, Variationen im Alter der Bäume, Variation der Pflanzenarten, Variationen der Blattgröße, unterschiedliche Bodeneigenschaften, Schwankungen der Wasserverfügbarkeit, Variation der atmosphärischen CO_2-Konzentration; Henninger, 2015).

4.8 Nebenwirkungen von bodennahem Ozon

Die gesundheitlichen Nebenwirkungen des Ozons auf den menschlichen Organismus sind unterschiedlich [Henninger, 2012b; 2014b]. In Tabelle 2 sind einige Folgewirkungen aufgelistet und zeigen deutlich, weshalb die durch diverse Pflanzen geförderte Ozonproduktion innerhalb von urbanen Grünflächen ein sensibles Thema darstellt [Henninger, 2013a]. Basierend auf Daten aus den Jahren 2011 bis 2014 konnte nachgewiesen werden, dass es einen offensichtlichen Zusammenhang zwischen Standorten mit einer hohen bodennahen Ozonkonzentration und dem Auftreten von Atemwegserkrankungen gibt, v. a. innerhalb urbaner Park- und Erholungsflächen. Hierbei spielt die Tatsache eine Rolle, dass luftgetragene Allergene (z. B. Blütenpollen) durch die Wirkung des Ozons an Aggressivität gewinnen und mitunter bei bereits vorbelasteten Menschen (Allergiker, Asthmatiker u. a.) zu unerwartet heftigen Reaktionen führen. Besonders kritisch ist diese Entwicklung im Bezug zum Klimawandel zu sehen, da, wie bereits oben beschrieben, die Produktion von bodennahem Ozon durch höhere Umgebungstemperaturen und eine gesteigerte Zahl einstrahlungsintensiver Sonnentage gefördert wird [Henninger, 2012b; 2013a; 2014b].

	Potenzielle Wirkung auf den Organismus
Substanz: Ozon (O_3)	• Vordringen in die unteren Atemwege • Husten, Reizung der Atemwege/ Atembeschwerden, Tränenreiz, Kopfschmerzen • verringerte körperliche Leistungsfähigkeit • Anstieg der Asthmaanfälle • Erhöhung der allergischen Reaktionsbereitschaft = davon betroffen: ~10-20 % der Bevölkerung
Risikogruppe:	Sportler, Personen mit Freiluftarbeitsplätzen, Asthmatiker, Kleinkinder/ Säuglinge

Tabelle 2: Wirkung des bodennahen Ozons auf den menschlichen Organismus [verändert nach Henninger, 2013a].

4.9 Matrix-Methode

Um aus ökologischer und ökonomischer Sicht eine adäquate Aussage über klimaangepasste Veränderungen in einer Stadtstruktur treffen zu können, ist es heute ratsam auf mathematische Simulationen zurückzugreifen. Mithilfe solcher mikroklimatischen Modellierungen können urbane Problem- und Handlungsfelder besser identifiziert und entsprechende Strategien besser abgeschätzt werden. Die Wechselbeziehungen zwischen den unterschiedlichen Klimaelementen und der heterogenen baulichen Struktur im Stadtgebiet sind komplex, sodass es zunehmend schwerer wird zwischen dem Ist- und dem beabsichtigten Planzustand klare Ergebnisse vorherzusagen, v. a. für hochverdichtete Siedlungsräume wie z. B. die Großstädte Asiens [Ringhof & Henninger, 2010; Henninger, 2011c]. Mikroklimatische Simulationsmodelle ermöglichen letztendlich eine Berücksichtigung der verschiedenen Elemente, wie urbane Vegetation und Bebauung, und wie diese in Wechselwirkung mit der Atmosphäre treten. Hierdurch wird eine vorausschauende Planung zur Vermeidung von thermischen oder auch lufthygienischen Belastungsräumen möglich. Aber auch eine Optimierung der bereits vorhandenen Baustrukturen ist denkbar [Bruse, 2000]. Da solche Maßnahmen oftmals sehr zeitaufwendig und kostenintensiv sind, entwickelt die Lehr- und Forschungseinheit Physische Geographie der TU Kaiserslautern die sog. Matrixmethode [Fabisch & Henninger, 2014]. Die stadtklimatischen Modifikationen finden sich nicht nur in großen Städten, sondern sind bereits auf kleinräumiger Ebene zu erkennen. Dabei können schon kleine Veränderungen (z. B.: Temperaturanstieg im Vergleich zum Umland) zu einer erheblichen Beeinträchtigung der Lebensqualität führen und bei Risikogruppen, wie kleinen Kindern oder Senioren, gesundheitliche Probleme hervorrufen. Während große Städte meist die Finanzkraft besitzen diesen Stadtklimaeffekt durch empirische Erhebungen oder komplexe Modellierungen nachzuweisen und zu analysieren fehlen kleinen Gemeinden oft diese Mittel. Eine ökologisch ausgerichtete Siedlungsentwicklung ist allerdings nur unter zur Hilfenahme einer belastbaren Bestandsaufnahme der ökologischen Rahmenbedingungen möglich. Die Kosten von empirische Erhebungen und nummerischen Modellierungen können zwar durch eine Verringerung der räumlichen Auflösungen bzw. der Detaillierung reduziert werden, doch dabei wird die Belastbarkeit der Ergebnisse erheblich verschlechtert. Hier bietet die Matrixmethode eine Möglichkeit für siedlungsklimatische/ -ökologische Untersuchungen auch für kleinere Gemeinden [Fabisch & Henninger, 2015]. Die Intention der Methode beruht auf der Betrachtung von siedlungsökologisch relevanten Indikatoren (z. B. Versiegelungsgrad oder Grünflächenanteil). Diese werden allerdings nicht wie bisher üblich getrennt voneinander betrachtet, sondern in Bezug zueinander gesetzt, sodass die Wirkungszusammenhänge, die zur Ausprägung eines Stadtklimaphänomens führen, berücksichtigt werden. So kann beispielsweise eine Wiesenfläche als potenzielles Kaltluftentstehungsgebiet klassifiziert werden, doch erst eine Hangneigung, mit einer geringen Oberflächenrauigkeit, in Richtung des Siedlungsraums ermöglicht eine stadtklimarelevante Wirkung. Die Bestandsaufnahme der Indikatoren erfolgt anhand eines Rasters mit einer Auflösung zwischen 50 und 100 Metern. Dazu wird ein Fragenkatalog entwickelt, mit dem in einer Smartphone- oder Tablet-App vor Ort zu jedem Raster die benötigten Indikatoren abgefragt werden können. Diese einfache Handhabung ermöglicht es auch Laien die Bestandsaufnahme durchzuführen, um so die Kosten zu reduzieren. Die so gewonnenen Ergebnisse werden in einer Datenbank gespeichert und im Anschluss mithilfe eines Geographischen Informationssystems ausgewertet werden [Allbach et al., 2014; Fabisch & Henninger, 2014; 2015]. Die verwendeten Matrizen erlauben eine Abschätzung der Eintrittswahrscheinlichkeit eines Stadtklimaphänomens aufgrund der verwendeten Indikatoren. Je nach Auswirkung des Phänomens auf den Menschen, kann diese Eintrittswahrscheinlichkeit als positiv oder negativ bewertet werden. Auf diese Weise können Risiko- und Potenzialkarten erstellt werden, die die Gemeinden dabei unterstützen können, eine siedlungsökologisch orientierte Gemeindeentwicklung voranzutreiben und gezielte Handlungsempfehlungen zu entwickeln [Fabisch & Henninger, 2014; 2015].

5 FAZIT UND AUSBLICK

Die angewandte Stadtklimaforschung wird in Anbetracht des rezenten globalen Klimawandels in der Zukunft eine immer größere Rolle spielen. Die Stadt als Wohnort für viele Menschen muss als lokalklimatologischer „Hot-Spot“ bezeichnet werden. Aufgrund der Beeinflussung des natürlichen Ökosystems durch den urbanen Siedlungsraum und die daraus hervorgehenden Problemfelder, wird ein Handeln aus Sicht der Stadtplanung unausweichlich. Dabei gilt es sowohl die klimatischen als auch die lufthygienischen urbanen Belastungsräume zu lokalisieren und zu typisieren, sowie basierend auf den Erkenntnissen mittels geeigneter Klimafunktions- und Planungshinweiskarten entsprechende Gegenmaßnahmen vorzuschlagen. Denn das Wissen und die Kenntnis bezüglich des lokalen Klimas und der daraus resultierenden lufthygienischen Situation sowie deren klimatische Funktionszusammenhänge stellen wichtige Aspekte der Umweltvorsorge und Stadtentwicklung dar. Die beiden Schutzgüter Klima und Luft sind wichtige Bestandteile räumlicher Planung im Abwägungsprozess der Bauleitplanung, Umweltverträglichkeitsprüfungen und entsprechenden Standortuntersuchungen. Ziel einer angewandten und planungsorientierten Stadtklimatologie muss es daher aus klimatischer Sicht sein urbane Problemfelder zu identifizieren und unter Berücksichtigung flächen- und objektbezogener Handlungsfelder immissionsklimatisch relevante Flächennutzungsstrukturen zu sichern, zu entwickeln und wiederherzustellen.

6 LITERATURVERZEICHNIS

ALLBACH, B., HENNINGER, S., DEITCHE, E.: An urban sensing system as backbone of smart cities. In: SCHRENK, M., POPOVICH, V., ZEILE, P., ELISEI, P. [Hrsg.]: REAL CORP: Plan it Smart, pp. 55-64. 2014.

BRUSE, M: Anwendung von mikroskaligen Simulationsmodellen in der Stadtplanung. In: BERNHARD, L., KRÜGER, T. [Hrsg.]: Simulation raumbezogener Prozesse: Methoden und Anwendung. Münster. 2000.

BONGARDT, B.: Stadtklimatische Bedeutung kleiner Parkanlagen – dargestellt am Beispiel des Dortmunder Westparks. In: Essener Ökologische Schriften, Bd. 24, Westarp Wissenschaften, Hohenwarsleben. 2006.

COHEN, P., POTCHTER, O., MATZARAKIS, A.: Daily and seasonal climatic conditions of green open spaces in the Mediterranean climate and their impact on human comfort. In: Building and Environment, 51, pp. 285-295. 2012.

ERELL, E., PEARLMUTTER, D., WILLIAMSON, T.: Urban Microclimate – Designing the spaces between buildings. Earthscan, London. 2011.

CHIFFLARD, P.: Urbaner Wasserhaushalt. In: HENNINGER, S. [Hrsg.]: Stadtökologie. Ferdinand Schöningh Verlag, Paderborn. 2011.

FABISCH, M., HENNINGER, S.: Urban-ecological survey for small settlements. In: Journal of Ecology - Biomedical & Life Science, Vol. 4, pp. 591-600. 2014.

FABISCH, M., HENNINGER, S.: Smartphonegestützte Bestandsaufnahme zur ökologischen Bewertung von Siedlungsräumen. In: SCHRENK, M., POPOVICH, V., ZEILE, P., ELISEI, P., BEYER, C. [Hrsg.]: REAL CORP: Plan Togehter - Right Now - Overall, pp. 561-570. 2015.

HARTZ, A.: Neue Herausforderungen für die Stadtentwicklung – dargestellt am Beispiel des Klimawandels. In: HENNINGER, S. [Hrsg.]: Stadtökologie. Ferdinand Schöningh Verlag, Paderborn. 2011.

HENNINGER, S.: Energieeffizientes Bauen. In: Koblenzer Geographisches Kolloquium, Heft 32, pp. 53-65. 2010.

HENNINGER, S.: Das Klima der Stadt. In: HENNINGER, S. [Hrsg.]: Stadtökologie. Bausteine des Ökosystems Stadt, Ferdinand Schöningh Verlag, Paderborn. 2011a.

HENNINGER, S.: Ökosystemkomplex Stadt. In: HENNINGER, S. [Hrsg.]: Stadtökologie. Bausteine des Ökosystems Stadt. pp. 11-33. Ferdinand Schöningh Verlag, Paderborn. 2011b.

HENNINGER, S.: Improvement of the thermal comfort within dense housing complexes. In: HERBERT, M., JANKOVIC, V., WEBB, B. [Hrsg.]: City Weathers - meteorology and urban design 1950-2010. Manchester Architecture Research Centre, pp. 81-84. 2011c.

HENNINGER, S.: Urban gardening and urban climate. In: IGC – Down to Earth, 32nd International Geographical Congress, Köln. 2012a.

HENNINGER, S.: Biogenic isoprene and its impact on human health in dependence on meteorological conditions. In: Journal of Environmental Protection, Vol. 3, No. 29A, pp. 1206-1212. 2012b.

HENNINGER, S.: Notwendiger Wandel im Umgang mit innerstädtischen Grünflächen? In: JUNKERNHEINRICH, M., ZIEGLER, K. [Hrsg.]: Räume im Wandel - Empirie und Politik, pp. 73-92. 2013a.

HENNINGER, S.: Der urbane Wasserkreislauf - Veränderungen des lokalen Wasserkreislaufs durch Landnutzungsänderungen. In: Praxis Geographie: Alles im Fluss - Ökosystemare Kreisläufe, 01/2013, pp. 14-16. 2013b.

HENNINGER, S.: Endangerments on Schools. In: SCHRENK, M., POPOVICH, V., ZEILE, P., ELISEI, P. [Hrsg.]: REAL CORP: Planning Times, pp. 285-292. 2013c.

HENNINGER, S.: Urban green and health. In: PFAFFENBACH, C., SCHNEIDER, C. [Hrsg.]: Global Demographic and Climate Challenges in the City - An interdisciplinary assessment of impacts, needs and strategies. Aachener Geographische Arbeiten, Heft 50, pp. 115-130. 2014a.

HENNINGER, S.: The Impact of Biogenic Isoprene in Dependence on Meteorological Conditions within Urban Green. In: RAUCH, S., MORRISON, G., NORRA, S., SCHLEICHER, N. [Hrsg.]: Urban Environment - Proceedings of the 11th Urban Environment Symposium, Springer Verlag, pp. 153-162. 2014b.

HENNINGER, S.: Kann innerstädtisches Grün die Luftqualität beeinträchtigen? In: Neue Landschaft - Fachzeitschrift für Garten- und Landschaftsbau, 2, pp. 31-35. 2015.

HENNINGER, S., SAARONI, H.: Numeric simulation of microclimate modifications in a Mediterranean coastal urban park. In: Changes – Challenges – Responsibility, International Geographical Union, Krakau. 2014.

HENNINGER, S., ELMARSAFAWY, H., TOBIAS, K.: Bahrain Regains Greenery. In: Journal of Environmental Protection, Vol. 6, pp. 929-934. 2015.

HORBERT, M.: Klimatologische Aspekte der Stadt- und Landschaftsplanung. In: Landschaftsentwicklung und Umweltforschung - Schriftenreihe im Fachbereich Umwelt und Gesellschaft, Bd. 113. Berlin. 2000.

KUTTLER, W.: Klimatologie. Ferdinand Schönigh Verlag, Paderborn. 2013.

LITSCHKE, T., KUTTLER, W.: On the reduction of urban particle concentration by vegetation - a review. In: Meteorologische Zeitschrift, Vol. 17, No. 3, pp. 229-240. 2008.

MAYER, H.: Workshop „Ideales Stadtklima". In: Mitteilungen der Deutschen Meteorologischen Gesellschaft, Heft 3, pp. 52-54. 1989.

OSWALT, P., RIENIETS, T.: Atlas of shrinking cities. Hatje Cantz, Ostfildern. 2006.

OVERBECK, G., HARTZ, A., FLEISCHHAUER, M.: Ein 10-Punkte-Plan „Klimaanpassung. Raumentwicklungsstrategien zum Klimawandel im Überblick. In: Informationen zur Raumentwicklung, Heft 6, pp. 1-18. 2008.

RINGHOF, E., Henninger, S.: Verbesserung der thermischen Behaglichkeit innerhalb dichter Wohnkomplexe am Beispiel einer südkoreanischen Stadt. In: SCHRENK, V., POPOVICH, D., ZEILE, P. [Hrsg.]: REAL CORP: Cities for everyone: Liveable, prosper, healthy, pp. 889-897. 2010.

VDI - Verein Deutscher Ingenieure: Umweltmeteorologie – Klima und Lufthygienekarten für Städte und Regionen. VDI-Richtlinie 3787, Bl. 1, Düsseldorf. 2015.

WAGNER, P.: Analyse von biogenem und anthropogenem Isopren und seiner Bedeutung als Ozonvorläufersubstanz in der Stadtatmosphäre. In: Essener Ökologische Schriften, Bd. 34, Westarp Wissenschaften, Hohenwarsleben. 2014.

WUNDSAM, T., HENNINGER, S.: Leaf-Turning tree species and their local climatic influence on the city. In: ICUC `09, UCP-13, Toulouse. 2015.

Smart City Supply – Verkehrstechnologien, Güterversorgung und Stadtentwicklung auf dem Weg ins 4.0-Zeitalter

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1 ABSTRACT

Der Planungsansatz Smart City Supply zielt auf die Aussichten, Voraussetzungen und Möglichkeiten für eine Umstellung der Güterversorgung städtischer Siedlungsräume auf eine nachhaltige postfossile Gütermobilität ab, die Null-Emissionen in der urbanen Umwelt verursacht und eine allgemein verträgliche Nutzung der dafür erforderlichen Verkehrs- und Logistikinfrastrukturen gewährleistet. Die Ausgangslage wird von den technologischen Fortschritten bei der Digitalisierung der Warenflüsse, der Automatisierung der Transportläufe und der Elektrifizierung der Transportketten geprägt. Derartige Logistikprozesse müssen in die strukturelle Vielfalt der Stadtlandschaft eingebaut und an die Nachfrage in der Gütersenke angepasst werden.

Keywords: Paradigmenwechsel, städtische Strukturtypen, Stadtentwicklung, Verkehrstechnologien, postfossile Gütermobilität

1.1 Auslaufstandorte und Nachnutzung

Die folgenden Ausführungen bilden zugleich Zusammenschau und Ausblick aufgrund von Forschungsprojekten des Büros der Autorinnen und Autoren der letzten Jahre zum Thema Gütermobilität aus dem Blickwinkel von Technologieentwicklungen und von Raum- und Verkehrsplanungsaspekten. Dabei stellte sich heraus, dass die eingeübten Planungsprozesse und die üblichen Planungsinstrumente mit den technologiegetriebenen Zukunftsaussichten nur schwer zu Rande kommen. Es setzt sich die Erkenntnis durch, dass nicht mehr für eine “Ewigkeit” gebaut und genutzt wird. Großflächige Konversionen brachgefallener Industrie- und Lagerflächen oder aufgelassener Eisenbahngelände machen Nachnutzungskonzepte erforderlich, die in die Stadtlandschaft eingepasst werden müssen. Doch wird dann das Kind mit dem Bad ausgeschüttet, wenn die bisherige Logistikorganisation und die Bewirtschaftung solcher Umschlagstandorte zwar mittlerweile unrentabel geworden sind und daher aufgelassen werden, der Versorgungsbedarf der Stadt aber grundsätzlich bestehen bleibt und die Waren und Betriebsmittel weiterhin in die urbane Gütersenke geliefert und dort verteilt werden müssen (DÖRR, 2001, 2014).

Standortverwertung und Stadtentwicklung

Die Weiterverwertung von überholten Standorten im flächenknappen Stadtgebiet lässt einerseits privatwirtschaftliche Renditeerwartung und andererseits stadtpolitische Hoffnungen auf die Attraktivierung des Stadtteiles aufkommen, die die neuangesiedelten Wählerinnen und Wähler honorieren sollen. Unter diesen Umständen haben stadtdienliche, aber in der Öffentlichkeit wenig wahrgenommene oder gar als störend empfundene Funktionen, wie die Versorgung mit Gütern oder handwerkliche Dienstleistungen, kaum eine Chance, entsprechende Standorte oder Einmietungsflächen zu ergattern. Diese werden nach und nach in den städtischen Servicegürtel verdrängt, der die früheren Industriegürtel im Vorfeld der historischen Stadtgebiete abgelöst hat, oder im innerurbanen Gebiet zumindest räumlich marginalisiert (HÖRL, WANJEK, 2013).

In den Stadtteilentwicklungskonzepten dominieren die Maßnahmen zum Tiefbau (Leitungs- und Verkehrsinfrastruktur), Hochbau (Wohnbau und Folgeeinrichtungen) und Freiraum. Weitergehende Überlegungen werden oftmals der Initiative der Developer (Bauträger u.ä.) überlassen, die verständlicherweise mit dem Rechenstift im Sinne von Return on Investment agieren. Werden einzelne Modellprojekte der Stadtteilentwicklung unter dem Motto Smart City promotet, dann stehen technische Leistungsbilder, wie 5-G-Netze, Nullenergiehaus oder Nullemissionen, im Vordergrund, deren Betrieb dann aber nicht weiter einem Erfolgsmonitoring unterzogen wird.

Sollen alle Zukunftstechnologien für alle Bevölkerungsgruppen prinzipiell zugänglich und erschwinglich nutzbar sein, sind auch ihre Flächen- und Raumansprüche, vor allem in Hinblick auf ihre Netzdichten für die Flächenabdeckung, in die stadtplanerischen Entwicklungskonzepte einzubauen. Womit in den partizipativen

Planungsprozessen sowohl auf gesamtstädtisch-strategischer Ebene als auch auf Ebene der Restrukturierungs- und Expansionsvorhaben eine Fülle von Akteuren anzusprechen sein wird, die sich nicht immer in ihre Entscheidungsbereiche und Eigentumshoheiten hineinregieren lassen.

Die verschiedenen von den Anbietern des Warenhandels gepushten Konsumbedürfnisse (wie "same day delivery") lassen auch die Grenzen zwischen öffentlichem, halböffentlichem und privatem Raum verschwimmen, wenn in der Tiefgarage in den Kofferraum des Autos oder vielleicht mit der Drohne auf die Terrasse geliefert werden wird. Diese Vermarktungsvorstellungen könnten einen Druck auf die Neuordnung der Räume unter Niveau, an der Oberfläche und sogar im nahen Luftraum auslösen. Darin liegt eine Herausforderung, nämlich eine zunehmend grenzenlose Kommerzialisierung der Räume jeden Maßstabs und die Funktionalisierung der Stadtbevölkerung mit dem Argument der Nutzenstiftung durch smarte Technologien nicht bedingungslos gewähren zu lassen, sondern damit demokratisch und bedachtsam umzugehen. Schließlich stehen Nutzungsfreiräume, Privatsphäre oder Barrierefreiheit möglicherweise zur Disposition, wenn sie mit der behaupteten Smartness in Konfrontation geraten sollten.

2 TECHNOLOGISCHE ANGEBOTE AUF DEM WEG ZUR POSTFOSSILEN MOBILITÄT

2.1 Nachhaltige Mobilität für die urbane Gütersenke

Dazu sollen die Einsatzformen der relevanten Technologien der Generation 4.0 entlang konsumrelevanter Transportketten auf dem Weg bis zu den Orten des Verbrauches identifiziert werden. Dazu zählen die Antriebsformen der in Frage kommenden Transportmodi (einschließlich der aktiven Mobilität) und die dafür nötige Energieversorgungsinfrastruktur, die Ausrüstung mit Sensor- und Steuerungstechnologien für eine sinnvolle Automatisierung der Transportmittel, die Ausstattung mit Robotik für die Umschlagprozesse bis zur Letzten Meile und schließlich die räumlichen Möglichkeiten für Anlieferstationen, um diese an den Empfangsorten in verschiedenen städtebaulichen Strukturen, ob altstrukturiert oder neu geplant, unterbringen zu können und konfliktfrei mit anderen Nutzungsbedürfnissen wirksam werden zu lassen.

Gewöhnlich wird gefragt, welche Leistungsmerkmale bestimmte Fahrzeug-Technologien und Typen von Transportmitteln sowie die Digitalisierung der Prozesse zur Produktivitätssteigerung der Gütermobilität beitragen und welche Kapazitäten für Gütertransporte die Verkehrsinfrastruktur dazu bereitstellt. Weniger Beachtung finden außerhalb der öffentlichen und vor allem der proprietären Quell- und Zielstandorte von Güterlieferungen die benutzten Verkehrskorridore und noch weniger die den Versorgungsbedarf auslösenden physischen und demographischen Stadtstrukturen. Es sei daher die umgekehrte Fragestellung beleuchtet, welche Handlungsoptionen und Realisierungschancen sich aus unterschiedlichen städtischen Strukturtypen ergeben und wie mittels kommunalem Flächenmanagement diese Potenziale für eine nachhaltigere urbane Gütermobilität gehoben werden können. Allerdings, ohne dass dabei den Kommunen noch weiter ungebührliche Lasten, z.B. für die digitale Aufrüstung ihrer Verkehrsinfrastruktur, aufgebürdet werden.

Um Zero-Emission in der Logistik für die Stadt zu realisieren, bedeutet das, über die Einrichtung vollelektrifizierter (einschließlich der wasserstoffgestützten Brennstoffzellentechnologie) Transportketten nicht nur nachzudenken, sondern die schon heute gegebenen Anknüpfungspunkte herauszufinden und Strategien zu deren Ausnutzung zu entwickeln, die über Insellösungen und verstreute Best Practices hinausgehen. Hier kommt der Aspekt der Flächenvorsorge und der Infrastruktursicherung ins Spiel, damit nicht im kommenden dritten Jahrzehnt, wenn die Technologien für die postfossile Mobilität ausgereift sein werden, die infrastrukturellen Standortgelegenheiten im gewachsenen Stadtgebiet für ihre Implementierung zum Teil verspielt worden sind. Gerade Altstandorte haben diesbezüglich oftmals Konversionspotenzial, wenn sie unter den Zielaspekten der Nachhaltigkeit und den Optionen hierfür geprüft werden. Solche sind:

- Niedrigenergieverbrauchende Logistikgebäude und Umschlaginfrastruktur
- Ressourceneffiziente Produktionsprozesse in der Gütererzeugung, in den Logistikdienstleistungen und im Gütertransport (nachhaltiges Supply Chain Management)
- Dezentralisierte Ad-hoc-Fertigung von Waren („digitale Manufakturen" mittels CIM, 3-D-Druck)
- Emissionsreduzierte Antriebstechnologien (Elektrifizierung bzw. Hybridisierung der Kraftfahrzeuge und der Flurfördertechnik)
- Emissionsfreie Formen der Gütermobilität (Lastenfahrräder, Zustell-Roboter, Liefer-Drohnen)

- Informelle Vernetzungstechnologien (Kommunikation zwischen Akteuren)
- Interaktive Vernetzungstechnologien (Interkonnektivität im Internet der Dinge durch 5-G-Netze)
- Intelligente Leitungs- und Verkehrsnetze, einschließlich von Stadtmobiliar (wie Lichtsäulen)

2.2 Technologien 4.0 als Entwicklungstreiber

Die 4.0-Technologien im Logistik- und Mobilitätsbereich stellen Anforderungen an die Anwendungsräume, -subjekte und -objekte und deren Adaptibilität in technischer und sozialer Hinsicht. Hierzu sollte beachtet werden, sich nicht nur von den idealisierten Ansprüchen der Technologien an die Anwendungskreise (angekündigter „Kundennutzen bzw. „Use cases") leiten zu lassen, sondern immer eine Art Gerechtigkeit bei der Aufteilung des Fortschrittes im Auge zu behalten und auch traditionellere Strukturen, wie den stationären Handel in Geschäftsstraßen, nicht gänzlich für obsolet zu erklären, um nicht Bevölkerungsgruppen (z.B. ältere Generation, Mehrkinderfamilien) und ihre „Habitate" zurückzulassen.

Als visionäres Endziel werden von der einschlägigen Industrie sogar die fahrerlose Fahrzeugbewegung im Verkehrsnetz und die personallose Zustellung der Ware am Empfangsort angepeilt, damit Arbeitskosten eingespart werden können. Die Fragen der Entstehung externer Kosten anderswo und der Einschränkungen der individuellen Bewegungsfreiheiten im Wohnquartier wurden bisher noch nicht ausreichend thematisiert (ERTRAC, 2015 siehe ALICE).

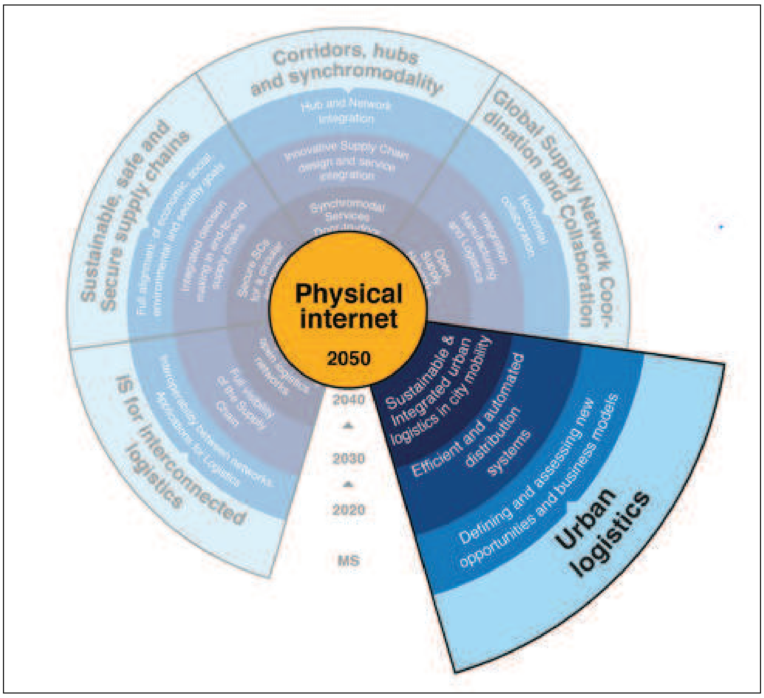

Abbildung 1: Road Map zur Automatisierung der urbanen Güterversorgung (Quelle: ALICE, 2015)

2.2.1 Güterproduktion und Transportsysteme

Die Güterproduktion ist heutzutage zumindest in ihrer industriellen Ausprägung von einer feinteiligen geographischen Arbeitsteilung geprägt, nicht nur um regionale Kompentenzvorteile („Cluster") zu nutzen, sondern vor allem auch um Arbeitskosten zu sparen. Das sorgt zwar in gewissem Maße für eine transregionale bis globale Wohlstandsverteilung, ist aber jedenfalls mit steigenden Transportleistungen verbunden. Die Globalisierung ermöglicht ubiquitär breit gefächerte Warenangebote, zumindest wenn die Kaufkraft der Konsumenten das auf den Absatzmärkten zulässt. Die weltweite Vernetzung der elektronischen Einkaufssysteme beschleunigt diesen Trend und führt bei trendigen Konsumgütern zu einem beträchtlichen Ausmaß an Retouren, was eigene Logistiksysteme erforderlich gemacht hat. Diese Art von scheinbarer Paarigkeit von Güterverkehren belastet unsere Verkehrsinfrastruktur und Umwelt noch zusätzlich.

Es hat im Übrigen auch die raumordnerischen Versorgungskonzepte der Zentralen Orte heftig erschüttert, deren hierarchische und territorial-monopolistische Strukturen freilich schon lange als "outdated" gelten. Wenn die Transformation in die 4.0-Generation Hoffnungen erweckt, dann, dass der Ressourcenverbrauch

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durch das Wachstum auf den Angebotsmärkten wegen der produktivitätsgesteigerten Herstellungsverfahren mit der Bedürfnisdeckung der Nachfragemärkte in ein nachhaltigkeitsgerechtes Gleichgewicht gebracht werden kann. Vorläufig scheint die Digitalisierung der Gütermärkte eher das Gegenteil zu erzielen, wenn man an die Erleichterung von Fehlallokationen denkt, wenngleich diese zu vermeiden, damit ebenso ermöglicht wird. Je nach Systemabgrenzung zeigt sich dabei die Ambivalenz technologischer Fortschritte.

2.2.2 Rahmenbedingungen der Konsumkultur für die Logistikdienste

Es handelt sich einerseits um die Anforderungen der Gütersenke an die logistische Bedienung, die sich aus dem Versorgungsbedarf und der Güternachfrage der Bevölkerung und der Wirtschaft im Wohnquartier, Baublock, Stadtteil etc. ergeben. Diese Anforderungen werden von der soziodemographischen Zusammensetzung der Bewohnerschaft und vom Wandel in den Lebensstilen und Konsumgewohnheiten geprägt, sind also Veränderungen unterworfen. Daher ist der sozialräumlichen bzw. bausozialen Segregation in der Stadtlandschaft mit Auswirkungen auf die Bedienungsanforderungen Rechnung zu tragen. Trendige Innenstadtquartiere, hoch belegte Gründerzeitviertel, am Stadtrand gelegene Plattenbausiedlungen mit Freiflächenpotenzial und noble Villenviertel mit hohen Sicherheitsbedürfnissen prägen unterschiedliche Voraussetzungen für die Warenversorgung aus. Sollen neue nachhaltige Formen der Stadtlogistik erfolgreich etabliert werden, sind folgende Analyse- und Zielfelder zu beachten:

- Spezifische Nutzen-Faktoren der Lebensqualität: Betrifft die Wohnbevölkerung mit ihren soziodemographischen Merkmalen, aus denen Versorgungsbedürfnisse ableitbar sind, aber auch deren Bedürfnisse nach einer freien Entfaltung der aktiven Mobilität und nach Bewegungsfreiheit des Individuums in seinem Wohnumfeld, die weiterhin zu gewährleisten sind.
- Bau- und Verkehrsinfrastruktur: Betrifft das städtebauliche Gerüst der öffentlichen und privaten Flächen und Standorte, auf denen den technologischen Ansprüchen der künftigen Güterversorgung Priorität eingeräumt werden kann oder aber Regulierungen wirksam werden sollen.
- Versorgungsstruktur: Dabei handelt es sich um Umschlags-, Verteilungs- und Empfangsorte des Endverbrauches als räumliches Netzwerk, das mit angepassten Transportmitteln bedient wird.
- Organisationsstruktur: Die verkehrslogistischen Betriebsmodelle und deren Trägerschaften sowie deren Zusammenwirken sind im Zuge der Projektentwicklung abzuklären und vertraglich abzusichern.

3 STATIONEN DER GÜTERVERSORGUNGSKETTE BIS IN DIE URBANE GÜTERSENKE

Logistische Transportketten werden hauptsächlich aus dem Blickwinkel der betriebswirtschaftlichen Prozesse und Parameter betrachtet und in diese Richtung optimiert. Auch die dafür frequentierten Standorte werden fast ausschließlich nach ihrer Flächenproduktivität beurteilt, ohne dass externe Effekte mit in die Bewertung mit einbezogen würden. Es verwundert daher nicht, dass in Hinblick auf die Rent-Paying-Ability auf dem Bodenmarkt als ausschlaggebend für die Standortentscheidungen die umweltverträglichen und stadtdienlichen Logistikstandorte gegenüber den wirtschaftlich lukrativeren und politisch opportuneren Nutzungen den Kürzeren ziehen, wenngleich den Planungsträgern der Stadtentwicklung regulative Spielräume in der Flächenwidmungs- und Bebauungsplanung zur Verfügung stünden (BVL, 2014, 56ff).

3.1 Stationen vom regionalen Warenempfang bis in die Bedienräume der Gütersenke

Gerade die ersten und letzten Meilen im umwelt- und verkehrsbelasteten Stadtgebiet stellen eine Schwachstelle in der Nachhaltigkeits- und Klimabewertung von Gütertransportketten dar. Gleichzeitig ist ein starker Trend der Stadt- und Standortentwicklung zu beobachten, die Umschlagpunkte zwischen Fern- und Verteilverkehren straßenaffin weit ins Umland der Kernstädte hinaus zu verlagern, die innerstädtischen Güterverkehrsanlagen der Bahn aber aufzulassen, damit sie der lukrativen Immobilienverwertung zugeführt werden können. Der Preis dieser Raumentwicklung ist immer mehr die „Stadt der langen Güterwege“, weil die Fahrleistungen und die Nutzlastkapazitäten im Distributionsverkehr innerhalb der Kernstadt und in der Stadtregion, wie KEP-Dienste zeigen, zunehmen. Der ehedem dezentralisierte Güterumschlag schien damit endgültig verschwunden zu sein (DÖRR, 2014). Aber es gibt zaghafte Anzeichen für eine Trendumkehr, wo es räumlich noch machbar ist. Projekte, die diesen Paradigmenwechsel markieren, sind gegenwärtig in Paris im Zusammenspiel von Staatsbahn, Logistikterminalbetreibern und der Stadtverwaltung in Realisierung.

3.1.1 Points of Cross Docking and Deconsolidation (PoCD)

An diesen Logistikknoten in der Gütertransportkette erfolgen die Anlieferung der Waren von den einzelnen Produzenten und der Empfang durch den Warenhandel für die Endkommissionierung zu den Empfangsorten in der Gütersenke des Endverbrauchs. Diese Zentralläger sind durch Standortkonzentration immer weiter ins Umland gewandert, wo sie an den Autobahnkreuzen angesiedelt worden sind. Allerdings wird diese räumliche Standortverteilung in der Logistikorganisation angesichts der getätigten Investitionen und wegen des Flächenmangels in den Innenstädten, wo der Wohnbau und die Bürokomplexe die früheren Standorte der Güterversorgung okkupiert haben, nicht so leicht umgedreht werden können (z.B. DÖRR, 1996).

Nunmehr eröffnen die intelligenten Logistik-, Fahrzeug- und Verkehrstechnologien neue Chancen, den Güterverkehr auf umweltschonendem Wege wieder in die städtische Gütersenke zu transportieren und dort flächensparende Transferanlagen in die Stadtentwicklungsprojekte integrieren zu können, wenn sich die Akteure darauf einlassen mögen. Das Logistik-Modell Chapelle-International in Paris der staatliche Bahngesellschaft SNCF und des Logistikterminalbetreibers SOGARIS wird bald in der Praxis zeigen können, ob das Modell zukunftsfähig sein wird (s. Kap. 5).

Dabei kann die Dekonsolidierung im Zuge des Cross Dockings durchaus in den Zentrallägern des Handels, die im weiteren Umland oder, wie heutzutage schon vielfach anzutreffen ist, „mittig“ zwischen den Ballungsräumen angesiedelt worden sind, erfolgen. Der Antransport in die städtische Gütersenke kann gebündelt, aber mit bereits endkommissionierten und zielrein verladenen Warensendungen zu den einzelnen Empfangsorten im Schienen-Pendelverkehr zu innenstadtaffinen Transferpunkten (PoUT) erfolgen, von wo die Sendungen in entsprechend standardisierten Behältern und Ladungsträgern (z.B. Halbwechselbrücke mit Düsseldorfer Halbpaletten) in stadtverträgliche emissionsfreie Distributionsfahrzeuge im Just-in-Sequence-Verfahren weitgehend automatisiert umgeschlagen werden. Die Integration in ein multifunktionelles Stadtentwicklungsprojekt ist die zweite hervorzuhebende Besonderheit dabei und unterstreicht damit die Bedeutung eines akteursübergreifenden Flächenmanagements.

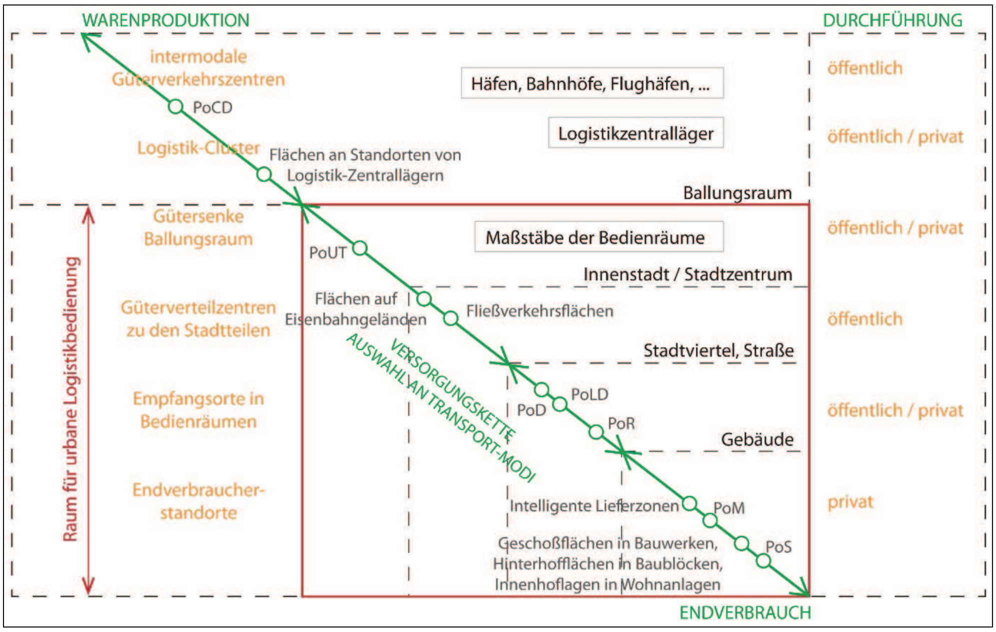

Abb. 2: Stationen der Transportkette der urbanen Güterversorgung (Quelle: aus AFILOG, 2012, weiterbearbeitet Y. TOIFL)

3.1.2 Points of Urban Transhipment (PoUT)

Der Antransport der Waren erfolgt im Ganz-Zug, wenn eine Schienenanbindung reaktiviert oder hergestellt werden kann, oder, wenn das nicht geht, im emissionsminimierten Lkw-Zug-Konvoi (z.B. künftig mittels Platooning-Fahrweise, wo ein Führungsfahrzeug andere Lkw ohne Fahrer ins digitale Schlepptau nimmt) sowie allenfalls mit dem Binnenschiff in festgelegten Zeitfenstern und auf kapazitätsoptimierten Fahrwegtrassen mehrmals täglich im Pendelverkehr von den in der Stadtregion außenliegenden Logistik-Zentrallägern im Umland in die innerstädtischen Umschlagstationen, wo die bereits zielrein vorsortierten Versorgungsgüter auf stadtverträgliche Lieferfahrzeuge automatisiert verbracht werden, die unverzüglich ihre Liefertour in den Bedienraum starten.

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3.1.3 Points of Local (decentralized) Distribution (PoLD)

Es handelt sich um Standorte, wie Frei-, Verkehrs- oder Gebäudeflächen, denen ein Potenzial für eine dezentralisierte Logistikbedienung und Warenverteilung für einen urbanen Bedienraum innewohnt. Schließlich erfüllen auch die beliebten Bauernmärkte solche Versorgungsfunktionen neben der Marktkonzentration auf wenige Anbieter im Lebensmittelhandel. Dazu kommt die spontane und individuelle Haushaltsanlieferung durch einen lokalen Distributeur (à la Pizza-Service) und die kurzfristige Zustellung durch den Lebensmittel-Internet-Service von Handelsketten.

Empfangsorte auf der Letzten Meile und den „letzten Metern“ bis zum Endverbrauchsort

3.1.4 Points of Sale (PoS)

Sie sind als Geschäftslokale unterschiedlicher Verkaufsflächengröße und Warensortimente eindeutig lokalisierbar, weil prinzipiell jeder Laufkundschaft öffentlich zugänglich. Ihre Standortfeststellung kann am besten über die Homepages des Handels erfolgen (s. Abb. 3). Ihre Flächenausmaße müssen bei kleineren, in gemischt genutzten Gebäuden (v.a. Lage im Geschäftssockel) angesiedelten Lokalen abgeschätzt werden; können aber hingegen bei größeren solitären Handelsstandorten über Geoinformationen (wie Bodennutzungskartierung) ermittelt werden. Aus der Verkaufsfläche und dem Warensortiment kann ungefähr auf die Lieferfrequenzen und die eingesetzten Nutzfahrzeugtypen rückgeschlossen werden, ohne betriebsvertrauliche Daten abfragen zu müssen.

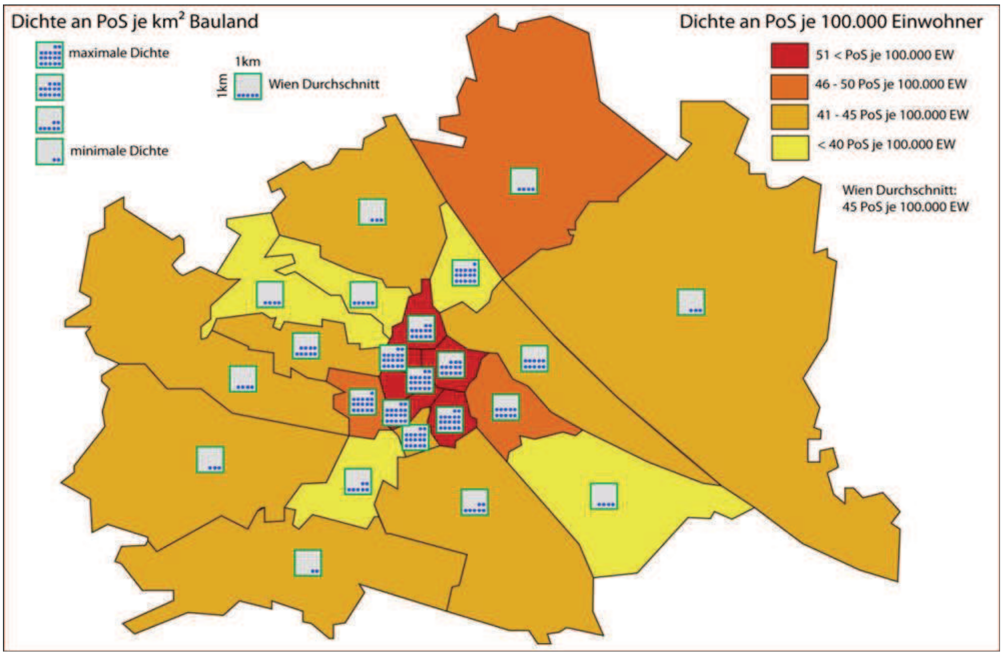

Abb. 3: Die Verteilung der Points of Sale für die Gütersenke Lebensmittelhandel in Wien (Quelle: EFLOG, 2014, 23)

3.1.5 Points of Deliveries (PoD)

Das sind Orte unregelmäßiger individueller Anlieferungen an Haushalte, Gewerbebetriebe und ähnliche Empfänger. Diese Daten sind datengeschützt, aber anhand von Haushaltdichten in den Baustrukturen abschätzbar. Allerdings gibt es eine Vielzahl an KEP-Diensten, die dieselben Lieferbezirke in Konkurrenz bedienen, sodass eine gewisse Bündelung der Fahrleistungen und der Hinterlegungen der Sendungen (Site-Sharing) im Sinne einer nachhaltigen Gütermobilität und einer Minderung von Belästigungseffekten sinnvoll wäre. Das könnte eine Wiederbelebung von City-Logistik-Konzepten aus den 1990er-Jahren bedeuten.

Dazu kann das im EFLOG-Projekt entwickelte Indikatoren-Konzept zur transportökologischen Bewertung in der Flächenbedienung in zweierlei Hinsicht dienen: Erstens der Standortfeststellung der Anfahrbarkeit von geeigneten Flächen in der Stadtstruktur, die für eine Neuorganisation der emissionsarmen Wegeketten für Bedienfahrten gebraucht würden und zweitens der Nachhaltigkeitsüberprüfung, welche Antriebstechnologie in welchem Nutzfahrzeugtyp bei der jeweiligen verkehrslogistischen Aufgabe (z.B. Lebensmittelversorgung, Paketdienst) dem am besten gerecht werden kann (DÖRR et al. 2014, 195ff & Anhang).

3.1.6 Points of Manufacturing (PoM)

Dies sind weiterhin nicht zu unterschätzende urbane Standorte der gütererzeugenden, weiterverarbeitenden, installierenden oder reparierenden Wirtschaft der Industrie, des Gewerbes oder des Handwerks, etwa der Bauwirtschaft und des Baunebengewerbes, die in unterschiedlichem Umfang einen Nutzfahrzeugpark betreiben und Vorprodukte und Materialien für ihre Produktionen und Dienstleistungen sowohl bedarfsgerecht beziehen als auch kundengerecht ausliefern. Ein noch kaum abschätzbares Potenzial wird die Produktionstechnik des 3-D-Druckens bieten, welche in gewisser Weise als „digitale Manufakturen“ mit relativ geringen Flächenansprüchen und begrenztem Logistikaufkommen zu einer urbanen Reindustrialisierung 4.0 beitragen könnte. Vielleicht werden dadurch für bestimmte Warengruppen große zentrale Ersatzteillager obosolet, weil dezentral maßgeschneiderte Einzelteile (wie einst beim Schmied) kurzfristig hergestellt werden können.

3.1.7 Points of Recycling (PoR)

Da Städte schätzungsweise ein Mehrfaches an Gütertonnen importieren als sie exportieren, ist die Frage der Organisation des Recyclings von Wertstoffen und der Verwertung von Reststoffen ebenso eine verkehrslogistische Herausforderung, die sowohl in kommunaler als auch in privater Verantwortung wahrgenommen wird. Bei diesem hohen Materialdurchsatz der städtischen Gesellschaft und Wirtschaft sind die lokalen Sortierungs- und Aufbereitungsverfahren, die Abholungs- und Verbringungsprozesse ebenso ein Thema für eine emissionslose und (teil-)automatisierte Verkehrslogistik aus der Gütersenken hinaus. Nicht zuletzt hat der Entsorgungssektor bereits mancherorts eine Pionierrolle bei der Umstellung von Nutzfahrzeugflotten auf emissionsreduzierte Antriebe gespielt.

Das Wechselspiel von Entsorgungsstationen im Stadtquartier mit der Tourenplanung der Abholung birgt reiche Erfahrungen auch für eine ähnliche Systematisierung künftiger Lieferprozesse, stellt aber auch eine weitere Anforderung, nämlich den Material-Input in die Gütersenke und den Material-Output aus der Gütersenke koordiniert zu betrachten und konzertiert räumlich in der Fläche zu organisieren, um gegenseitige Behinderungen gering zu halten. Freilich können Warenanlieferungen und die Wertstoffabholung im Regelfall nicht mit denselben Fahrzeugen geschehen. Aber die Retourenlogistik von nicht verkaufter Ware oder deren Gebinden und Verpackungen sehrwohl.

Hierbei steckt noch Potenzial in der digitalen Vernetzung der Distributions-, Retouren- und Wertstoff-Logistiksysteme mit der Fahrzeugdisposition der Fuhrparkhalter über automatische Inventory-Systeme an den genannten Funktionsstandorten. Sind die Standorte dezentralisiert im Stadtgebiet verteilt, um die Stadt der kurzen emissionsfreien Wege zu ermöglichen, ist ein übergeordnetes Ein- und Ausfahrmanagement für die Touren innerhalb von beengten Altbaugebieten anzudenken. Dabei stellen Kontingentierungen der Lieferzeiten, die eine Lieferzonenreservierung beinhalten, kontrolliert mittels Geofencing eine Option dar.

4 ANTIZIPATIVE PLANUNGSSTRATEGIEN ZUM FLÄCHENMANAGEMENT

4.1 Potenziale der Standorte (= Intelligenz des Monitorings)

Die in einem Flächen-Surveying und -Monitoring einzubeziehenden Objekte, wobei die räumlichen Anforderungsprofile der antizipierten Technologiesprünge und der prognostizierten Trends der Endverbrauchs-Gewohnheiten die Prüfkriterien darstellen, sind:

- Geschoßflächen in Bauwerken nach ihrem Nutzungsgrad und Entwicklungspotenzial (leerstehend, mindergenutzt, mit Nutzungspotenzial für urbane Logistikzwecke bzw. für Gütertransporte der postfossilen Mobilität), wie vor allem:
- Flächen im straßenseitigen Geschäftssockel von gemischt genutzten Gebäuden
- Flächen in Wohnhäusern zur dezentralisierten Anlieferung und Kurzzeitlagerung (z.B. Umbau nicht mehr gebrauchter Kellerabteile oder Anbau von Paketboxen an nachgerüsteten Lifttürmen bei älteren Gemeindebauten)
- Flächen in Wirtschaftsimmobilien an Logistikstandorten
- Flächen in Wirtschaftsimmobilien anderer Nutzungen (wie ehemalige Produktionshallen, Lager-
- häuser, Garagen)

- Generell „Hoffnungs“-Flächen, die bislang für die Anlieferung noch nicht angedacht wurden, wie die Dachlandschaft oder Innenhöfe für allfällige Drohnen-Landungen etc.
- Hinterhofflächen in Baublöcken für Innenanlieferungen von Points of Sale aus
- Innenhoflagen in Wohnanlagen für gebündelte Individualanlieferungen der KEP-Dienste
- Flächen auf Eisenbahngeländen mit aufgelassenen Güterumschlagfazilitäten zur Restrukturierung
- Flächen an Standorten von Logistik-Zentrallägern an den Bruchpunkten zum Fernverkehr

Als Monitoring-Instrument für die Standort- und Flächenansprüche künftiger Zero-Emission-Zonen einerseits und für ebensolche Transportlösungen kann eine GIS-fähige Systematik für das Auffinden, Sichern und Ausstatten solcher räumlicher Infrastrukturen bzw. Stützpunkte aufgestellt werden. Weil diese für die Durchsetzung eine systematische Dichte zur Nutzung durch Fuhrparkbetreiber, wie beim Einsatz von E-Fahrzeugen aller Art, brauchen, die durch eine strategische Vorausplanung abgesichert werden muss. Die üblichen Realnutzungskartierungen verzeichnen solche Infrastrukturen und Stützpunkte erst, wenn sie in Betrieb gehen. Die prinzipielle Eignung und die potenzielle Verfügbarkeit muss aber vorweg systematisch (d. h. flächendeckend und zweckorientiert) auf der jeweiligen Maßstabsebene festgestellt werden.

Abb. 4-9: Hoffnungsstandorte in Berlin (am mittlerweile wiederhergestellten Südring), Brüssel (ehemaliger Güterterminal Thurn&Taxis), Paris (ehemaliger Bezirksgüterterminal Les Gobelins am eingestellten Güterring Petite Ceinture-Sud); Wien (Güterhallen am Westbahnhof und am Franz-Josefs-Bahnhof) und Warszawa-Wola (Containerumschlagstation)

4.2 Intelligenz der Infrastruktur

Dazu ist die Ausarbeitung einer zweckgerichteten Flächen- bzw. Standortkategorisierung nützlich, die der Flächenvorsorge und der Ausbauplanung (wie einer Rückverdichtung im lokalen Versorgungsnetz) dienen soll. Die Ausbauplanung könnte dabei mit der territorialen Abgrenzung bzw. Gebietsausweisung mittels geeigneter Überwachungs- und Lenkungs-Technologien („Geofencing“) verknüpft werden. Das bedeutet, individuelle Fahrzeugbewegungen im proprietären Logistikeinsatz in ausgewiesenen Lieferzonen werden künftig informativ oder zentral regulierend gesteuert werden, um eine gleichmäßige Kapazitätsauslastung der für die Verkehrslogistik beanspruchten Infrastruktur zu gewährleisten. Elemente der verkehrslogistischen Infrastruktur, die in Hinblick auf eine technologische Aufrüstung ins Auge gefasst werden können, sind:

- Fließverkehrsflächen auf den Zulauf- und Bedienrouten mit Ausstattungsbedarf, wie Induktionsaufladung von E-Fahrzeugen auf speziellen Fahrstreifen, H2- und LNG/CNG-Tankstellen, Wartezonen bei Einfahrtskontingentierung in Bediengebiete, Vorzugsspuren für stadtdienliche Verkehre etc.
- Standards für die straßenbauliche und logistiktechnische Gestaltung der Zufahrtssituationen zu den Zielpunkten des Güterempfanges für Lieferfahrzeuge mit alternativen Antrieben (z.B. auf Vorzugsstreifen und E-Ladestationen an der Rampe und in einem Innenhof)

- Intelligente Lieferzonen auf öffentlicher Verkehrsfläche oder privatem Grund (mit Bordstein-Belegungserkennung und Fahrzeugerfassung für die Anfahrbarkeitsregulierung bzw. Lieferzonen–Bewirtschaftung, z.B. über GPS oder mittels RFID-Transponder) u.a.m.

4.3 Fazit zur Standortaktivierung für postfossile Gütermobilität in europäischen Metropolen

Legt man die genannten Ziele und die angeführten Prüfkriterien einer Standortwahl für eine künftig emissionsfreie Innenstadt-Logistik zugrunde, so erweisen sich in vielen Metropolen etliche Stadtbrachen mit einer Vergangenheit im Güterumschlag als geeignete Hoffnungstandorte für ein „Reshifting2Rail“, weil sie Innenstadtaffinität, dichte Konsumnachfrage im Umfeld, Bahnanschluss und Verkehrsnetzeinbindungen, eine ausreichende Flächenerstreckung für die Logistikdienste, aber auch Möglichkeiten für eine multifunktionale Stadtteilentwicklung anbieten würden. Die Fallbeispiele aus Paris mögen das untermauern.

5 SHIFT2RAIL IN PROJEKTEN DER STADTTEILENTWICKLUNG IN PARIS

5.1 ZAC Clichy-Batignolles

Diese als Zone d´aménagement concertée (ZAC) akteursübergreifend komprimierte Stadtteilentwicklung findet auf früheren Eisenbahnanlagen statt und gehört zum städtbaulichen Restrukturierungsprogramm für die nördlichen Stadtbezirke der Kernstadt Paris, die zu den hochverdichteten und stark verkehrsbelasteten Bezirken an der Nahtstelle zu den Vorstädten gehören (Abb. 10). So waren in der urbanistischen Konzeption die Schaffung einer grünen kraftverkehrsfreien Achse (Abb. 12), der Ausbau der öffentlichen Verkehrsträger (vollautomatische Metrolinie 14, Neubau der Tramlinie 3b neben der Schnellbahn RER C) sowie die Berücksichtigung der bahngebundenen Ver- und Entsorgungslogistik wesentliche Teilprojekte, um die Verdichtung der baulichen Nutzungsstruktur zu rechtfertigen. Die Wiederherstellung der Ringbahntrasse hat eisenbahnrechtliche Hintergründe, da eine Entwidmung nie stattgefunden hatte (Abb. 11). Die unabhängig davon von der Hauptstrecke anfahrbare Logistik-Versorgungsstation soll auf vier Etagen mit 4.8 ha Gesamtgeschoßfläche für den Umschlag von 60.000 t Waren pro Jahr sorgen (MAIRIE DE PARIS, 2015).

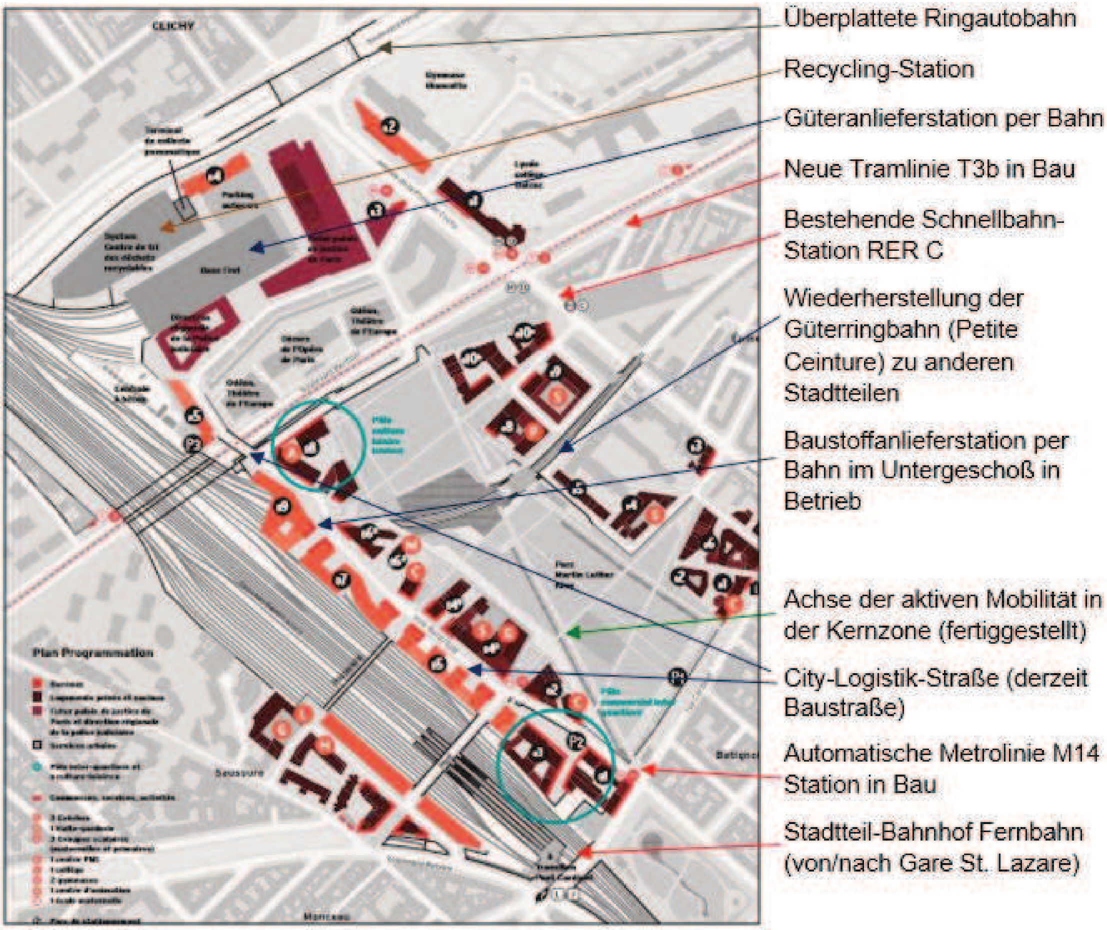

Abb. 10: Mobilitätsintegrierende Stadtteilplanung auf einer Eisenbahn-Konversionsfläche am Beispiel ZAC Clichy-Batignolles (Quelle. MAIRIE DE PARIS)

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Abb. 11-13: Die Baustelle des Stadtteiles ZAC Clichy-Batigno lles im Sommer 2016 mit der wiedererrichteten Güterbahntrasse

5.2 Chapelle International

Das Wohnquartier als Kernnutzung des neuen Stadtquartiers auf einem aufgelassenen Güterbahnhofsgelände wird 900 Wohnungen samt Folgeeinrichtungen und Freiräumen beherbergen sowie eine Güteranlieferstation (Abb. 15-17), die von einer multimodalen Transportkette (vom Fernlauf u.a. mit Küsten- und Binnenschiff über den Hafen- bzw. Lkw-Umschlag an der Oise über Zugpendelfahrten in der Region bis zur Distribution mit elektrischen Nutzfahrzeugen im Arrondissement) bedient werden wird (Abb. 14). Es ist der erste Logistikbahnhof neuer Art (Hôtel de Logistique) auf Pariser Stadtgebiet, der seit der Schließung des letzten Güterbahnhofes Ende der 1990er Jahre jetzt im Rohbau auf 4 ha mit 390 m Gleislänge für den Indoor-Güterumschlag auf vier Geschoßebenen fertiggestellt und im Herbst 2017 in Betrieb genommen wird. Dadurch sollen jährlich 2,6 Mio. Lkw-Kilometer eingespart werden. Der Grundeigentümer SNCF, die Stadt Paris und der Logistikterminalbetreiber SOGARIS haben gemeinsam die Projektentwicklung betrieben.

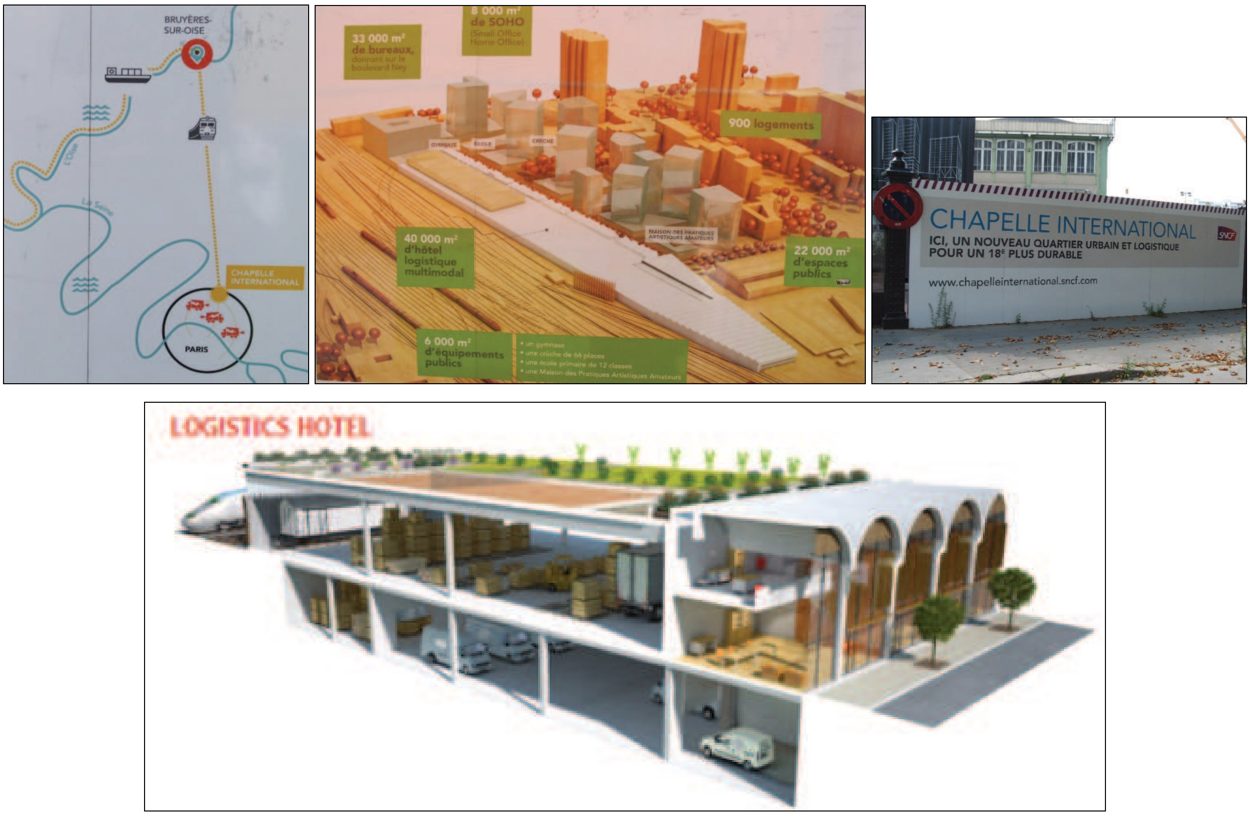

Abb. 14-17: Der multifunktional-“selbstversorgende” Stadtteil Chapelle international für eine Güterlogistik der kurzen Straßentransportläufe (Quelle: SOGARIS)

6 QUELLEN

L´ASSOCIATION DE RÉFERÉNCE POUR CONSTRUIERE LE LOGISTIQUE DE DEMAIN (AFILOG): Le Livre blanc de la Logistique urbaine. Paris, 2012

BUNDESVEREINIGUNG LOGISTIK (BVL): Grünbuch Nachhaltige Logistik in urbanen Räumen. Wien, 2014 .

DÖRR, H.: Planungsstrategien zum Wirtschaftsverkehr in Metropolregionen. Eine Momentaufnahme in den Regionen London, Paris, München und Wien. In: Raumforschung und Raumordnung 59(1). S. 49-59. Bonn, 2001

DÖRR, H.: Vom Güterbahnhof zum Stadtquartier. Die Allée Vivaldi im Pariser Osten. In: Zolltexte Nr. 21. S. 14-19. Wien, 1996
DÖRR, H.: Perspektiven für die Schienengüterbedienung in Ballungsräumen. Versorgungsstrategien für die Gütersenke Großstadt. In: Bahntechnik aktuell 48/2014. S. 49-73. Interdisziplinärer Forschungsverbund Bahntechnik e.V. Berlin, 2014
DÖRR, H.; PRENNINGER, P.; HUSS, A.; HÖRL, B.; MARSCH, V.; TOIFL, Y.; BERKOWITSCH, C.; WANJEK, M.; ROMSTORFER, A.; BUKOLD, St.: Neue Fahrzeugtechnologien und ihre Effekte auf Logistik und Güterverkehr – EFLOG. Forschungs- und Entwicklungsdienstleistung für das Bundesministerium für Verkehr, Innovation und Technologie im Rahmen des Programmes Mobilität der Zukunft. Wien, 2014
EUROPEAN ROAD TRANSPORT ADVISORY COUNCIL (ERTRAC) und ALLIANCE FOR LOGISTICS INNOVATION THROUGH COLLABORATION (ALICE): Urban Mobility. Urban Freight Research Roadmap. Brussels, 2015.
HÖRL, B.; WANJEK, M.: Strategien zu einer effizienten Nutzung der Schieneninfrastruktur für Güterverkehre in Stadtregionen. In: Department für Raumplanung TU Wien (Hrsg.): Jahrbuch Raumplanung Band 1, 113-128, Wien/Graz, 2013
MAIRIE DE PARIS-DIRECTION DE L´URBANISME: ZAC Clichy-Batignolles (17e): Base logistique ferroviaire urbaine. Protocol d´accord avec SNCF Mobilités, SNCF Reseau et la société CIEH, Paris, 2015

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reviewed paper

Smart Village as an Instrument to Curb the Rural to Urban Migration in India

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1 ABSTRACT

Migration is an indicator to understand the degree of alteration in socio-economic, political sphere at national as well as international levels. It is also a symptom of disparity in economic and social aspects between the origin of migrant and destination of migrant. Disparities in regional development are main reason for migration in Indian. During year 1951 in India the share of urban population to the total population was only 17 percent. According to 2011 census of India the total population of the country is 1.2 billion with annual growth rate of 1.8 percent. The total urban population is 377 million, which is 31.6 percent of the total population of the country. Due to rapid industrial growth and agglomeration of economic activities, cities are pulling people from rural hinterland. The population is largely concentrated in a few large cities and metropolitan cities of the country, it accounts for 35.4 percent of the total urban population. The urbanization in India is mainly due rural to urban migration of population. During last 50 years the share of rural population of the country has decreased from 82.0 to 68.9 per cent.

According to National Sample Survey 64th Round approximately a third of Indians (i.e. some 325 million people, out of a population of 1.14 billion in 2008) are migrants. Employment seems to be the prime force for migration; in rural areas, 55 per cent of the households have migrated for employment related reasons. Analysis of the statistical data says that after migration a higher percentage of the persons were found to be engaged in economic activities: for males the percentage of workers have increased from 51 per cent before migration to 63 per cent after migration in rural areas while in case of females, it has increased from 20 per cent to 33 per cent in rural areas. Getting employment is always a major area of concern. In most cases it is found that migrants are not getting job in urban areas according to their capacity, they are either engaged in lower capacity job or become self-employed. For rural males, self-employment has appeared as main choice to employment after migration. The share of self-employment in total migrants have increased from 16 per cent before migration to 27 per cent after migration, while the shares of regular employees and casual labours remained almost stable, in both before and after migration.

The causes of migration are usually explained with two broad categories, namely, push and pull factors. For rural India, poverty is still considered to be the main push factor for illiterates and moderately educated migrants. The lack of employment opportunities in the rural areas and better employment opportunity and infrastructure facilities in the urban areas attract people to migrate to urban areas. In the rural areas, sluggish agricultural growth and lack of development of the rural non-farm sector raises the incidence of rural poverty, unemployment and underemployment. People from rural areas move towards town or cities with a expectation of better livelihood opportunities. The story of migration has its own tales of sorrow as several children turn into rag pickers and families have to live in inhuman conditions in urban areas. Many don't get employment throughout the year and commute between urban and rural areas. However, for the landless and marginal farmers who are in constant debt, migration is the only choice for livelihood.

Government of Indian has taken various initiatives towards rural development. Some of the rural development programmers undertaken by the Government of India are Community Development Programme, Twenty Point Programme, Drought Prone Areas programme, Desert Development programme, National Fund for Rural Development, Council for Advancement of People's Action and Rural Technology, Har Khet ko Pani, Mahatma Gandhi National Rural Employment Guarantee Scheme, etc. All these programme/ Schemes aim to improve the rural economy. After implementation of Smart City Programme the Government of India has launched SMART Village –a community driven initiative for re-constructuring of rural India. It is also known as Rurban Mission. The National Rurban Mission aims at development of a cluster of villages which conserve and nurture the essence of the rural community life with focus on equity and inclusiveness without compromising with the facilities perceived to be essentially urban in nature, thus creating a cluster of 'Rurban villages'. The Mission intends to simulate local economic development, enhance basic services and create well planned Rurban clusters. About 300 Rurban clusters will be developed over the next five years, which have latent potential for growth, in all States and Union

Territories, which would trigger overall development in the region (.Ministry of Rural Development, 2016). In this article an attempt has been made to understand state wise spatio-temporal characteristics to rural to urban migration and to evaluate the smart city as a tool to curb the rate of rural to urban migration in future.

Keywords: employment, urban, rural, migration, smart village

2 INTRODUCTION

Demographic Dictionary of United Nation defines migration as "an event in which people move from one geographical area to another geographical area. When people leaving their place of residence go to live permanently in another area, then this is called migration". Migration may be permanent or temporary depending upon the intention of returning to the place of origin in future. It is the third factor that changes the demographic characteristics. As compared to birth rate and death rate, the impact of migration on the demographic characteristics is evident in various ways. This is an indicator to understand the degree of alteration in socio-economic, political sphere at national as well as international levels. It is also a symptom of disparity in economic and social aspects between the origin of migrant and destination of migrant.

In the history of human civilization migration is one of the most dynamic activities. At the early age people used to move from one forest area to another forest area in search of food. Gradually people adopted lifestyle attached with domestic animal and fertile soil. This has transformed their wanderer's lives towards developing settlement. Though, at this stage also mobility of mankind did not stop completely. In fact people continued to move from one region to another looking for fertile land for agricultural activities. In the later stage the characteristics of mobility has changed frequently. Gradually the mobility becomes governed by agricultural, trade, investigation purposes, etc. . People used to move from less advantageous areas to better places.

Likewise other nations of the world the characteristics of migration in India vary spatially as well as temporally. During colonial period a huge number of indentured labourers were transported to Mauritius, Caribbean Island, Fiji and South Africa by British Government from the states of Uttar Pradesh, Bihar, etc. The labourers from Goa, Daman and Diu were sent to Angola, Mozambique, etc by French, Dutch and Portugal. During this same period the labourers also were migrated from various parts of India to tea estates of Assam and West Bengal.

In India during the post independence period the rate of urbanization has got accelerated. After independence the Government of India had adopted mixed economy and had taken various initiatives for industrial development. This has given rise in development of private sectors. Various towns have emerged as industrial town while some have developed as administrative, trade and commerce based towns. Opportunities of livelihood are gradually accumulated in the urban areas. As per 1901 census the share of urban population to total population of the country was 11.4 per cent and it has increased up to 31.6 per cent in 2011. As per the United Nation survey report on the World Population (2007) about 40.30 percent of the total population of the country will reside in urban areas. It can be easily said that the due to disparity in level of development migration of population from rural to urban areas is the major contributor to rapid urbanization in India.

Various research studies undertaken by different scholars observed that poverty, unemployment, sluggish agricultural growth, lack of infrastructure development, lack of educational facility searching for job, better quality of life and family influence have been the major push factors for rural to urban migration, while job opportunity, better employment, prior migrants , availability of better education facility, etc, have been considered as the factors responsible for attracting people towards the urban areas. Migration in any form leaves its impression by creating imbalance in social, demographic, economic, infrastructure etc. Migration is the outcome of disparities in regional development.

According to some economists and developmental experts - migration is an integral prerequisite and desirable phenomenon for development. But in most of the cases in India the migration is distressed in nature. The distressed migration creates mushrooming of slums, pressure on infrastructure facility . In India some states experience higher investment and resources for development and attacked more in-migrants while the backward states of the country are experiencing out-migration. Mumbai metropolitan is receiving the maximum number of migrants every year.

3 MIGRATION SCENARIO IN INDIA

During year 1951 in India the share of urban population to the total population was only 17 per cent. According to 2011 census of India, the total population of the country is 1.2 billion with annual growth rate of 1.8 percent. The total urban population is 377 million, which is 31.6 per cent of the total population of the country. Due to rapid industrial growth and agglomeration of economic activities cities become the hubs of employment opportunities and pulled people from rural hinterlands. The population is largely concentrated in a few large cities and metropolitan cities of the country, it accounts for 35.4 percent of the total urban population. The rapid urbanization in India is mainly due rural to urban migration of population. During last 50 years the share of rural population of the country has decreased from 82.0 per cent to 68.9 per cent.

According to National Sample Survey 64th Round almost a third of Indian population are migrants. The migration rate in urban areas is much higher than in case of rural areas. Employment seems to be the prime motivating force for migration. As per the data of National Sample Survey around 55 per cent of the rural households have migrated due to employment related reasons. Migration has been notably modifying the traditional socio-economic structure of rural India. Through rural to urban migration the livelihood activities of rural people are no more confined to agricultural and faming activities. Migration has introduced diversification in economic activities in rural India.

Till today in India migration in hunt of livelihood is a harsh reality. The depressing occupational opportunity in geographically remote, less advantageous locations such as hilly, desert, drought-prone, rain-fed, flood-affected areas use to encourage migration as a survival strategy for a large number of poor people towards urban areas with better possibility of livelihood. The estimated number of internal migrants obtaining their livelihood out of seasonal migration is about 100 million. This migrants are mostly engaged in the informal sectors and work devoid of social security and legal protection. They are primarily preferred due to low wage. As per the Census of India inter-state migration has increased from 12.02 per cent in 1981 to 13.31 per cent in 2001. As per National Sample Survey, rural-urban migration data show that the inter-State migrants increased from 19.6 per cent in 1999–2000 to 25.2 per cent in 2007–08. The level of development and employment opportunity are not uniform across the country. Some of the states are lacking in economic development, have low per capita income and lack of employment opportunity. While some of the states are showing upward curve in economic development. For example Uttarakhand, Rajasthan, Jharkhand Uttar Pradesh, Bihar, Odisha, West Bengal with straggler economies and surplus labor are the primary suppliers of labor to Maharashtra, Gujarat, Haryana, Punjab and Tamil Nadu known for their flourishing economies, attract large numbers of migrant workers. Maharashtra, for example, demonstrates a high correlation (0.77) between net in-migration rate and per capita NSDP. The construction sector accommodate 40 million migrant-workers, followed by 20 million as domestic workers, 11 million in textile industries,10 million in brick-kilns, and many more in transportation, mines, quarries and agriculture. The Constitution of India guarantee freedom of movement and freedom to settle within the territory of India as a fundamental right of all citizens (Article 19). But due to difference in linguistic and cultural sphere, migrants face several barriers in accessing civic amenities, housing and employment, as well as restrictions on their political and cultural rights There is no suitable measures to provide the migrant-workers residential, work security and they are compelled to live and work in crowded slums and unauthorized public lands/ locations with insufficient civic amenities and access to basic services, these lead to repetitive displacement of the migrants. Even child labors are also found in brick-kilns, stone quarries, carpet-weaving, etc industries. Gradually urban policy has become more exclusionary. The increasing cost of migration for poor and anti migrant rhetoric are becoming more strident in many States and urban metropolises. This discourages the migrants in the decision making process in the city and increase their vulnerability to natural and social hazards. The poor, illiterate, unskilled rural migrants used to settle in slums and hazardous locations prone to manmade disaster and natural calamities. Thus, they are more vulnerable to discrimination and exploitation. Slums are a sign of deficiencies in cities, and slums dwellers are denied of their right to shelter, potable water, sanitation and health care.

During year 2009-2010 the estimated number of casual workers in agriculture is 91.4 and casual worker in non-agricultural sector is 58.6 million. Some research studies says that about 90- 95 per cent of casual workers are migrants. The implementation of Mahatma Gandhi National Rural Employment Guarantee Act has reduced rural to urban seasonal migration particularly in case of women migrants. Even during the Eleventh Five Year Plan of Government of India in the context of rural urban migration two approaches were

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adopted to improve the quality of life in urban areas; they are [i] upgradation in the quality of infrastructure in existing cities to provide improved municipal services to large numbers of people and [ii] development of new suburban townships as satellites/ counter-magnets to reduce/ redistribute the influx of population.

4 FACTORS INFLUENCING MIGRATION IN INDIA

There are numerous factors influence migration of population. The factors can be broadly grouped into three categories i.e economic, social and environmental. The factors within the economic group are: disparity in regional development, employment opportunity, increase in per capita income, income maximization, inequitable distribution of benefits of economic development.. The factors related to social aspects are law and order situation, social conflicts and social tension, gap in civilization/ culture, inequalities in the available social opportunities and other amenities of life between groups of people and or sectors, social mobility, social status aspirations, friend and family influences , desire for attaining lifestyle, residential satisfaction. The factors related to environmental factors influencing migration are occurrence of flood, drought, sea level rise, earth quack, etc.

The reasons for migration are usually summarized as push and pull factors. While push factors are mostly convincing reasons which help the migrants to make up their mind for migration. The pull factors offer opportunity and attract migrants towards the place of destination. . According to Greenwood economic factors such as transportation costs, income and job opportunities significantly affect individual's decision to migrate to city in less developed country like India. The push factors include the population pressure, declining yields, institution of marriage, disintegration of joint family system, lack of livelihood opportunities, etc; the pull factors also include better educational, health care facilities, modern means of transport and communications, more employment opportunities and a growing craze for urban life. The prime factors for rural to urban migration are described as below:

- Population Pressure: With the growth of population pressure on natural resources, agricultural land is increasing day by day. To meet the need of housing, infrastructure, etc the natural resources are depleted. More population means additional demand on limited resources available with the rural families. This leads to decrease in per capita income, per capita availability of land, fragmentation of land, low productivity from agricultural sector. According to estimation about 80 per cent of the farmers are now marginal farmers.
- Employment opportunity: Due to the increase population pressure, the demand for economic return from the agricultural sector increases while agricultural production is not increasing in the same pace. Moreover with the increase of population and fragmentation of big agricultural land into small landholding, agricultural activities become gradually converted to subsistence farming only. Most of the rural people leave their houses and move to cities in search of employment in various types of industries. In urban areas different types of industries have the capacity to absorb these migrants as work force.
- Lack of livelihood opportunities: Lack of livelihood opportunities in rural areas along with inadequate and low quality of basic needs like good schools, health care facilities, financial institutions, inaccessibility and suitable markets have also compelled the rural people to migrate to urban centers.
- Climate refugee: The incidents of climate change is affecting the rural ecosystem in various ways. It is causing flood, drought, sea level rise , etc. These events trigger rural to urban migration.
- Improvement in communication and transport facilities: Improvement in communication and transport facilities have reduced the physiographic barriers and brought the people together. The areas with accessible good roads, communication and transport facilities encourages migration of the rural communities. During the agricultural off season villagers migrate to urban areas for earning and then return back with the start of sowing season. Such type of seasonal and circular (also known as cyclical, oscillatory) migration has long been part of the livelihood portfolio of poor people across India.

5 RURAL TO URBAN MIGRATION AND URBAN SCENARIO IN INDIA

Sometimes the concepts of urbanization and growth of urban population are used as synonyms. This may lead to improper policy decisions. Rural to urban migration is the major driver for urbanization. Rapid growth in urban population is a big challenge to the city administrator to serve housing, infrastructure, environmental quality, etc to the city dwellers. Rural to urban migration has both positive and negative impacts on urban areas. Due migration of people from rural to urban areas the mushrooimg of slums in are around the urban areas/ urban centre takes place. According to the study carried out by economic and social commission for Asia and the Pacific (ESCAP, 1991) "migration from rural to urban areas continues at a rapid pace in many countries of the region, and it was often beyond the capacity of towns, cities and metropolitan areas to cope with the increasing numbers". Increasing inflow of distressed population from rural to urban area results into overcrowding of cities and development of slums. Economically weaker migrants from rural areas come to the urban areas and settle in the slums. It is observed that unskilled marginal farmers or landless labours migrates to the urban areas become unskilled labourers and settle in the slums. The great slums of India are mainly formed because of migration of large numbers of individuals or families to the urban centers in search of their dreams, usually in hunt of better economic prospects/ livelihood.

The higher productivity of urban areas is contingent upon the availability of quality infrastructure services. Urban economic activities are dependent on infrastructure, such as power, telecom, roads, water supply, and mass transportation, coupled with civic infrastructure, such as sanitation and solid waste management. The challenges of urbanization in India are unprecedented in scale and significance. The fast growing metropolitan cities in India has contributed negatively in the development process through different issues. Lopsided pattern of urbanization and inadequate investments has led to serious deficiencies in urban infrastructure and services like housing, transport, water supply, sanitation and social infrastructure especially in small and medium size cities.

As per census 2011, 68 million Indians lived in slums, comprising one-quarter of the population of India's 19 cities with more than 1 million residents. In Mumbai almost 50 percent population lives in slums and Kolkata has 32 percent of slum dwellers. As per Census 2011, drinking water within the premises is available to 71.2 per cent of the urban population, 20.7 per cent of the population has access to drinking water near the premises vide Census 2011. None of the cities have 24x7 water supplies. The challenge of sanitation in Indian cities is acute. A sanitation rating of 423 class-I cities carried out during 2009-10 by Ministry of Urban Development, Government of India revealed that only 39 cities qualified on 3 basic water quality parameters of turbidity, residual chlorine and Thermo Tolerant Coliform bacteria. According to Census 2011, 32.7 per cent of the urban population has access to a piped sewer system and 12.6 per cent of the urban population still defecates in the open. Under Swatch Bharat Mission the Government of India is providing fund for construction of toilets across the country. Installed sewage treatment capacity is only 30 percent as per Central Pollution Control Board (CPCB) Report 2009. According to the CPCB Report 2005, about 1,15,000 MT of municipal waste is generated daily. Collection performance varies from city to city. Staff deployed to manage solid waste management (SWM) is also fairly low as per requirements. In most of the cities, waste is transported and dumped to land fill sites. Scientific treatment and disposal of solid waste is practically non-existent. Public transport accounts for only 22 percent of urban transport in India. Out of 423 class I cities, only 65 have a formal city bus service as of 2012 and that too owing to the intervention of the Central Government intervention through the programme of funding of buses for city transport. The increasing number of slum pockets revel the imbalance effectively. It is clear that most of the cities in country are suffocated with exiting population. In addition to this migrants from rural areas adds addition stress to the urban facilities.

6 IMPACTS OF RURAL TO URBAN MIGRATION IN INDIA

Rural to urban migration has both merits and demerits. The impacts of rural to urban migration are summarized as below:

- Urbanization: Migration helps in urbanization. The rate of urbanization to some extent governed by migration. Preston considers rural urban migration as an indicator of regional and sectoral distortions in the pattern of development. According to UN studies about 60 per cent of the urban growth in

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developing countries is due to the rate of natural increase of urban areas and the remaining 40 per cent is due to migration. Migration is the prime contributor to urbanization.

- Rural depopulation: Rural to urban migration results in rural depopulation. The most productive rural work force leaves villages in search of better opportunities in urban areas and the rural areas are left behind with the olds and the unable.
- Social status: Migration helps in improvement of social status, income of rural as well as urban settlements, reduces fragmentation of land holdings and facilitates division of labour and specialization. Migration also nurtures cultural integration.
- Remittances: Rural migrants' income sent home in rural areas in the form of monetary assistance. It helps in increasing food security, nurtures diversity of livelihoods and reduces vulnerability associated with shocks. The NSSO 64th report also states that nearly 10 per cent of the households in the rural areas had used remittances for 'debt repayment'.
- Slum development: Unskilled, semi-skilled, illiterate migrants from rural areas find their space to settle in the slums. This leads to mushrooming of slums in urban areas.
- Cheap labour: The unskilled and illiterate migrants are the source of cheap labour for various industries.

7 VARIOUS RURAL DEVELOPMENT PROGRAMMES UNTAKEN BY GOVERNMENT OF INDIA

Government of Indian has taken various initiatives towards rural development. Some of the rural development programmers undertaken by the Government of India are Community Development Programme, Twenty Point Programme, Drought Prone Areas programme, Desert Development programme, National Fund for Rural Development, Council for Advancement of People's Action and Rural Technology, Har Khet ko Pani, Mahatma Gandhi National Rural Employment Guarantee Scheme, etc. All these programme/ Schemes aim to improve the rural economy.

7.1 Smart Village/ Rurban Mission

According to 2011 census of India the rural population of the country is 833 million which is almost 68 per cent of the total population of the nation. Further, the rural population has shown a growth of 12 per cent during 2001-2011 and the number of villages in the country has increased by 2279 units during this period. Most of the rural areas in the country are not stand-alone settlements rather they have developed as a part of a cluster of settlements, which are relatively proximate to each other. These clusters have potentiality of growth, acts as economic drivers and obtain locational and competitive advantages. Government of India has taken initiatives to develop these clusters .These clusters once developed can then be classified as 'Rurban'. It is also known as Smart Village. Hence considering this, the Government of India, has proposed the Shyama Prasad Mukherji Rurban Mission (SPMRM), aimed at developing rural areas by providing economic, social and physical infrastructure facilities. The cluster level economic and infrastructure development is the focus of the mission. Mission aims to develop 300 Rurban clusters in the next five years. These clusters would be reinforced with the required amenities and the requisite resources would be mobilized through convergence of various schemes undertaken by Government of India, over and above a Critical Gap Funding (CGF) would be provided under this Mission, for focused development of these clusters.

7.2 Rurban Mission – An overview

Government of India has launched Rurban Mission during February, 2016. The aim of National Rurban Mission is to develop a cluster of villages that preserves and nurtures the essence of the rural community life with prime focus on equity and inclusiveness without compromising with the facilities perceived to be basically urban in nature, thus creating a cluster of 'Rurban villages'. The Mission proposes to simulate local economic development, improves basic services and crafts well planned Rurban clusters. About 300 Rurban Clusters will be developed across the country within a period of next five years and this will .elicit overall regional development. Under this Mission, every Rurban cluster will be developed as a project including components like training linked to economic activities, developing skills and local entrepreneurship and will provide necessary infrastructure amenities. These projects will be implemented over a fixed timeframe of three years by integrating and converging the implementation of project components. This will be followed by an operations and maintenance period of ten years.

7.3 Integrated Cluster Action Plan (ICAP)

An Integrated Cluster Action Plan (ICAP) for each Rurban cluster will be prepared to guide the development of the cluster. It shall be a key document covering baseline studies outlining the requirements of the cluster and the key interventions needed to address these needs and to leverage its potential. The ICAP prepared for the cluster will speak:

(1) A strategy for the cluster integrating the vision for each Gram Sabha, identified in the cluster.

(2) The desired outcomes for the cluster under the Rurban Mission

(3) The resources to be converged under various Central Sector, Centrally Sponsored and State Sector schemes.

(4) The Critical Gap Funding (CGF) required for the cluster.

(5) Most importantly, the ICAP would delineate the cluster areas to form well planned layouts following the planning norms (as laid down in the State Town and Country Planning Acts/similar Central or State statutes as may be applicable), which would be duly notified by the State/UTs. These plans would be finally integrated with the District Plans/Master Plans as the case may be.

The ICAP for a cluster will have two components . they are as follows:

(A) Socio Economic and Infrastructure Planning Component:

The Socio Economic and Infrastructure Planning component of the ICAP will primarily identify the socio-economic and infrastructure needs of the cluster, converge various government schemes and implement the project level interventions in the cluster as per the process indicated in this framework.

(B) Spatial Planning Component:

The Spatial Planning Component of the ICAP will be initiated after the selection and delineation of the Rurban Cluster and the process shall follow the planning norms as laid down in the State Town and Country Planning Acts/similar Central or State statutes as may be applicable for the State. The Spatial Planning component of the ICAP will result in a structure plan/land use plan for the Rurban cluster along with an enforcement mechanism for the same. The components of ICAP are presented in Figure 1.

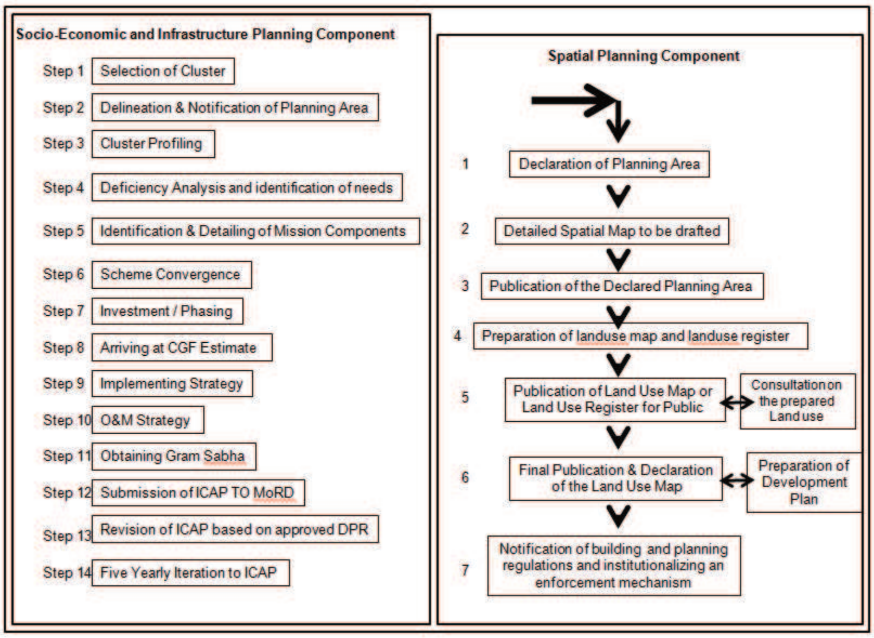

Figure 1: Components of Integrated Cluster Action plan. Source: Ministry of Rural Development

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7.4 Steps of the Action plan for Rurban cluster

Stages for preparation of action plan for Rurban Cluster is grouped into 14 identified and well defined steps. They are Selection of cluster, Delineation and notification of Planning areas , Cluster profiling, Deficiency analysis and Identification of need, Identification and Detailing of Mission Components Stakeholder Consultation, Scheme Convergence , Investing and Phasing, Arriving at Critical Gap Funding Estimate, Implementation Strategy, Operation and Management Strategy, Obtaining Gram Sabha resolution, Submission of ICAP to Ministry of Rural development, Revision of ICAP based on approved DPR costing, Five yearly iteration to ICAP.

7.5 Salient feature of Rurban cluster

(1) In the mission the identified unit for development is village cluster. Developing village clusters socially as well as economically will reduce the regional disparity in various level of development.

(2) In the mission the spatial data , resource map will be prepared on GIS platform in 1:8000 scale.

(3) The Mission ensures the preservation and nurture of the rural community.

(4) The components of the cluster profile include demography, socio-economy, culture and administrative profiles of the clusters. This will facilitate to understand the basic characteristics of the cluster.

(5) According to the needs of individual cluster the Mission improves basic services and crafts well planned Rurban clusters

(6) Detailed project report will be prepared for individual Rurban cluster including components like training for economic activities, developing skills and local entrepreneurship and infrastructure amenities. Therefore, the need of each village cluster will be taken care.

(7) In the mission fourteen components namely; Skill development training linked to economic activities, Agro Processing, Agri Services, Storage and Warehousing, Fully equipped mobile health unit, Upgrading school/higher education facilities, Sanitation, Provision of piped water supply, Solid and liquid waste management, Village streets and drains, Street lights, Inter-village road connectivity, Public transport, LPG gas connections, Digital Literacy, Citizen Service Centers- for electronic delivery of citizen centric services/e-gram connectivity are listed for identification of the relevant components required for development of the cluster.

(8) For each cluster the comprehensive assessment will be made on economic profile of the cluster to understand drivers of economic growth of the cluster, assess the basic strengths and weakness of the cluster and identify the opportunities for economic growth of the cluster. This exercise will not be restricted at the cluster level and will include economic assessments at the block and district levels.

(9) The cluster level strength and deficiency analysis and identification of needs are integrated with the ongoing schemes of the Government of India. The resources for cluster development to be converged under various ongoing central and state level schemes.

(10) For implementation of the mission, bottom to top integration approach is adopted. In the entire process of cluster development gram panchayat and gram sabha play important role

(11) ICAP is a dynamic document it will revised in every five years

7.6 Smart village/ Rurban cluster as an instrument to curb rural to urban migration

In this mission village clusters are considered as unit of development. The economic, social and infrastructural health of each cluster is evaluated. Cluster level deficiency analysis has been carried out for the components like (i) Skill development training linked to economic activities (ii) Agro Processing, Agri Services, Storage and Warehousing (iii) Fully equipped mobile health unit (iv) Upgrading school/higher education facilities (v) Sanitation (vi) Provision of piped water suppl (vii) Solid and liquid waste management (viii) Village streets and drains (ix) Street lights (x) Inter-village road connectivity. (xi) Public transport (xii) LPG gas connections (xiii) Digital Literacy (xiv) Citizen Service Centres- for electronic delivery of citizen centric services/e-gram connectivity. These components are directly related to socio-economic and infrastructure development. With the help of this Mission Ministry of Rural Development will be able to prepare plan for each Village cluster across the country. This will ultimately improve agricultural production, marketing facility of agricultural product, health, education, infrastructure development, etc. The gap in level of development between rural and urban areas will reduce and help in balanced development of the region. With course of time village will no more act as push factor for migration. Villages will be developed with all urban facilities and will gradually discourage the people for rural to urban migration.

8 CONCLUSION

In India about 6,40,000 villages accommodate about 68 per cent of total population of the country. According to 2011 census 54.6 per cent of total workers in India are now part of the agriculture sector it shows a sharp decline 3.6 per cent as compared to 2001. 263 million people are engaged in the agriculture sector and over half of them are now agricultural labourers. As compared to 2001 during 2011 the total number of farm labourers have increased by 3.5 per cent. There is continuous migration from rural to urban areas .The hunt for better livelihood is the motivation behind rural to urban migration . Since 2001 migration from rural to urban areas is up from 27.8 per cent to 31.1 per cent. It is reported that 57 per cent of urban migrant households are migrated from rural areas. Further approximately 55 per cent of household in rural areas had migrated for employment. These migrants are mostly the source of cheap labor and most of them used to work in the informal sector devoid of social security and legal protection.

Regular inflow of migrants from the rural hinterlands creates cumulative pressure on the exiting urban infrastructure. They usually settle in the slum areas. Gradually shrink the quality of life in urban areas. Rural to urban migration is mostly distressed migration. In order to reduce the flow of migrants to urban areas there is a need to secure livelihood at the village for of small land holders, land-less agricultural laborers. Another area which needs special attention is to strengthen employment opportunities in the rural areas to protract agriculture and agriculture based industries. Broadly speaking on-farm rural employment is the remedy to combat rural poverty, precisely rural to urban migration.

The prime objective of Rurban mission is to create 300 rural growth clusters across the country. The mission will bridge the gap between rural urban divide- economic, technological and those related to facilities and services. It will spread development in the region and also attract investment in the rural

With the introduction of modern facilities the villages clusters will be transformed into clusters with urban facilities having essence of Indian village. The cluster will witness development with respect to economic standards, education facilities, electricity, health care facilities and employment opportunities. The mission will bring economic and social development . It will give security to agricultural workers; provide marketing facility to the agricultural product. Educational, skill development related programmes will improve the skill of villagers. All these together will reduce the level of distress among the villages and this will gradually curb the flow of rural to urban migration in the country.

9 REFERENCES

(1) Census of India. Soft copy, India D-series, Migration Tables. Registrar General and Census commissioner, India, 2001-2011.
(2) Chakravarty B. The Census and the NSS Data on Internal Migration, in Ashish Bose, 1997,
(3) Chatterjee Atreyi, Ashish Bose. Demographic Data on Internal Migration and Urbanisation from Census and NSS – An Appraisal, in Ashish Bose, Davendra B. Gupta, and Gaurisankar Raychaudhuri (eds.), Population Statistics in India. New Delhi: Vikas Publishing House Pvt. Ltd, 1977.
(4) Government of India. Indian Labour Statistics (various Issues), Labour Bureau, Ministry of Labour, Government of India.
(5) Government of India , Ministry of Rural Development, Shyama Prasad Mukherji Rurban Mission National Rurban Mission (nRurm) Integrated Cluster Action Plan (ICAP), 2016

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SmartRegio – Employing Spatial Data to Provide Decision Support for SMEs and City Administrations

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1 ABSTRACT

When decisions have to be made which are based on the characteristics and expected developments in specific spatial environments (such as finding the best place for a new production site or for a new shop), geo data and the information that can be derived from it plays a crucial role. While larger companies typically can afford the setup of the required organisational units as well as the access to relevant data from commercial providers, smaller organisations such as SMEs or city administrations are at a disadvantage. The aim of the SmartRegio project was to develop solutions for such organisations that combine freely available (mass) spatial data from many different sources as a decision-making basis focusing on governmental and private actors operating with a focus on a specific region. The data sources include data from infrastructures like energy and mobility, data from public entities, and also data from social media and media channels. The SmartRegio project successfully identified and tackled major technical and legal challenges when aiming to exploit such data, while at the same time realising a generic infrastructure that supports the required processes within the given context.

Keywords: data economy, (big) spatial data architecture, sociodemographics, smart data, spatial data analytics

2 INTRODUCTION

Governmental and private actors operating with a focus on a specific region must constantly adapt to diverse changes in their environment. This concerns a variety of organisations ranging from companies to city administrations. In order to understand the characteristics of the focused environment, the existence of spatial data about it is becoming more and more important, as well as the ability to work with this data.

While large companies are usually able to employ departments that are able to get access to relevant data and to derive strategic measures from them, city administrations, non-profit organizations as well as small and medium-sized enterprises are at a disadvantage. On the one hand, their financial and (IT) technological possibilities are often limited. On the other hand, they are much more rooted in their specific region – and for small-scale areas, data at a high resolution is sometimes more expensive, and the data quality is often not very good.

Consequently, the aim of the project SmartRegio[1] funded by the German Federal Ministry for Economic Affairs and Energy was to develop solutions that combine (mass) spatial data from many different sources – ranging from closed sources only available to the data owners to open data sources – as a decision-making basis focusing on these players. The data sources include data about infrastructures like energy and mobility, data from public administrations (like occurrences of administrative processes involving citizens) and data from social media and media channels. These sources provide some outstanding advantages. Firstly, as a by-product of normal business operation, data collection is relatively cheap. Moreover, they are arising continuously, so it can be assumed that in the near future it will be possible to detect trends at a very early stage – even before people are becoming aware of it. Thirdly, they enable the machine-driven learning of

[1] see https://www.smartregio.org

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patterns and correlations on a low level. The major challenge lies in their interpretation. In order to allow the exploitation of this variety of data sources, reference architecture was developed within SmartRegio that allows for integrating and analysing heterogeneous spatial data in order to better understand the local environment. This includes the characterisation of spatial areas according to several criteria as well as the recognition of developments.

The use of heterogeneous (mass) data poses high technical and legal challenges. Firstly, they are distributed over many different and separated data silos, and the potential data suppliers often have no experience with the involved problems. Secondly, they are available in many different formats and structures, so that many have to be preprocessed comprehensively in order to be able to work with the content itself. Thirdly, the references to spatial and temporal entities often differ in terms of representation means and granularities (e.g., some data sets provide aggregated information from several months about a large spatial entity, while other data sets provide daily information about much smaller regions), which makes their comparison more difficult. While statistics are collected, for example, for administrative areas, infrastructures are technically dependent on their own spatial divisions, and in the case of media or discussions in social networks the spatial reference is often difficult to determine. Fourthly, many of the sources contain personal information and their anonymisation is particularly difficult because of the spatial reference and the combination of many sources.

In the following, the SmartRegio project, the approach and the technical architecture followed within the SmartRegio project, the main challenges when aiming to work with several types of spatial data from different sources, questions regarding security, anonymity, and legal aspects, business models as well as the most important lessons learned will be presented. Furthermore, some specific use cases will be described in more detail.

3 THE SMARTREGIO PROJECT

3.1 Project Context and Partners

SmartRegio is a consortium project sponsored by the German Federal Ministry for Economic Affairs and Energy (BMWi) from 12/2014 until 05/2017. It is part of the technology program "SmartData – Innovations from Data" where a total of 13 selected lighthouse projects were promoted in order to develop innovative services, and to stimulate the broad use of intelligent, data-based technologies.

The SmartRegio consortium comprises partners for technology development and transfer (YellowMap AG, USU Software AG, Disy Informationssysteme GmbH), a partner for the examination of legal aspects (Research Center for Data Protection at the Goethe University Frankfurt a.M.), and a research partner (DFKI GmbH). To realise usage scenarios in the selected pilot region Kaiserslautern, the municipal service provider SWK Kaiserslautern as well as the City Administration of Kaiserslautern joined the project as associated partners.

3.2 General Vision of SmartRegio

Geomarketing and location planning are a profitable business and since decades an oligopoly of few pre-dominant market players. The reason for the high concentration in the market is the exclusive access to socio-economic data. These data are collected, analysed and used to determine, e.g., the spending power, the demands, and the economically relevant behaviour of customers in a given region. Finally, evidence-based recommendations on many essential corporate decisions, e.g., how to create an optimal fit between a branches location, product and service portfolio, marketing strategy, etc. can be given. The outcome is impressive. E.g., given a portfolio change, new product or marketing campaign large retailers receive an estimate of their future revenues with 90 percent accuracy. But there are significant drawbacks:

(1) The services are not affordable for SMEs, creating a competitive disadvantage for those.

(2) The services provide a snap-shot – they do not reflect the continuous development of a region.

(3) The provided data is limited to answer a pre-known set of questions.

SmartRegio, on the one hand, addresses the fact that the more technology enters our everyday life, the more the behaviour of people is reflected in various kinds of data. Moreover, recent advances in the integration and processing of heterogeneous data sources make it possible to assemble those data fragments to an increasingly precise picture. This picture shows development and includes more facets allowing to ask a variety of questions – including such we do not know yet. And by the fact that this data is emerging as a by-product of conventional business operation, its price can be significantly lower making it available to a wider target group.

On the other hand, the business architecture of SmartRegio stands in contrast to traditional business models in that field. Its main principle is the design of an open platform that supports collaboration between participants of different kind – like data providers, service and software developers.

4 SMARTREGIO ARCHITECTURE AND APPROACH

4.1 Architecture and Components

This section gives a short overview of the SmartRegio platform architecture. SmartRegio intends to offer an open, cloud-based platform for processing and analysing heterogeneous geo-spatial data. The architecture as depicted in Figure 1 follows a standard three-layer approach comprising components for data integration, data processing, and data visualisation (see, e.g., Kahn et al. 2012 for a more detailed discussion of required capabilities for platforms in the given problem context). SmartRegio aimed at using existing and proven tools whenever possible, and the architecture was continually evaluated by the accompanying research.

In the data integration layer, we mainly distinguish between three different kinds of data: (i) geo-spatial data with direct geo-spatial reference, (ii) social media data with indirect or direct geo-spatial reference, and (iii) big-data with usually no or indirect geo-spatial reference. Within the platform these pre-processed data sets are stored in a central data-warehouse. The metadata management system for data and services manages these data sets and provides services for data set retrieval. The service library functions as an equivalent to the data-warehouse, but for the services used to process and analyse the data. Services are also registered at the metadata management for data and services.

Having (i) data sets and (ii) services working on these data sets, the configuration cockpit can be used to implement data pipes, orchestrating several services and data sets to process and analyse the data. The SmartRegio engine executes these service orchestration programs. If such a data pipe generates a new data set, the data set is registered within the metadata management and is published at the Geo-Server. The Geo-Server publishes the data based on OGC[2] standards for visualisation.

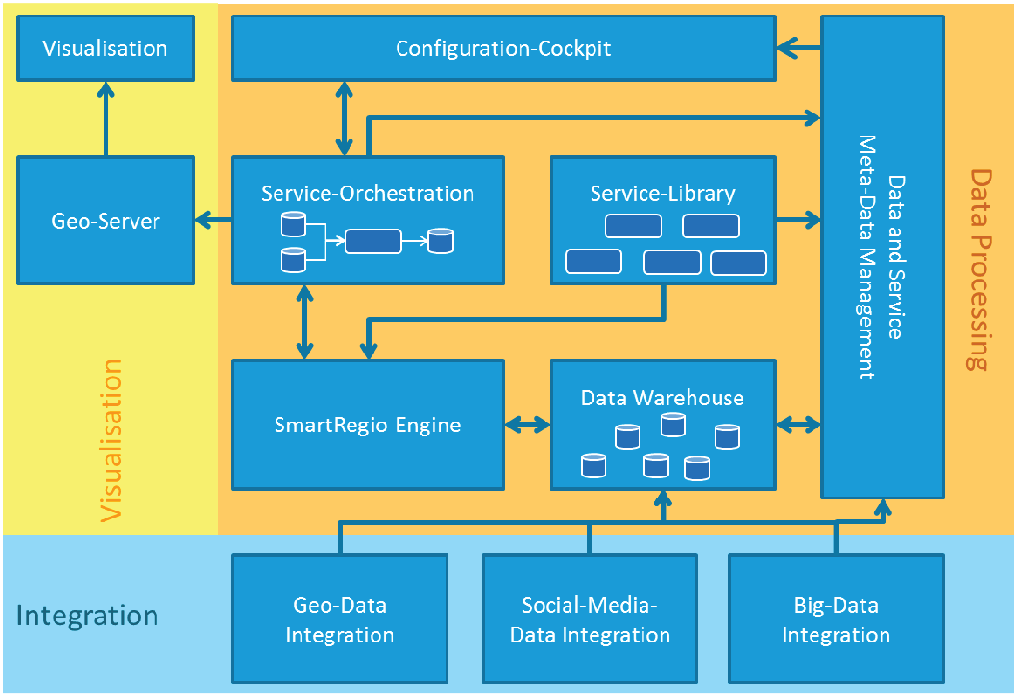

Figure 1: An overview of the SmartRegio System Architecture

[2] http://www.opengeospatial.org

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4.2 Data Acquisition, Data Integration and Processing, and Data Analysis

4.2.1 Data Acquisition

The first step in processing and analysing data is data acquisition. SmartRegio made use of a variety of data sources that provide information on a regional level. Figure 2 shows these data sources ordered according to their characteristics. On the one hand, there are open data sources that can be accessed by anyone; on the other hand, there are closed data sources that, at least, require some administrative steps (e.g., regarding privacy protection or national and international law) before they can be exploited. Furthermore, it is important to make a distinction between public, non-profit data providers and commercial entities.

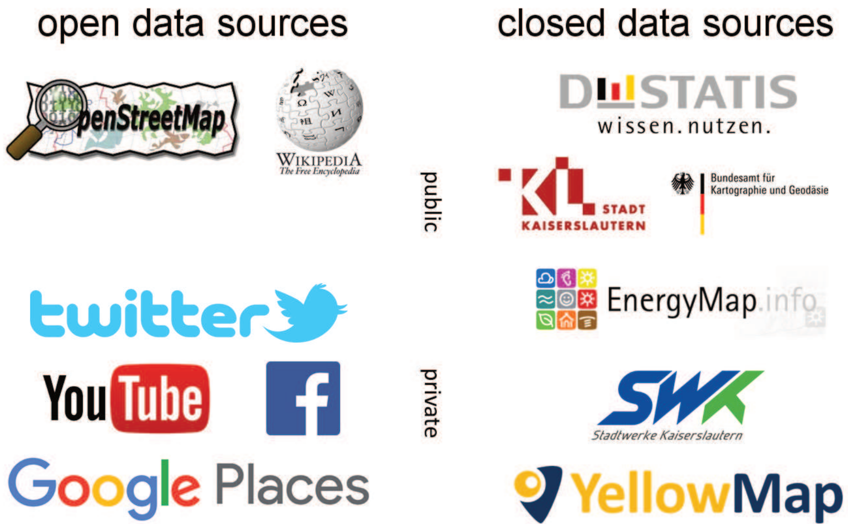

Figure 2: Data types and data sources used within SmartRegio

Depending on the data source type, different challenges have to be tackled when aiming to work with the data. This starts with the problem of finding relevant data sets: E.g., there are still only few open data portals, searching data on these portals is often very time-consuming, and raw data that is crucial for any further processing steps, is often not published. When working with companies and public authorities, there is often a lack of well-structured overviews regarding existing data, and superior contact persons with the required knowledge are often missing. Thus, relevant sources can often only be identified in a complex and lengthy process involving contact persons in different specialist departments that usually have no experience with such requests. Furthermore, raw data is often very expensive in these contexts.

Once a relevant data source is found and access to the data is possible, questions of data characteristics, data quality, and data representation arise. The most common problems here are that we often only find aggregated and preprocessed data (e.g., in annual reports) instead of raw, machine-processable data. Data about smaller regional entities is often completely missing. Furthermore, the data sets are often not up-to-date. A further problem that is of great importance when trying to work with spatial data from heterogeneous sources, is the fact that they usually are not referring to uniform spatial entities, which makes any comparison between data sets difficult. In SmartRegio, this is usually solved by mapping spatial data on a common grid.

4.2.2 Data Integration and Processing

Before using data in a system or platform, it usually first has to be (pre)processed and integrated in a way that allows its usage, e.g., for data analysis, or data visualisation. In the SmartRegio data integration process, different data pools were used for different purposes, depending on the nature of the data (e.g., distinguishing between spatial data and text data). Consequently, different tools such as Talend Open Studio[3], Kibana[4], or

[3] Talend Open Studio (see https://www.talend.com/products/talend-open-studio) is an Open Source ETL & Data Integration tool

[4] Kibana (see https://www.elastic.co/products/kibana) is an Open Source plugin for the Lucene-based search engine Elasticsearch that is used to host large amounts of mostly text-based data in SmartRegio

Katana Platform[5] were used exploratory data visualisation and analysis. In several preprocessing steps, the data is transformed into a generic format that allows conducting further processing steps independent of the format of the original data source. Such transformation steps include, e.g., the mapping of spatial data to a common grid, the mapping of metadata to the schemas used in SmartRegio, or the mapping of terms to semantic concepts in the SmartRegio ontologies. It is very important to note that there are almost no generic approaches for data integration – there are countless different data formats, and each data set requires individual decisions.

As a last step in the SmartRegio integration process, metadata about each data set is published on a metadata management system that allows the publication and description of metadata about data sets, and that offers convenient means to search and access the data. In SmartRegio, the established Open Source data portal platform CKAN[6] was used for this purpose.

4.2.3 Data Analysis

In SmartRegio, four different kinds of analyses have been distinguished:

(1) Aggregated display of different topics: Here, several topics can be displayed together in a way that allows users to draw their own conclusions. This is technically rather simple, yet requires usually a lot of expertise on the user side, as it is often very difficult to recognise connections or dependencies.

(2) Different visualisation means: The same data set can be displayed in many different ways, depending on its characteristics. Examples for such visualisations in the context of SmartRegio are scatter diagrams, heatmaps, or timelines.

(3) Prepared evaluations for a question or issue: A user evaluates a result which has been preprocessed in a way that allows for a quick and easy analysis. Such a prepared evaluation requires some domain knowledge on the side of the technology experts who then can choose and prepare proper data sets and services.

(4) Exploratory data examination: A viewer can filter, highlight, and process interesting records with other records.

For all types of analyses, tools and services have been realised within SmartRegio. Examples and sample use cases will be presented in Section 7.

5 SECURITY, ANONYMITY, AND LEGAL CONSIDERATIONS IN SMARTREGIO

This section provides some insights into the challenges and requirements on security within the SmartRegio platform as well as the technical concept and realisation on legal aspects as discussed in Section 5.3.

5.1 Experiences in Applying Security in SmartRegio

SmartRegio intends to offer an open, cloud-based platform for processing and analysing heterogeneous geo-spatial data. This leads to several challenges in terms of security, some of which are summarised here. Open and cloud-based implies that the platform has open borders. Several stakeholders with different intentions need access to the platform. Data sets from several sources and processing services from different providers need to be run on the platform. Topics like trust, integrity, and authenticity play a major role in using the platform. And within a globally operating platform, local and global legal aspects need to be considered on where data are stored and processed.

Based on the architecture of the SmartRegio platform (cf. Figure 1) we identified several stakeholders required to operate the intended platform. Stakeholders are:

- Platform operator – operating the SmartRegio platform,
- Data provider – providing data sets for the platform,
- Service provider – providing services for processing the data within the platform,
- Application developer – orchestrating services for processing data sets, to provide added values for end users, and

[5] USU Katana Platform (see http://katana.usu.de/) is a platform for data processing on big scale, high velocity and variety

[6] see https://ckan.org

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- End user – consuming processed data.

These stakeholders were used as direct input for developing the role concept within SmartRegio with their respective competencies and access rights within the platform. Another dimension within the platform is the access right on services and data sets we needed to consider. Different tenants, e.g., providing data sets or services, need different access to the resources even within the same role. Application developers need to access data sets and services in order to process data for end users. This requires dynamic access right management for resources based on the licensed resources.

Within SmartRegio we analysed several frameworks for identity and access management, amongst them freeIPA[7], OpenIAM[8], FORGEROCK[9], gluu[10], and Keycloak[11]. Main requirements amongst the security requirements for identity and access management were (i) the support of open standards, especially of the World Wide Web and for extensibility of the security concept, (ii) the ease of integration of legacy systems and third party services as well as (iii) the ease of administration of the system. Based on our own experience with the systems we decided for Keycloak. It provides web-based administration, fulfils the functional as well as non-functional requirements and is part of the RedHat[12] community projects.

In addition to the identity and access management, a major challenge in the security concept of the platform is data security. This includes transport security as well as storage security. Being an open, cloud-based platform requires building on open web-standards. The data upload or provision for the platform is realised by protocols like https[13] or other secure protocols like ftps[14], ssh[15], and ssh file transfer protocol. Platform components and in particular services communicate via https-based on RESTful web-services.

Storage security can be achieved via several mechanisms. For critical data, like data only accessible for one tenant, data need to be stored within a secure storage only accessible for the tenant itself. This can be achieved, e.g., physically or virtually providing appropriate access right mechanisms for these secure areas. Other data sets need to be secured by access right rules within the identity and access management. Providing additional security for preventing security flaws can be achieved by encrypting data. This allows the protection of data where only users and systems with access rights and the key for decryption can use the data. There are several software and hardware options on the market.

Even though we have found solutions in order to implement a security layer within SmartRegio, the complexity still exists in terms of implementing access rules for different tenants and roles.

5.2 Anonymity Approach within SmartRegio

With a rising awareness and discussion on privacy protection within Germany and the EU there is a need on protecting these rights within the SmartRegio platform. Conventional methods on protecting these rights are done via pseudonymisation and anonymisation. While the former only replaces the identifiers, the latter transforms the data set so no single entry causes a risk on identification. Conventional technical solutions are data encryption and data transformation (cf. Ronning et al. 2005, Höhne 2010). However, increasing anonymity usually leads to a reduction of expressivity of the data in terms of the analysis potential (Rosemann 2006, Hochfellner et al. 2012).

Having an anonymised data set, however, does not imply that a de-identification by correlating different data sets is not possible. In (Bender 2015), the author mentions several risks on de-identification:

- Identity disclosure – risk of identifying individuals,
- Attribute disclosure – risk of identifying sensitive attributes of an individual, and

[7] http://www.freeipa.org
[8] http://www.openiam.com/
[9] http://www.forgerock.com
[10] https://www.gluu.org/
[11] http://ww.keycloak.org
[12] https://www.redhat.com/en
[13] https://tools.ietf.org/html/rfc2818
[14] https://tools.ietf.org/html/rfc4217
[15] RFC 4250 – 4256, RFC 4335, RFC 4344 – 4345

- Membership disclosure – risk of identifying sensitive attributes of an individual when proving the individual is likely part of the data set.

The author also lists criteria for anonymity that prevent these risks for de-identification. The criteria are namely:

- k-anonymity – divides the data set into several equivalence classes where each equivalence class has at least k different data set entries,
- l-diversity – requires that each equivalence class has at least l diverse sensitive attributes, and
- t-closeness – requires that the distribution of sensitive attributes value within one equivalence class and the distribution of this attribute value within the overall data set exceed a threshold t.

Within a data processing platform as prototypically realised within SmartRegio, a lot of data sets from third parties are uploaded to the system. This involves the risk that these data might not be conforming to data protection regulations. Therefore, anonymity has to be ensured. The approach chosen within SmartRegio is to measure the above mentioned anonymity criteria in order to evaluate the level of anonymity of data sets uploaded to the platform. Additionally, these KPIs need to be evaluated after the analysis process and before the analysed and combined data are presented to the end user in order to prevent de-identification risks.

In (Bender 2015) the author evaluated several frameworks for anonymising data sets and implemented distributed algorithms for anonymisation. However, the need on efficiently checking anonymity levels for large amounts of data still existed. Our approach is based on platform services utilising Apache Spark data-frames[16] within the USU Katana Platform[17] which provide efficient algorithms on grouping data that we are using to calculate k and l for k-anonymity and l-diversity. To the best of our knowledge we were the first that actually realised the calculation of these KPIs within a cloud based platform to ensure anonymity before data are uploaded and after they were processed and combined with additional data.

5.3 Legal Considerations

5.3.1 In general at European level

After a thorough analysis of the technical part of SmartRegio, we want to have a look at the legal aspects of smart data analysis especially in the field of data protection law. Therefore the SmartRegio approach must be in accordance with legal requirements. So we investigate the technical progress as described above with regard to its compliance with legal requirements, in particular with European Law and the upcoming General Data Protection Regulation (GDPR). At European level, the “Directive 95/46/EC on protection of individuals with regard of the processing of personal data and on the free movement of such data” (Directive 95/46/EC) and the “General Data Protection Regulation” (Regulation (EU) 2016/679) have to be legally assessed. A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods. In comparison to the directive which has to be implemented by the Member States and is insofar not directly legally binding by itself, the regulation is however directly applicable. The Directive 95/46/EC is repealed with effect from May 25th 2018 (cf. Article 94 GDPR), so that the GDPR will apply from this date on. Therefore subsequently we will only have a look at the GDRP.

5.3.2 General Data Protection Regulation (GDPR)

Before any data protection requirements can be considered at all, the fundamental question about the applicability of data protection law must be clarified as a particular challenge. Data protection law is only relevant in the case of processing personal data (Article 2 GDPR). Therefore, it must always be the first step to check whether the analysis relates to personal data or not.

The legal link for the assessment of the existence of personal data is Article 4 no. 1 GDPR. Personal data in the context of the GDPR means any information relating to an identified or identifiable natural person; an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier, or to one or more

[16] see https://spark.apache.org/docs/latest/sql-programming-guide.html
[17] USU Katana Platform (see http://katana.usu.de/) is a platform for data processing on big scale, high velocity and variaty

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factors specific to the physical, physiological, genetic, mental, economic, cultural, or social identity of that natural person. In the context of SmartRegio for each individual processing step (data acquisition, data processing, data analysis and data visualisation), it is necessary to check whether personal data are concerned or not. It is highly controversial when a person is identifiable. To handle this problem the use of technical methods for anonymisation as described above is useful to exclude the personal data, and then data protection law is not applicable, or to minimise the risk of identification at least. In case of doubt, data protection regulations should be observed. Then, a legal basis is necessary. Processing shall be lawful only if the data subject (Article 4 no. 1 GDPR) has given consent to the processing of his or her personal data for one or more specific purposes (Article 6 no. 1 lit. a GDPR) or a legal provision exists (e.g., Article 6 no. 1 lit. f GDPR). Processing is lawful if processing is necessary for the purposes of the legitimate interests pursued by the controller or by a third party, except where such interests are overridden by the interests or fundamental rights and freedoms of the data subject which require protection of personal data (Article 6 no. 1 lit. f GDPR). Therefore a balancing of interests is necessary. The smart data controller can refer to Article 15 (Freedom to choose an occupation and right to engage in work), Article 16 (Freedom to conduct a business), and Article 17 (Right to property) Charter of Fundamental Rights of the European Union. The data subject can refer to Article 7 (Respect for private and family life) and Article 8 (Protection of personal data) Charter of Fundamental Rights of the European Union. Both legal positions must be harmonised. Furthermore smart data collection and analysis techniques are in general in conflict with fundamental data protection requirements like the principle of purpose limitation (Article 5 lit. b GDPR), the principle of necessity, the principle of data minimisation (Article 5 lit. c GDPR), or the principle of transparency (Article 5 lit. a GDPR). In addition, the controller (Article 4 no. 7 GDPR) has in general many legal obligations (Article 24 et seq. GDPR). Also the data subject has various rights (e.g., right of information and access to personal data, right of rectification and erasure, right to object and automated individual decision-making, cf. Article 12 et seq. GDPR). This should also be taken into account when processing, evaluating and transmitting data, because, if necessary, the procedural steps must be verified and the smart data controller must also be able to comply with the claims of the data subject. In the view of the tendency of the data protection law to eliminate existing enforcement deficiencies increasingly and to prove infringe¬ments with considerable fines, the observance of such obligations is already increasingly important in the sense of compliance. Infringements can be subject to administrative fines up to 20 000 000 EUR, or in the case of an undertaking, up to 4 % of the total worldwide annual turnover of the preceding financial year (Article 83 no. 5 GDPR). Thus, companies which collect and analyse personal data based on smart data analyses are subject to numerous legal obligations which they must comply with. All these problems, which illustrate the challenges concerning new technologies and law, must be analysed and require further intensive scientific research.

6 BUSINESS MODEL AND BILLING

In Section 5.1 we identified different stakeholders and their roles within the SmartRegio eco-system. In order to generate revenue these different stakeholders need to have a common business concept, while all want to sell their products and services:

- Platform operator – generate revenue on management and maintenance of a platform for third parties,
- Data provider – generate revenue on data usage,
- Service provider – generate revenue on usage of implemented algorithms and services, and
- Application developer – generate revenue on orchestrated data-pipes providing new insights on the data.

The first question remains on how to operate in terms of who pays whom in this eco-system. Within SmartRegio we identified several possible options. A selection (cf. Figure 3) of these options is shortly discussed here.

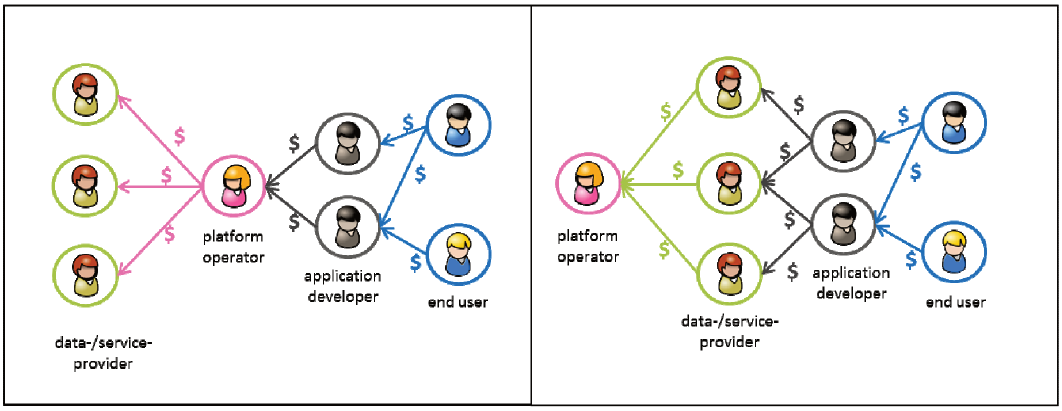

Figure 3: Two possible distribution options within SmartRegio

(1) The end-user pays the application developer as the one that provides the added value to the user.

(a) The application developer pays the platform operator; the platform operator pays data and service providers (cf. Figure 3, left side).

(b) The application developer pays data and service providers, and these pay the application provider (cf. Figure 3, right side).

(2) The end-user pays the platform operator which pays the other stakeholders.

(3) The end-user pays all other stakeholders (which leads to a complex billing for customers).

Having defined the distribution options one needs to define how to evaluate the costs. Here SmartRegio evaluated different options of which a subset is shortly discussed here.

(1) Buying the platform with selected services and data sets, which is not applicable for SMEs due to the large costs this implies.

(2) Pay-per-use based on, e.g., time or data and service usage. Here an appropriate logging mechanism for the platform usage needs to be implemented. There is still variable cost for end users based on the usage. A slight modification would be tiered pricing where the end user gets discounts after a defined amount of usage.

(3) Flat-rate, which allows the usage for a pre-defined time or usage of data and services. This model allows defining fixed costs for end users.

While app stores for several smart phones and operating systems have solved some of the issues arising on the multi-stakeholder scenario the platform for geo-spatial data processing and analysis, SmartRegio still requires some more practical evaluation.

7 SAMPLE USE CASE: THE SPATIAL PROFILER APPLICATION

In this section, the Spatial Profiler application developed within SmartRegio will be presented as a sample use case that illustrates a variety of the challenges and approaches mentioned so far.

The idea behind the Spatial Profiler was to provide an interactive and easy-to-use tool for experts that allows for showing characteristics of given regions and to allow the comparison between regions, given potentially arbitrary many datasets that contain information about them.

Consequently, the Spatial Profiler was developed as a generic, modular web application that offers

- to integrate arbitrary many data sources about a region,
- to work with different spatial granularities, and
- to choose among a variety of different visualisation methods, while at the same time offering to easily integrate new methods.

Furthermore, textual information is supported in a way that allows integrating different mappings for ontologies, so that information from different sources can be easily aggregated or compared for further evaluation.

The application was developed based on the existing infrastructures ALOE (Memmel & Schirru 2007) and RADAR (Memmel & Gross 2011) developed in DFKI and uses an Elasticsearch index for storing spatial entities as well as the information about them. The visualisations where realised based on the D3 JavaScript library.[18]

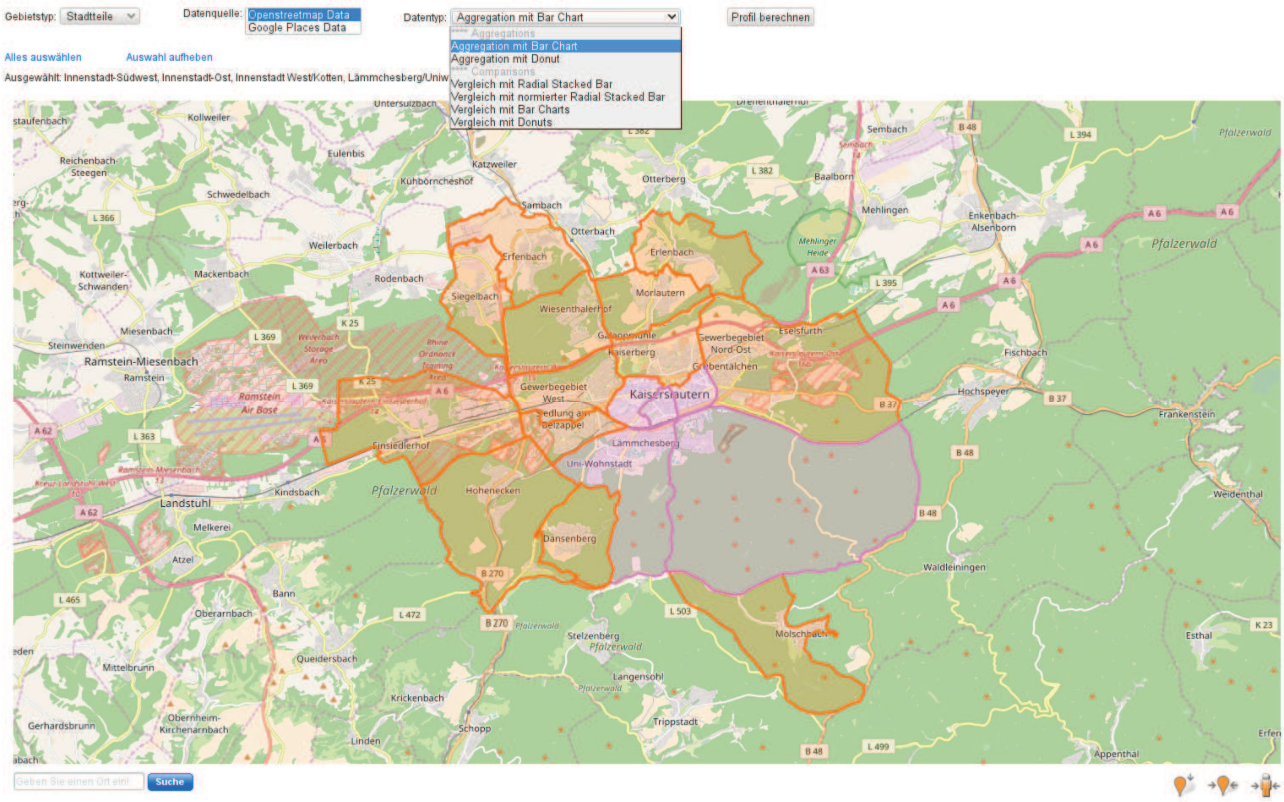

Figure 4: Selection of regions, data sources and visualisation types within the Spatial Profiler application

Figure 4 shows a screenshot of the Sample Profiler with a scenario realised for analysing different quarters in the City of Kaiserslautern. In the top bar, users can choose the following parameters:

- Spatial type: In this scenario the granularities “urban quarters”, “school districts”, and “electoral districts” are offered. The respective shape data required for the display on the map and the analysis of data were provided by the City of Kaiserslautern. Users can select and deselect the regions by simply clicking on them.
- Data source: In our example, two different sources (OpenStreetMaps and GooglePlaces) have been integrated with the focus in distinguishing city parts according to the type of POIs that can be found. They are harvested regularly to ensure that the data sources are up-to-date. Users can choose to use single data sources, but also combinations of them. In order to evaluate the disjunct categories from the sources, a mapping was created to our own ontology that is based on the YellowMap branches categorisation.
- Analysis type: In a first step, users can here decide whether they want to examine all selected regions as one, aggregated region, or if they want to compare them. Depending on this choice and the visualisation means that are integrated, different options are offered then.

[18] see https://d3js.org

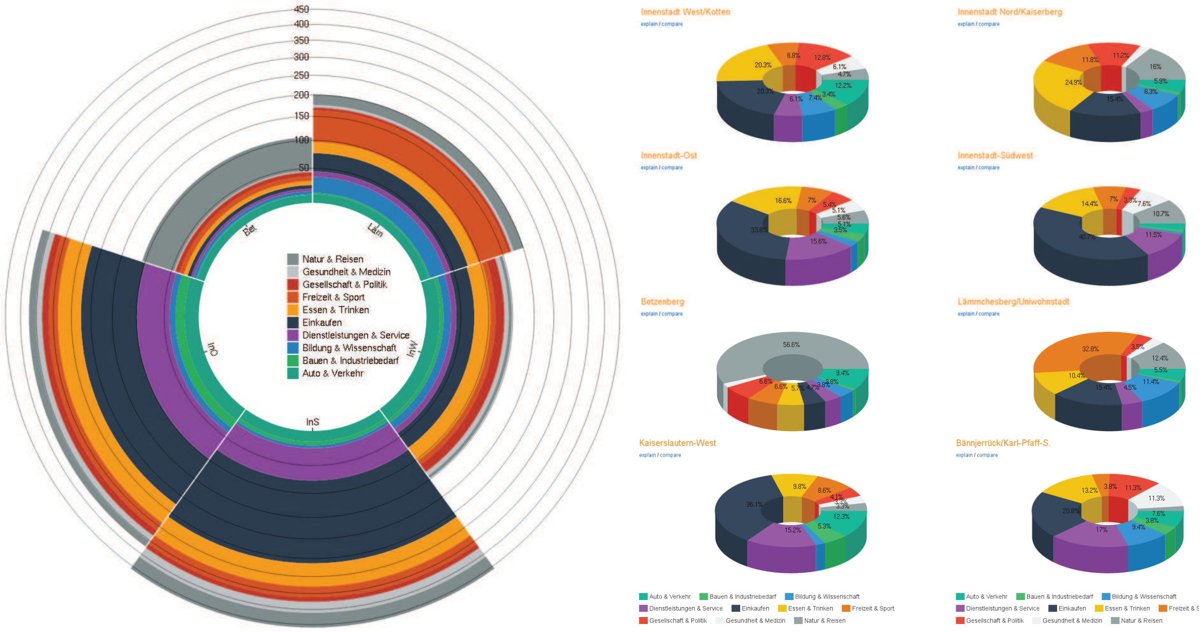

Figure 5: A comparison between the number/distribution of entity types in different city quarters using a non-normalised radial stacked bar (left) and donuts (right) within the Spatial Profiler application

Two different analyses created with the Spatial Profiler are shown in Figure 5. On the left side, five city quarters are compared in a non-normalised radial stacked bar. The size of each sector corresponds to the total number of POIs found in the respective region, and the colour distribution corresponds to the types of POI. This allows, e.g., for characterising quarters as inner-urban or not, while at the same time also providing a lot of information about the structure of the quarter. On the right side, eight city quarters have been chosen for a comparison using donuts to display the distribution of different POI types. Here, it is also possible for each region to display a comparison to the average of all regions in order to find out whether there are interesting specifics.

8 SUMMARY AND CONCLUSIONS

The main hypothesis of the SmartRegio project was that the intelligent analysis of spatial data available already today or in the near future, could help SMEs and local/regional administrations significantly with their strategic decisions regarding local and regional topics – in a great variety of applications such as infrastructure planning, urban planning, geo marketing, all kinds of location planning, to mention just a few. Novel and upcoming Smart Data technologies should be able to integrate heterogeneous kinds of data (open government data, user-generated data, social media content streams, geo-referenced sensor data streams, proprietary data sets like customer and marketing data, etc.), to analyse them intelligently and to visualise the results in user-friendly ways – thus making Smart Data analytics available to domain experts without specific Data Science know-how.

Within the SmartRegio project, we developed and integrated a number of building blocks and technologies for such a solution and showed how they can play together in an integrated architecture. For data acquisition, data ingestion, and data integration, ETL processes have been established for different kinds of data sources (geo data, social media content, non-spatial big-data streams) which are then merged into the SmartRegio Data Warehouse. Central topics were always (i) the creation of spatial references for data without them (geocoding), and (ii) the spatio-temporal integration of data with spatial references in the presence of different spatio-temporal resolutions, granularities and reference systems. For data processing and analytics, a processing-workflow machinery has been realised based on a processing-service library, a metadata management for data sets and processing services, and an orchestration engine; all that managed from the SmartRegio Configuration Cockpit for Data Scientists who are competent with the data and the processing services. For end users, knowledgeable in the application domain and in the analysis goals, but not necessary in the ICT technologies and manipulated data sets behind, a couple of intuitive, expressive visualisations have been created, some of them interactive, in order to give to the end users some freedom for their own experiments and analyses (examples of this interactive visualisation approach have been shown in Section 7).

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Further modules for ensuring data security and for checking privacy requirements have been added to the platform in order to prepare a real-world application.

Business model and billing aspects have been investigated and partially integrated into the software prototype. Challenges in that respect also rely on the acceptance of the stakeholders. Our experience is that specifically SMEs want to have transparent and, ideally, fixed costs so they can plan ahead without taking too much risks. However, this increases the complexity in having a billing model for other stakeholders like data and service providers.

To sum up: Many technical solution elements have been realised at least in a basic form. The level of heterogeneity should not be underestimated, whereas the accessibility and quality of available spatial data should not be overestimated. Often, the required data is not available at the needed level of granularity. Integration of data with different resolution scales and spatial reference systems may require tricky and/or heuristic approaches. This makes spatial data integration still a cumbersome and often manual process. Here, more transformation operators / workflows and a higher degree of automation still provide some interesting future work. Also the realisation of successful business models and billing approaches requires more practical experience and experimentation. Finally, the implemented interactive visualisation methods found great acceptance by test users. But for a broader and easier application of the SmartRegio platform in a wide range of real-world applications, the processing-service library and the toolbox of visualisation methods will still have to be extended if non-technical end users shall be able to work efficiently and intuitively with the SmartRegio platform. Yet, SmartRegio developed prototypical and promising solutions.

So far, SmartRegio delivered a number of technical solution elements for practical employment of Smart Data technologies. But, the biggest problems for project impact were not encountered on the technical, but on the non-technical side.

On the one hand, legal aspects may become a significant hurdle for practical Smart Data applications and prevent businesses to invest in it. We have thoroughly analysed the current state of affairs. In terms of security, trust, and privacy protection there is still some uncertainty for all stakeholders (Kollmann 2016), (QSC 2016), (Pols & Vogel, 2017), (Zacher 2016). And with the European General Data Protection Regulation (GDPR) applicable as of May 25th, 2018 the uncertainty on the provider side will possibly rise (Schonschek 2017). Even though the cloud usage has increased in the last few years, the number of private cloud users is still higher than the number of public cloud users (Pols & Vogel, 2017). Therefore trust in European cloud services needs to be implemented by providing secure services and privacy protection. SmartRegio addressed these topics and builds upon existing standards and state of the art technology.

On the other hand, the availability of useful and usable Open Data may have been the biggest hurdle. Especially, the lack of machine-consumable data was one of the biggest problems. In particular in public administrations, a lack of organisation structures (workflows, defined procedures, responsibilities) and staff that enables an organisation-wide gathering, analysis and publication of data, could be observed. Knowledge about internally available data sets, legal and licensing (!) issues, potentials as well as challenges are often missing, and processes that could help to overcome these problems do not exist. If Open Government Data (OGD) shall act as a fuel for initiating a European Data Economy, much political investments must be spent here. Many concrete activities can be imagined: Concrete large-scale lighthouse projects, more standardisation activities, budgets and binding plans for OGD realization, a closer cooperation of politics, administration, companies, science, and much more. The investments would certainly pay off in better decisions and novel usage ideas in the administration and in the economy.

9 REFERENCES

Andreas Bender: Anwendbarkeit von Anonymisierungstechniken im Bereich Big Data. Master Thesis, KIT, Karlsruhe, Germany. 2015.

Sebastian Bretthauer: Compliance-by-Design-Anforderungen bei Smart Data – Rahmenbedingungen am Beispiel der Datennutzung im Energiesektor, ZD 2016, S. 267 ff.

Daniela Hochfellner, Dana Müller, Alexandra Schmucker and Elisabeth Roß: Datenschutz am Forschungsdatenzentrum. FDZ method reports. 2012. Ref.: http://doku.iab.de/fdz/reporte/2012/MR_06-12.pdf

Jörg Höhne: Verfahren zur Anonymisierung von Einzeldaten. Band 16 der Reihe Statistik und Wissenschaft. Statistisches Bundesamt. 2010.

Zaheer Khan, David Ludlow, Richard McClatchey and Ashiq Anjum: An architecture for integrated intelligence in urban management using cloud computing, in: Journal of Cloud Computing: Advances, Systems and Applications, Volume 1, Number 1. Springer, 2012.

Malte Kollmann: Cloud-Anbieter haben Nachholbedarf beim Thema Sicherheit. Electronic document. Date of publication: November 15, 2016. Retrieved May 30, 2017, from https://www.computerwoche.de/a/cloud-anbieter-haben-nachholbedarf-beim-thema-sicherheit,3326314.

Martin Memmel, Rafael Schirru: ALOE - A Socially Aware Learning Resource and Metadata Hub, in: Martin Wolpers, Ralf Klamma and Erik Duval (Eds.): Proceedings of the EC-TEL 2007 Poster Session. CEUR workshop proceedings, 2007.

Martin Memmel, Florian Groß: RADAR - Potentials for Supporting Urban Development with a Social Geocontent Hub, in: Schrenk, M.; Popovich, Vasily, V.; Zeile, P. (Eds.): Proceedings REAL CORP 2011, p. 777-784, ISBN 978-3-9503110-1-3, Schwechat, (Austria), 2011.

Axel Pols, Marko Vogel: Cloud Monitor 2017 – Eine Studie von Bitkom Research im Auftrag von KPMG. Electronic document. Date of publication: March 14, 2017. Retrieved May 30, 2017, from https://www.bitkom.org/Presse/Anhaenge-an-PIs/2017/03-Maerz/Bitkom-KPMG-Charts-PK-Cloud-Monitor-14032017.pdf.

QSC AG: In die Cloud? Aber sicher! Electronic document. Date of publication: July 15, 2016. Retrieved May 30, 2017, from https://digitales-wirtschaftswunder.de/in-die-cloud-sicher.

Gerd Ronning, Roland Sturm, Jörg Höhne, Rainer Lenz, Martin Rosemann, Michael Scheffler and Daniel Vorgrimler: Handbuch zur Anonymisierung wirtschaftsstatistischer Mikrodaten. Band 4 der Reihe Statistik und Wissenschaft. Statistisches Bundesamt. 2005.

Martin Rosemann: Auswirkungen datenverändernder Anonymisierungsverfahren auf die Analyse von Mikrodaten. Institut f. Angew. Wirtsch.-Forsch. 2006.

Oliver Schonschek: Datenschutz-Grundverordnung - was Cloud-Nutzer wissen müssen. Electronic document. Date of publication: May 04, 2017. Retrieved May 30, 2017, from https://www.computerwoche.de/a/datenschutz-grundverordnung-was-cloud-nutzer-wissen-muessen,3330645.

Matthias Zacher: Unternehmen müssen ihre Vorbehalte abbauen. Electronic document. Date of publication: December 19, 2016. Retrieved May 30, 2017, from https://www.cio.de/a/unternehmen-muessen-ihre-vorbehalte-abbauen,3260926.

reviewed paper

Social Media as A Source of Self Organizing City: Bridging the Gap Between Policy Making and Public Act

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1 ABSTRACT

Cities are complex systems, which creates spontaneous movements and reactions in urban space. These self-organized networks and environment continuously reproduce each other by involving series of social and cultural communication patterns, ideas and decision-making processes. Unlike conventional participation tools ICT, social media and mobile technologies provide an alternative, virtual platform, that enables citizens to connect with decision makers, share information, comment and vote for changes, and self-organizing their environment. This new platform delivers a practical tool to decision makers for accessing a wider interest group, collecting location based, real time data and enables citizens to get involved in the planning process. In recent years Turkey has gone through many urban conflicts, and social media tools, especially Facebook, and Twitter densely used for information sharing and to be heard by government. In this study, the usage of social media as a participation tool was discussed in two parts. Firstly, A literature review on the engaging potential of mobile participation tools was given. Secondly, the usage and the impact of social media and mobile platforms was evaluated over examples from Turkey.

Keywords: social media, data mobilisation, participatory plannung, urban planning, self-organisation

2 INTRODUCTION

Constantly evolving, technology-based communication tools have changed the perception and increased the awareness of communities against all activities around them. Cities are complex systems that involve a series of unpredictabile mobile activities in economical, cultural, physical, and social relations. This user-generated, mobile process can be described as a self-organized system, which turns urban planning and management into a challenging situation that needs to be considered with various parameters (Portugali, 2000).

The user oriented, interactive information and communication technologies (ICT) provide a new platform especially for citizens to raise their voice, share their interests and demands, even if they are not encouraged by the government. This directly and rapidly changed the routine and forced administrators to react the ideas comes through this platform (Evans-Cowley & Hollander, 2010; Kleinhans, Van Ham, & Evans-Cowley, 2015). In the previous researches it was specified that today social networking tools such as Facebook and Twitter became part of the political environment by providing the user an in-network experience, enhancing reciprocal communication, removing spatial boundaries and increasing accessibility in domains (Evans-Cowley & Hollander, 2010; Twitchen & Adams, 2011). They also emphasized these tools can be used for increasing community awareness through rapid circulation of information, and for engaging especially the young people in decision-making process by providing users free and easy to use interfaces.

In this context, anyone who has a computer and internet connection provide individual and collective data for decision making and planning activities. Due to there are still many questions on its legitimacy, the data obtained from these sources provide a vast information and give local communities to chance to achieve self-organized, sustainable environment by strengthening the sense of belonging, revealing local needs and priorities, increasing the interaction within the neighborhoods, and defining the real use of urban spaces. On the decision maker's site the most important outcome obtained from web-based data is the ability of developing insights on the citizens' reactions to proposed changes. Besides many two important data can be driven from the results, first, the general feeling of the community, and second, approaches of different groups. These knowledge also involves location and user information such as coordinates, country, city or neighborhood names, timestamps, gender, ethnicity, cultural and political insights, and allows georeferenced visualizations (Ciuccarelli, Lupi, & Simeone, 2014; Evans-Cowley & Hollander, 2010; Pucci, Manfredini, & Tagliolato, 2015; Twitchen & Adams, 2011).

This research aims to discuss social media as a mobile participation tool in a self-organizing system. In this context, in the first chapter, the role of the social media in decision making process has been discussed. In the second chapter, Facebook, Twitter, Instagram and Foursquare discussed in terms of the possible outcomes. In the third chapter the data obtained from Twitter discussed over a recent urban management process in Turkey. In the conclusion, obtained results were discussed and recommendations were presented.

3 MATERIALS AND METHODS

3.1 Mobile Participation in Decision Making

For many years conventional participation tools such as a referendum, public surveys, focus groups or meetings, have been developed and applied by many countries for decoding these patterns and processes and for localizing urban policies at various scales. On the other hand, these tools require the community to be at a specific place in a particular time. Therefore, they fall behind to understand the patterns related to time and physical environment, and to incorporate a broad spectrum of the public. In the last decade, computers, cell phones, wireless networks decentralized the way of communication and they produce a great amount of individual and collective data enabling anyone to monitor and collect information (Batty, 2013). Twitchen and Adams (2011) emphasized that unlike conventional control group methods, Web 2.0 user-oriented interfaces increases the capacity building by reaching the high level of participation. According to Burke et al. (2006) when these tools developed and used in the right context they could act as important and interactive data collection instruments, which increase the quality, quantity, credibility, and shareability of the data. In parallel with the rapidly increasing usage of social media, geo-referenced images, mentiones, hashtags, contributions became one of the main data sources for local. it compels the governments to be responsive to the community. Therefore, governments are forced into paying attention to the results of the analyzed data obtained through these sources (Batty, 2013; Burke et al., 2006).

3.2 Social Media as a Tool for Self-Organization

In a self-organized system, agents stay in equilibrium at the initial condition, but when the system is triggered by an influence, agents respond without the control of an outsider or another component. Therefore, it is a temporary situation of a reaction to an action, and this rule can be applied to many scientific fields. The complexity of the self-organization process is created by individual behaviours according to the actions of the neighboring agent. In this perspective self-organized systems get their power from below, which can be defined as a bottom-up process (Johnson, 2001). According to Allen (1997), although, community is the main actor of self-organization process, it is shaped by the social and physical environment. On the other hand, this idea has expanded since the virtuality has changed the environmental boundries.

According to Krätzig and Warren-Kretzschmar (2014), public protests that ripple throughout the world reflect the growing expectations of citizens from government authorities and as well as the reactions against the issues that they were affected. Using the social media with a communicative approach enables administrators to spread the necessary information to the larger numbers of citizens (Krätzig & Warren-Kretzschmar, 2014; Twitchen & Adams, 2011). On the other hand, government-led usage of social networking tools is limited because of the technical restrictions, such as social media bans in the workplaces, and the lack of a comprehensive and focused communication strategy. The official language used by administrators also decrease the inefficiency social media tools. Accordingly, casual language found more engaging (Evans-Cowley & Hollander, 2010). In Turkey Twitter is commonly used by public for expressing agreements and disagreements on government projects with a completely citizen-initiated platforms or individual acts. The reactions especially occur and succeed at urban scale. These collective reactions usually generated by government policies, and achievement is gained at a certain level through a self-organizing, bottom-up process that provides an important opportunity for governments to gain public support for the future plans (Batty, 2013; Krätzig & Warren-Kretzschmar, 2014).

The social media interfaces such as Facebook and Twitter hold a great potential for a self-organizing process by reflecting personal experiences into the real world and provide information about collective trust and satisfaction. This big data obtained from social media can be seen as a part of complexity theory and as a virtual self-organizing system (Batty, 2013; Krätzig & Warren-Kretzschmar, 2014). In the decision making process, it is also common that the information spread through social media reaches random passive users and allows remote participation. This outcome, results with the gain of a certain degree of knowledge and increase in the capacity building (Evans-Cowley & Hollander, 2010; Twitchen & Adams, 2011). People tend to support the planned policies and projects when they are involved in the decision-making process. Instead of the conventional, one-way tools to inform citizens about a decision that has already been made, it is important for the policy makers to provide mobile platforms for public dialogue and consultation (Evans-Cowley & Hollander, 2010).

In their study on visualization of the urban data obtained from social media Ciuccarelli, Lupi and Simeone (2014) examined Facebook, Twitter, Instagram, Panoramio and Foursquare in terms of data provision. According to their study, Panoramio and Instagram data include the number of photos in a specific coordinate, and likes on pictures that present the urban concentration areas. Similarly, Foursquare provides the number of check-ins, and comments on a specific location, and they are all provide a detailed information on the real use of an urban area. From Facebook and Twitter, it is possible to obtain the information on the number of mentions, comments, tweets, followers, and hashtags. The synthesis of this big data can provide a vast information on general public opinions as well as different approaches of various groups. Because, even though each tool involves a series of context specific data, they are all provide profile information including gender, age, mobility and location (Ciuccarelli et al., 2014).

Previous researches also revealed that, in combination with the profile information the Twitter can act as a powerful source for analysing citizens' sensitivity on a certain issue in a particular location. Because, on the contrary of other tools the main idea of Twitter is based on sharing any information with a limited number of characters, which provides a certain level of simplicity, user-friendly interface, and high intensity of user contributions (Ciuccarelli et al., 2014; Kurkcu, Ozbay, & Morgul, 2016). Accordingly, the study focused on Twitter over a current urban management process, which involves a public act against a government bill that allows industrial development in olive grooves. In this scope, the most used hashtag #zeytinhayattır (#oliveislife) analysed through keyhole hashtag tracking software in different time periods to be able to discuss the relations between the communication process and the Twitter usage.

4 RESULTS

Twitter is a multi-language, social media interface that has more than 300 million active users monthly. Information circulation through Twitter is coming from approximately 500 million, 140 characters long tweets that provide open data every day. This data enables to obtain collective information for decision makers (Kurkcu et al., 2016). In 2015 a public act started via change.org to stop a government bill which will open olive grooves, meadows and coasts to industrial development with the permission of Ministry of Food, Agriculture and Livestock with the approval of a board selected from 6 Ministeries. The proposed regulation will be valid for each city that has one of these land uses and all initiatives that has industrial registry certificate will allow to apply for the site without paying taxes. It proposes to building industrial sites without harming the grooves and bring the area to its old quality after the allocation agreement ends. The bill was proposed in 2002 for the first time and rejected 6 times since then. The last proposal was introduced in 2015 (Url 1; Url 2).

Besides the negative environmental effects, the bill critisized because of its economic results in agriculture and social destruction for olive producers in the country. Due to the public act started in 2015, it spreaded in the spring of 2017 and the government agreed to make changes in the bill. The Twitter played an important role in the expansion of the reactions. The government organized a public meeting in 31st May of 2017 and announced that they are not going to withdrawl the proposal. One week later tweets related to the bill reached at the peak point. The process mainly conducted by the citizens who will be directly affected by the change, and shortly it turned out to a public reaction on a virtual platform.

According to the data obtained from the tweets in the peak point period, most of the users tended to write a custom tweet with the #ZeytinHayattır (olive is life), #zeytinimedokunma (do not touch my olive), #zeytinağacı (olive tree), #zeytinmilliservettir (olive is national wealth), #zeytinbarıştır (oliveispeace), #birliktemümkün (it is possible together), #zeytin (olive) hashtags, and almost 40% percent of the users retweeted the mentions. Most of the users linked their tweets to the change.org campaign. It has seen that approximately 40% of the tweets sent via mobile phones, this followed by desktop computers.

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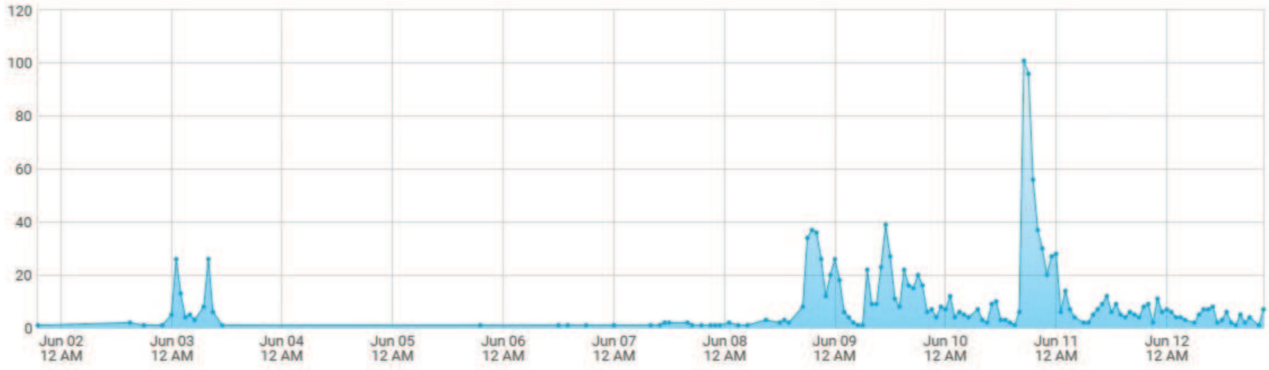

Fig. 1: Timeline (June)

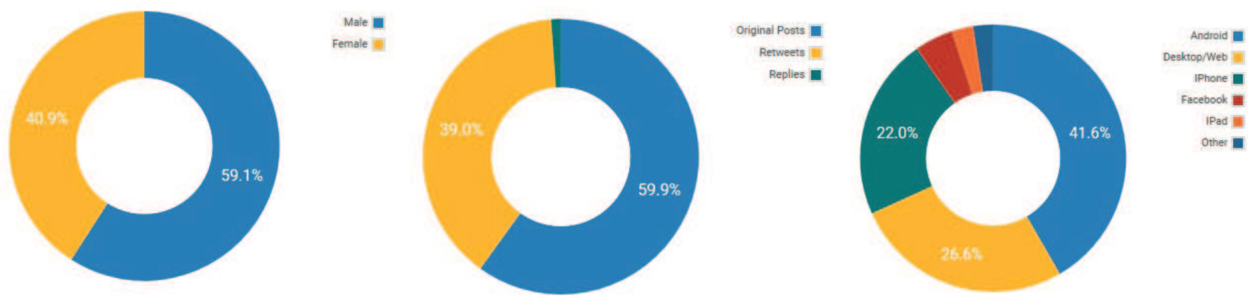

Fig. 2: Gender, Share and Sources (June)

The tweets sent in a week reaches more than 1000 people, and more than 100000 impressions. The area covered mainly Turkey but also United States, Brazil, some parts of Europe, Irland, Iran and India. This expansion also indicates the virtual local borders.

Fig. 3: Virtual Borders (June)

As the start of the negotiations between government and public, the government expanded the olive groove definiton based on the number of trees. Accordingly the site will be approached as an olive groove even if there is one olive tree on the land. The penalties increased in case of damaging the trees. The land uses including housing and touristic facilities were banned on the grooves, and the last but not the least the NGO's included to the conservation board, which in turn started to change the way of public act against government and also the number of tweets started to decrease. Once the communication between citizens and governmnet has started, the process moved to another stage, and the role of the Twitter transformed from platform for the public act to tool for the information flow.

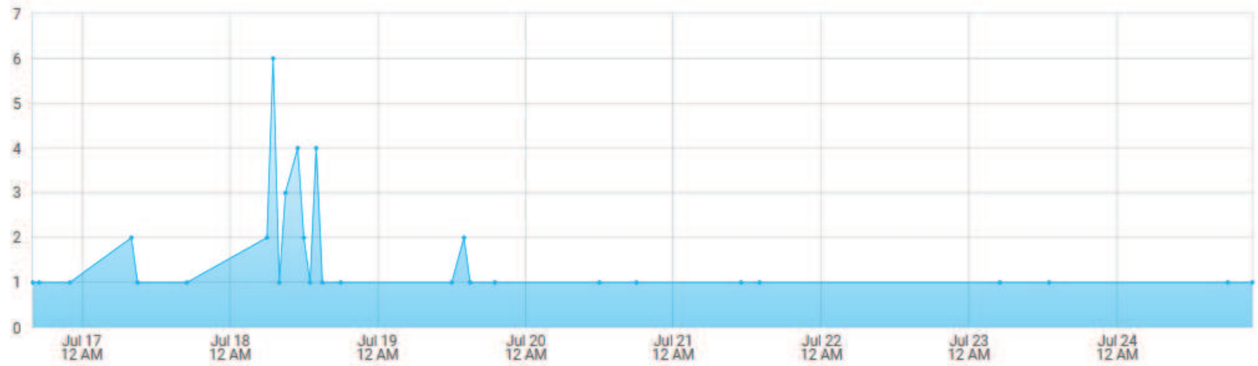

Fig. 4: Timeline (July)

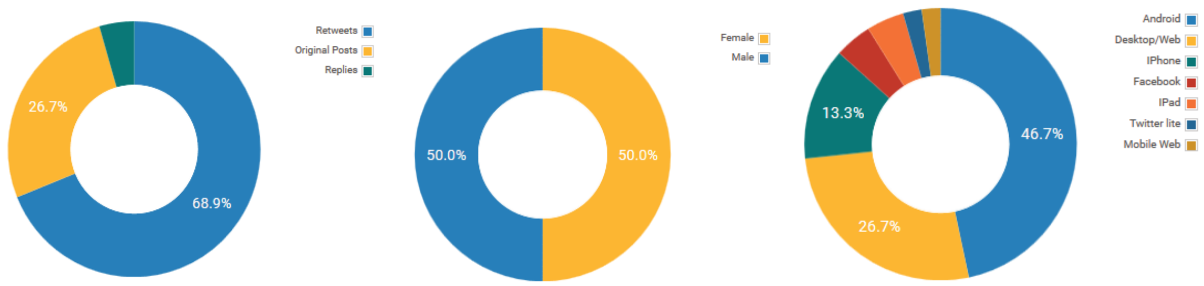

Fig. 5: Gender, Share and Sources (July)

Fig. 6: Virtual Borders (July)

The comparison between the hashtag analysis before and after negotiations started revealed that the peak point reduced 6 original posts from 100 after the government-citizens meeting. The virtual borders shrinked to Italy, Ireland, Venezuela, England and United States in terms of number of mentions. The large number of Twitter users were mobile during the process.

5 DISCUSSIONS AND CONCLUSION

Due to many advantages that social networking provides for the successful public participation process, it is still is an emergent methodology, which can be criticized in terms of its dependence on internet accessibility, costs and privacy. Therefore, it is important to integrate these cost and time effective technologies into existing methodologies for strengthening the public engagement. The big data obtained from social media is certainly enriching the social interaction, the function of cities, and planning and decision-making

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experiences. (Batty, 2013; Twitchen & Adams, 2011). On the other hand, the accessibility concerns related to the challenges of using the technical software, limited to the income and age diversity or the number of the participants. However, it should be remembered that the social media is only one tool out of others, and conventional public hearing methods that requires citizens to provide official letters or participation to a meeting has many limitations as well.

This study aimed to develop a basic understanding on the relation between social media can help to self organize the environment that we live in. Turkey provides an important example because the country is in the rapid development process at all levels, which has an important potential for adapting innovative approaches. In this context, mobile technologies provided not only a virtual communication platform, but also created an opportunity to face to face meetings with the authorities and achieved to become a part of the decision making process even if the goal is not completely suceeded. Even in a short period of time it is possible to read that an action of the government can create a public reaction, can be spreaded very rapidly through social media. Since it is a developing debate, the combination of different participation tools and methodologies should be analyzed to fully understand the efficiency of social media and other ICT tools in participatory planning an decision making process.

6 REFERENCES

Allen, P. M.: Cities and Regions as Self-Organizing Systems: Model of Complexity: Taylor & Francis, Amsterdam, 1997.

Batty, M. (2013). Big data, smart cities and city planning. Dialogues in Human Geography, 3(3), 274–279. https://doi.org/10.1177/2043820613513390

Burke, J. A., Estrin, D., Hansen, M., Parker, A., Ramanathan, N., Reddy, S., & Srivastava, M. B. (2006). Participatory sensing. UC Los Angeles: Center for Embedded Network Sensing. California. Retrieved from http://escholarship.org/uc/item/19h777qd

Ciuccarelli, P., Lupi, G., & Simeone, L. (2014). Visualizing the Data City Social Media as a Source of Knowledge for Urban Planning and Management. https://doi.org/10.1007/978-3-319-02195-9

Evans-Cowley, J., & Hollander, J. (2010). The New Generation of Public Participation: Internet-based Participation Tools. Planning Practice & Research, 25(3), 397–408. https://doi.org/10.1080/02697459.2010.503432

Kleinhans, R., Van Ham, M., & Evans-Cowley, J. (2015). Using Social Media and Mobile Technologies to Foster Engagement and Self-Organization in Participatory Urban Planning and Neighbourhood Governance. Planning Practice & Research, 30(3), 237–247. https://doi.org/10.1080/02697459.2015.1051320

Krätzig, S., & Warren-Kretzschmar, B. (2014). Using Interactive Web Tools in Environmental Planning to Improve Communication about Sustainable Development. Sustainability, 6(1), 236–250. https://doi.org/10.3390/su6010236

Kurkcu, A., Ozbay, K., & Morgul, E. F. (2016). Evaluating The Usability of Geo-Located Twitter As A Tool For Human Activity and Mobility Patterns: A Case Study for NYC. In Transportation Research Board's 95th Annual Meeting (pp. 1–20). Washingron. Retrieved from https://www.researchgate.net/publication/290395438_Evaluating_the_Usability_of_Geo-Located_Twitter_as_a_Tool_for_Human_Activity_and_Mobility_Patterns_A_Case_Study_for_New_York_City

Portugali, J. (2000). Self-Organization and the City. Heidelberg: Springer. https://doi.org/10.1007/978-3-662-04099-7

Pucci, P., Manfredini, F., & Tagliolato, P. (2015). Mobile Phone Data to Describe Urban Practices: An Overview in the Literature. In Mapping Urban Practices Through Mobile Phone Data (pp. 71–76). Milan: Springer. https://doi.org/10.1007/978-3-319-14833-5

Twitchen, C., & Adams, D. (2011). Using web technology to increase levels of public participation in planning (No. 5). Town Planning Review. Birmingham. https://doi.org/10.3828/tpr.2012.38

reviewed paper

Spatial Complexity: Identifying Critical Zones in the Egyptian Underground Reciprocal Stations

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1 ABSTRACT

Greater Cairo, the Egyptian capital, hosts around 10 million inhabitants, in addition to 2 million commuting, 5 million of that total are daily subway users. Large subway stations are considered, nowadays, one of the most frequently used public spaces in cities nowadays. The underground reciprocal stations are quite complex, and the majority of their users, no matter how familiar they are with the building facilities, are observed to face difficulties in wayfinding behaviors. The users perceptions, in terms of spatial configuration, strongly influence the success of wayfinding, with a specific consideration to the case of illiteracy of the Egyptian users, which is estimated at 20.9%. This paper aims at providing an objective approach to validly predict wayfinding performance. It attempts to to determine the critical zones features of wayfinding and the possible ways of dealing with them to avoid adding movement patterns to the expected planned stations layout and the surrounding urban context.

Keywords: reciprocal subway stations, space syntax, wayfinding, critical zones, spatial complexity

2 INTRODUCTION

Most of the wayfinding literature focuses on the wayfinding process rather than the environment in which wayfinding takes place (Rüetschi, U. J., & Timpf, S. 2004, October), but as wayfinding is an interaction between the wayfinding and wayfinder (Allen 1999, Darken et al. 1999), to focus on the environment is essential. Following that perspective, several studies started to determine features of the environment and different that improve the wayfinding process through settings, and confirm that people's movements is affected to a remarkable extent by the spatial configuration through spatial cognition (e.g. Wiseman, 1983; Kim & Penn, 2004).

However, there is a gap to be bridged between the design process and architectural design disciplines. In the design of large-scale underground stations spaces where the level of difficulties in spatial cognition increases such as wayfinding and legibility, architects have difficulty with perceiving the outcome of a design in terms of the spatial configuration and cognition, which strongly affects the success of wayfinding, and therefore designers and operational teams tend to use signage system. In the Egyptian context that witnesses a high degree of users illiteracy, the presence of signage is an important factor but could not compensate for floor plan complexity (Raubal, M. 2001), which highlights the importance of settings in wayfinding according to its ability to deal with different culture, the level of cognition and literacy. In that context different authors have mentioned different underlying factors that influence user's judgments of complexity, those factors related to the plan configuration symmetry, the number of possible connections between parts of setting and observer view point (O'Neill, M.J.1991, Werner, S., & Long, P.2002, Le Corbusier.1931/1986).That adds to Hillier's concept of "generic function" (1996, p.258). which refers to three aspects of human occupancy of buildings that is prior to particular functional programs or activities, first, to occupy space means to be aware of its relationships to others, second, to occupy a building means to move in it, finally to move in a building it depends on being able to retain an intelligible picture of it. So, we would follow the more holistic view to understand the Egyptian context. The Egyptian underground reciprocal stations would be our selected case study and space syntax (SS) techniques would be applied to explore station settings and its implications on users perceptions and choices. We would analyse the reason why the users struggled to find their ways or tending to re-find way through surround urban context by adding more pattern of movements, wasting time and effort.

3 SCOPE AND METHODS

The research methodology can be summarized in four stages as follows; Firstly, the study of the three main underground reciprocal stations in Greater Cairo through basic architectural analysis, using j-graph analysis by Hillier. This would lead to the selection of the case study, presenting higher complexity, in terms of spatial configuration with respect to functions of spaces and user's flow. Secondly, underground network case study analysis using decision point density analysis and route mapping by Xiaoling Dai. This would be done in order to determine the number of directions at all decision points of the case, helping to select the studying zone depending on the higher points of directions. Then, the space syntax analysis would be followed and include Axial and VGA analysis to spot and identify the features of movement's critical zones. Thirdly, the selected case study redesign, using space syntax analysis for activation of spatial configuration. Finally, the fourth stage includes a comparison of the redesign with the current status of the case study, concentrating on the importance of the four wayfinding factors (number of turns, symmetry degree, distance to the target, the visual field) and how to control wayfinding performance, with respect to the functional relationships. This would include an identification of the critical zones and its visual field properties, which mainly affect the quality of wayfinding, and the sequential paths priorities on the multi possibilities paths as the main reason to improve user's perception and mental map. Thus, the paper concludes by providing a proposal for the design process and guidelines for underground reciprocal stations, based on the above results for station space activation.

4 BACKGROUND

The selected reciprocal stations represent the of intersection of the three lines. Attaba station combines lines 2&3, Ramsis and Tahrir stations combine lines 1&2. The three stations are located in downtown to target the most crowded contexts of greater Cairo. According to Cairo's future development prospects, the underground network will include 3 lines, and this would increase the number of reciprocal stations from 3 to 14. These new additions would highlight the importance of studying wayfinding and settings of the reciprocal stations to be able to improve pedestrians movements, fig.1.

Fig. 1 Subway current & future lines, Red circle for current reciprocal stations

5 COMPARATIVE STUDY

This section tries to elaborate the distinctive spatial features of the three reciprocal stations by comparing them through basic architectural analysis (the layout features, vertical and horizontal movements) and j-graph analysis, to provide a cross reading for the reciprocal stations as a preliminary stage to understand stations and users movements patterns.

5.1 Basic architectural analysis

The following table illustrates the different spatial configuration effect on users movements patterns as follows: Attaba station represents the simplest configuration and least number of exits. As a result of its symmetry and radiation pattern of movement, which emanates from the ticket hall, disconnecting the users movements patterns. The small space of the station and near distance between exits supports the ability of path adjustment of the urban context. In the case of Ramsis station, it represented the least symmetry in terms of configuration and path, on the other hand, it also represented the most connected case with the urban context, due to its large circular path between tickets halls and available exists. Finally, Tahrir station presented the middle situation between Ramsis and Attaba stations, having symmetry and simple configuration as Attaba, and circular path and overlapping movement patterns as Ramsis station.

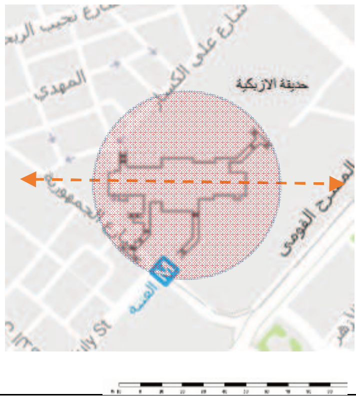
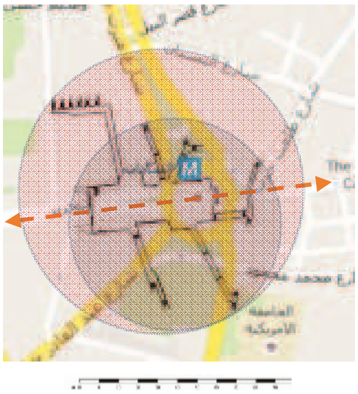
Comparison	layout	Analysis				
		Exists no			symmetry	Av. of adjustment path from urbn
		real	Op.	co.		
Ataba Station		3	4	6	High degree of symmetry on one main axis With slight variations according to the relation with urban context	25182m²
Tahrir Sation		6	4	6	High degree of symmetry on one main axis With slight variations according to the relation with urban context.	44793m² after subtracting area for un working exist 33486m²
Ramsis Station		8	7	7	Complex relation between two axes, in addition to numbers of axis revealed for the relation of urban context (low symmetry).	45117 m²
Spatial						

Table 1. Movement pattern analysis according to urban context, Red circle represent area of adjustment path at urban context.

Comparis	Horizontal movement	analysis	Vertical movement	analysis

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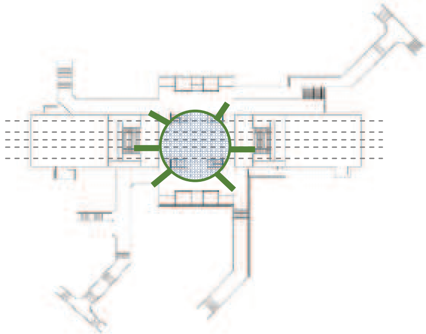
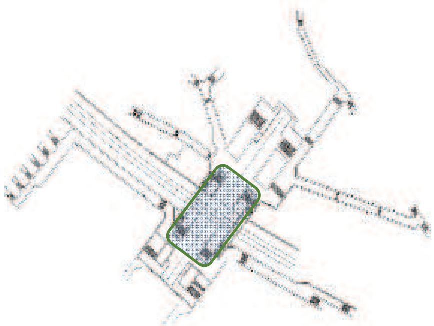
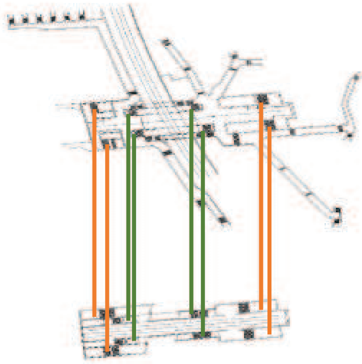
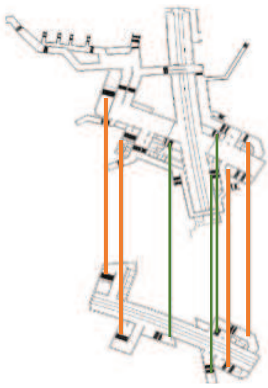
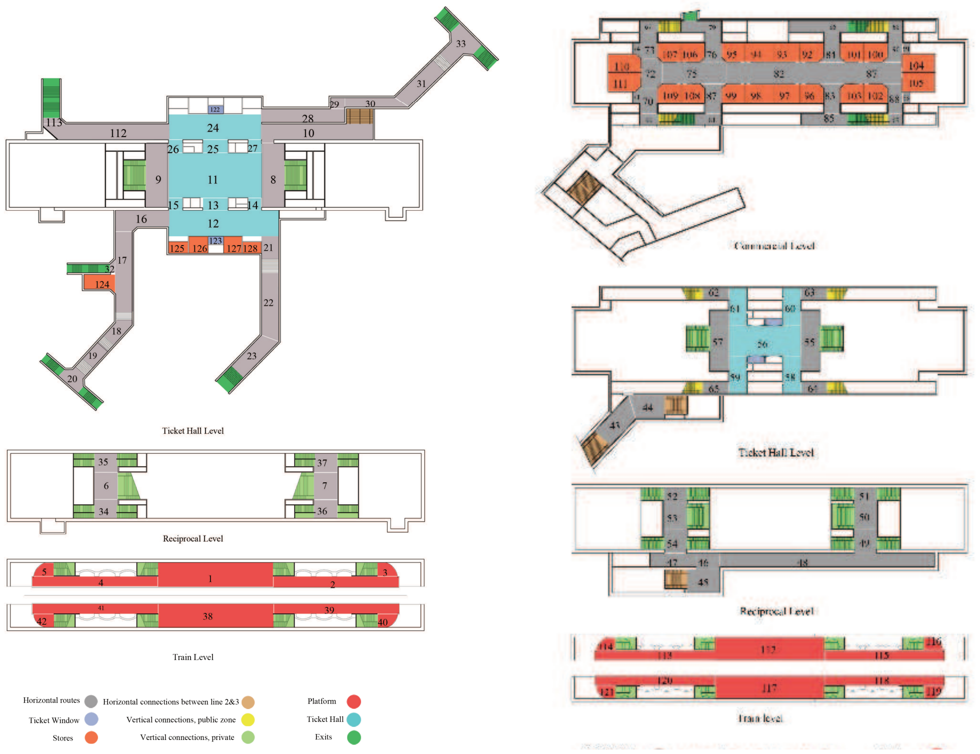
on		Movement pattern		Movement pattern
Ataba Station		Emanating from ticket hall		Separate movements with ability to connect from ticket hall(L2)
Tahrir Sation		Emanating from each ticket hall, connected together with small symmetrical circular path		Fully overlapping movement of the users
Ramsis Station		Emanating from each ticket hall, connected together with large symmetrical circular path		Fully overlapping movement of the users

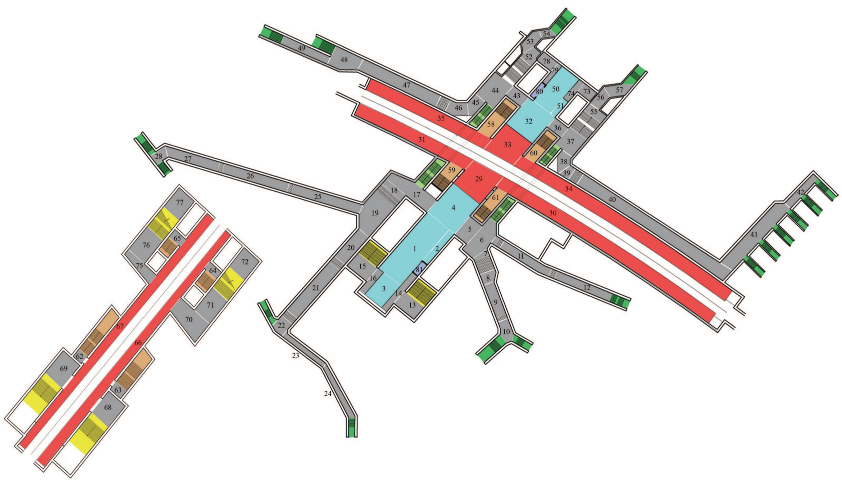
Table 2. Movement pattern analysis according to vertical and horizontal configuration. Green vertical lines for line or direction changer, Orange line for arrivals and departing users.

5.2 J-graph analysis

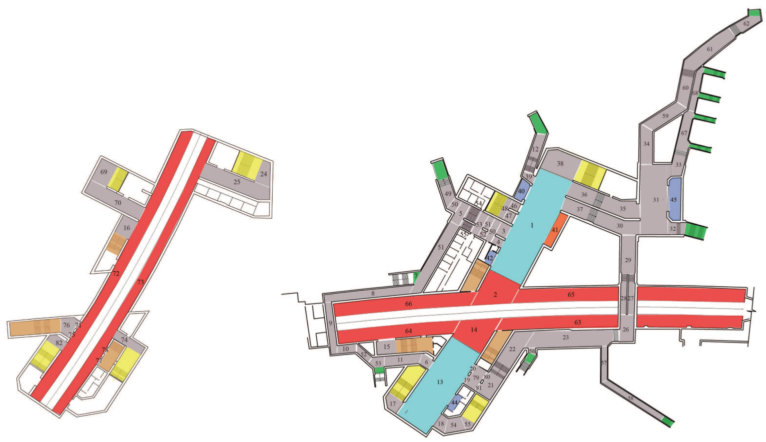
The j-graph analysis provides a clearer vision of the differences between stations (Figure 2) by determining the depth degree, spaces integration and losing way possibilities according to possible routes in each node. The three j-graphs are drawn starting from the same deepest space of the system (Tickets Hall), and in order to embed the accuracy of movement's routes with the current operating status, the closed routes nodes are all indicated by special symbols.



Attaba station



Tahris station



Ramsis station

Fig. 2: Reciprocal stations plans

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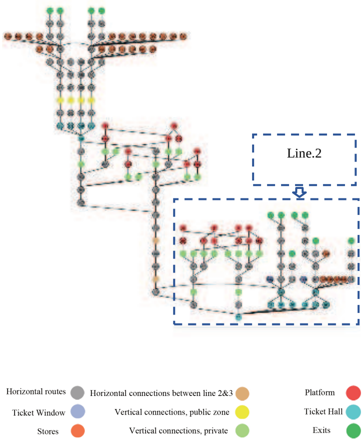
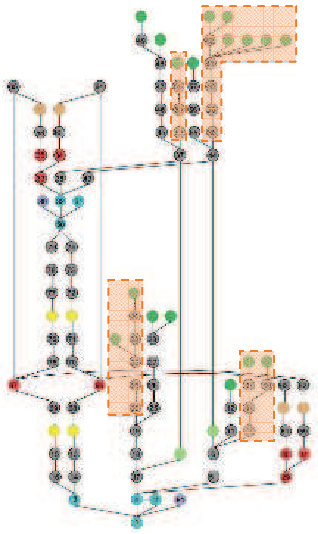
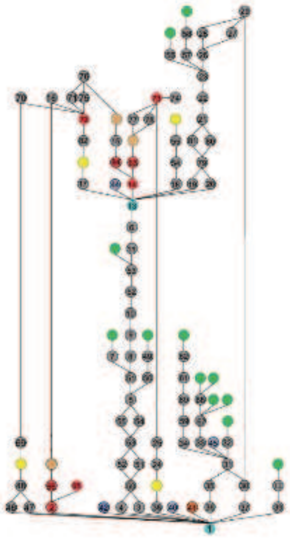
Compari-son	Ataba Station	Tahrir Sation	Ramsis Station
Analysis			
Depth & dependencies	A tree like structure shows different possibilities of routes from hall space which belongs to d-type. Long routes are an indicator of the depth degree especially for line3 users, but according to functional side this could decrease decision point and enhance user's flow. High degree of similarity leads to only 4 sets of rings, which increase mental map quality. High integrated degree for line 2 enhance movement intelligibility.	A structure combines tree and rings type. Hall space is a d-type node, in its absence the building turns into four. Closed access turned routes to mandatory ones which enhanced decisions and flow.	A structure combines tree and rings type. Hall space is a d-type node, contains numbers of overlapping movement. Low degree of similarity leads to difficulty of mental map present and remembering. Long routes with many decision points, once the users are in the route it's easy to lose your sense of direction.

Table 3. J-graph Analysis, Red rectangle represent closed exits.

The previous table shows that Attaba station represent the most popular sample of underground single stations which is characterized by the limited number of exits (not more than 4) and clarity of its configuration, which support the ease of mental map process although it contain many deep spaces as a result of long routes. In the case of Tahrir station, it shows a great similarity with Ramsis station configuration, but according to operational conditions in Tahrir, routes turned to semi mandatory as a result of closed exits with respect to low users density which supported perception quality. On the other hand, Ramsis station is somehow 'out of control' this reflects overlapping relations which produce overlapping routes, in addition to frequent turns and movements detour to gain low visual connection and high possibilities of direction. This all led to low quality of mental map and disability to determine the short route.

Respectively the comparative study would conclude that Ramsis station configuration could be seen as the most complex sample, focusing on the ticket hall as a study zone that belongs to d-type space according to Hillier's classification.

6 RAMSIS STATION ANALYSIS

The pervious comparative study analysis suggested that the circulation system of Ramsis station is very different from the other reciprocal stations, thus Ramsis station could be counted as the most complex case. In the following part, the quantitative analysis was then conducted to uncover critical zones and their feature that causes complexity through decision point density analysis by X Dai (2015) and space syntax technique by Hillier (2007).

6.1 Decision point density analysis

X Dai, Q Dong & J Guo (2015) have modified Both O'Neill (1991) and Peponis (1990) definition of decision point by developing the idea from Hillier's (1996) statement on a/b/c/d topological type classification. Therefore, in an "L" shaped corner, the effort for making a decision is almost nothing compared to a crossing with many directions. So, only "d" space is regarded as a decision point, where the forward route choice is more than one direction, that is to say the directions at that point is more than two. This descriptive image may be captured by a quantitative measure as the decision point density analysis. This measure should be able to tell whether there are too many decisions to be made when a user is entering a building and has a navigation task.

In the following part, the (DPD) map will be used to reveal the rates of decision points and their relationship to walking distance according to optimal route for each type of users, thus determining meeting points that have high density flow as a factor effecting perception quality, and finally ensure J-graph results to locate studying zone.

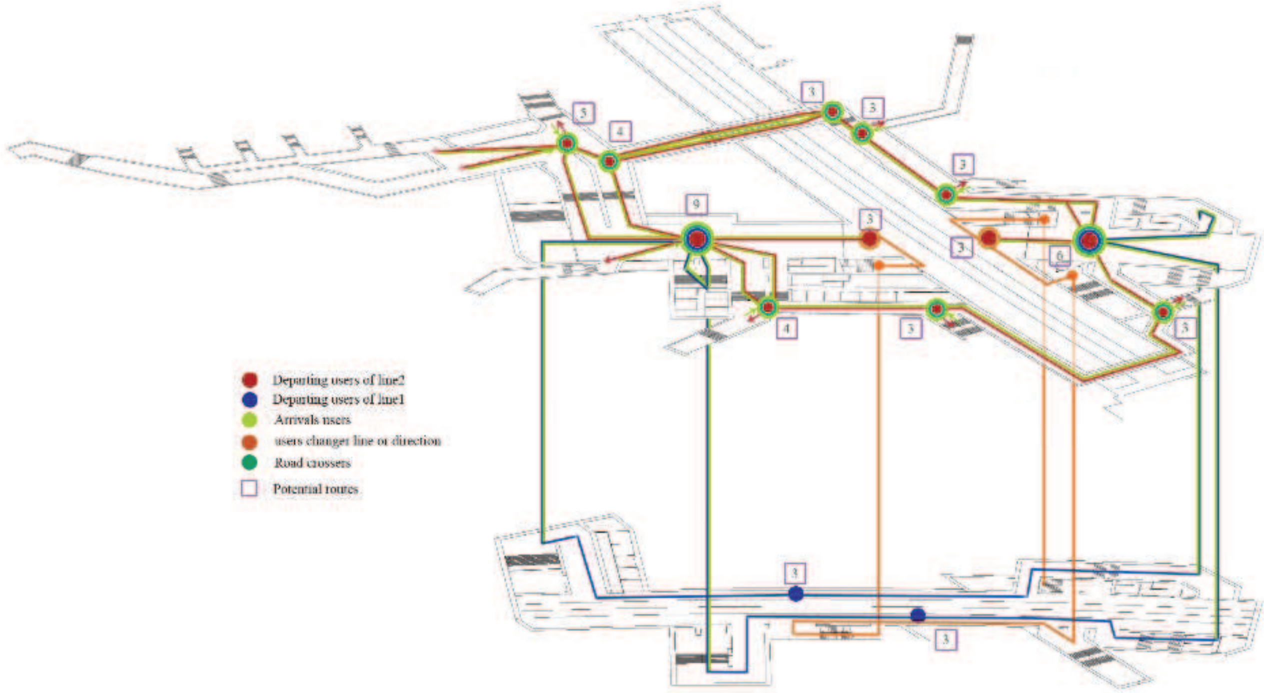


Fig. 3 Route Mapping, Decision points are noted as spots, a number is assigned to the spot represented the number of directions at this point.

High rate of decision points along the path reached 14 decisions, estimated in average as, a decision every 15 meters. The ticket hall at (El- Marj) represents the highest rate which stood 9 decisions, followed by Helwan hall at 6 decisions. After that the possibilities began to decline to 4 at two positions, but actually those positions which stood 2 decisions were raised to 4 by structure elements that opposed with function.

According to the pervious analysis, wider movements represented to users at ticket hall level, where ticket hall had the highest users density, collecting all routes and users types thus j-graph analysis result confirmed for the ticket hall classification as d type space.

6.2 Intelligibility of Ramsis station

Conroy Dalton, 2000 suggested that the correlation between some measures might describe some characteristic properties of layouts that relate to wayfinding, where Kinda Al-Sayed, 2015 clarified the intelligibility through the correlation between integration and connectivity graphs. According to Hillier (1996), intelligibility means the capacity of a single space to give an impression of the integration of the whole system, so high degree of intelligibility could ease making decisions through an unexplored environment.

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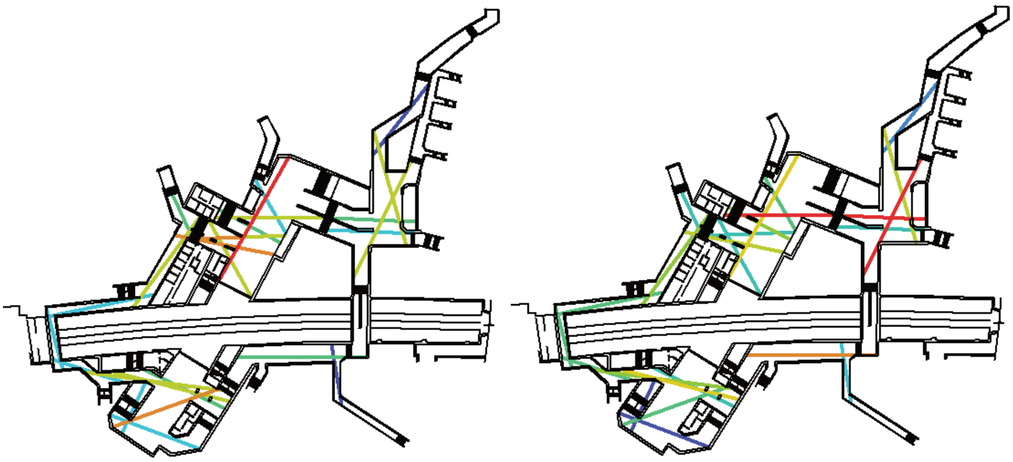

Fig. 4 Left, the axial integration HH graph. Right, the axial connectivity graph

Fig. 5 Scatter plot of the correlation between axial integration and connectivity (R^2=0.25).

According to the color coding, axial connectivity graph is the opposite side of the integration graph which represents the low value of R-square of 0.25. This signifies that it is difficult to obtain a guide to the overall system from single spaces . Thus, this building would be hard to navigate and the wayfinding task should be complicated to perform.

6.3 Determining critical spaces

The VGA analysis was brought in to provide the quantitative measures. It would give us the mean visible area in every position of the spatial system through four patterns. Starting with VGA integration would clear the locations where people tend and pause to evaluate their navigation, visual control to locate places where route choice decisions need to be taken, the visual clustering coefficient is indicative to how much one loses in terms of visual information when moving from one location to another, Finally, the through vision graph clarifies the longer lines of vision with higher values. The data map is drawn in the way that every door and window is open to the line of sight; the grid in depthmapX program is set as 500mm*500mm.

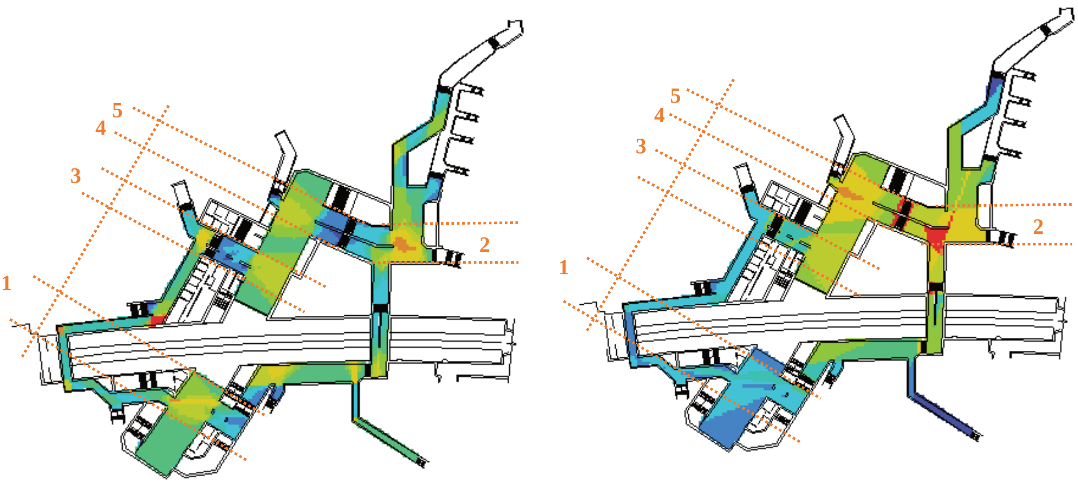

Fig. 6 Left, the VGA Visual control. Right, the VGA integration HH graph

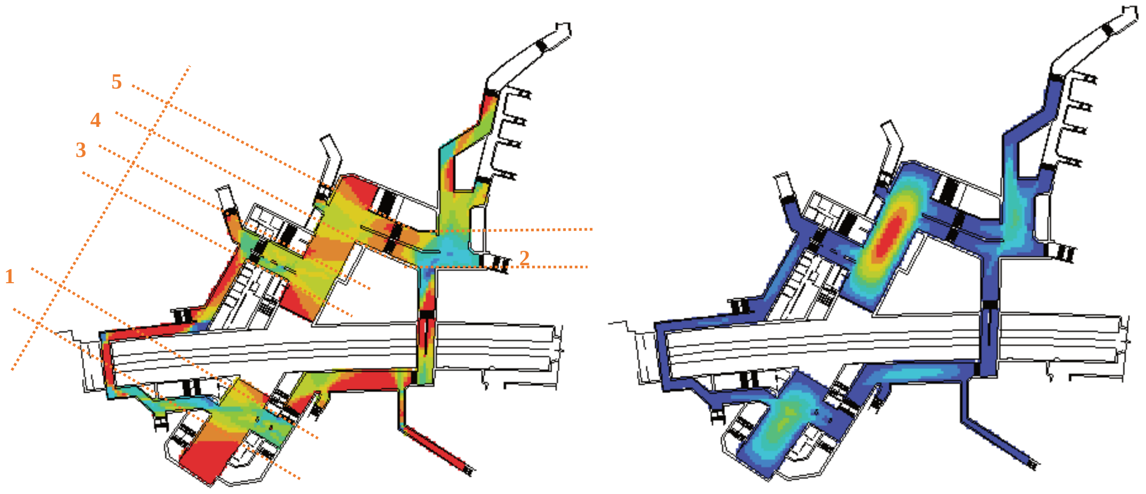

Fig. 7 Left, the VGA clustering coefficient. Right, the VGA through vision

Following depthampX's color scheme, graphs located 5 main critical zones where people tend to pause whether to evaluate their progress, take route choice decision or lose visual information. Additionally, the last graph (through vision) highlights that the tickets halls record longer lines of vision with higher values which means the ease access of arriving users and many challenges for departing users. Consequently, the characteristics of those poses would be studied to determine abilities of improvements depending on the visual control graph.

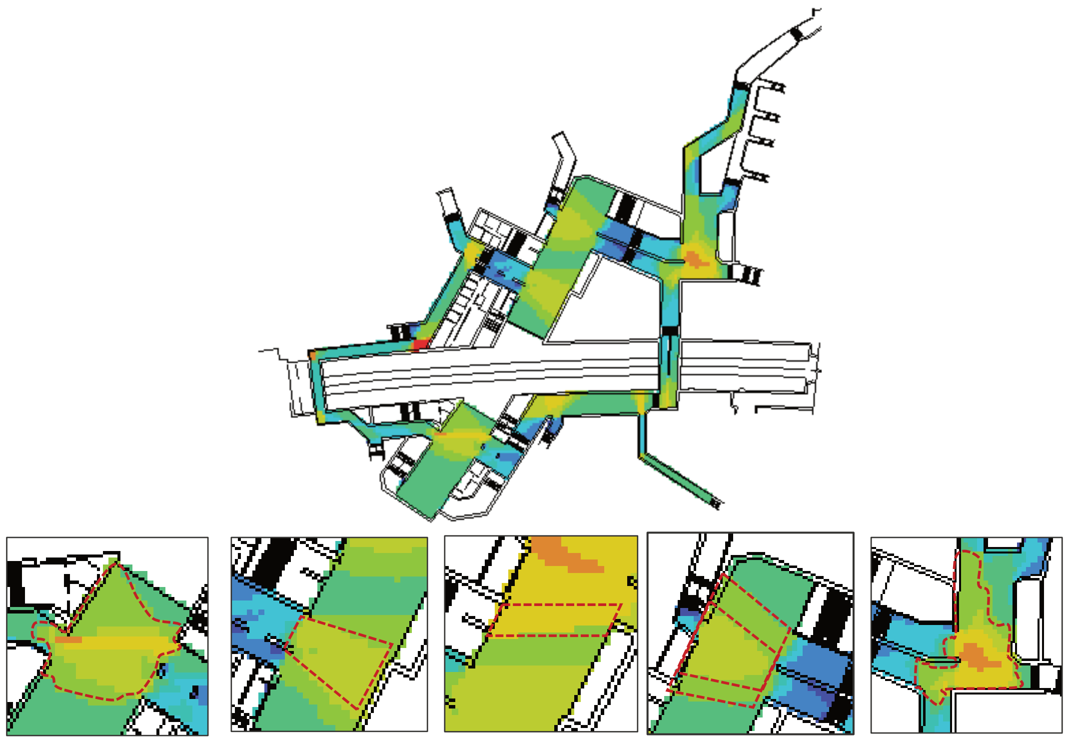

Fig. 8 Movements pattern and critical pauses characteristics

6.4 Features of critical space

According to studying critical zone features it was clear that:

- Structural system location feeling up paths and decisions, plus its impact on the percentage of vision as shown in (pause 3,4) thus confirming the Prejudice to the objective on increased path width to withstand flow.
- It is preferred to locate structural elements in the middle of paths due to the relation between visual field and path width (pause 1,2,5).

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- The involvement of movements' routes in the same visual field would ensure wayfinding ease (pause 1) and also could explain the low overcrowding rate in Helwan hall.
- By following directions of movements flow, in Helwan ticket hall, movement of users of line 1, 2 converge in the middle of the hall to decide destination directions whether left or right without overlapping. One the other hand El-Marg Hall has a different kind of movement scenario, users flow of both lines1,2 converge in three sequenced positions, in additions to their opposite directions. This would conclude that Helwan hall direct movement better than El Marj Hall.

7 STATION REMODELED SCENARIO

In the analysis above, the spatial system of Ramsis station has been compared with other Egyptian reciprocal stations as a benchmark. A detailed understanding of how to construct an extremely complicated circulation system is then achieved. It is mainly about how you design the horizontal routes leading to vertical connections between ticket hall and urban context.

By creating a series of redevelopment actions, we can benefit from Helwan hall by reducing the number of critical pauses, possible routes, and increasing similarity degree and width of the visual field to obtain all routes. On the other hand, reducing number of turns by straightening station routes to have a continuing line of sight instead of abrupt turns. By a simple visual inspection, we can realise that the new version is a much simpler structure than the original one even with maintaining all functional spaces fig.9.

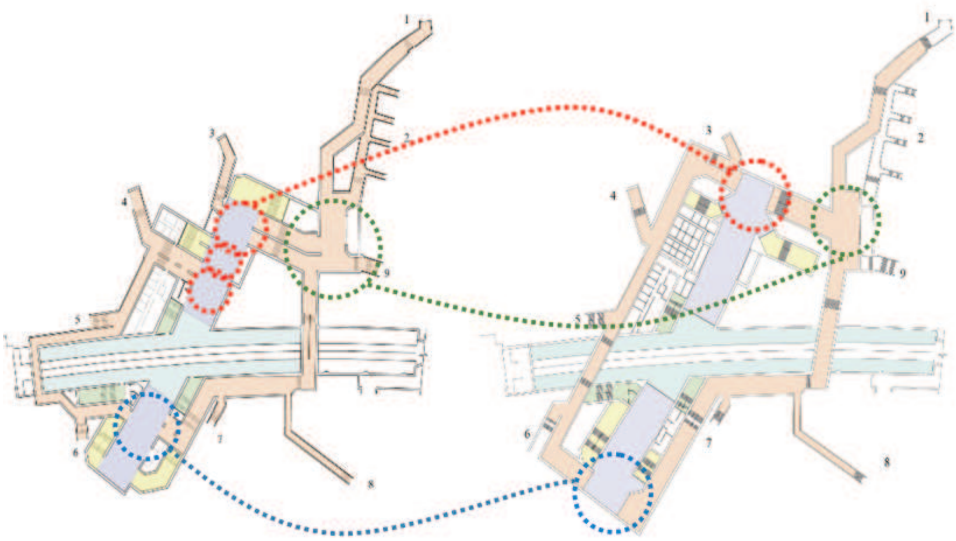

Fig. 9 Left, the original design. Right, the remodeled scenario.

7.1 Remodeled scenario analysis

In the following text we will follow the same steps of the original version analysis, starting with determining intelligibility degree through axial analysis then turning to VGA analysis, but in this scenario it will be sufficient to focus on Visual control graph helping to study then new characteristics.

7.2 Intelligibility of Ramsis station

As shown of the following graph there is a high degree of similarity between the integration and connectivity, which affected the value of R-square that represents the intelligibility of the system to be fairly high, with an R square of 0.82, which means that from single spaces it is possible to easily obtain a guide to the overall system. This could be interpreted as the building is easy to navigate and the wayfinding task should be easy to perform.

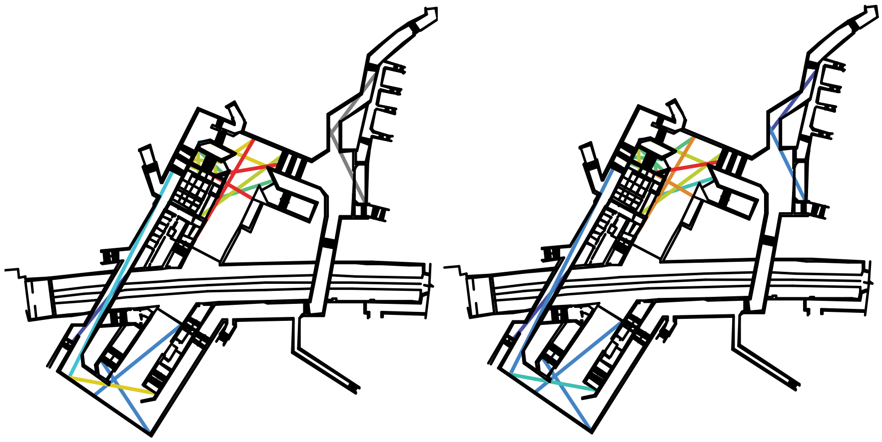

Fig. 10 Left, the axial integration HH graph. Right, the axial connectivity graph

Fig. 11 Scatter plot of the correlation between axial integration and connectivity (R^2=0.82).

7.3 Characteristics of remodeled scenario

VGA visual control graph could clarify the reasons for the high degree of intelligibility fig.12. By examining the visibility distributing in the new scenarios, a trend is discovered - the visibility of the three main critical zones improved dramatically along with increasing the width of the visual field, similarity degree and the straightening of the plan which enhanced visual access and ease of wayfinding. Hence, by following the users flow, it was clear that users converge at one pause for each hall with no overlapping or opposite flow of line 2 users, in addition to separating passenger of the occasional movement of the route crossers which enhances reducing overcrowding flow capacities, and therefore, it is transformed into a normal building which people can understand and memorize, that is to say, gains a legible spatial system.

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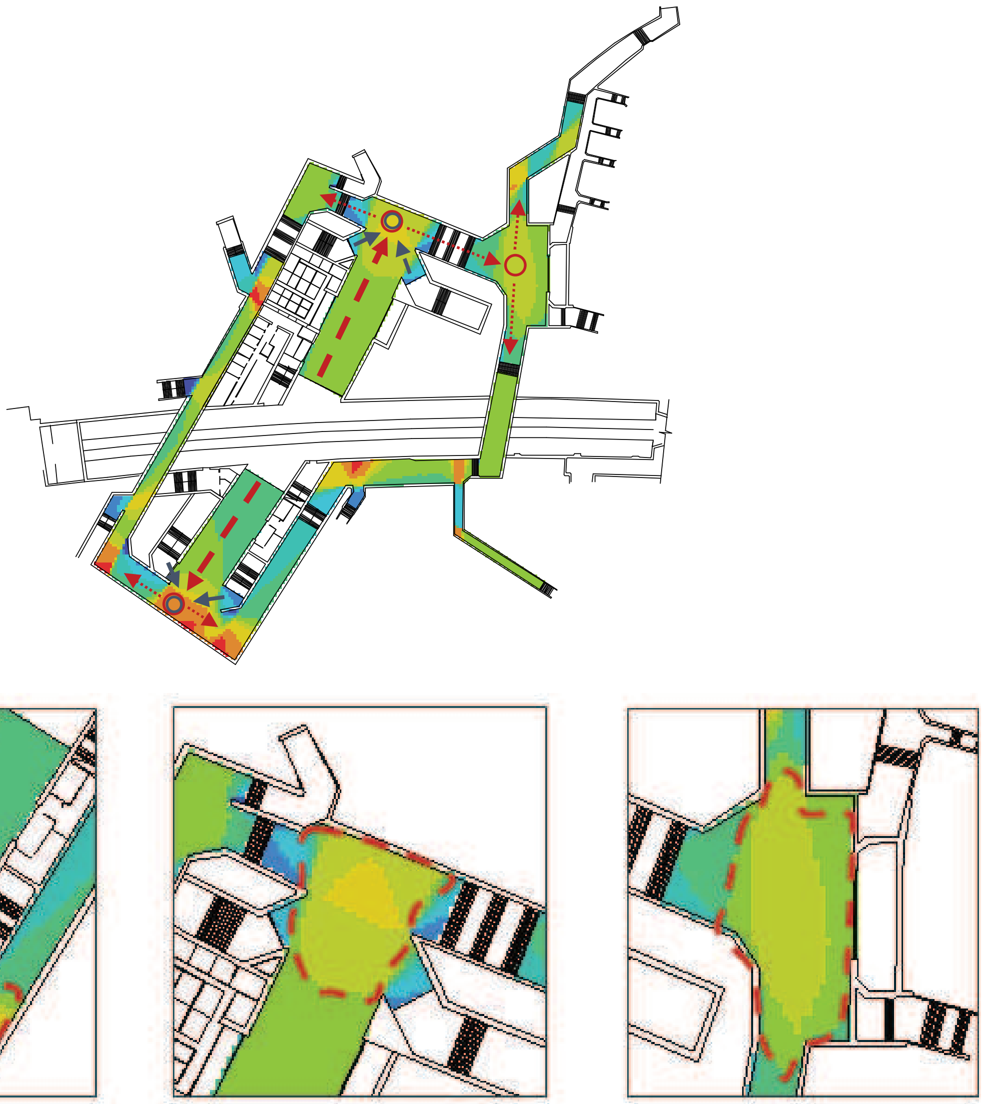

Fig. 12 Movements pattern and critical pauses characteristics

8 CONCLUSION AND DISCUSSION

In this study, J-Graph was utilized to analyse the spatial configuration of three large-scale underground reciprocal stations in greater Cairo: Attaba station, Tahrir and Ramsis stations. The operational design of these stations were analyzed based on interviews with the operational office in charge of each facility. Ramsis station was found to have the lowest integration, and its layout and circulation were designed from the viewpoint of spatial configuration. The degree of wayfinding quality was analyzed through space syntax technique. The following are design guidelines for invigorating underground reciprocal stations.

- Design process

This paper gives a thorough explanation for the production of spatial complexity for a special building. This effort is in line with many other studies aiming at providing an objective, quantitative approach to validly predicting wayfinding performance during the early planning stages of a building (Werner & Schindler, 2004). First of all, there is a need for an integrated design process which takes into account the quantification of the diverse passengers experiencess and their perception as the center of planning indoor pedestrian. Thus, the complexity model of a large-scale underground reciprocal stations appears to be closely related to the production of critical zones which could identify as pauses that discontinues the sequence of movements, which is normally present, in case of increased possibilities paths, and creating difficulties of mental map representation.

- Circulation plan

In a large-scale underground space, a circulation system should be formed from the user perspective to improve wayfinding. First, users movements could be controlled and directed through decreasing critical zones with respect to its characteristics of wide visual field. Second, confirming the importance of increasing visual access and symmetry degree, and decreasing number of turns and distance to the target. Third, as proposed by this study two main types of paths could be identified, the sequential paths which could guide users flow, and multi possibilities paths which enhance space interactively. Thus, in such a functional buildings sequential paths have the priority on the multi possibilities paths.

- Spatial configuration plan

To activate a large scale space, a main axis of activation is required. It is also important to form a main core to concentrate the flow of floating users. First, Consensus value of axial integration and connectivity is the main anchor to achieve a clear suitable configuration. Second, structure elements should be designed with respect to the spatial configuration to avoid production of additional paths affecting users flow, if necessary to place an element in a route. It's also preferred to be set in the middle, as a way to not affect visual field. Third, the spatial configuration of routes and its role in directing movements affect users flow more than caring about routes width. Fourth, avoiding overlapping passenger flow could be reached without affecting stations functional relationships. Finally, the singage system is not always the suitable solution to enhance wayfinding especially in case of users illiteracy, thus the importance of configuration reveal to have the priority.

- Site plan

Well connecting of urban context with indoor environments is a challenge to balance ease access of arriving and out departing users, as proposed. Providing various access is not the anchor of balance especially for departing, but it's mainly depending on the ease of reaching destinations by confirming the importance of increasing visual access and symmetry degree, and decreasing number of turns and distance to the target. Therefore, the designers may be able to cope with the spatial complexity with higher controllability by these efforts that contributes improving the efficiency of pedestrians flow. The enhancement of the indoor environment which affects the densities of movement on the urban scale, thus, avoiding adding more movements patterns to the expected planning over these stations.

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10 REFERENCES

Al-Sayed, K., Turner, A., Hillier, B., Iida, S., & Penn, A. Space syntax methodology, 2015.

Allen, G.: Spatial Abilities, Cognitive Maps, and Wayfinding. Pages 46–80 in Wayfinding behavior: cognitive mapping and other spatial processes, edited by R. G. Golledge. Baltimore, Maryland: John Hopkins University Press,1999.

Dai, X., Dong, Q., & Guo, J. Production of spatial complexity in an educational building, 2015.

Darken, R. P., Allard, T., and Achille, L. B: Spatial Orientation andWayfinding in Large-Scale Virtual Spaces II. Presence 8(6), pp. iii–vi.), 1999.

Hillier, B. and Hanson, J. The Social Logic of Space. CUP, Cambridge,1984.

Hillier,B. Space is the machine: a configurational theory of architecture,2007.

Le Corbusier. Towards a new architecture. New York: Dover, 1931 / 1986.

O'Neill, M.J. Effects of signage and floor plan configuration on wayfinding accuracy.Environment and Behavior, 23, 553-574, 1991.

Peponis, J., Zimring, C., & Choi, Y. K. 'Finding the Building in Way-finding'. In Environment and Behavior, Vol.22(5), p.555-590, 1990.

Raubal, M. Agent-based simulation of human wayfinding: A perceptual model for unfamiliar buildings. Na,2001.

Rüetschi, U. J., & Timpf, S. Modelling wayfinding in public transport: Network space and scene space. In International Conference on Spatial Cognition (pp. 24-41). Springer Berlin Heidelberg, 2004, October.

Werner, S., & Long, P. Cognition meets Le Corbusier—Cognitive principles of architectural design. In Spatial cognition III (pp. 112-126). Springer Berlin Heidelberg, 2002.

Werner, S., & Schindler, L.'The Role of Spatial Reference Frames in Architecture: Misalignment Impairs Way-Finding Performance'. In Environment and Behavior, Vol.36(4), p.461-482, 2004.

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Stadt in Bewegung – „City Sport“ als Motor nachhaltiger sozio-kultureller Integration

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1 ABSTRACT

Sport ist heute als dynamisches, komplexes und interdisziplinäres Themenfeld in der Freiraum- und Stadtplanung zu verstehen und nicht länger als sektorale Fachplanung zu bearbeiten. Als Querschnittsaufgabe bildet Sport neben der Berücksichtigung des demographischen Wandels, den Forderungen und Anforderungen unterschiedlicher Gesellschaftsgruppen und den Aspekten der (Flächen-)Ressourcenschonung einen wichtigen Eckpfeiler der Stadt- und Freiraumplanung.

Sport stellt einen sich immer rascher wandelnden Bereich des Lebens dar. Eine Analyse der Sporttrends der letzten Jahre und der Lebensumstände der heutigen Gesellschaft sind unabdingbar miteinander verknüpft, um eine nachhaltig erfolgreiche Sportentwicklungsplanung in der Stadt umzusetzen. Durch Optimierung und Anpassung von bestehenden Sport- und Bewegungsangeboten an Anforderungen der heutigen Zeit sowie durch die Schaffung von neuen Bewegungsstätten kommt es zur Aufwertung von Stadtteilen und zur Belebung öffentlicher Räume: Es entsteht eine Stadt, die den Bewegungsbedürfnissen aller Bevölkerungsgruppen und Altersklassen etwas bietet. Darüber hinaus ist Sport als Werkzeug zur Integration von Menschen mit unterschiedlichem sozialen oder kulturellen Hintergrund von großer Bedeutung.

Das Paper beleuchtet mit dem Sportentwicklungskonzept Leoben und dem Praxisforschungsprojekt sport.your.space zwei Projektansätze zur Schaffung einer sport- und bewegungsgerechten Stadt für alle Bevölkerungsgruppen.

Keywords: Sportentwicklungskonzept, Freiraum- und Stadtplanung, Integration, Sport, sport.your.space

2 SPORTENTWICKLUNGSKONZEPT LEOBEN

Die Stadt Leoben erstellte 2015 ein flächendeckendes Sportentwicklungskonzept und legte damit den Grundstein für eine nachhaltige strategische Sportentwicklungsplanung im Stadtgemeindegebiet. Es galt den Sport und das sportliche Angebot in Leoben zeitgemäß zu gestalten. Ebenso wurde der Individualsport im öffentlichen Raum in die Planung miteinbezogen.

Auf Basis einer flächendeckenden Analyse der Bestandssituation in Leoben sowie der Sportentwicklungen und Sporttrends insbesondere im europäischen Raum, Bedarfserhebungen durch Interviews und einen Workshop sowie einer SWOT-Analyse wurden Leitziele und Handlungsempfehlungen formuliert, die sich derzeit in Umsetzung befinden.

Berücksichtigung bei der Ableitung der Leitziele und Handlungsempfehlungen fanden unter anderem die Einbeziehung des Bereiches Sport in unterschiedliche Lebensumstände und -situationen (Bevölkerungsgruppen, Altersgruppen, ...) sowie die Bedeutung von Sport als Integrationswerkzeug in der Stadt- und Freiraumplanung.

2.1 Sport in der Gesellschaft des 21. Jahrhunderts

In einer Welt, geprägt von Individualisierung auf der einen und Globalisierung auf der anderen Seite, entwickelt sich das Verständnis von Sport in Richtung „Sportifizierung der Gesellschaft“ (Kirig & Huber, 2014) oder auch „Sportivity“ genannt: Es entsteht zunehmend der Eindruck, Sport sei allgegenwärtig. Im Sinne von aktiver Ausübung, flexibler Integration von Bewegung in den (Arbeits-)Alltag, passive Teilnahme an Sportereignissen als Zuseher oder auch durch z. B. durch Sportmode als Ausdruck von Lifestyle. Wir treffen täglich in irgendeiner Weise auf Sport. All diese Facetten geben unserer Gesellschaft eine sportliche Prägung, eine „Sportivity“, die es in der zukünftigen Entwicklung unserer Städte und Gemeindeflächen zu berücksichtigen gilt.

2.1.1 Sport und Arbeit

Bis in das Zeitalter der Industrialisierung und auch noch darüber hinaus war das Leben eine permanente körperliche Betätigung. Heute findet die Arbeit vieler Menschen zur Sicherung ihrer Lebensunterhalte weitgehend bewegungslos statt (sitzende Tätigkeiten) und gesundheitsförderliche Bewegung wird zur Mangelware. Immer mehr Unternehmen bieten Bewegungsangebote an. Die arbeitende Bevölkerung möchte ihre berufliche Tätigkeit jedoch vielfach nicht zu einer vorgegebenen Zeit unterbrechen, sondern sich individuell bewegen. Es bedarf flexibler Arbeitszeitmodelle, um diesen Anspruch zu erfüllen. Die Dringlichkeit der Veränderung erwächst besonders aus der Tatsache, dass körperliche Betätigung eine wichtige Säule der Gesundheitsprävention ist.

2.1.2 Sport als Integrationswerkzeug

Die Funktion von Sport zur Integration von Menschen mit Migrationshintergrund ist nicht zu unterschätzen. Sport verfügt über klare Symbole und Regeln und erfordert die Eigenleistung des Menschen. Diese steht unabhängig von der Herkunft im Vordergrund. Sie ist transparent, vergleichbar und nachvollziehbar. Sportliche Leistungen ernten Anerkennung und Anerkennung bedeutet gleichzeitig Integration (Weiß, 2013).

2.2 Entwicklungstendenzen im Sport

Sport ist ein globales Phänomen und wird sowohl individuell als auch organisiert ausgeführt. Aufgrund der Vielschichtigkeit und des Variantenreichtums an Sportarten ergeben sich aus unterschiedlichen Kombinationen laufend Innovationen am Sportsektor. Auf der einen Seite gehen die Trends in Richtung Extremisierungen, auf der anderen Seite finden immer mehr sanfte Bewegungsformen Anerkennung als sportliche Aktivität.

2.2.1 Ad-hoc-Sportlerinnen und -Sportler

So wie auch sanfte Bewegungsformen bewusst gewählt werden, um sich zeitlich begrenzt aus der Hektik des Alltags zurückzuziehen, so bieten auch Outdoorsportarten die Möglichkeit kurzfristig Sport zu treiben und Abstand vom Alltag zu gewinnen. Sie erfüllen die Anforderung einer spontanen Momentabsicht, die sich z. B. durch einen entfallenen Besprechungstermin oder aber auch einer notwendigen kurzen Verschnaufpause ergeben. Sogenannte Ad-hoc-Sportlerinnen und Ad-hoc-Sportler (Kirig & Huber, 2014) treiben Sport in von Vereinsstrukturen unabhängiger Form, verabreden sich beispielsweise nicht nur zu einem After-Work-Bier, sondern auch bewusst zum Sporteln. Diese Gruppe sucht Sportstätten und -plätze, die sie spontan und jederzeit benutzen können, um ihre sportliche Aktivität in den (urbanen) Alltag so unkompliziert wie möglich integrieren zu können. Die Berücksichtigung dieser Entwicklung ist eine neue Aufgabe für die Stadt- und Freiraumplanung.

2.2.2 Street-Fitness

Aus den Anforderungen der Ad-hoc-Sportlerinnen und Ad-hoc-Sportler heraus hat sich die sogenannte Street-Fitness entwickelt. Bestehende Einrichtungen in Städten werden für andere Bewegungsformate und Trainings benutzt: Parkbänke, Stiegengeländer und Treppen dienen als Hindernisse im Parkour, trainiert wird mit dem eigenen Körpergewicht. Der öffentliche Raum wird zum Bewegungsraum: mit Parkour-Parks, Street Workout-Plätzen, Outdoor Gyms, Calisthenics-Stationen oder Freeletics-Spots werden Freiräume sportlich erweitert und aufgeladen.

An dieser Stelle sei auch auf das Projekt „Bewegt im Park“ hingewiesen, welches vom Sportministerium und dem Hauptverband der österreichischen Sozialversicherungsträger mit zahlreichen Projektpartnern unterstützt wird. „Bewegt im Park“ bietet vielfältige Bewegungsprogramme (z. B. Fechten, Yoga, uvm.) in öffentlichen Parkanlagen, ohne Mitgliedschaft und somit unverbindich und kostenlos, an.

2.3 Leitziele und Handlungsempfehlungen

Die im Rahmen des Sportentwicklungskonzeptes erarbeiteten Leitziele und Handlungsempfehlungen fokussierten auf die Themengruppen „Sport- und Bewegungsräume“, „Sport- und Bewegungsangebote“ für unterschiedliche Altersgruppen und „Organisation“. Nachstehend werden jene Maßnahmenbereiche hervorgehoben, die in direkter Beziehung zum öffentlichen Raum stehen.

2.3.1 Sport- und Bewegungsräume

Sicherung von bestehenden und potenziellen Sport- und Bewegungsflächen mit Hilfe der Raumplanungsinstrumente

Sich ändernde Bedürfnisse und Sporttrends benötigen oft Flächen, die im Anlassfall schwer zu finden sind. Durch vorausschauende Ausweisungen im Stadtentwicklungskonzept, im Flächenwidmungsplan und in Bebauungsplänen können Frei- und Grünräume im Gemeindegebiet strategisch gesichert und von konkurrierenden Nutzungen freigehalten werden. Entsprechende Festlegungen sind Ausdruck eines hohen öffentlichen Interesses. Dabei ist auf eine sinnvolle Verteilung von Freiflächen über das Stadtgebiet sowie ein der Bevölkerungsstruktur angemessenes Angebot, zum Beispiel für überalterte Stadtquartiere oder für Quartiere mit vielen Jungfamilien oder mit einem hohen Anteil an Personen mit Migrationshintergrund, zu achten.

Qualitative Aufwertung und Vernetzung von Sport- und Bewegungswegen

Ein Großteil individueller sportlicher Aktivitäten findet auf Straßen oder Wegen im unmittelbaren Umkreis des Wohnstandortes statt (Laufen, Radfahren, Spazieren, etc.). Wege werden dabei gerne für die „schnelle Feierabend-Laufrunde“ genutzt. Bewegung und körperliche Ertüchtigung ist einfacher in den Alltag zu integrieren und spontaner umzusetzen, wenn lange Anfahrtszeiten wegfallen. Die Vernetzung der linearen Rad- und Fußwege, flächigen Sport- und Bewegungsfreiräume, Sportstätten, Wohn-, Schul- und Universitätsstandorte spielt dabei eine sehr große Rolle. Dies kann zu einer gesteigerten Nutzung der Infrastruktur und zu mehr Bewegung im Alltag beitragen. Die unkomplizierte Erreichbarkeit ohne Nutzung des privaten Autos steht bei den Sportlerinnen und Sportlern im Vordergrund.

2.3.2 Sport- und Bewegungsangebot

Aufwertung von bestehenden Naherholungsräumen durch Angebote für Sport und Bewegung

Durch die Ergänzung von bestehenden Naherholungsräumen wie Parks durch Sport- und Bewegungsmöglichkeiten können diese Räume für die Bevölkerung zusätzlich aufgewertet werden. Dies kann zum Beispiel durch Bezirkssportplätze oder einfache Fitnessstationen für Street-Workouts oder Freeletics erreicht werden. Wichtig dabei ist, dass diese Einrichtungen frei von Konsumzwang sind, sodass sie auch von weniger kaufstarken Bevölkerungsgruppen in Anspruch genommen werden können.

Durch den Faktor der Multifunktionalität erhalten Sportstätten einen erhöhten Nutzen, können vielseitiger zum Einsatz kommen, bieten unterschiedlichen Sportarten nebeneinander Raum und dienen als Treffpunkt über den eigentlichen Zweck der „Sportausübung“ hinaus. Multifunktionalität bedeutet gleichzeitig Flächen- und Ressourcenschonung, Adaptierbarkeit nach individuellen Bedürfnissen und beschränkt sich nicht mehr allein auf den Bereich Sport. Intelligent durchdachte, multifunktionale Stätten bereichern und sind über einen längeren Zeitraum aufgrund ihrer Wandelbarkeit existent. Multifunktional nutzbare Flächen tragen zur Belebtheit öffentlicher Räume bei, die ihrerseits auch wieder auf die umliegenden Handels- und Gastronomieeinrichtungen ausstrahlt.

Eine kombinierte Nutzung aus Sport- und Bewegungsmöglichkeiten (zum Beispiel Basketballplätze, Tennisplätze, Tischtennis, Streetfitness) mit Erholungsmöglichkeiten und Spielmöglichkeiten für Kinder stößt erfahrungsgemäß auf großen Anklang. Die Aufenthaltsqualität der Bewegungsräume ist auch abhängig von der naheliegenden Versorgungsinfrastruktur, von sauberen Sanitäreinrichtungen und Sitzmöglichkeiten mit und ohne Beschattung

Aufgrund der Diversifizierung von Bewegung und Sport sind auf der einen Seite multifunktionale Flächen ohne spezifische Ausstattungserfordernisse notwendig, um bedarfsbedingt die Flächen für unterschiedliche Sportarten nutzen zu können. Auf der anderen Seite werden jedoch neue Infrastruktureinrichtungen für Sportarten, wie zum Beispiel Dirtbike, Klettern, etc. benötigt, welche spezielle Anforderungen an den Raum oder die Halle aufweisen. Es ist der Bedarf und die Nachfrage innerhalb der einzelnen Zielgruppen „Kinder und Jugendliche“, „Erwachsene“ und „65+“ zu eruieren und in der Planung miteinzubeziehen.

Verdichtung und attraktive Gestaltung des Radwegenetzes

Die Lebensqualität in Städten steht in einem unmittelbaren Zusammenhang mit der Mobilität. Untersuchungen zeigen, dass in der Stadt das Fahrrad bis zu einem Umkreis von 5 km das schnellste Verkehrsmittel ist. Ein geschlossenes Radwegenetz innerhalb von Städten erhöht die Attraktivität im Sinne einer „Stadt der kurzen Wege“. Auch auf einladende Rastmöglichkeiten, ausreichende Beleuchtung und schlüssige Beschilderung des Rad- und Fußwegenetzes ist zu achten.

2.3.3 Organisation

Bereitstellung von übersichtlicher und öffentlich zugänglicher Informationen über das Sport- und Bewegungsangebot

Das Sport- und Bewegungsangebot in Leoben ist vielseitig, dieses muss transparent und leicht verständlich an Sportlerinnen und Sportler kommuniziert werden. Neben einem zeitgemäßen Internetauftritt kann vor allem ein klares Leitsystem im öffentlichen Raum viel zum Informationstransfer beitragen.

Abbildung 1 zeigt die Rahmen des Sportentwicklungskonzepts Leoben verorteten Leitziele und Handlungsempfehlungen im Überblick.

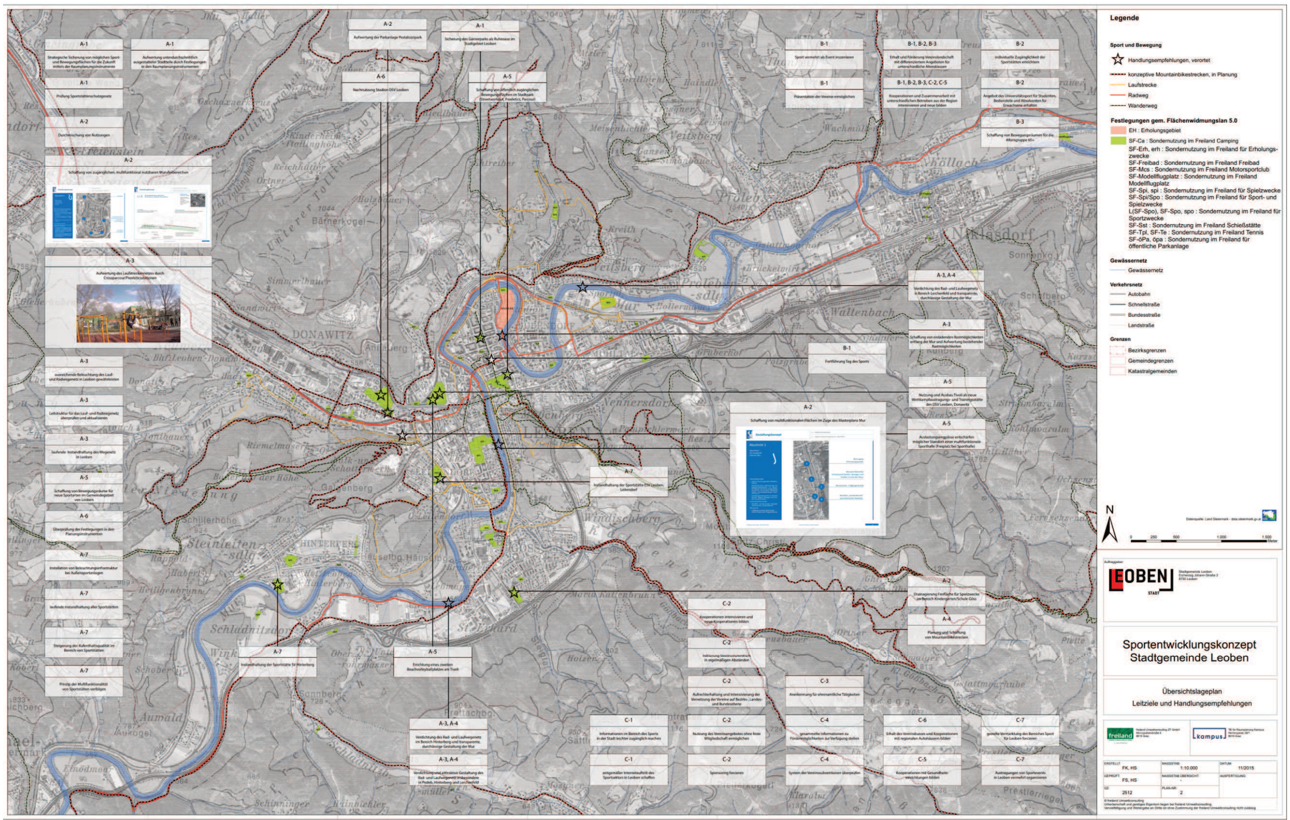

Abbildung 1: Leitziele und Handlungsempfehlungen Sportentwicklungskonzept Leoben

Das Sportentwicklungskonzept für Leoben enthält kurz-, mittel- und langfristige Handlungsempfehlungen, die eine strategische und umsetzungsorientierte Sportentwicklungsplanung für die Stadtgemeinde ermöglichen. Durch Optimierung und Anpassung bestehender Sport- und Bewegungsräume sowie durch die Schaffung von neuen Bewegungsstätten können Stadtteile aufgewertet und der öffentliche Raum belebt werden. Im Vordergrund steht dabei immer die Schaffung einer Stadt für Menschen aller Bevölkerungsgruppen und Altersklassen.

3 PRAXISFORSCHUNGSPROJEKT SPORT.YOUR.SPACE

Das Projekt sport.your.space bietet „Funsport aus dem Container“. Ein adaptierter Frachtcontainer dient Mädchen und Burschen im Alter zwischen 12 und 18 Jahren als Verleihstation für Trendsportgeräte, die keine eigene Sportstätte benötigen, sondern gleich in den städtischen Freiräumen verwendet werden können.

Jugendliche hatten in den Sommermonaten 2015 und 2016 in vier niederösterreichischen Pilotstädten (Tulln an der Donau, Zwettl, Amstetten, Gänserndorf) die Möglichkeit, Waveboards, Speedminton, Waboba-Street-Bälle, Einräder, Disc Golf, Slacklines etc. kostenlos auszuleihen und damit die Stadt zu erobern. Eine Holzplattform, die an jedem Standort von Jugendlichen selbst gebaut wurde, dockte als Treffpunkt an den Container an. Verantwortliche für Jugend, Integration, Sport und Freiraum, Vereinsvertreterinnen, Vereinsvertreter, Streetworker und Jugendliche gestalteten die Projektumsetzung gemeinsam.

Abbildung 2: Pilotprojekt sport.your.space – Funsport aus dem Container

3.1 Projektkonzept

Die hohe Drop-out-Rate aus Vereinen sowie das Suchtpotenzial elektronischer Medien und die damit einhergehende mangelnde Bewegung gaben Anlass zur Initiative. Jugendliche, die aus Spaß – ohne besondere sportliche Leistungsziele zu verfolgen – mit Gleichaltrigen sporteln, fühlen sich in Vereinen häufig nicht aufgehoben. Informelle Sport- und Bewegungsplätze können gerade für diese Jugendlichen ein attraktives Freizeitangebot sein. Hauptmotive zur Ausübung von Sport und Bewegung sind für Jugendliche neben Gesundheit und Fitness vor allem soziale Kontaktmöglichkeiten und Entspannung (Bundesministerium für Wirtschaft, Familie und Jugend, 2011).

Das Projekt sport.your.space versteht sich als Motor für jugendkulturgerechten Sport und Bewegung im öffentlichen Freiraum. Es verknüpft die Arbeitsmethoden der mobilen Jugendarbeit mit dem Know-How der Freiraumplanung und den Potenzialen der neuen Trend- und Funsportarten. Die Gesundheitsförderung passiert so in der frei zugänglichen Alltagswelt der Jugendlichen – im öffentlichen Freiraum. Hauptziel ist, durch unmittelbare Anreize im öffentlichen Freiraum Jugendliche zu Bewegung zu motivieren sowie Gemeinde- und Vereinsverantwortlichen den Bedarf von jugendkulturgerechten, niederschwelligen Bewegungsangeboten aufzuzeigen. Ein weiteres Projektziel ist es, Mehrfachnutzung von Freiräumen für bewegungsorientierte Aktivitäten und soziale Kontakte zu fördern.

Folgende Vorbildprojekte wurden im Projektentwurf für sport.your.space berücksichtigt:

- Die Schweizer idee:sport-Stiftung, die u. a. die abendliche Nutzung von Sporthallen ermöglicht (mid-night:sports). www.ideesport.ch
- Der Deutsche Kinder- & Jugendfonds, durch dessen Einrichtung 24 Pilotprojekte in Eigeninitiative von Jugendlichen in Zusammenarbeit mit Gemeindevertreterinnen und Gemeindevertretern realisiert wurden. www.d-nb.info
- Inspiration lieferte den sport.your.space-Initiatorinnen auch das Projekt „was schafft raum? - Die Stadt als Fitness Center". "was schafft raum" ist ein Vermittlungsangebot zu Architektur und Stadtplanung im Auftrag der Stadtplanung Wien (MA 18, MA19, MA 21A) in Kooperation mit dem Stadtschulrat Wien. www.was-schafft-raum.at

Setting

sport.your.space wurde in den vier niederösterreichischen Pilotstädten Tulln an der Donau, Gänserndorf, Amstetten und Zwettl, welche zwischen 10.000 und 25.000 Einwohnern haben, durchgeführt, um aus dem Vergleich ableiten zu können, welche Impuls- und Erfolgswirkung das Projekt in unterschiedlichen räumlichen und organisatorischen Umfeldern erzielen kann. Erfahrungen wurden gemacht, unter welchen Voraussetzungen sich Jugendliche im Stadtfreiraum sportlich aktivieren lassen und welche Veränderung in den vorhandenen Strukturen der Vereins- und Jugendarbeit möglich sind. Die Auswahl der Städte gründete nicht nur auf einer Mindestgröße der Stadt, sondern auch auf folgenden Kriterien: Die Stadt verfügt über ein Jugendzentrum und/oder Mobile Jugendarbeit. Die Stadt verfügt über geeignete Freiräume. Die Stadtvertreter signalisieren Kooperationsbereitschaft und Eigenantrieb in der internen Entscheidungsfindung.

Der Standort des Containers gilt als wichtigstes Erfolgskriterium für das Projekt und wurde in gut frequentierten, möglichst zentrumsnahen Lagen gemeinsam mit der jeweiligen Gemeindevertretung und Vertretern der mobilen Jugendarbeit festgelegt.

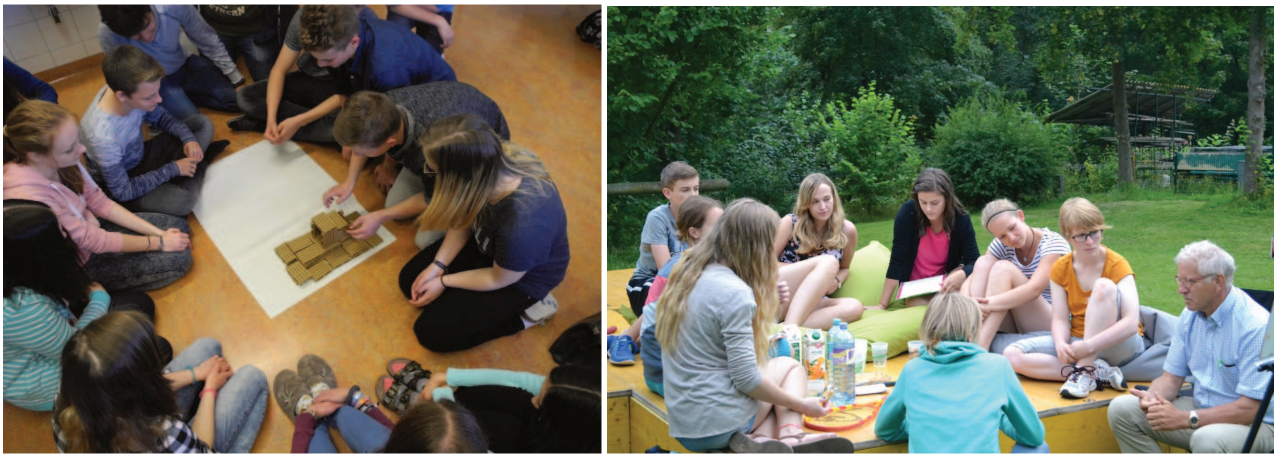

Abbildung 3: Gemeinschaftliche Umsetzung von Jugendlichen, Planern, Gemeindeverantwortlichen und Betreuerinnen und Betreuern vor Ort

Neben dem Geräteverleih am sport.your.space-Container sollten besondere Aktivitäten das Interesse wecken: Eingeladen wurden sogenannte Sport-Botschafter, die mit den Jugendlichen neue Bewegungsformen, z. B. Parkouring, Freestyle-Soccer und Einradfahren ausprobierten. Andere Aktivitäten, initiiert von den Projektleiterinnen, waren Jugenddialoge mit Jugendlichen, Betreuern/-innen, Sozialarbeitern/-innen und Streetworkern/-innen, sowie Vertretern/-innen der jeweiligen Stadtgemeinde. Der Jugenddialog vor Ort diente der Ideensuche für ein Folgeprojekt nach dem achtwöchigen Containerbetrieb.

3.2 Herausforderungen

3.2.1 Haftungsfragen

Das Projekt zu ermöglichen, verlangte unter anderem eine ausführliche Beleuchtung der Haftungsfragen in Bezug auf Jugendliche im öffentlichen Raum: Rechtlich betrachtet macht es einen großen Unterschied, ob ein Jugendlicher im Alter zwischen 12 und 14 oder zwischen 14 und 18 Jahren ist. Bei Jugendlichen unter 14 Jahren handelt es sich um Unmündige, bei solchen zwischen 14 und 18 Jahren um mündige Minderjährige.

Folgende Vorkehrungen wurden getroffen:

- Das Projekt stützt sich auf die Tatsache, dass der öffentliche Raum keine Sportstätte ist. Es können daher keine Ansprüche auf die Sporttauglichkeit des bespielten Freiraumes gestellt werden. Es wurde auf jegliche Form der Abgrenzung, z. B. mittels Banden verzichtet, die den Eindruck einer formalen Sportstätte erwecken könnten.
- Gemeinsam mit Gemeindevertretern wurde eine Kernzone rund um den Geräteverleih festgelegt. Die Betreuerinnen und Betreuer besichtigten täglich vor dem Beginn des Geräteverleihs diesen Bereich, um offenkundige Gefahrenquellen zu entfernen oder bei der Stadtgemeinde zu melden. Die tägliche Dokumentation erfolgte mittels Projekttagebuchs. Die Besichtigung erfolgte freiwillig, mit Hausverstand, jedoch ohne Verantwortung für die Sicherheit des öffentlichen Raumes.
- Die sport.your.space-Betreuerinnen und –Betreuer sind als Vereinsmitglieder durch eine Sport-Kollektiv-Versicherung versichert.
- Der Verein übernimmt keine Aufsichtspflicht, sondern ist lediglich Verleiher von Sportgeräten. Die Sportgeräte werden ausschließlich in Eigenverantwortung verwendet. Ein Beispiel: Verletzt sich ein 12-Jähriger ohne Fremdverschulden und war auch das Sportgerät in Ordnung, so trifft ihn ausschließlich selbst das Verschulden, möglicherweise seinen Aufsichtspflichtigen (z. B. die Eltern). Grundsätzlich ist ein 12-jähriger so weit einsichtsfähig, dass er den Leihvertrag mit dem Verein oder der Kommune abschließen kann, zumal er keine Kosten zu tragen hat.
- Die Jugendlichen registrierten sich vor der ersten Entleihe unter Vorweisung eins Ausweises bzw. der E-Card. Bei den Unter-14jährigen wurde soweit möglich, die Zustimmung der

Erziehungsberechtigten bzw. des Jugendwohlfahrtsträgers (bei minderjährigen unbegleiteten Fremden[1]) eingeholt, was jedoch die Niederschwelligkeit und unkomplizierte Zugänglichkeit des Projektes stark mindert.

3.2.2 Weitere maßgebende erfolgsrelevante Kriterien

Container-Standort

Der Standort von sport.your.space ist dann attraktiv, wenn der Container gut sichtbar ist und viele Jugendliche täglich vorbei kommen. Orte, an denen „noch nichts los ist“, werden nicht so leicht als neuer Treffpunkt angenommen. Zentrale Standorte, die konfliktfrei bespielt werden können sind rar. Das Nahe Schulumfeld ist ebenfalls ein Erfolgskriterium für sport.your.space. In Freistunden oder Buswartezeiten haben Jugendliche die Möglichkeit, ihre Zeit für Bewegung zu nutzen und sport.your.space kennen zu lernen.

Flexible Öffnungszeiten

Jugendliche sind spontan, ihre Aktivitäten kurzlebig und ihr Alltag lebt von schnell wechselnden Ereignissen. Die Öffnungszeiten sollten an Schul- und Ferienzeiten sowie an die Verfügbarkeit von öffentlichen Verkehrsmitteln angepasst sein. Fokusgruppengespräche mit Jugendlichen im Vorfeld sind sinnvoll, um Details gemeinsam festzulegen.

Eigeninitiative der Betreuer

Ein guter Betreuer ist Coach, Trainer, Sozialarbeiter, Psychologe, Zuhörer und ein guter Trendsportler in Einem. Das Betreuungspersonal bei sport.your.space hat eine sozial anspruchsvolle Aufgabe. Solche Allrounder, die auf Jugendliche motivierend wirken, sind schwer zu finden und meist nur für kurze Zeiträume verfügbar. Der Dienst von zwei Betreuerinnen und Betreuern gleichzeitig ist sinnvoll, da sie für die Geräteausgabe zuständig und gleichzeitig Ansprechpersonen für die Jugendlichen sind. Sie sollen aktivierend wirken, mit den Jugendlichen zusammen Sport treiben, Hilfestellungen beim Erlernen, sowie Tipps und Tricks mit den Funsportgeräten geben. Mit einer Kurzausbildung zur sportlichen Didaktik und dem sozialen Input eines Streetworkers wurden die sport.your.space-Betreuerinnen und –Betreuern auf ihre Aufgabe im öffentlichen Raum vorbereitet.

3.3 Evaluation

Als Evaluationsinstrumente für die Bewertung der laufenden Durchführung sowie für die kurz- und mittelfristige Adaption von Projektbereichen dienten Tagesprotokolle („Projekttagebücher“), Ausleihlisten, Registrierbögen, Gespräche mit Projektmitarbeiterinnen und Projektmitarbeitern und Fragebögen zur Bewertung der Projektangebote durch die Nutzerinnen und Nutzer vor Ort.

In 4 x 8 Wochen haben knapp 700 Jugendliche das Angebot genutzt mit mindestens 1.700 Kontakten. Die Geräte wurden rund 3.500 mal verliehen. Die Kontaktaufzeichung erfolgte nur für die ausleihende Person, nicht aber für die Mitspielerinnen und Mitspieler. Daher liegt die Zahl der tatsächlichen Kontakte höher. 56% der Nutzerinnen und Nutzer waren männlich, 44% weiblich, was die Erwartungen hinsichtlich der Erreichung weiblicher Jugendlicher übertroffen hat.

Aufgrund der Rückmeldungen der Betreuerinnen und Betreuer (aber auch aufgrund der Namen in den Ausleihlisten) kann man davon ausgehen, dass ein großer Anteil der Nutzerinnen und Nutzer einen Migrationshintergrund hatte. Auch kamen gerade jene Jugendlichen, die sonst weniger Angebote für sich finden, möglicherweise auch aufgrund der sozio-ökonomischen Situation und den Kosten der vorhandenen Angebote. Sozial benachteiligte Jugendliche sowie Jugendliche mit Migrationshintergrund fanden so niederschwelligen Zugang zu Bewegungsangeboten – und nutzten diesen.

[1] „Unbegleitete minderjährige Fremde", fallen in die Obsorge des Jugendwohlfahrtsträgers, die bei den Bezirkshauptmannschaften eingerichtet sind. Nach einer OGH-Entscheidung ist jedem unbegleitenden Minderjährigen ein Obsorgeberechtigter beizugeben. Die Realität sieht meist leider anders aus. Ob für einen unbegleiteten minderjährigen Fremden eine Versicherung besteht, hängt auch von dessen jeweiligem Asylstatus ab. Verletzt sich ein unbegleiteter minderjähriger Fremder selbst, werden – sofern er sich legal im Land aufhält – die Kosten seiner Heilbehandlung gedeckt sein. Beschädigt dieser Minderjährige allerdings fremdes Eigentum oder verletzt jemand anderen, wird die Haftungsfrage kompliziert, insbesondere wenn er unter 14 Jahre alt ist. Hier ist im Vorfeld besonders sorgfältig zu klären, wer für ihn aufsichtspflichtig ist.

Die Raumaneignung des Angebotsorts ist unterschiedlich gut gelungen. Jugendliche konnten speziell in Gänserndorf einen zentralen Ort als Freiraum und Zone für Sozialkontakte für sich entdecken und erobern.

Die Nachhaltigkeit des Projektes ist auf mehreren Ebenen erkennbar:

- Jene Jugendlichen, die wiederholt Geräte ausborgten, bauten durch das Projekt ihre körperlichen (und sozialen) Fähigkeiten auf.
- Die Gemeindeverantwortlichen erlebten einen direkten, positiven Zugang zu den Jugendlichen und erhielten so einen genaueren Einblick in deren Bedürfnisse.
- Das Projekt machte die Bedürfnisse nach jugendkulturgerechten, sportlichen Angeboten öffentlich sichtbar (Bewusstseinsbildung in der Gemeinde).
- Im Bewusstsein der Fördergeberinnen und Fördergeber wurde die sportliche Jugendarbeit im Freiraum als Potential erkannt.
- Das Projekt wird 2017 in vier niederösterreichischen Städten (Bruck an der Leitha, Fischamend, Schwechat und Gänserndorf) in enger Zusammenarbeit mit der mobilen Jugendarbeit fortgesetzt.

Die Evaluierung wurde von der Donau Universität Krems, Department Migration und Globalisierung, MMag. Manfred Zentner, durchgeführt.

4 CONCLUSIO

Aktuelle Entwicklungstendenzen im Sport gehen in Richtung Ad-hoc Sport und Street Fitness. Die Möglichkeit zur flexiblen Integration von Bewegung in den Alltag stellt die Stadt- und Freiraumplanung vor neue Herausforderungen und erfordert die interdisziplinäre Zusammenarbeit mit der Sozial- und Jugendarbeit, der Integration und Vereinsvertreterinnen und Vereinsvertretern. Ziel ist es, durch vorrausschauende Planung, Sicherung und Aufwertung von städtischen öffentlichen Flächen sowie der Bereitstellung der nötigen Bewegungsinfrastruktur die Entwicklung von multifunktionalen öffentlichen Räumen zu fördern, die das Interesse und die Eigeninitiative der Nutzerinnen und Nutzer wecken, individuell adaptiert und erobert zu werden. Gelingt es, diesen Rahmen zu schaffen und institutionell zu begleiten, kann der Sport die Rolle eines Antriebsmotors zur Belebung der öffentlichen Räume und zur nachhaltigen sozialen Integration unterschiedlicher gesellschaftlicher Bevölkerungsgruppen übernehmen.

5 QUELLEN

BUNDESMINISTERIUM FÜR WIRTSCHAFT, FAMILIE UND JUGEND: Kinder- und Jugendgesundheitsstrategie 2011.
JANSEN, O.: Trendsport - stetig ist nur der Wandel. www.wdr.de, 2013.
KIRIG, A., & HUBER, T.: Von Sport zu Sportivity. Zukunftsinstitut Matthias Horx, 2014.
WEISS, O.: Sportsoziologe an der Universität Wien, pers. Interview 2013.
STADT LEOBEN: Stadtmagazin, Leoben 2016.
STURMBERGER, W.: Sport und Gesellschaft. Falter, 2013.
www.bewegt-im-park.at
www.d-nb.info
www.ideesport.ch
www.sportyourspace.at
www.was-schafft-raum.at

Struggle for Change – Process of Urban Transformation of Koroska Street in Maribor

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1 ABSTRACT

The function of city streets has been in recent century mainly focused on the movement. This has often resulted in urban spaces dominated by motor vehicles to the extent that they failed to make a positive contribution to the quality of life in the city. Nevertheless, in recent decades a noticable effort has been made to change the use and design of city streets so they could host a broader variety of functions thus becoming more user-friendly and sustainable. However the process of introducing change is often considered long-term and difficult, accompanied with hot public debates.

The purpose of this study is to highlight the broad range of the processes leading to substantial transformation and reuse of city streets, ranging from the political top-down approaches to the more recent bottom-up community led approaches using tactical urbanism. Theoretical part is supported by the case-study presenting the processes and attempts of urban transformation of Koroška street in Maribor through the period of two decades. The study shows the multitude of approaches trying to redesign the oldest street in Maribor, ranging from classic urban planning, architectural competition, interdisciplinary approach in the frame of Actors of urban change project, toward tactical urbanism and monitoring of traffic flows within the European mobility week 2015. In conclusion, the transformation processes of city streets can be successfully supported by civil initiatives, but the most decisive factor remains a clear vision and determination to facilitate change by the public administration.

Keywords: Maribor, European Mobility Week, streets for people, tactical urbanism, urban transformation

2 INTRODUCTION

"Streets are the lifeblood of our communities and the foundation of our urban economies. They make up more than 80 percent of all public space in cities and have the potential to foster business activity, serve as front yard for residents, and provide safe place for people to get around, whether on foot, by bicycle, car, or transit. The vitality of urban life demands a design approach sensitive to the multifaceted role streets play in our cities" (NACTO, 2013)

Most of the mankind's urban history streets were used as multifunctional spaces. A road was a market, a playground, a park, and it was also a thoroughfare – but before 1903 no city had a traffic code. There were no traffic lights, painted lines or zebra crossings (Montgomery, 2013). A street as a public space represented one of the most important social and economic environments for people in the cities, as quoted "Streets are a primary ingredient of urban existence as they provide the structure on which to weave the complex interactions of the architectural fabric with human organisation" (Çelik et al., 1994).

However, since the rise of motorization (predominantly after the WWII), city streets became predominantly used for mobility and transport function, which on one hand benefited personal mobility and paved the way for fast economic development, but at the same time caused the immense rise of traffic and related problems. Environmental problems such as poor air quality and unacceptable levels of noise have consequently reduced the quality of life in many city areas. Heavy motor traffic has weakened the sense of neighbourhood and local community (European Commission, 2014), as showcased in the 1980s by Donald Appleyard's analysis of social interaction on three streets with heavy, moderate and light traffic (Livable Streets, 1981). For the past 100 years streets were considered as mostly technical/infrastructural spaces, their standardisation subordinated to motor vehicles has shaped the environments we live in and caused physical and social impacts (Çelik et al., 1994). Consequently, an average of 80% of the street space is nowadays dedicated to motor traffic, the remaining 20% for the movement and interaction of people – such as sidewalks for pedestrians, cyclists and other possible activities (Lydon, Garcia, 2015). Furthermore, the use of streets is still predominantly monofunctional, the inclusion of multifaceted contents into the street space on the regular basis is usually prevented by the traffic regulation intended to assure health and safety. Last but not least, motor traffic proved to consume a lot of space in the cities – at least one third of all developed land is devoted to roads, parking lots, and other motor vehicle infrastructure, in USA an automobile consumes close to the half the land of cities – therefore the waste of street space and its economic impact has been a prolonged phenomenon (Çelik et al., 1994).

Nevertheless, the need for the redesign of streets into more human and heterogenes places of the city, in a way reclaiming city streets for people, occurred not only in professional and scientific work but also in concrete actions already since the 1960s of the 20th century. The importance of a street as a social space and living environment was promoted by Jane Jacobs (The Death and Life of Great American Cities, 1961), followed by William H. Whyte (The Street Life Project, 1971), Christofer Alexander (A Pattern Language, 1977), Donald Appleyard (Livable Streets, 1981), Allan Jacobs (Great Streets, 1993), Jan Gehl (Cities for people, 2010) and others (Gehl, Swarre, 2013). The latter supported several transformations of city streets and city centers in recent decade with an aim to create better conditions for quality public life in the cities, by improving conditions for pedestrians in accordance to the mantra of spatial planning on a human scale (Gehl, 2010).

One has to consider streets as particular spaces of our cities that will undertake even bigger changes in their function and appearance in the future - e.g. be it the implementation of driverless mobility and its broad consequences, from new models of public transport and car-sharing to reorganisation of space use, above all the shaping of more inclusive streets (Smolnicki, Soltys, 2016), or be it the continuative rise and influence of cycling and walking as the most sustainable transport means, land appropriation processes and engagement of communities or even new regulations. The shift should happen mainly because of the arguments related to environmental sustainability, but also to social change. "Over the coming century, the challenges borne by cities and the burdens placed upon their streets will multiply in quantity and complexity. Growing urban populations will demand that their streets serve not only as corridors for conveyance of people, goods, and services, but as front yards, parks, playgrounds, and public spaces. Street must accommodate and ever-expanding set of needs. They must be safe, sustainable, resilient, multi-modal, and economically beneficial, all while accommodating traffic" (NACTO, 2013).

3 APPROACHES TO TRANSFORMATION OF CITY STREETS

How to initiate, support and achieve the expected change of street spaces into places that function above sole traffic corridors? In general, the processes that stimulate change vary from case to case, since they affect the change of gained rights and habits of users on one side (especially car drivers), as well as regulations and practices of street planning on the other. Traffic and building engineers are mostly responsible for latter, whereas involvement of architects and other experts is not a common practice, let alone participation of citizens and interested public. The approaches can be different, ranging from the classic top-down solutions, wherein the correct, but often very formally regulated street spaces are conceived. More creative and complex spatial solutions of transformation of street spaces can be obtained by the means of urban-planning and architectural competitions, especially when achieving professional and political consensus, along with sufficiant financial support.

However, in the past 10 years one can notice successful examples of transformation of influential street spaces in bigger cities such as New York, Sydney, Montreal… which utterly differ from previous practices and provide a model and encouragement to other cities and actors. Earlier practices often proved to be inefficient[1], mainly because they lack resources, power and control to implement formal masterplans (Bishop, Williams, 2012). On the contrary, new approaches often work as experiments on site, characterised by direct action, creative, temporary solutions and involvement of interested public. Their main aim is "to activate urban public space by setting in motion certain aspects of the public, social, political, cultural, and economic spheres of the city, to generate or accelerate particular reactions in the users" (Zotes, 2012). Furthermore, Zotes states that there is "an urgent need to find new ways to reclaim public spaces and urban structures in order to challenge the limited and outdated uses for which they were originally intended since cities are increasingly becoming more restrictive and exclusionary, not only in physical terms but also in terms of self-autonomy and spontaneous social manifestation" (Zotes, 2012). The 'DIY urbanism', 'temporary urbanism' (Bishop, Williams, 2012), 'handmade urbanism' (Rosa, Weiland, 2013), above all

[1] According to Kaplan, 80% of all planned projects are never implemented (Kaplan et al, 2005; from Lydon, Garcia, 2015).

'tactical urbanism' (Lydon, Garcia, 2015) describe the less framed and rigid approach to urban change[2], as the word tactical explains it well: "a) of or relating to small-scale actions serving a large purpose and b) adroit in planning and manoeuvring to accomplish a purpose" (Lydon, Garcia, 2015). Regardless of name, the new approaches emerge in different, often interconnected formats as presented below.

3.1 Temporary use of space

Temporary use of street spaces is driven by rapidly changing possibilities, need for expression, time-limited exclusivity, need for flexibility and opportunity to unlock the site potentials (Bishop, Williams, 2012) such as pop-up events, art installations, urban agriculture, sports and recreation activities, exploration of street spaces. "Some are planned and formal, some informal, accidental, spontaneous or even illegal" (Bishop, Williams, 2012). Some already formed in initiatives such as 'Open street project' (started in 2010, involving more than 70 American cities), which shows the change of paradigm and the growing importance of street space (Lydon et.al, 2013). Its aim is to introduce gradual change e.g. by closing roads for traffic on weekends, so that people can gain positive experience of different mobility than driving, especially walking and cycling, but also to instigate a long-term change of perspective. Temporary use of space is often accompanied by a need for physical change of space which can be a successful tool in the process of urban change (i.e. Temporary landscaping in Times square, New York).

3.2 Interim spatial solutions

According to Bishop and Williams "landowners and developers are recognising that their plans need to be more flexible, and that there may be a role for temporary activities or interim phases of development" (2012). Interim design stages are promoted as a tool when funding streams are limited, complex approval and regulatory processes are challenging to deliver results that communities demand. "Interim design strategies are tools and tactics that cities can use to improve their roadways and public spaces in near term" (NACTO, 2013). Changes are taking place toward physical transformation of streets, as in the case of Montreal and many other cities, where actors try to make streets visually attractive for users with smaller and less financially demanding interventions, especially by greening, by designating space for pedestrians and cyclists, and for other purposes (Lydon, Garcia, 2015) but also to expose certain societal or political problems (i.e. urban hacking, art guerrilla). Mike Lydon, founder and supporter of tactical urbanism, states that achieving the objective often requires future solutions to be 'shown' as a one to one model and constructed by the simple material resources (i.e. benches, greenery pots, markings, railings, etc.) adding new interesting contents (i.e. yoga on the street, basketball, seating in the middle of the street, concerts, chess, ...). In addition, the high costs at the later stage of the project can be avoided by the so-called 'live rendering' at the early stages of the project development. Such physical simulation can encourage people's interest, inspiration and integration, it is possible to directly measure the effects, suggest improvements, enable quick learning, promote change, as well experiment with different ideas, etc... and all this in a relatively short period of time, with a little risk taken, and often with the high degree of efficiency (Lydon, Garcia, 2015).

3.3 Partitipation of citizens

In cases of small and gradual changes in the area, as well as in cases solving more problematic traffic situations or introducing advanced traffic-spatial solutions, the participation of the lay and the wider professional public is highly recommended. This confirms the example of the design and implementation of the first shared space in Graz (Sonnenfelsplatz) in 2009/2010, which was conceived as the result of collaboration between municipality, experts and interested public and would not have been imaginable without their contribution (understanding, acceptance, involvement).

Furthermore, examples from the Netherlands show the participation of residents, involved in a very broad range of activities, such as taking care for the street space, maintening, bringing content and even transforming. Van Eggerat states that in the frame of the project OpzoomerMee in Rotterdam, over 1800

[2] In previous decades, such approaches were frequently despised and looked down upon as marginal projects without any true value, primarily because they were economically marginal and were often labelled with derogatory terms related to urban squats or gardening and shantytowns. Nowadays, many such forms of community and hence space organisation are slowly becoming more legitimate, mostly due to their social cohesion element (Pogačar, 2012).

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street communities were registered since 1994. There are many other similar small initiatives such as 'Mens maken de stad: Rotterdam Ideeand Meerdoen', 'Gebiedscommissie'... Due to inefficiency of public services, and the need of the urban population to integrate and decide upon the development of the street they live in, the initiatives of engaged citizens are generally in uprise.

3.4 Creative regulations

Standardization and byrocratic procedures often prevent creative use of streetspaces. An example of overcoming byrocratic obstacles when dealing with streets as public spaces is the concept of ‘Playfull commons’ – licensing co-creation in public spaces (Karjevsky, Quack, 2015). According to Karjevsky and Quack users of public spaces face boring and mundane environments that are either neglected or optimized for commercial activities. As surveillance and regulation grows, users are criminalised. In most cases, users are distanced from decision making processes and separated from the definition, design and creation of public spaces (Karjevsky, Quack, 2015). Therefore, the tool ‘Playfull commons’ should trigger public debate on the regulation of public spaces, licensing to enable owners and administrators of public spaces to allow for clearly defined kinds of playful uses, to create high quality, safe and fun environments and influence the design and construction of new public spaces (Karjevsky, Quack, 2015).

4 CASE STUDY OF KOROŠKA STREET

Case study describes different approaches for urban transformation of the Koroška street, which is the oldest straight road in the city of Maribor.[3] Its foundations were layed around 1250 when the medival town of Markburg (Mark an der Burg) was formed inside the fortification walls. According to Sapač (2013), Koroška street is consiedered to be “the mother of all city streets in Maribor”. Situated at the old city centre of Maribor with well preserved medieval parcelation (typical houses with 2 innercourtyards), it bears historic importance as some of the cities oldest buildings are still located there, at the same time it has been considered as one of the most degraded and congested road in the city centre. Traffic meassurments performed in winter 2015 reported a daily average of 18.181 vehicles, aprox. 1 million vehicles per year (Gornik, Pogačar, 2016). The part of the street taken in observation is only 250m long and connects the Main square with the location of the historic gates called ’Koroška vrata’. The street profile is at its narrowest part only 9 m wide and as such unapropriate for high traffic density (especially trucks and busses), causing imbalance for other users of space as pedestrains and cyclists, but also for other people working and living there. As a result of longlasting nagative effect of traffic, the whole area has been visible degraded, the level of noise and PM10 particles had been clearly exceeding the allowed values. One can notice empty buildings, dusty and degraded facades, poor economic activity at the ground floor, etc. Once a vivid city street (still so in the first half of the 20th Century) full of small craftmans and artisan shops (bakeries, pubs, tailors, carpenters, glaziers…) got suffocated by motorised traffic. However, not only the intense traffic caused the degradation of the street, but also other factors such as the contested nationalisation of property in 1945, the attitude of the new owners without historic bounds to the land and properties, denationalisation processes after 1991 and new economic development, general shift of the centre of economic activities from the old city centre to the perifery, ageing and depopulation of the area, poor economic capacity of ist inhabitants/owners, and demanding renovation of the built historic heritage. It must have been clear from the start that the task to revitalise the area as a whole is a complex one and that not all problems can be solved only by proposing the reorganisation of the traffic and street redesign. However, the necesity to reduce motorised traffic on this particular street has been recognised by architects and urban planners as one of the major problems since the turn of the millenium.

[3] Maribor is the second largest city in Slovenia, with approx. 110.000 inhabitatnts. It was an important industrial city in times of former Yougoslavia, involved in car, metal and textile industry. Since the 1990s most factories collapsed, causing big unemployment, and the need for restructuring. The city also beared the title of European Capial of Culture in 2012. The unemployment is still above the countries average.


Fig. 1: Main square and Koroška street as shared spaces in 1961 (photo: Jože Gal). Fig. 2: (right): Motorised traffic at Koroška street in 2015 (photo: Urška Pignar)

4.1 Classic vs. contemporary approach to urban transformation

The process of the redevelopment of Koroška street can be segmented into two major phases. One is characterised by classic urban development approach. The other is characterised by using elements of tactical urbanism, e.g. small physical interventions into the street space, as well participation of the local community (see Fig. 3). Upon the list of released documents, studies, different activities related to Koroška street, the process aiming at urban renewal is described.

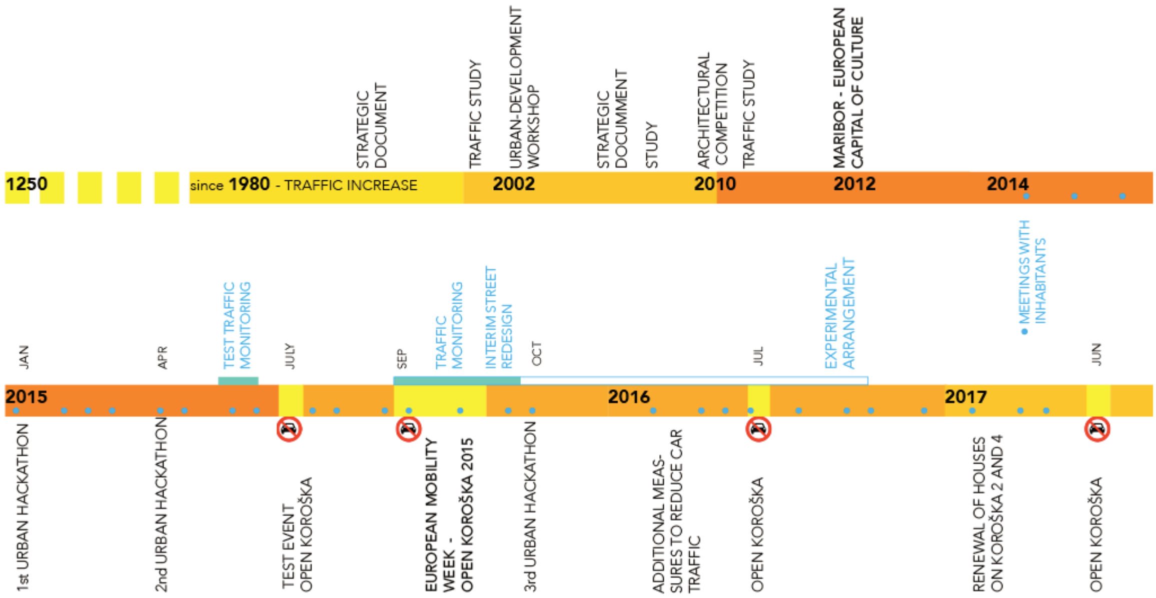

Fig. 3: Timeline of activities related to urban transformation of Koroška street (time scale in not proportionate), (source: author).

4.1.1 Classic approach (1985-2013)

(1) Recognition of the problem by architects, urban planners, as well municipality. The need to revive Koroška street was first mentioned in the official document named 'General plan of the renewal of the old core of Maribor' (Recer, Reichenberg, 1985), released in 1985 as the first strategic document to deal with the built substance of the medieval part of the city.

(2) 'Traffic analysis of the new traffic regime of the central area of Maribor' in 2002 (org. 'Prometna analiza novega prometnega režima na centralnem območju Maribora', by Cestno-prometni institut/Traffic institute); the study is proposing tendency to reduce traffic on Koroška street to become a one-way street (in the west/east direction); the concept is incorporated into the so called 'PUP Old city center' – the official planning document of the Municipality of Maribor.

(3) 'Pilot project for the renewal of buildings on Koroška street 2, 4, 6, 8 and 10' was proposed in 2002. Project included consulting as well preparation of the planning documentation, arrangements with the house owners and residents, proposals for the use of stores in the ground floor. The renovation of facades did not occur.

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(4) International urban-development workshop 'Reminiscence' was carried out in 2002 by 6 teams from Slovenia, Austria and Holland (organised by the Institute for spatial planning – Municipality of Maribor, Architects Association Maribor, private architectural office Igre d.o.o.). The aim was to search for reason for degradation of the area along Koroška street and for spatial solutions for its revitalisation. An exhibition took place in 2003 (Recer et al., 2003).

(5) Strategic document 'Project of renovation of the old town core, 2003 (org. 'Projekt prenove starega mestnega jedra', Igre d.o.o.) has dedicated a considerate sequence to Koroška street and its historic importance as well problems related to traffic and degradation, e.g. "Koroška street is one of the traffic routes, that conditioned the birth of the city. On the west side of the fortification wall, the entrance gates 'Koroška vrata' were built as a powerful fort. On the other side Koroška street expanded and formed the Main Square. The facts speak about the destiny of the medieval city connected to the destiny of Koroška street and vice versa, even today the destiny of Koroška street is related with the destiny of the whole old city centre" (Recer et al., 2003).

(6) 'Study of urban development and revitalisation of the old city, with an emphasis on renovation of façades on Koroška street' in 2010 (org. 'Študija urbanistične ureditve ter revitalizacije mestnega jedra, s poudarkom na ureditvi fasad Koroške ceste v poteku starega mestnega jedra Maribora'). Study was conducted in a frame of cross-border project scheme City Network Graz-Maribor. Part of the study was a questionnaire related to the traffic development options for Koroška street (among 590 responses, 68% answered that pedestrian zone would be the best solution). Excerpt from the text shows the description of the situation of the street at the time i.e. "Koroška street is degraded into two-way traffic route with narrow pavements and without bicycle lanes. Buildings adjacent to it are degraded, many stores are abandoned or they mostly have, by few exceptions, a dubious purpose considered for a part of the city with the highest historic and urban value" (Ambrožič, 2010). One of the local architects, Lobnik states "one of the main conditions that the planned can be realised, is that the main role on Koroška street should be gained by the pedestrians" (Ambrožič, 2010).

(7) 'Architectural and urban planning competition for the wider area of the Main square, Koroška street and Kneza Koclja street' in 2010. The competition results divide the area by three different solutions of three architectural teams. The one for Koroška street is designed by the Slovene-Mexican architects (MX_SI arhitects), Boris Bežan and partners (competition is organised by the Chamber of Architects, Municipality of Maribor, Architects Association Maribor). It proposes a new ambient, with more space devoted for pedestrians along with the one-way street for motorised traffic (Fig. 5), (ZAPS, 2010).

Fig. 4 (left): Old city centre of Maribor with Main Square and Koroška street. Fig. 5 (right): Koroška street according to architectural competition of MX_SI architects, Boris Bežan and partners

(8) New traffic study was conducted in 2011 (Pavlinič, 2011), (org. 'Maribor stara mestna sredica: prometna študija vplivov režimskih ukrepov in planiranih prometnih novogradenj na prometno sliko območja stare mestne sredice', Municipality of Maribor, Traffic institute). Traffic simulations were made to test the possibility of the partial or complete closing of Koroška street for motorised traffic. Simulations were made by the assumption of constant growth of the motorised traffic and they did not include any consideration of other types of mobility such as cycling. Study proved that closing of the Kroška street for motorised traffic is not possible at all, as it will cause the collapse of the traffic system. The study among others proposed the building of the tunnel under the Koroška street, that should be connected to the already planned rather big underground garage at the Main square.

Further, results of the first phase show several different approaches to transform Koroška street. The most important among them is the recognition of the historic and urban importance of the street that got embedded into the strategic documents. The list shows rather serious intentions of formal preparation for the urban transformation of the street, however, conducted studies, strategies, workshops, competitions, etc. did not have any concrete or positive effect on the space of the street itself. On contrary, within the period of 20 years since the problematic was first tracked, the number of motor vehicles has risen and the degradation of space – e.g. demolished road surface, dilapidating buildings facades, unused courtyards, abandoned buildings - got more severe. One could argue that the lack of finance or the change of local government (in 2013) prevented the realisation of bold plans, but the fact that the European Capital of Culture[4] took place in 2012 could mean that the opportunity and challenge was big enough. The peak of the phase could be marked by the proposal for building the tunnel[5] that could solve traffic problems in the east–west direction through the city centre and that would entirely release Koroška street from motorised traffic. However, it would be the biggest and the most expensive project of the city for the past 10 years and as such even more difficult to achieve. In addition, the underground garage also did not find investor until now.

4.1.2 Informal approach (2014-2017)

The second phase of the urban transformation of Koroška street can however be characterised by alternative approach to urban development. Since the year 2014 many different and for the local environment rather untypical activities took place with an aim to activate inhabitants of the street, to activate local authorities, to activate the experts and interested public, but most importantly to activate the space of the street itself. In the following page, each approach is briefly described. A series of 'events' and actions undertaken in recent years, is presented below.

(1) 'Living city project' 2013-2015 - Research of the area along the Koroška street' in the frame of the program ‚Actors of Urban Change'[6] (Schwegmann, 2015). The project at first place addressed the revival of the degraded courtyards in the city centre together with local participants. It resulted in many different activities (such as cleaning actions in the courtyards, exhibition with students of architecture, picnics with residents…). Research was systematically conducted on every courtyard with an aim to get data from the field and to establish direct contact with the inhabitants of the area. In 2014 the scope of the project spread from the courtyards to involving the street space of Koroška street.

(2) 'Regular meetings with the inhabitants of Koroška street' – with an established direct contact with the inhabitants, but also owners and employees of local shops and stores, regular meetings have been organised since April 2014. 10 meetings were organised in the frame of the 'Living city project'. Since April 2015 to April 2016, 27 meetings were organised in the frame of 'Actors of Koroška street'. Participants, usually between 10 and 20 meet on different locations on Koroška street, that were mostly unknown to them before, although they live nearby (i.e. gathering space for local divers' club, gathering space for local fire brigade, local galleries…). The meetings were moderated by Association House! (main partner at the 'Living city project'), guests were from Municipality, University of Maribor and local media. The aim of meetings was to mobilise local population for active involvement in the street revitalisation, but also to deal with the daily problems of vandalism on the street, safety, garbage disposal problems, etc. One of the more visible results of the meeting process was the self-organisation of the smaller group of inhabitants who formed the 'Initiative of Koroška street' in April 2016 and organised 11 meetings until today.

(3) 'Urban Hackathons', in 2015, as a part of the 'Actors of urban change' pilot program, the 'Maribor team' (Living city project) organized 3 urban hackathons related to the renewal of the old city centre of Maribor (Schwegmann, 2015). The three two-day's events took place in January 2015 ('City-toolbox: Revive the city

[4] Two art interventions took place at Koroška street for the ECOC 2012 – one was laser illumination to impose the location of the historic gates, the other was an outdoor exhibition of the renown comics artist on the topic of aggression and local football team.

[5] Maribor has 80% of inhabitants living within the radius of 3 km measured from the Main square. Distance of 3 km is supposed to be easy to overcome by bicycle.

[6] The program Actors of Urban Change aims to achieve sustainable and participatory urban development through cultural activities. Actors from the cultural scene, the administration, and the private sector are given an opportunity to strengthen their competencies in cross-sector collaboration. Through local projects, process-related consulting, and Europe-wide exchange, the program participants put their skills into practice.

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together’), April 2015 (‘Reviving Koroška street’) and October 2015 (‘Reviving the city centre’) of 2015 with 40-60 participants at each event. All three hackathons were organized with an intention to activate, inform and empower those willing to support urban change in the area. There was a conscious attempt to merge different groups of stakeholders. Consequently, all three hackathons were characterized by a broad variety of participants, ranging from municipal officials, university researchers (architect and traffic engineers), experts from different fields of urban development, representatives of NGO’s, civil initiatives (e.g. Initiative City Council), students and most importantly by local people who were interested in helping to solve the problems of their own living environment. (Pogačar, Žižek, 2016)

Fig. 6 (left): 2nd Urban Hackathon – Reviving Koroška street in 2015 (photo: Igor Unuk). Fig. 7 (right): Inhabinants meeting of Koroška street (photo: Kaja Pogačar)

(4) Research project ‚Contemporary Spatial Analysis’ (April - July 2015) was conducted by the students and mentors of the Department of Architecture and Department of Sociology (University of Maribor) – 14 days observation and analysis of user’s behaviour and counting of pedestrians, cyclists, car drivers deviations (i.e. parking on the pavement...), recording age structure. Among interesting results were high numbers of cyclists driving on the pavement, crossing the street by pedestrians outside of marked areas, incorrect parking upon the pavements, people using the street for transit and not evolving in conversation, only few children spotted on the street… Counting of pedestrian and cyclist was never performed on that street before (Pogačar et al., 2015).

(5) Interviews (22 June 2015 – 3 July 2015) - part of the previously mentioned research were also interviews with more than 40 coincidentally chosen passerby. Method was a half-structured interview consisting of questions: how often are you found in Koroška street, why do you use Koroška street, what do you like and dislike about the Koroška street and commentary about the current traffic arrangement. The most common answers were: the street is neglected, interviewers expressed that they mostly like ‚nothing’, there were little positive commentars about the street, those who were had a nostalgic note, more than half of the interviewers mentioned they thought the street had too much traffic, less than half reported that they don’t mind the traffic (Pogačar et al., 2015).

(6) ‘OPEN Koroška Street’ (5 July 2015) – One-day event in July 2015 was the first time the street was not used for motor-traffic. More than 30 volunteers help to arrange temporary equipment (30 tables and benches, 3 bath tubs filled with water by fireman brigade located in the middle of Koroška street, 20 bamboo plants and exhibition stands were inserted). Many different activities were organised such as urban sports (basketball, football), cultural events (dancing performances, street theatre, visiting exhibitions at 5 galleries located at Koroška street…), culinary and children workshops, direct action such as marking new pedestrian crossings with colour chalks. A series of interviews were performed on that day, with answers completely diametrical to those gathered just shortly before. Most interesting answers were that visitors feel like being at the see-site or even as being in Ljubljana (the capital of Slovenia), which showed that people perception on the street changed instantly. As a part of the event, an exhibition about Koroška street was organised explaining the origins of the street, presented data of traffic flows and the results of the architectural competition on the renovation of Koroška street (Odprta Koroška, 2016).


Fig. 8 and 9: Open Koroška street – test event in 2015 (photo: Kaja Pogačar)

(7) 'European Mobility Week - Open Koroška street 2015' – Based on the good experience from the test day in July 2015, municipality of Maribor, together with the University of Maribor (Faculty of Civil Engineering, Transportation Engineering and Architecture, University Sports Association Maribor), NGO's (Maribor cycling network, Association House!, Citilab Institute, Institute Breath, Living city initiative,…) decided to use the opportunity of the European Mobility Week to foster further activities related to the revitalisation of the Koroška street, related mainly to motorised traffic reduction. In September 2015, the street was closed for motorised traffic (except for taxis and buses) for entire three weeks. Many events were organised along it in order to rise awareness on sustainable mobility. As a part of the project, Koroška street was partly redesigned[7] and renewed (new pavement on one side of the street, 4 new creative dotted street crossings, 6 trees in large pots, stands for bicycles, new stations for buses…). A more comprehensive exhibition was prepared (20 posters), adding short information about each of the buildings history (sticker on each house), interactive wall for exchange of opinions was prepared (Gornik, Pogačar, 2016). Allthough the change was maily positively accepted, the whole project was accompanied with rather unexpected and extremely emotional response of individuals through the local media (local radio station got warned by the 'State information protection agent' because of the hostile speach and negative campaign against the project[8]). There was a huge media response in the local newspaper Večer (daily at least 3 main articles were released related to the topic), the project launched hot public debates, also an extremely negative response from the side of the Architects Association. As a concequnce municipality stopped supporting the project and the dotted street crossing were erased and replaced by normal ones. In addition, after three weeks of 'Open Koroška' traffic retourned on the street.

(8) 'Traffic monitoring' – Parallel to the European Mobility week, Faculty of Civil Engineering, Transportation Engineering and Architecture (University of Maribor) conducted the monitoring on 13 streets, to measure what happened with the distribution of traffic if Koroška street was closed for motor traffic. Results proved the tendency of evaporation, since approx. 15% of vehicles counted were not present at any of the surrounding streets where measurements were conducted. Smaller congestions were noticed, but only in peak hours and not more than 10 minutes' delay and part of the traffic was redistributed to Lent (historic side along the river Drava), which was found unacceptable. "The initial thesis was proven to be correct. As much as 3200 vehicles daily "evaporated". The main importance of monitoring was to gain concrete numbers on car redistribution - data that wasn't available before in such an extent. The experiment simultaneously showed the flexibility of changing the traffic habits, but also the aggressivity of certain population groups (in report male age group of around 55 years was identified as beeing the least acceptable of the temporary regulations). The experiment was considered as one step toward implementation of sustainable mobility in the city of Maribor" (Gornik, Pogačar, 2016).

[7] Architects that won the competition were informed and agreed about the planned interim design of the street.
[8] Car still represents important status symbol in Maribor.

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Fig. 10 and 11: Koroška street with the new interim appearance at European Mobility Week 2015 (photo: Alexia Tyriakidou).

Fig. 12: Koroška street with the dotted street crossings, that were erased and replaced by the classic ones just after the European Mobility Week 2015.

(9) ‘Lent festival - OPEN Koroška 2016’ – still once a year as a part of the yearly summer festival (Lent Festival), Koroška street is closed for traffic. Similar to the first event in 2015, it aims to open new perspective on the street, to enable genuine physical experience of the street without the traffic and to walk in the middle of the street, to dance in the middle of the street, to play football on the street in the middle of the city centre. It will be closed again on 25 June 2017.

(10) ‘ISUDS’ – The city of Maribor is taking part in Integrated urban strategies, co-funded by the ERDF. The strategic part was confirmed at the City council at the end of 2016 (Naterer, Žižek, 2017). The renewal of Koroška street according to architectural plan gained at the competition 2010, is put into the strategic plan. Through that mechanism finantial means for renewal will be assured.

Furthermore, the results of the second phase of urban transformation of Koroška street show visible changes in the appearance of the street as well improved conditions mainly for pedestrians with 4 new pedestrian crossings and for cyclist by inserting cycle lanes on both side of the street. Greenery was added to improve the ambient quality of the street space. At the same time conditions for car-drivers got worse (e.g. cycle lanes were inserted within the widths of the driving lanes – the so called Dutch model and bus stops were also put on driving lanes, so drivers must wait for bus to fill). There was an intentional decision to try to change the hierarchy on the street by imposing pedestrians and cyclist and at the same time to subordinate car drivers. The latter should get the feeling as being strangers on that historic street. As a result, the new spatial constellation caused a lot of complaints by car-drivers. With better communication strategy and campaign by the Municipality, many negative effects of the experiment could be mitigated. The scale of the project also changed immensely, since in the preparation phase all stakeholders were mostly personally informed, involved and prepared for the change, which wasn’t the case in the phase that included all citizens. Urban transformation of Koroška street was a main topic in the city of Maribor in the fall 2015 and even later. The street was for the entire year after the experiment marked by the sign ‘Experimental arrangement’.

Nowadays one can see a further change in the offer on the street as many café-owners put chairs on sideways, where possible. Buildings at Koroška street 2 and 4 got renovated, there are less empty buildings than 5 years ago. Although there is still too much traffic on the street, the traffic got slower (speed restriction to 30 km/h). With interim design street looks livelier and more dynamic than before.

5 CONCLUSION

Process of urban transformation of cities towards sustainable urban development can often turn into a long-term struggle, especially if street spaces are those that need to be changed. The habits of users gained in the previous century, when streets were hijacked by the motorised traffic, demand a sustained effort to be transformed. Streets as public spaces are at the junction of various interests, above that there will be many new demands put on them for the future. If we want streets to become more than just traffic corridors, efforts from many different expert profiles such as architects, traffic engineers, urban planners, civil engineers, landscape architects, urban sociologist, etc., but also municipality administration, local inhabitants, interested public will be necessary.

Reasons why important centrally located historic street in the town of Maribor still hasn't got its new role and appearance are many, but similarly the steps and the processes that would lead to improving the conditions of Koroška street were many. One can notice different actions and different actors being involved in different steps of the process spreading through more than 2 decades.

First phase

- Step 1: Recognition of the problems from the side of experts, architects, urban planners, informal search for development options
- Step 2: Traffic studies, Incorporation into the strategic documents
- Step 3: Architectural and urban planning competition
- Second phase
- Step 4: Promotion of the redevelopment from the side of different bottom-up initiatives
- Step 5: Experiment on site – testing the new traffic model on site and temporary urban interventions on site
- Step 6: Redevelopment of Koroška street included into the Integrated Urban Strategy (ISUDS /ERDF)

The first phase of the redevelopment process of the Koroška street, characterised by the classic approach, did not result in any physical intervention or any kind of improvement of the street itself, however the second phase supported by the small physical interventions showed the citizens as one to one model the perspective of the future development possibilities of the street. Although the street got a bit of fresh atmosphere, most problems are still not resolved and the demand for a serious approach taken from the side of responsible institutions is still more than necessary. Ineffective long term struggle relates mainly to bad planning and organisational capacities from the side of municipality (no clear priorities, bad decision-making…), divided public opinion (pro–motor vehicle community), no consensus about the general traffic scheme of the inner-city area and others.

Finally, the location of Koroška street proved to be a neuralgic point of the city of Maribor. As shown in the case-study, certain classical practices and approaches aiming at urban transformation proved to be inefficient and even outdated. However, the potential of contemporary approaches exists. It is thus necessary to find new solutions and to try out creative and more efficient approaches, such as tactical urbanism and participatory practices, which should be taken seriously primarily by the architects and urban planners. Top down practices should be complemented by the bottom-up approaches or vice-versa. It can be concluded that the transformation processes of the city streets can be successfully supported by the small physical interventions and bottom-up approaches of civil initiatives, but the most decisive factor remains a clear vision and determination to facilitate change on the side of public administration.

6 REFERENCES

Ambrožič, I. (ed.), 2010. Study of urban development and revitalisation of the old city, with an emphasis on renovation of façades on Koroška street = Študija urbanistične ureditve ter revitalizacije mestnega jedra, s poudarkom na ureditvi fasad Koroške ceste v poteku starega mestnega jedra Maribora. Maribor, Mestna občina Maribor.

Appleyard, D., Gerson, M.S., Lintell, M., 1981. Livable streets. Berkeley, University of California Press.

Bishop, P., Williams, L., 2012. The temporary city. NewYork, Routledge.

Çelik, Z., Favro, D., Ingersoll, R., 1994. Streets: critical perspectives on public space. Berkeley and Los Angeles, California, University of California Press.

European commission, 2004. Reclaiming city streets for people, Chaos or quality of life. Luxembourg: Office for Official Publications of the European Communities.
Gehl, J., 2010. Cities for people. Washington (DC), Covelo, London, Island Press.
Gehl, J., Swarre, B. 2013: How to study public life, London, Island Press.
Gornik. N., Pogačar, K. (ed.), 2105. European mobility week: Maribor 2015, Odprta Koroška = Open Koroška street. Maribor, Mestna občina Maribor.
Jacobs, J. (1961), 2009. Umiranje in življenje velikih ameriških mest = The Death and Life of Great American Cities. Ljubljana, Studia humanitatis.
Jacobs, A. B., (1993). Great Streets. Cambridge (Mass.), London, The MIT Press.
Karjevsky, G., Quack, S., 2015. Playful commons. Web: http://www.playfulcommons.org, (25.4.2017).
Lydon, M. et al., 2013. The open streets guide: Opening Streets to People, Sharing Resources, Transforming Communities. Miami, New York (web: http://www.bikewalkalliance.org/storage/documents/reports/OpenStreetsGuide.pdf).
Lydon, M., Garcia, A., 2015. Tactical Urbanism. Short-term action for long-term change, London, Island Press.
Manual for streets, 2007, Thomas Telford publishing, London.
Montgomery, C., 2013. Happy city: Transforming our lives through urban design. London, Penguin Books.
NACTO (National Association of City Transportation Officials), 2013. Urban Street design guide. London, Island Press.
Naterer, A., Žižek, A., 2017. Urban development of Slovenian cities: an analysis of Integrated urban strategies in Slovenia. Maribor, (unpublished article).
Odprta Koroška, 2016, Web: http://koroskacesta.si/dogajanje/ziva-koroska/ (15.8.2016).
Pavlinič, B., 2011. Prometna analiza novega prometnega režima na centralnem območju Maribora, Cestno-prometni institut/Traffic institute.
Pogačar, K., 2012. Urban activator - Participatory and bottom-up tool of urban change: definition and selected examples. Prostor, znanstveni časopis za arhitekturu i urbanizam. ISSN 1330-0652. - Vol. 22, No. 2 (48) (2014), p. 188-199.
Pogačar, K. et al., 2015. Sodobni pristopi prostorskih raziskav: končno poročilo o raziskovalnem projektu. Program 'Po kreativni poti do praktičnega znanja'. Maribor, Fakulteta za gradbeništvo, prometno inženirstvo in arhitekturo.
Pogačar, K., Žižek, A., 2016. Urban hackathon - alternative information based and participatory approach to urban development. Procedia Engineering, Volume 161, 2016, Pages 1971-1976. https://dk.um.si/IzpisGradiva.php?id=64577.
Recer, I., 2003. Project of the renovation of the town core = Projekt prenove starega mestnega jedra. Maribor, Mestna občina Maribor.
Recer, I., Reichenberg, B., 1985. General plan of the renewal of the town core of Maribor = Generalni plan prenove starega mestnega jedra mariborskega. Maribor, Skupščina mesta.
Sapač, I., 2013. Mariborski srednjeveški obrambni sistem: znanstveno teoretični in projektni elaborat, Mestna občina Maribor, http://www.maribor.si/dokument.aspx?id=20281.
Schwegmann, M., et al. (ed.), 2015. Actors of urban change. Program documentation 2013-2015. Robert Bosch Stiftung, Stuttgart.
Smolnicki, P.M., Soltys, J., (2016). Driverless Mobility: The Impact on Metropolitan Spatial Structures, Procedia engineering.
Zotes, M., 2012. Appropriate, Subvert, Activate! Projection as Urban Activator. EME3, Barcelona.
ZAPS, 2010. Ureditev širšega območja Glavnega trga v Mariboru ter paviljon Stari peron. Web: http://www.zaps.si/index.php?m_id=natecaji_izvedeni&nat_id=45, (15.5.2017).

reviewed paper

Sustainable Urban Mobility: Assessing Different Neighbourhood Models in Greater Cairo Region, Egypt

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1 ABSTRACT

Sustainable urban mobility aims to encourage movement behavior that reduce automobile dependency and induce non-automobile and public mobility. As cities continue to change, planners are facing the challenge of designing urban mobility systems that are sustainable on social, economic, and ecological levels. They aim to reduce transportation energy consumption; increase social interaction between residents; and increase subsidiary effects of side path through movement. There is a growing calls for planners to shift paradigm of urban mobility to enable economic activity, social connectivity, and ecology. Movement behavior is influenced by different factors, part of them due to socioeconomic variables, others due to urban form. Some neighborhoods seem to support alternative modes of movement of non-motorized or public motorized as feasible mobility solutions and meet resident's expectations and accordingly reduce the need for high level of motor vehicle ownership; Where other neighborhoods don't and encourages residents to depend on private alternatives accordingly increase fuel consumption, cost, and environmental pollution. Based on a case study of six neighborhoods that represent chronological development of neighborhood types in greater Cairo region, this research provides an understanding of how urban mobility was influenced by neighborhoods urban patterns. This research suggests that some specific neighborhood features can efficiently influence people mobility, demand and travel behavior than others, accordingly enhance achieving sustainable urban mobility and overall sustainability of development.

Keywords: Greater Cairo Region, Measuring urban form, Mode choices, Sustainable Urban Mobility, Movement Behaviour

2 INTRODUCTION

Sustainable urban mobility aims to achieve sustainability goals through movement behavior in environmental, economic and social level. Last decades, a massive scientific research worked to test the impacts of neighborhood patterns urban form on movement behavior as a way to achieve sustainability in the built environment. Different scholars concerned the role of public transportation, walking and cycling in achieving this goal, through using urban form that encourages such trends. This paper work on the way neighborhood pattern could achieve efficient public transportation and so achieve sustainable transportation and enhance built environment sustainability.

Old neighborhoods, the grid pattern, high density with crowded streets; make public transport is un-useful, undesirable, and uncomfortable for residents. So it encourages them to depend on private alternatives accordingly increase fuel consumption, cost, and environmental pollution. Modern neighborhoods with low density, separate use, large distance caused a low feasibility in public transportation so it also increases private alternatives; accordingly increase fuel consumption, cost, and environmental pollution. The overcrowded and low quality in old towns and the low feasibility in new towns are key factors for reducing the impact of on movement behavior.

Different neighborhood models can play a significant role in shaping individual travel behavior. Landuse pattern, housing income pattern, and street network pattern are factors that differentiate neighbourhood models and can affect movement behavior inside our cities. Neighborhood patterns impacts the type, quality and quantity of mobility facilities that can be used and accordingly shape residents travel choices of movement behavior (Giles-Corti et al., 2013). Mode choices depends on residents socioeconomic charachterstics like age, gender and socioeconomic level; at the same time, urban form characteristics creates conditions that can facilitate and encourge some kinds of travel behavior while discouraging other types of travel behavior. Most studies of movement behavior have focused on the impact of some neighborhood patterns like land use, housing income, and street network pattern and density.

2.1 Research Aim

Some neighborhood patterns characteristics facilitate types of travel behavior and discourage other types, whereas other charachterstics do not do so. An understanding of the reason that some neighborhoods provide more chances of pedestrian, cycle movement and public transportation and improve trips distance and frequency than others is important to improve energy saving and reduce resource depletion and reduce environment pollution. The aim of this paper is to analyses current evidence relating to the impact of urban form patterns on travel behavior patterns, based on a case study in greater Cairo region. The article examines how travel behavior was influenced by urban form in six neighborhoods; The results suggest that urban form can mediate the impacts of movment behaviour on sustainability issues.

2.2 Research Hypothis

This research suggest that neighbourhood patterns can effectively influence people's mobility demand and travel behaviour towards achieving sustainable urban mobility in Cairo. And that traditional neighborhood is pedestrian oriented that discourages motorized travel and increase non-motorized one, and could reduce trip distance and trip frequency. on the other hand modern neighborhood is car oriented that encourage motorized travel and minimize the pedestrian one.

2.3 Research Method

An inductive analysis using comparative methods is used to test and compare the relation between neighbourhood pattern and movment behaviour. The research depends on two interlocking stages. First, literature review to introduce the two variables of the research, movment behaviour and urban mobility in terms of concept, historical development, and measurable variables. In addition, to introduce sustainable urban mobility in terms of concepts, types and measurable indices. Finally, Field study for sic neighborhoods in Greater Cairo Region to test the mutual relationship between the two variables. The field study go through three steps: Measuring neighbourhood patterns, measuring movment behavior and measuring resident's perception of sustainable development indicators, and testing the validity of their relations. The research based on spatial model for measuring land-use pattern and semi structured interview for measuring resident's satisfaction to urban development.

3 URBAN FORM AND SUSTIANBLE URBAN MOBILITY

This part intends to explore the meanning and factors of movment behaviou, the paradigm shift to sustainable urban mobility, and based on previous studies to review the relation between urban form and urban mobility.

3.1 Movement Behaviour

Movment behaviour is a social behaviour of residents, like any other behaviour it is based on demand, constraints and potentialities. Movment behaviour can be defined using different travel parameters, such as (trip frequency, trip distances, mode choices of travel, or overall vehicle ki¬lometers traveled, trip rates, overall traveling distances, traveling distances by mode, modal shares, and energy con-sumption.

The variable "Modal Choices" means whether and to what degree residents, welling to use certain travel modes (private versus public), (motorized versus non motorized), (motor, walking, cycling). To what degree they feel satisfied with public transportation, private car, walkability, cycling. For what degree they depend on each travel mode during day hours, during night hours, till late night. Percentage of Each mode trip per total trips.

The variable "Public Transportation" refer to available public transportation and their sutability. Residents satisfaction with quality of public transportation, and the degree of proximity and accissibility of to public transportation, and the main reason of using or not using publc transportation (expense, availability, quality, safety, comfortability, flexibility).

The variable "Private vehcile" refere to no. of car ownership. Times of using private car per day, and the main reason of using or not using priavte car (available parking spaces, traffic jam, traffic information, safety, comfortability, flexibility, accedents risk, fuel cost due to distance and frequency, mintatnce cost).

The variable "Cycling" refere to no. of cycle ownership. Times of using cycle per day, and the main reason of using or not using cycling (available cycle lanes and their quality, traffic jam, safety, comfortability, flexibility, accedents risk, effort due to distance and frequency).

The variable "walkability" refers to times of using walkability per day, and the main reason of using or not using walkability (available walk ways and their quality, safety, comfortability, flexibility, accedents risk, effort due to distance and frequency).

The variable "Trip Frequency" includes the times residents can repeat this trip per week; it probe the degree to which resident found it easy to repeat the trip. Trip frequency in traditional neighbourhoods is limited by car due to the lacke of parking area.

The variable "Trip Distance" includes the actual network distance travelled by the residents from their own residence to various destinations. It measures residents weeling to drive long or short distances.

The Variable "Travel Obsticals" was measured whether and to what degree their is a physical and pschycological conditions that limit traveling by certain modes at certain times of the day.

The variable "Car Ownership" (vehcile ownership is high in high income neighbourhoods, and bycicle is high in traditional neighbourhoods). In traditional neighbourhoods residents can aford cars but due to the unavailability of parking area they prefere to reduce car ownership and reduce depending on them.

The variable "Parking Area Availability" include Questions regarding available public transportation and their sutability.

3.2 Sustainable Urban Mobility

UN- habitat in the global report of human settelments, reported a paradigm shift in transportation planning. It diferentiated between two paradigm shifts in movment, the first that found effeceincy in increasing traffic flow effeceincy based on the speed, affordability and convenience of motorized transport. On the contrary, current paradigm strives for sustainavbile mobility through accessibility based on minimizing the need for extended movment, Reducing the need for motorized demand, Reducing the Number of Motorized Trips, Reducing Travel Distances in Cities, and Changing the Modal Split. As cities continue to change, planners are facing the challenge of designing urban mobility systems that are sustainable on social, economic, and ecological levels.

The development of sustainable mobility starts with the organization of urban form to reduce the need for mobility, reduce travel distnaces and reduce travel frequency in the first hand, and to concern mode choices to pedisterian and public transportation and shared modes instead of private alternatives. Accordingly, better impact of urban form on movement behavior could enhance social, economic, and environmental impacts of sustainable development. Their is a growing calls for planners to make paradigm shift in mode choices to enable economic activity, social connectivity, and ecological sustainability.

This shift put fourward an interst to urban planners. To develop urban form that impact well on movement behavior and acheive sustainable urban mobility in term of social, economic, and environmental levels. Their is a growing call for planners to make paradigm shift in mode choices to enable economic activity, social connectivity, and ecological. Traditional neighbourhood by mixed use between residential units and commercial, compaction, high community size, may encourges non-motorized communiting modes and reduce travel distance and. On the contrary modern neighbourhoods by separate use, low density, low community size, may encourge the reliance on private car, increase travel distance, trip frequency, the need for motorized demand, Reducing the Number of Motorized Trips, Reducing Travel Distances in Cities, and Changing the modal Split.

Sustainable urban mobility should Enhance Movement behaviors in term of mode choices, trip distance, trip frequency and reduce pollution and traffic cognition and transportation cost including energy consumption, mintance, time and effort. It should acheive the following criteria:

- Enhance Permeability increases the property of how easy it is to move through an environment and depends heavily upon the paths and objects placed within the space. There are two types of permeability: physical properties (e.g. a path) and visual appearance. For example although a path may exist in some environment, if it is not visually obvious it may remain unused (McCal et al, 2005). It meane to avoid restrictions that distort the continuity of city urban fabric, and distort traffic

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movement, and make the residents looking for alternative roads that could be longer which reduces the movement functional efficiency. “Freezes” the urban fabric forever.

- Enhance Accessibility by providing range of choices of safe routes, and removing barriers for movement to accessibility of residents to services, facilities, and urban spaces, reducing the degree to which "ability to access" and possible benefit of services, amenities and urban environment is accessible by as many people as possible. Hence it affects the urban, economic and social mutual and exchange benefit of the community in this urban fabric.
- Enhance Connectivity and Integration through promoting external dependency to connect people with each other and to facilities with a range of choices of save routes.
- Encourge Movment Behavior by reducing travel distances, travel frequency, and accordingly avoids travel time and cost and reduce traffic volumes. In addition don't isolate people without vehicles, create efficient “day” and¬¬¬ “night” districts (Masnavi, 2000).
- Encourge Alternative movement systems by increasing the degree that urban form could encourage potential for alternative movment options (pedestrian, cycling, public transport) and discourge car dependency and improve pedestrian oriented public realm. In addition, it refers to transit, pedestrian, and bicycle systems should maximize access and mobility. It refers to a framework of streets and urban spaces to be easy, safe, and pleasure (Urbed 1997).
- Improve public transportation: Refer to critical mass of activity and sufficient densities, and micro and macro connected street network (Frey 1999, Newton 2000, Buxton 2000). The public modes proved to achieve maximum sustainability in saving fuel consumption, and co2 pollution reduction. Metro, bus, minibus, tram are alternative public transportation options that move large no. of people in one trip, otherwise each of them would have his own car, and accordingly it will be replaced with a large no. of private cars that could consume more fuel consumption and increase co2 emission and accordingly environmental pollution. This research work on linking the relation between public transportation and neighborhood pattern. To how extent the neighborhood pattern can affect the efficiency of sustainable public transportation.
- Encourage walkability: Refer to ensuring that most people's needs are within walking distance, and providing an environment which is safe and pleasant for pedestrians.

3.3 The Impacts of Neighbourhood Patterns on Movement Behaviour

The Correlation between urban form and movment behaviour has found in numerous studies. Some scholars found that urban form could facilitateate movement behavior using different factors including density (Cervero, 1996), better street connectivity (Boarnet and Crane, 2001), and the presence of mixed land uses (Cervero, 1996; Moudon et al., 1997; Saelens et al., 2003). A current debate exists between scholars for the role of modern versus traditional patterns in their impacts on acheiving sustaiable urban mobility. The paper rests on four charachterstics of neighbourhood to test their impact on residents movement behaviour. They have a continuing effect on transport demand, in terms of the number of trips, mode choice and trip lengths.

3.3.1 Regarding Density:

Scholars consider desnity as the main factor that could impact movment behaviour. They found a relative dependancy on private car in low density communities compaired to high density communities. They put four reasons how density impacts travel patterns (Banister, 2005, p:106). They found high population densities widen the range of opportunities for the development of local personal contacts and activities, and services that can be maintained without resort to motorized travel, and reduce avarage distances between homes and services, reducing the need to travel and reduce travel distance. In addition high densities may be more amenable to public transport operation and use and less amenable to car ownership and use which have implications for modal choice. On the other hand, low density could impact modal choices, since residents's forced to cut long distance trips, they mostly depend on motorized mode choices. The public motorized modes are unpractical in case of low densities and low community size, so residents's mostly depend on private motorized mode choices. In addition, density could impact trip frequency.

3.3.2 Regarding Socio-economic Level.

Scholars argued that socioeconomic patterns could be more significant in their impacts on movment behaviour, communitng behaviour among various income groups, income status is highly associated with certain commuting patterns. High income residents mostly depend on private cars and neglect the public aternatives, they also depend on long distance trips with high frequency with private cars (Hanson,1982). The higher the residents income, the more likely to choose faster and more comfortable and more flixble modes.

3.3.3 Regarding Street Network Pattern:

Some street layouts can be more environmentally sustainable to travel patterns than others. Street network pattern can impact the visibility of achieving public transportation. Grid pattern can increase the intersections and so increase the alternative ways so increase. Not only regarding conditions of individual streets, ranging from the dimensions and design of sidewalks to the prevailing levels of environmental comfort that may encourage pedestrian movement (Gehl et al., 2006), but also the structure of street networks and street connectivity that encourage such behavior.

Figure 1: Street network patterns

Grid-like patterns have high intersection and access points that provide greater connectivity and permeability and promotes short and direct routes that offers shorter trips and reduces travel distance, It provide different pass alternatives and chances. It highly encourages public transportation as it allows more direct access to public transport. It can be more transit friendly to the extent that they may allow greater penetration of an area by transit services. It is expected to enhance walkability, and increase trips frequency by foot and reduce trip frequency by private cars especially with low parking area.But at the same time it could facilitate private car trips. On the other hand, tree like patterns have very low noumber of intersections and access points that reduces permiability, connectivity and accessibility, it promotes very long distances and increases travel distance, and reduce alternatives public transportation options. It is expected to increase private car dependancy, high frequent trips by cars.

3.3.4 Regarding landuse pattern

Moving from mixed to separate landuse probably impact nonwork - travel behaviour regarding modechoices, trip distance, trip time and and frequency. Landuse pattern affect the relation between residential and commercial uses, it could cause a separation between residents and services, accordingly impacts travel demand. Schoolars found mixed use is determenant for travel behaviour and mobility. It could make mode choices depend on walkability than on cars. In addition it reduce avarage trip distance by cars, and the frequency of their use. On the other hand it could increae less energy intensive comuting modes, namely walking and cycling. It impacts its trip frequency and donot affect trip distances.

The literature defined the favorable neighbourhood configuration to achieve sustainable urban mobility. Some of them are contradictory between studies according to difference contexts, this paves the way to test such hypotheses in local context. These litrature will form guidline to assess the selection of neighbourhood in Cairo, Egypt.

4 THE CASE STUDY OF SIX NEIGHBORHOODS IN CAIRO

The objective of this research is to trace any statistical significant differences in responses to resident's movment behaviour across different categories of neighborhoods, starting from the traditional, to the sprawled contemporary. Shoubra and Abasia represent early developed urban growth, Masr Elgdida and Nasr City represent early planned urban growth, and 1st district, and Jasmin in new cairo represent new planned growth. They represent three different chronological ages of cairo development ranging from

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traditional, mixed-use, pedestrian-oriented neighborhood to the contemporary, separate use, car-oriented neighborhood.

4.1 Selection of Case Studies

Six neighborhoods were selected to present different categories of physical and social attributes, as shown in Figure 2. They should be developed as public property, not a private. They should satisfy variables incorporated within the study regarding configuration difference in urban form including the historical development, street network patterns, land-use pattern, housing patterns, population demographics and household characteristics ranging between traditional and contemporary.

Early Developed	Early planned	New Planned
1) Shoubra 1850 (Early planned)	3) Masr EL-gdida 1900	5) 1st district 1985 (New Cairo)
2) Abasia 1850 (Early planned)	4) Nasr City 1960	6) Jasmin 2000 (New Cairo)

Figure 2: Case Study Selection (Greater Cairo Region)

Figure 3: different spatial configuration in cairo development stages NUCA 2008

Cairo urban form revealed deferent typologies of adopted urban development patterns that are different in density, land-use pattern, housing income pattern, and street network pattern. Four typologies of urban form are traced starting from Fatimid old Cairo. Followed by early developed districts that informally grow over green land and adjacent to the planned settlements, like Shoubra, Abassia, Sharabia and others. Followed by early planned by private developers in end of18th and the early 19th century like Khedewi Cairo, Maadi, EL Muhandssin, and Heliopolis and early planned by government like Nasr city. Finally, the latest modern new planed Egyptian settlements surrounding Cairo like new Cairo, Shorouk and El Obour to the east and six October and Sheikh Zayd to the west.

The Fatimic traditional urban form will be excluded from the analysis due to deep socio-economic changes take that place along 1500 year from the establishment to now; and due to unconsiderable design trend for considerig automobile as it was not a exist mobility solution. Accordingly the research will depend on three typologies the early developed, the early planned, and the new planned. In most of the following analysis, the neighborhood arranged according to such categorization to present the movment behaviour moving between these categorize. Six neighbourhood are selected to present different chronological patterns in cairo development.

- Early developed: Abasia and Shoubra are selected to present the early developed neighbourhoods.

- Early planned: Masr EL-Gdida and Nasr City are selected to present the early planed neighbourhoods.
- New planned: 1st district and Jasmin are selected to present the new planed neighbourhoods.

4.2 Data collection and classification:

The purpose is to measure the impact of neighborhoods urban form on resident's movment behaviour and accordingly on sustainable urban mobility. Two forms of data collection were used – the first to measure urban form patterns, and the other to measure resident's movment behaviour in their neighborhood in term of behaviour and satisfaction. Finally, the correlation between both is measured.

4.3 Measurements of Neighborhood urban configuration patterns:

Urban form data were collected using surveying maps, observation, satalite maps, photographic images to document and explore neighbourhoods urban configuration patterns including land-use pattern, housing income pattern, and street network pattern including density.

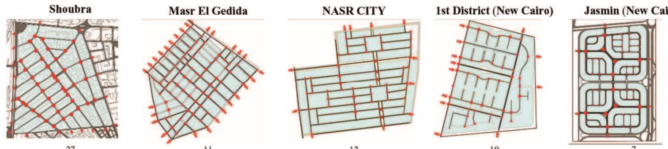
(1) Street network pattern can be classified under three categorize between the grid to the herarchial as (grid, loop, and cul-de-sac) patterns. Their spatial structure can be classified under heading of type of street, linear meter of streets, No. of blocks, Intersections density, No. of access point, No. of cul-de-sacs, percentage of streets area per community area, and the no. of continous routes (Ghonimi 2014).

(2) Land use pattern can be classified under heading of landuse type, variation and density. They can be measured using the length in meter of (dividing vs. connecting) line between different land-use represents the degree of landuse mix vs. separation (Ghonimi et.al, 2011).

(3) Housing pattern can be classified under heading of housing type, variation and density; They can be measured using the length in meter of (dividing vs. connecting) line between different housing types represents the degree of housing exclusion vs. segregation (Ghonimi et.al, 2010).

(4) Community density range between low density (60 -150 Person/Fedan), Middle density (300 -600 Person/Fedan) and High Density (800-1500 Person/Fedan). Also community size is measured and ranged between small, medium and large community size.

The urban form analysis results, for each case study, are gathered, measured and scored in Table 2. It is categorized starting from the traditional type ending with the modern type. The traditional pattern is higher in percentage than the modern pattern.



		(Early Development)		(Early Development)		(New Planned)	
		Abasia	Shoubra	Masr El Gedida	NASR CITY	1st District (New Cairo)	Jasmin (New Cairo)
	Entrances	27	27	11	12	10	7
	Intersections	85	85	46	49	39	18
	Length	12344.9434	12344.9434	11467.1854	57610.8395	13623.6725	8070.7919
	Street network	Grid outward oriented	Grid outward oriented	Treed inward oriented	Treed inward oriented	Treed inward oriented	Treed inward oriented
	No. of intersections	High	High	Mid	Low	Low	Low
Street Pattern	L. of grid	16166.5529	16166.5529	14736.7059	58309.2754	613.5728	
		Low	Low	Mid	High	High	High
	L. of loops					1878.2703	6958.8716
		Low	Low	Mid	High	High	High
	L. of cul-de-sacs					7739.3594	
		Low	Low	Mid	High	High	High
	No. of blocks						
		High	High	Mid	Low	Low	Low
	Street network No. of intersections	(A): Connected fine grained public urban form Transit oriented Development Fine grained with high no. Of intersections, egrees points, and street length.	(A): Connected fine grained public urban form Transit oriented Development Fine grained with high no. Of intersections, egrees points, and street length.	(B): Connected fine grained public urban form Transit oriented Development Fine grained street network	(B): Connected fine grained public urban form Transit oriented Development Fine grained street network	(C): Connected fine grained public urban form Treed inward oriented Super block with high intersection density, egrees points, and street length.	(C): Divided Super block public urban form Treed inward oriented Super block with high intersection density, egrees points, and street length.
Land use Pattrn	Type	Diverse - Residential, Commercial, and crafts	Diverse - Residential, Commercial, and crafts	Mixed – Residential and Commercial	Mixed – Residential and Commercial	Single -Residential	Single - Residential
	Density	High	High	Mid	Mid	Low	Low
	Mix	7091	6543	3951	2627	561	250
		Highly mixed	Highly mixed	Mixed	Mixed	Separate	Separate
Housing Pattrn	Type	Low, Mid and High income	Low, Mid and High income	Mid and High income	Mid and High income	High Income	High Income
	Density	High	High	Mid	Mid	Low	Low
	Mix	Mixed	Mixed	Moderate	Moderate	Separate	Separate

Table 1: Main Socio-Spatial Characteristics of Case Study Areas.

4.4 Measurements of sustainabilty of Movment behaviour:

Two forms of data collection, the first objective quantitiative data concerns resident's movment pattern and behaviour. The second is subjective qualitative data concerns resident's satisfaction to movment.

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4.4.1 Measuring urban mobility in term of Bahaviour:

The study of movment behaviour is based on a questionnaire administered to district residents. The questionnaire was designed to explore the influence of urban form to residents' movement behavior. Sample selection and characteristics depends on 40 residents per each neighborhood with total 240 questionnaires. They are randomly selected in each case study area, to represent different socio-economic characteristics age, gender, education, income level and to measure key factors of travel behavior indicators (Table 2):

The variable "Sustainable Mode Choices Measure": Questions regarding modal choices of certain travel modes (private versus public) (motor, walking, cycling). And Percentage of each mode trip per total trips. The larger percentage depending on public transportation and walkability will be more sustainable.

The variable "Sustainable Trip Distance Measure": Questions regarding avarage travel distance per week for differen uses including work, shop, school, collge, health facilities, restaurant, garden, the smaller distance will be more sustainable.

The variable "Sustainable Trip Frequency Measure": Question regarding no. of trips per week using each mode choice trips, the lower frequent trips by cars will be more sustainable; in addition the high frequent trips by public transportation and cycling, and walkability will be more sustainable.

A five points Likert scale (1 to 5) were used to compute each indicator score from the household survey and the average scores have been converted into percentage scale. These dependent variables were measured as described in the following paragraphs:

Movment Behaviour Assesment Factors		NH1	NH2	NH3	NH4	NH5	NH6
Car Ownership		0-1	0-1	1	2	2-3	3-4
Public Transportation		80%	80%	60%	40%	20%	10%
Parking Area		20%	20%	40%	60%	80%	80%
Mode Choices	Private car	20%	20%	30%	40%	60%	80%
	Public transportation	40%	40%	40%	30%	20%	10%
	Walkability	40%	40%	30%	30%	20%	10%
Sustainabile mode choice index		80%	80%	70%	60%	40%	20%
Trip Frequency	Private car	10%	10%	30	50	70	80%
	Public transportation	20%	20%	30	30	20	10%
	Walkability	70%	70%	40	20	10%	10%
Sustainabile low Trip frequency index		80%	80%	70%	50%	30%	20%
Trip Distance	Private car	20%	20%	30	50	70	80%
	Public transportation	20%	20%	20	30	20	10%
	Walkability	60%	60%	40	20	10%	10%
Sustainable low trip distance index		80%	80%	60%	60%	30%	20%
Sum Percentage		80%	80%	65%	60%	35%	20%

Table 2: Measured Neighborhood Urban Mobility in term of Behaviour (in percentage).

4.4.2 Measurements of urban mobility in Term of Satisfaction:

Satisfaction is measured using 5 Lkirte scale is to measure resident's attitude and preferences of their neighbourhood. Questions first explore resident's socio-economic characteristics then it investigates their satisfaction to movment including: Functional aspects (parking space, crowding, delay, travel accessibility; services accessibility), Social aspects (safety, attractiveness, interaction) Environmental aspects (air polution, noise polution, resource consumtion and traffic cognition), Economic aspects (commuting cost, mentance).

Movment Satisfaction Assesment factors		NH1	NH2	NH3	NH4	NH5	NH6
Functional	Accessibility	80	80	60	50	30	20
	Walkability	80	80	60	40	20	10
	Delay	20	20	30	50	40	20
	Crowdness	70	70	50	30	20	30
	Parking requirments	10	10	20	50	40	30
Social	Safety	30	30	40	50	40	30
	Attractivness	20	20	30	40	60	70
	Interaction	70	70	50	30	20	10
Environmental	Air pollution	70	70	50	30	20	10
	Noise polution	70	70	50	30	20	10
	Resource consumption	20	20	30	40	60	70
	Traffic Cognition	70	70	50	30	20	30
Economic	Comuting Cost	20	20	30	40	60	70
	Mentanance Cost	20	20	30	40	60	70
Sum Percentage							

Table (3): Measured Neighborhood Urban mobility in term of resident's satisfaction (in percentage).

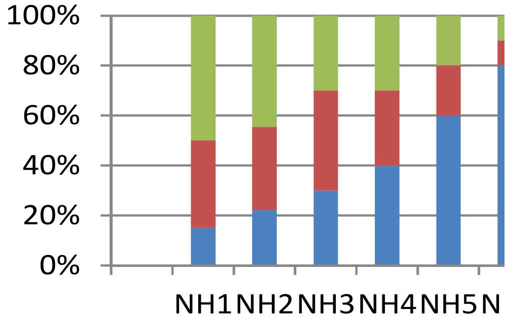
5 CONCLUSION AND DISCUSSION

This part aims to discuss two interloking issues, the first regaring the relation between neighbourhood model and urban mobility in term of behaviour including mode choices, travel distance, travel frequency, trip lengths to different destinations and to define how it varies across the neighbourhood categories. The second regaring the relation between urban charachterstics and urban mobility in term of behaviour and satisfaction.

5.1 Sustainability Mobility Measure in Term of Behaviour

5.1.1 Mode Choices:

Figure (3) compaires different mode choics in the six case studies, it illustrates that traditional one recorded mostly non-motorized, and public modes and reduce reliance on private cars, this in comparison to modern neighbourhoods, that recorded private car dependancy and reject public transportation. High walkability is noted in traditional neighbourhoods where high mixed use and high density. People donot prefere to walk in contemporary neighbourhood due to great long distance trips. Public transportation does not depend on neighbourhood type. car trips are noted in modern car oriented neighbourhoods.



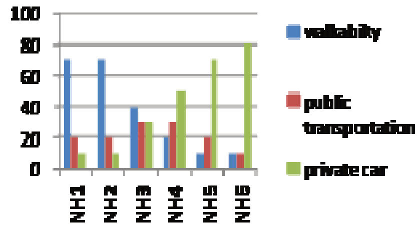


Figure 3: Mode Choices in Percenage. Figure 4: Trip Frequency (in percenage)

Private Car:

In traditional neighbourhoods, residents depend on public transportation due to their low cost, accessibility to their home; they will not take time, effort to get home from bus station, on the other hand other residents found it dirty, not comfortable, noisy, and crouded. On the other hand, modern neighbourhood, public transportation revaled that it do not fit to their needs, it is not flixble for their daily trips, they refuse to cut very long distance and consume time and effort from bus station to get their destiation in long distance, unsafe and environmentaly uncomfortable context; they found private car would be more flixble for them.

Public transportation:

Traditional neighbourhoods, associated with high dependency on public transportation due to their low cost, accessibility to their home; they will not take time or effort to get home from bus station. But some consider it as not welcomed due to it is dirty, uncomfortable, noisy, and crouded. On the other hand, modern neighbourhood associated with low dependency on public transportation, it do not fit to their needs, it is not flixble, they will cut very long distance and consume time and effort from bus station to get their distiation due to long distance and unsafe and environmentaly uncomfortable context. Private car would be more flixble and save for them.

Walkability:

Traditional neighbourhoods associated with public transportation and walkability. This is due to the short distance trips in livable, safe and attractive streets residensts need to walk in areas where residential parking is limited to retain their parking space. Residents seek to reduce the number of journeys and hence the number of times they have to search for a parking space on their return home. On the contrary, modern neighbourhoods associated with low walkability, due to the long distance trips and unsafe and unattractive streets make them depend mainly on private automobile alternative.

It is noted that traditional urban form makes useing motorized modes more difficult compaired to non-motorized modes such as walking and cycling that are easier in traditional communities on the other hand

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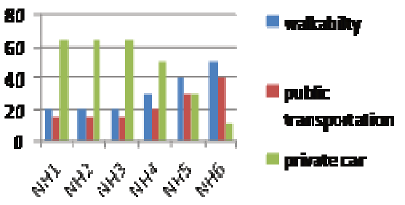
modern urban form tends to increase private motor vehicle use because it can provides travel options of a range of household activities.

5.1.2 Trip frequency:

Figure (4) Traditional neighbourhoods associated with high pedestrian frequent trips. Due to the short distance trips with safety. On the other hand it is associated low car frequent trips and hence the number of times they have to search for a parking space on their return home. Difficulties in finding a parking space may not necessarily deter car ownership or intentions to acquire additional vehicles even with increasing parking problems. On the contrary, modern neighbourhoods are associated with low frequent private car trips; residents try to avoid long trips with great effort and cost.

5.1.3 Trip distance:

Figure (5) Modern neighbourhoods are associated with high travel distances, residents are forced to cut long distance due to the low densities and small community sizes that lake to provide residents with suffeceint range of services and facilities, accordingly impacts residents's travel needs they are forced to cut longer distances to have required facilities and services.



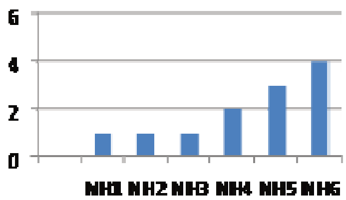
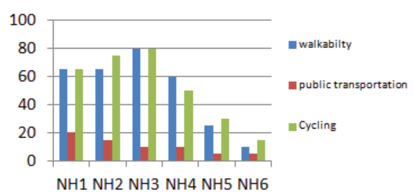
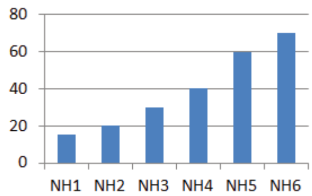
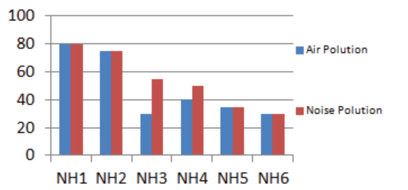
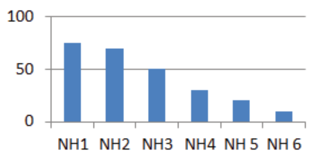


Figure 5: Trip Distance (in percenage). Figure 6 : Car Ownership (in percenage)









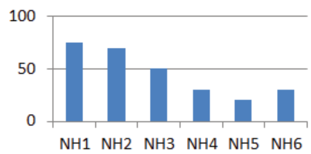


Figure 7: Modes Attractivness (in percenage). Figure 8: Travel Cost (in percenage). Figure 9 : Environment Polution (in percenage). Figure 10: Social Interaction (in percenage). Figure 11: Traffic Cognition (in percenage)

It is noted that traditional urban form redusces trip frequency and trip distance for private cars compaired to trip distance and frequency done by walking and cycling that are higher in traditional communities. On the other hand, modern urban form tends to increase trip distance using private car public transportation, and walkability; on the same time, it noted to reduce travel frequency for using private car public transportation, and walkability because it reduce residents willing to move due to the long distance trips that are associiated with cost and time, it may impact social engagement and interaction, an impacts residents health.

5.1.4 Private Car Ownership:

Figure (6) Modern neighbourhood associated with high rates of car ownership ranges between two to three car lot per family, compaired to traditional cities that revealed lower value of car ownership. Residents found their car very essintial for living, As stated by on of the residents. Accordingly they require large no. of parking lots, accordingly cause low effeceincy in meeting residents huge demand of car parking.

5.2 Sustainability Mobility Measure in Term of Satisfaction

perception measurement in reference to different parameters, socially (Safety, Attractivness, Social interaction, Accessibility, crowding, delay). Environmentaly (Air polution, noise polution, resource consumtion and traffic cognition), Economic (commuting cost, mentance cost,...).

5.2.1 Attractivness of mode choices:

Figure (7) all neighbourhoods are recorded lower attractivness for public transportation. Resident's starts to think twice to move to public transportation options. They only need to have good quality public transportation, to effectively discourage use of private cars and encouraged to public transportation. On the other hand walkability and cycling recorded lower attractiveness in modern neighbourhoods, residents found neighbourhoods unsafe for walkability. On the other hand it records highr values in Masr El-Gdida and Nasr City.

5.2.2 Travel Cost:

Figure (8) Modern neighbourhood is associated with high comute cost due to long distance that discourge walkability and increase dependency on private car with high frequent trips that consume more travel time, effort, and fuel consumpption cost to reach services in adition to cost of car mintance. Traditional neighbourhoods are associated with lower comuting cost, service in proximity to residents, they can walk, use public transportation, to get services. They donot have to use private car for every trip .

5.2.3 Environmental Polution:

Figure (9) Modern neighbourhood is associated with lower noise and air polution, due to low traffic density caused by low frequent trips with large green areas. On the contrary traditional neighbourhood associated with high noise and air polution due to the high traffic density caused by high frequent trips and high trafic jams, with minimum green area.

5.2.4 Social Interaction:

Figure (10) Modern neighbourhood is associated with lower social interaction, due to the long distances and low frequent trips using all travel modes, residents are not willing to move, to avoid travel cost, effort and waste time. They become unsocialized to meet thesir freind and neighbours. On the other hand traditional neighbourhood associated high social interaction.

5.2.5 Traffic Cognition:

Figure (11) Traditional neighbourhood is associated with high traffic cognition, it also associated with low parking requirments. Also traditional neighbourhood associated with high traffic cognition at main streets and high traffic cognition at peak hours greater than traffic cognition that take place in old traditional neighbourhoods.

Traditional communtities with high density and mixed housing types were livable communities encourge walking and biking. Communities where the users finds all services especialy daily one with walkable distance where more secure, livabile and attractive to residents to make all travel to be more depending on alternative transportation options, public transport, walkability, and biking; and discourge private cars.

On the contrary, modern neighbourhood isolate its residents away from everything, to go anywhere one must leaf the community and go on arterial road its boundaries just a wall, which pedestrian walks are long, inconvenient and unsafe, so residents should have their cars for any daily needs increasing car dependency, and generate traffic cognition in the outer city that should increase noise and air pollution and accordingly reduce sustainability. All these characteristics affected the movement behaviour that become less depending on alternative transportation options, public transport, walkability, and biking; versus encouraging private cars dependency.

In modern neighbourhood, Walking or biking has become a main problem, daily needs are out of walking distance, to walk from a point to another it talks to longer pathes which consumes more distance and time. Even all passes turned into artaeil roads its boundaries donont have any use, only some fences which increae street. it is unsafe, unpleasent environment, and just walls. it encourge criminality and reduce sense of safety, In additions there is no motivations inside these streets to encourage walkabilbility, so make its residents depend mainly on private car as a primary mode of transportation.

Public transportation has become unpractical movement solution. Public transportation need connected permeable street network, and need accessibility to bus stop, which is not acceptable, hence public transportation is not a practical transportation option. Private car has become the available way for movement inside the city. unpracticality of alternative transportation options make private car becomes the only available choice for residents. No walking, biking or public or any alternative transportation options, Only private car. To go anywhere one must leaf and get out the gate and go on collector roads its boundaries become just a wall, where pedestrian walks, cycling are long, inconvenient and unsafe, and where public transportation, inconvenient, in visible.

Therefore, residents should depend on their private cars for all daily life needs, increasing car dependency. Even they use inside the or outside the community in the city streets or even on the regional roads that are connecting the city with Cairo. The approval for road closures in many cases depends on the nature of the roads, as well as the road layout. The closure of major through routes is not allowed. Bearing this in mind, it is usually neighborhoods designed on a closed road network system that are likely to be granted approval, since these have a limited number of traffic intersections (therefore less roads to close). Which affect pattern of movement (land man, 2002:9).

Traffic cognition has existed on city scale and regional roads that connect new towns to Cairo; it was a result of two reasons. The first is due to restricting public transportation and centering movement on private cars, make traffic volume increase especially in the major arterial roads networks. The second, as more residential roads are withdrawn from public use, the cars movement in the city are restricted and diverted to alternative adjacent roads, which are subjected to increased traffic volumes, that they are not originally designed for. This could affect the functional efficiency of local, regional street networks. Commuting cost was a result of two factors, the first due to increased car dependency and the other due to longer distances and increased travel time journeys that required to go anywhere. This could increase of commuting time and fuel cost for residents, visitors and other road users.

6 THE RELATION BETWEEN URBAN FORM AND SUSTAINABLE MOBILITY:

Deducing the correlation between uran form patterns in one hand and sustainable mobility represented in movment behaviour and movment satisfaction in the other hand.

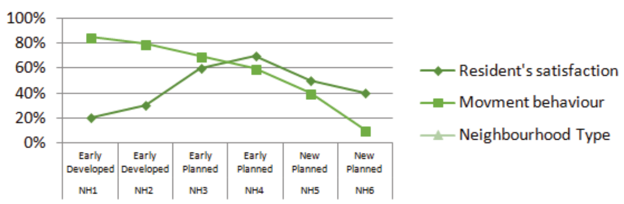


Figure (12): the relation between urban mobility on sustainability and satisfaction level.

Moving between different neighbourhood models, starting from traditional to modern one, reveals a negative relation between movment in behaviour level and movment in satisfaction level. It is clear that traditional neighbourhoods records high value of sustainable mobility on behaviour level, and lower level on satisfaction level. on the contray, modern neighbourhoods records loer sustainable mobility value in behaviour level and records midium value on satisfaction level. A moderate neighbourhood types will acheive obtimum sustainable mobility in term of both behaviour and satisfaction level.

6.1 The relation between Crime Prevention measure and Density pattern:

Figure (13) reveals that sustainable movment behaviour is acheived with moving from low density to high density community. This can be explained because increasing density causes a relevant increase in community size accoridngly widen the range of opportunities contacts, activities and services that can be supported in neighbourhood, and reduce average distances between homes and services. Accordingly reduce the need for long distances trips, frequency and concern public and walkability and increase sustainable urban mobility. Density is inversly proportional with trip distance, private car ownership, comuting cost. Increasing density reduces trip distance and trip frequency by car and increase trip frequency by walkability, and reducing density increase trip distance.

On the other hand both high and low density community is associated with low satisfaction level, the first cause high traffic, croudness, delay, cognition, air and noise polution and unattractivness for public transportation and the second records high commuting cost and traffic cognition on arterial roads.

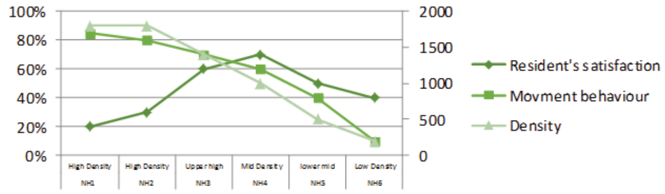


Figure 13: Relation between density and movment behaviour.

6.2 The relation between movment behaviour measure and streetnetwork pattern:

Figure (14) reveals that sustainable movment behaviour increases with moving from herarchial network to grid network. This can be explained because increasing access points and intersections density create fine graind spatial fabric that provide greater connectivity, permiability and accessbility connectivity and promotes short and direct routes that offers shorter trips and reduces travel distance, It provide different pass alternatives and chances. It highly encourages public transportation as it allows more direct access to public transport. It can be more transit friendly to the extent that they may allow greater penetration of an area by transit services. It is recorded to enhance walkability, and increase trips frequency by foot and reduce trip frequency by private cars especially with low parking area, accordingly increase sustainable urban mobility.

On the other hand, both extremely grid and herarchial street pattern is associated with low satisfaction level, the first increases the flow of private car and accordingly reduce safety and security of nodes and increase accedents, through traffic, and traffic jams and the second records high commuting cost due to the complete dpendency on private cars and lake of any other alternative.

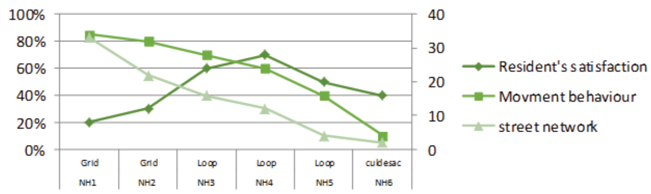


Figure 14: Relation between street network pattern and movment behaviour.

6.3 The relation between movment behaviour measure and landuse pattern:

Figure (15) reveals that sustainable movment behaviour increases with moving from separate to mixed landuse. This can be explored because it could cause a separation between residents and services, accordingly impacts their travel demand. Mixed use make neighbourhood more secure, livabile and attractive for residents to use all mode choices walkability and cycling than private cars. In addition it recorded low avarage trip distance by cars, with low trip frequency. On ther hand, it recorded less energy intensive namely walking and cycling. It impacts its trip frequency and donot affect trip distances. Accordingly increase sustainable urban mobility. On the other hand, urban mobility in term of satisfaction records lower values in both extremely mixed and extremely separate use, the first cause high traffic cognition, crowdness, and donot provide suffeceint parking areas, at the same time streets are full of strangers that make it unsafe for walkability and crouded, noisy, and recorded high cognition. The second cause reduces the existence of unknown persons and avoid shareing parking of residential area with non-residental users.

6.4 The relation between urban mobility and housing-income pattern:

Figure (16) reveals that moving from separate housing income to mixed housing income increase sustainable movment behaviour. This can be explored because it cause diversity of transportation options that meet

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different levels. Taken in mind the basic fact that, different mixed housing types generate different kinds and amounts of mobility standards. On the other hand lack of diversity reduces transportation standards, and reduces the diversity and choices of allowed transportation options. Accordingly reduce sustainable urban mobility. On the contrary, urban mobility in term of satisfaction revealed lower values in both extremely mixed income and extremely separate income. Both reduce the possibility of alternative travel choices to meet different income levels.

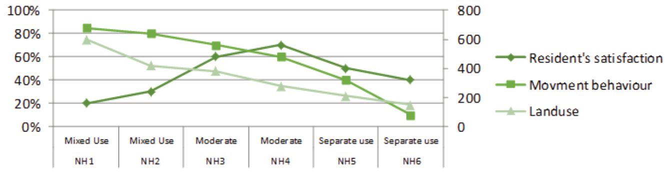

Figure 15: Relation between landuse pattern and movment behaviour.

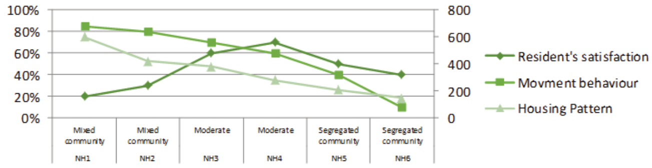

Figure 16: Relation between landuse pattern and movment behaviour.

7 CONCLUSION AND RECOMMENDATIONS:

This research suggest that the way we design our neighborhoods affects our movment behaviour and thus affects acheiving sustainability. This study gives evidence of the relation between travel behaviour and different urban forms to try and identify the current drivers of travel behaviour. It is hoped that this provides an understanding how to make future developments be more sustainable and be more low carbon-based in their transport activities. The results indicates three conclusions:

The first indicate that resedints movment behaviour does not coincide with their movment satisfaction.

The second that traditional neighbourhoods recorded lower value in carownership, trip distances, trip frequency by car, Its modal choice based on public transportation and walkability, high trip frequency by pedisterian, lower trip frequency by private car. Accordingly lower travel expenses. It recorded highest sustainability with lower satisfaction level for movment behaviour.

The third that Modern neighbourhoods recorded high value of carownership, modal choices by private car, with minimum share, high trip frequency, and distances by cars, lower public transportation and private car dependency. Accordingly, It causes high travel cost and consumption of resources. It recorded lower sustainability with high satisfaction level.

The fourth that moderate neighbourhoods like masr El-Gdida and nasr city, recorded moderst sustainability with moderst satisfaction level. The research found that traditional neighbourhood are sustainable in term of movment behaviour that depend on short trips, modechoices that encourge walkability and discourge private car, and low private car frequent trips. On the other hand they are not prefered in satisfaction level due to the high traffic cognition, noise and polution, and delay. on the contrary modern neighbourhood proved to be unsustainable in term of movment behaviour it consume more trip distance and more time and cost to get services, with complete dependency on private car; but they are unprefered in satisfaction level for residents due to different externalities, such as trafic cognition, high polution.

Accordingly planners and urban designers are recommends to take in their consideration the impacts of physical characteristics on movment behaviour and movment satisfaction.

(1) Good design should in one hand facilitate public modes and walkability to increase sustainability on the other hand should give resident's participation a great role in urban design, to found what is suitable for their movment satisfaction.

(2) Both high and low density could reduce sustainability. The first increase community size to an extent that facilitate sustainable mobility at bahaviour level but reduces comunity sustainble mobility at perception level it increase croudness, delay, cognition, air and noise polution. And the second reduce community size to an extent that reduce sustainable mobility by restricting travel modes to private motorized and increase trip

distance. A moderate community density and size values proved to be efficient to enhance movment behaviour and satisfaction.

(3) Both high mixed and high separate use community reduce sustainability. The first in one hand increas travel behaviour with reducing travel distance, private modes, and reduce trip frequencies by private car. On the other hand it reduces movment satisfaction, resdients donot find suffeceint parking areas, at the same time streets are full of strangers that make it unsafe for walkability and crouded, noisy, and recorded high cognition. The second in one hand reduce sustainable movment behaviour by increaseing travel demand and increase private mode and trip distance; on the other hand, it increase satisfaction level by reducing the existence of unknown persons and avoid shareing parking of residential area with non-residental users. A moderate community landuse mix could be sustainable on movment behaviour and satisfaction level.

(4) Both high income and low income residents could reduce travel behaviour and satisfaction. The first Reduce diversity of transportation options that meet different income levels. The second enables residents to interact with different social groups and encourage sense of trust and sense of connection between them. A moderate mix is recommended.

(5) Both grid and herarcial street network pattern could acheive sustainable mobility. The first increases permiability, connectivieity and accissibility that makes better behaviour of reducing trip distance, trip frequency by private car, and orint mode choices to discourge private car and encourge walkability; on the other hand it reduce resident movment satisfaction by increaseing flow of private car and accordingly reduce safety and increease traffic cognition. The second reduces permiability and increase trip distances that make residents seek private solution and discourge walkability on the other hand residents are satisfied with low carbon emmesion. A moderate value is recomended.

A further research with more case studies needs to be carried out to obtain clear conclusions of the relationship between movment behaviour and satisfaction and neighborhood patterns.

8 REFERENCES

Banister, D. (2005) Unsustainable Transport: City transport in the new century. Abingdon, Oxfordshire, Routledge Taylor & Francis Group.

Boarnet, M.G.; Crane, R. (2001) Travel by Design; the influence of urban form on travel. New York, Oxford University Press.

Stead, D. (2001) Relationships between land use, socio-economic factors, and travel patterns. Environment and Planning B: Planning and Design 28: 499-528.

Cervero, R. (2002) Built environments and mode choice: toward a normative framework. Transportation Research Part D 7: 265-284.

Cervero, R.; Kockelman., K. (1997) Travel Demand and the 3Ds: Density, Diversity, and Design. Transportation Research Part D 2(3): 199-219.

Buliung, R. N., & Kanaroglou, P. S. (2006). Urban form and household activity-travel behavior. Growth and Change, 37, 172–199.

Cervero, R., & Day, J. (2008). Residential relocation and commuting behavior in Shanghai, China: The case for transit oriented development (Working Paper UCB-ITS-VWP-2008-4). Berkeley, CA: UC Berkeley Center for Future Urban Transport.

Coaffee, J., & Rogers, P. (2008). Rebordering the city for new security challenges: From counterterrorism to community resilience. Space and Polity, 12, 101–118.

Gigerenzer, G. (2006). Out of the frying pan into the fire: Behavioral reactions to terrorist attacks. Risk Analysis, 26, 347–351.

Glaeser, E. L., & Shapiro, J. M. (2002). Cities and warfare: The impact of terrorism on urban form. Journal of Urban Economics, 51, 205–224.

Graham, S. (2008). Cities, war, and terrorism: Towards an urban geopolitics. Oxford: Wiley-Blackwell.

Huddy, L., Feldman, S., Capelos, T., & Provost, C. (2002). The consequences of terrorism: Disentangling the effects of personal and national threat. Political Psychology, 23, 485–509.

Pan, H., et al. (2009). Influence of urban form on travel behaviour in four neighbourhoods of Shanghai. Urban Studies, 46, 275–294.

Ruby, C. L. (2002). The definition of terrorism. Analyses of Social Issues and Public Policy, 2, 9–14.

Savitch, H. V. (2008). Cities in a time of terror: Space, territory, and local resilience. Armonk, NY: ME Sharpe Incorporated.

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reviewed paper

Tehran's Mobility Pathology: An Urban Transportation View

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1 ABSTRACT

Tehran city grows as a metropolitan, but unfortunately not well- planned and even unplanned and haphazardly; as frequently migration to the city causes congestion, lack of accessibility, huge densities, harmful air pollution and mobility difficulties. A part of mobility and transportation problems in Tehran is rooted in numerous inappropriate urban design and urban planning actions and measures. For example, the sidewalk pavements and their design are not safe and suitable, pedestrian ways are not well defined and are confronting with offenses by the vehicles and motor cycles, small metal bridges on the streets water drainage canals (Joobs) are not standard, specifically for disabled and adolescences and children; many of the street and alley curbs are uneven and causes obstacles for passing ; traffic lights situation aren't appropriate and in some places are unnecessary installed and causes mobility to be halted .Therefore problems such as terrible traffic jams, unnecessary waiting time behind traffic lights, traffic nodes, lack of walkability, Cycling, and even mobility difficulties for disabled and pedestrian with special needs and even without disability people could be seen.

Therefore this paper aim to explain clearly these deficiencies and their likely reasons pathologically and suggest proper remedies for that deficiencies in order to decrease accidents and casualties to make a livable city to preserve quality of life for their residences physically and mentally.

Keywords: Mobility pathology, urban disorder, lack of accessibility, traffic circulation deficiencies, traffic congestion, traffic and street design inappropriateness.

2 INTRODUCTION

Rapid and tremendous growth of Tehran due to unplanned migration from any part of country from small villages to big cities to find a job , to benefit from better services and facilities and to reach to better living conditions , especially in Three to four last decades in one hand , and the lack of a pre- defined plan for this population growth and lack of growth management because of the revolution, Imposed War and also sanctions , inflation and recession in the other hand , brought trial and error methods for Tehran's urban management and short term domicile planning decisions in different presidential periods and most important of all political management of Tehran's municipality and the Mayors different approaches to the city that followed no long term and well- tailored and thought solutions have no outcome except city disorderliness and distress which among them the mobility and transportation confusion is the worst one ,which misspent thousands hours of the Tehran's Citizens time each day in traffic traps and is the main reason of various physical , mental and behavioral illnesses and disorders.

On the other hand, walkability and other means of accessibility is not in human scale and proper situation for daily use of the residents, and confusion between different means of traffic and lack of traffic separation, and even very simple disobeying of traffic rules and regulations by on foot pedestrians and motorists which is a kind of civil disobedience is obvious .

Therefore, recognition of this sophisticated mobility phenomena require a precise pathological diagnosis first and in the second step demands multi- dimensional Socio- Economic, cultural and institutional - managerial solutions which seems not so easy in a short period of time.

In the following section of the paper, first, the problem will be stated and the different probable scenarios will be proposed in the shape of hypotheses and then according to a descriptive – analytical methodology the hypotheses will be tested on the basis of existing data and statistics. The accepted hypotheses could be supposed as an acceptable scenario to the problems.

3 PROBLEM STATEMENT:

Mobility is the focal point of urban transportation and accessibility, is at the core of urban mobility. It is verified and obvious that mobility (as part of transportation) couldn't continue "as a business as usual" and should be transform to sustainable one, but we must be aware that, as Marcus Says:" Sustainability is not enough" (Marcus; 1998'103) . The most reasons are as follows:

- sustainability is not a goal for a programme – many bad programmes are sustainable – but a constraint; its absence may limit the usefulness of a good programme;
- stamping a program by sustainability stamp and verify it , allowing not to be put to discuss or to be criticized because it suggests the possibility of a conflict-free consensus on policies , although it may be not so complete and perfect as Masdar City in Abu Dhabi.
- Sustainability is both an honorable goal for carefully defined purposes and a camouflaged trap for the well-intentioned unwary. (Marcus ;1998;104)

It is a reality that in recent decades so many urban transportation plans were implemented and constructed in Great Tehran such as huge highways , freeways , two stories bridges , metro lines expansion and so on ; which all counts for moving towards sustainable mobility by the government , but all is an easement for mobility of motorists and private cars (which unfortunately in recent years has a tremendous growth) of effluents part of society , therefore we observe external effects to the detriment of low income and poor layers of the society ; such as more air pollution , more congestion, because of promoting of more private vehicles use , more sound pollution , spending longer hours in traffic jams , increasing more inversion of atmosphere layers , respiratory diseases such as asthma , allergies and even blood cancer which affect adolescents and children mostly.

At a glance to Tehran, it will be easily understood that in old and traditional part of the city in comparison to the new – built up part of it; still there is more possibility for on foot mobility, walkability and even cycling, although the infrastructure is frustrated, pavements and sidewalks are not in proper situation to be used, there may be find various unwanted physical obstacles, sometimes motor cyclists offenses to the pedestrian ways, and so on. It means that in new part of the city the motorists movement realm is dominant, the sidewalks are rare, there is no biking routes and on foot accessibility is very weak , except some small places which because of their traditional importance , specially in north part of Tehran, tried to reconcile the new means of transportation and on foot ones .

As we mentioned above in both traditional , old and also Modern and new- built part of the city, mobility has different pathological deficiencies that tried to suggest proper treatment for the deficiencies .

4 GREAT TEHRAN STATUS QUO AND URBAN CONTEXT ANALYSIS

Tehran, the capital of Iran, is a growing metropolitan city with a population of just over 8 million and covering nearly 600 square kilometers. It is the seat of central government and is the most important political and economic city in the country.

The city has grown in population and size over the past thirty years from being a relatively small city with a population of 0.7 million in 1941 to being one of the leading megacities of the region. The Imam Khomeini International Airport, the Mehrabad Airport, the central railway station and four intercity bus terminals located there makes Tehran an important local and international transit hub.

Today the population of greater Tehran is estimated to be around 14 million, making it one of the regions' megacities. The daily influx of people, mainly commuters, brings the 'daylight' population of Tehran up to more than 15 million more than a fifth of the whole country's population. The organic expansion of the city and its urban sprawl and wide catchment area has increased demand for transport; resulting in a complex and inefficient transport system. Since the late nineties, the extreme traffic congestion has gradually become a major challenge for the city authorities, and the city is also suffering from high levels of air pollution. This becomes worse at certain times of the year as Tehran is surrounded by mountains causing temperature inversions that trap the pollution over the city. (Allen; 2013; 4) .

By the end of the 1990s, despite having a public bus company and reasonable rail system, the lack of investment and inefficient organization of public transport was not delivering acceptable levels of service to an increasingly mobile public. As more people found better alternatives to public transport, the number of motorized trips went up, exacerbating congestion and air pollution problems and by beginning of the twenty first century the travelling public had become increasingly dissatisfied. (Ibid. 4).

National government started work on a transportation master plan for Iran at about this time, using outside consultants, looking at the investment needed to satisfy the growing demand and to try plan better for the future. With Tehran as the capital city and also the main urban centre for generating wealth, it was important to develop a transport master plan for Tehran that would also support the national transport plan.

The approach of the Tehran Municipality is noteworthy as they have tried to create a transport solution that will deliver a strategic vision for the city for 2025 and beyond. The focus is on high capacity mass transport. The backbone of this plan is a strong commitment to rail (supported at national level) but this is complemented with Bus Rapid Transport (BRT), improved regular bus services, as well as cycling and walking improvements. City authorities have tried to develop a comprehensive strategic plan which illustrates 'Tehran in 2025', based on the higher level strategic plan, 'Tehran Comprehensive Strategic Development Plan – 2025 Outlook'. (Allen 2013, 4).

Pessimistically , but based on existing reality of the daily current traffic of Tehran at the moment , (April 2017) , not only the increased amount of existing motorized route could not provide enough capacity for existing vehicles and sometimes you are facing with great parking in highways (specifically in Rush Hours)without any movement , but only , in spite of high prices of cars day by day , numbers of private cars increased exponentially , and it brings very sad and horrendous message with itself:" More , More , gigantic and vast traffic routes are still unable to swallow the increasing cars … ".

Constructing more roads tends to address the symptoms of a cause, rather than the cause itself. (khodabakhsh ; 2014; 76).

It is estimated that more than 3.5 million vehicles travel on Tehran's road network and today the municipality estimates that some nineteen million daily trips are made in Tehran (adopted from Hashemi, 2010a). Twenty two per cent of trips are made by bus, twenty three per cent by shared taxi, ten per cent by metro, ten per cent by minibus, seven per cent walking and cycling (NMT) and the rest by private car (twenty eight per cent). These vehicles were responsible for eighty eight per cent of local air pollution annually (adopted from Hashemi, 2010b).

5 UNCONTROLLED AIR POLLUTION, ANOTHER SIDE OF THE MOBILITY COIN IN TEHRAN

A problem with air quality, the relative and absolute (tonne/year) contribution for each emission source in 2005 could be seen in following table in 2005 . Mobile sources include light duty vehicles and private cars (LDV), motorcycles, buses (public and private), trucks, minibuses and motor-vans. According to the study performed by an Air Quality Control Company in Tehran, the contribution of light duty vehicle to air pollution has been considered to be close to 50 per cent of the mobile sources.

Emission	Mobile	Stationary
	Tonnes per year %	Tonnes per year %
CO	1,354,652, 99%	18,222, 1%
SO_2	6,142, 10%	57,173, 90%
NO_x	109,917, 70%	46,253, 30%
THC	155,609, 71%	64,761, 29%
PM	18,777, 9%	8,444, 31%

Table 1: Mobile and stationary sources of pollution. Source: http://www.ess.co.at/WEBAIR/TEHRAN/tehran.html, last accessed 16 June 2011.

6 HISTORICAL URBAN EXPANSION AND TRANSPORT DESIGN NETWORK

According to Fereydoon Firoozi, before 1786 Tehran was an agrarian community and an small village outside of Ray, the capital of Seljuk Dynasty was located on a main road, along the southern way of Alborz mountain and a part of Silk Route. But the establishment of the Qajar Dynasty brought soldiers and courtiers to the town, and this attracted more people and added a consumer aspect to the area.(Khodabaksh;2014;17).

This was the beginning of trade and traditional industries such as millinery, shoemaking, hosiery making, andblacksmithing, as well as the manufacture of munitions, which triggered economic and demographic concentration in Tehran.With a population of15,000 at the end of the 18th century, the population grew around tenfold by 1869, the first census of Tehran showed a population of 155,000. In 1930's when the city restricting wall demolished to allow further expansion of Tehran and following it in Pahlavi Dynasty the first new western adopted urban street design initiated and implemented in 1932 , Tehran's population was

310,139 and after 1341 it increased to 900,000 which was encounter with the first phase of Rural – Urban Migration in Iran after Iran's land Reform which followed by oil income revenues in country budget and its investment in cities and specifically in capital city of Tehran which directly resulted in Urban – Rural gap and speeding up the migration flow to Tehran.

The fast growth of Tehran's population due to inmigration caused the uncontrolled expansion of the city in all directions. The growing city absorbed and destroyed a significant portion of the existing suburban green spaces, gardens, and surrounding villages. According to Madanipour, the city managers felt the need to control the growth of the city, but the municipality didn't have the required legal and financial means to deal with this issue. Consequently, a legal agen- da was created in 1965 to form the Urban Planning High Council and set up comprehensive land use and urban development plans.(Ibid; 2014; 27).

In 1965 Victor Gruen firm in association with the Iranian architect Abdolaziz Farmafarmaian provided the first comprehensive plan of Tehran. According to Madanipour, in their studies the consultants documented "high density, , especially in the city center; expansion of commercial activities along the main roads; pollution; inefficient infrastructure; widespread unemployment in the poorer areas, and the continuous migration of low income groups to Tehran, due to the country's economic structure," as the city's main problems. (Kodabakhsh, 2014, 28).

The final proposal redirected Tehran's development from a north-south axis to an east- west axis through a new highway and subway network.. It included a number of satellite towns, which were meant to mitigate pressure on the city and provide local centers for the urban clusters of Tehran. The comprehensive plan was approved in 1968. (Ibid; 2014; 29).

A transportation network, which included motorways, a rapid transit route, and a bus route, connected the first ten districts. High-density residential areas were located on the rapid transit nodes to turn them into activity nodes.

Out of the proposals of the comprehensive plan, according to "Madanipour" only a few were implemented, including" a network of freeways to connect the disjointed parts of the sprawling metropolis; zoning as the basis for managing the social and physical character of different areas; and the introduction of floor area ratios for controlling development densities.(Ibid; 2014; 29).

The city of Tehran includes an irregular road network, 2700 km in length, of which 14% are highways and 27% are arterial roads. Every day there are 15 million trips on the network with an average speed of 21km/hour per vehicle (public and private), and the percentage of private vs. public vehicles (such as taxis) is estimated at respectively 52% and 58%. Many reasons for the traffic congestion and the high levels of air and noise pollution can be found in Tehran. Nearly 4 million cars and over 4 million motorcycles are driven in Tehran [6]. More than 400,000 cars in use are over 25 years old and more than 1.5 million vehicles are over 7 years old. Although a program to replace deficient vehicles has existed for many years, nonetheless during this same period the number of old vehicles (based on the informal definition given above) has continued to rise. There are 2.5 million vehicles in service that have not received a certificate of technical examination. Newer vehicles also introduce high levels of polluting agents into the air due to lack of maintenance and due to the fact that the vehicles that are produced nationally are of lower quality. Also, inadequate development of public transportation has led to unnecessary trips and has substantially increased the number of daily trips made by personal vehicles. Geographically, Tehran is surrounded on three sides by mountains that slow the circulation of air, causing the air pollution to remain stagnant over the city. From a social point of view, Tehran is one of the densest cities in the world. This density is the main cause for innumerable trips within the city. Thus Tehran is one of the top countries in the world for air and noise pollution.(Safaie & chavoshi ; 2012; 446-447).

As was mentioned before in the last 37 years ago, due to Islamic Revolution, Imposed war and consequently politico- economic and governance instability , authorities only was seeking fast and immediate remedies for the problems and deficiencies and many of the proposals , and approvals of comprehensive plans faced with lack of budget and don't implemented on time and consequently it worsen the conditions and in this chaos all the urban problems , and specifically transportation and mobility problems come to its unbearable and brutal phase.

7 STREET DESIGN DEFICIENCIES AND WALKABILITY

The legislation of pedestrian master plan in most pioneer cities of developed countries turns pedestrian and walkable environments into an important indicator of urban development (Mofidi and Kashani Jou, 2010); however, This approach is still confronted with difficulties in developing countries like Iran. A review of Tehran's comprehensive plan from 1969 (first comprehensive plan) (Habibi and Hourcade, 2005) to its newest version in 2007 reveals that pedestrians are neglected in the city's vision.

The street, as an ancient component of the built environment, not only provides accessibility and connection to different destinations in cities, but as a public realm, it also contains a range of activities and plays a significant role in the life of cities. The phrase that has been offered by Jane Jacobs effectively describes the importance of the street: "Think of a city and what comes to mind? Its streets. If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull" (Jacobs, 1961).

As walking means the presence of people, walkable streets can greatly contribute to the wealth, health, and sustainability of the city through raising the economic value of offices, retail businesses, and houses, improving both social interaction and social security while enhancing the sense of place (Zayed, 2016). (Motamed & Bitaraf;2016;77-78). Therefore any kind challenges to pedestrian and sidewalk accessibility are a threat for the sustainability of the cities. These harmful challenges are as follows:

- Lack of pedestrian activity
- Lack of sidewalk maintenance
- Lack of pedestrian planning
- Lack of political and financial support for pedestrian planning and
- Lack of administrative and technical capacity to implement pedestrian planning (Cowley;2006;71).

It should be noticed that the above terms unfortunately in Tehran were neglected, and therefore transforms to challenges; and mostly, have no meaning for the local government and urban authorities.

Design factors (Physical characters), location factors, user's factors, lack of proper maintenance, and social capacity building for using the sidewalks properly are among the deficiencies of sidewalks design and planning.

7.1 Design factors (physical Characters) :

- Path Width: a measure in meters of the width of the path that is available to pedestrians.
- Surface Quality: a description of the quality of the surface of the path. Excellent quality means a continuous, smooth but skid resistant surface, without cracks and bumps or weed intrusion.
- Obstructions: a measure of the number of obstructions per kilometer on the path being assessed. Assessment of this factor is essential to determine the access available to people with disabilities. Obstructions may be permanent (e.g. poles, signs, chairs etc.) or temporary (e.g. bins, parked cars etc.). Stairs are considered an obstruction if no alternative is available for people with mobility disabilities.

Source: Zarghami et al. (2015)

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- Crossing Opportunities: the type and number of facilities provided to assist in the safe crossing of roads and paths by pedestrians. Includes median refuges, pelican crossings, guarded crossings, crosswalks, underpasses, and overpasses. 'Delay in crossing' is also a characteristic of this factor.
- Support Facilities: the presence of facilities that assist pedestrians during their journey and includes tactile paving, colour contrast kerbing, provision of rest stops, kerb ramps, lane markings, signage, landings on long ramps etc.(Galin ; 2001; 48)

7.2 Location Factors:

- Connectivity: the degree to which the path provides a useful, direct and logical link between key departure points and destinations.
- Path Environment: a measure of the quality of the path environment dictated by its surroundings. The degree of 'pleasantness' of the surrounding environment will often relate to distance from the roadway.
- Potential for Vehicle Conflict: a count of the number of potential vehicle conflict points along the route including intersections and driveways. Conflict points to be measured per path kilometre. The potential for pedestrian conflict increases with increased intersection and driveway frequency. (Ibid; 2001; 48).

Source: Zarghami, et al. (2015)

7.3 User Factors :

- Pedestrian Volume: a count (or estimate) of the number of pedestrians using the path expressed as an average daily count.
- Mix of Path Users: an estimate of the various groups who use the path as a percentage of total pedestrians. Groups include pedestrians, cyclists, roller-skaters, etc. When assessing this factor, consideration should be given to the various types of pedestrians, including recreational pedestrians and pedestrians 'with a purpose' i.e. people walking to work, to shops etc.
- Personal Security: qualitative measurement of the degree to which the path is safe for users. Characteristics of this factor include the provision of adequate lighting (from both direct and indirect sources), path visibility from the surrounding environment, sight distance etc.(Galin, 2001, 48-49).

8 LACK OF PROPER MAINTENANCE:

- The pavements unleveled installation: The pavements are not leveled , some of them are not in its place, the pavement material are sometimes different.
- Excavating installations canals: These canals digging by different agencies such as electricity , water supply , drainage , gas company , telephone companies and so on. They leave inattention for some days and after the end of the work causes uneven routes and seldom return to the fist situation for pedestrians to use them with peace of mind.
- The pavements are not well- maintained for disabled or vision impaired persons in such a way that either the sidewalks are not usable at all ,or it is difficult and is risky to use it alone and without a person to accompanying them.

- Installing round cylinder- shaped metal rods: at the both side of sidewalks to prevent motor cycles intrusion to the sidewalks, which itself, is a dangerous obstacle for the blinds, wheel chaired and even adolescents.

Source: Zarghami et al. (2015)

9 SOCIAL CAPACITY BUILDINGS FOR USING THE SIDEWALKS:

- The sidewalks and pedestrian ways usually are underestimated as important and necessity means of walking and on foot mobility. Behavioral habits on providing, maintenance and using the sidewalks are neglected easily and sometimes you may observe that using the sidewalks are not considering so important; and you have another options in substitution: "Directing to the margin of motor way and moving there "if there is no sidewalk or if there is any obstacles or constructions to make using it impossible.
- Using the narrow sidewalks by motor cycles which are in hurry or need to access their shops, or deliver any goods to shops and homes suppose a very usual habit, without bringing in mind that it may causes terrible accidents for the pedestrians.

Source: Zarghami et al., 2015

- Colportage in sidewalks or using the sidewalks for storing some of grocery or green grocery shops or dealers are very usual and accepted habit , and in hot summer times some sun shades are itself serious harms for pedestrians head and face.
- Mostly there are no specific indicated routes for the bikes and in spite of hard efforts of governments and NGO's to propagate cycling, there is few streets to be customized for. Meanwhile uneven topography of Tehran in center to north of Tehran is not encouraging to use the bikes.

10 MOTORIZED MOVEMENT DEFICIENCIES (TECHNICAL, OPERATIONAL AND CULTURAL REASONS):

Motorized Mobility in Tehran is mainly private car dependent and as was said previously, the amount of car is exponentially increasing day by day. The motorized traffic condition will be most inappropriate when we add different technical and operational problems. It has been tried to categorize these problems here according to empirical study and close observation of the author in his daily engagements in the traffic congestions.

11 TECHNICAL NEGLECTS ABOUT SOME OF THE MAIN CROSS SECTIONS OF THE CITY :

Unfortunately, because of the rapid growth of the city in last three decades some new development districts are like the new attached parts to the city without considering the easement of their traffic conditions. For Example , it was tried to control the traffic between the to parts by the corners that have only traffic lights

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and no bridge or underground passing while there are two crossing highways and the traffic lights should decrease and halt the cars which have high speeds.!!!?

Another technical problem is in fact mechanical, about the old models and out of order cars in Tehran which not only are one of the main reasons of air pollution in Tehran, but also, are one of the reasons of road accidents, traffic congestions and marginal effects of traffic in Tehran. The owners of the cars are mostly poor people who use the cars as a means of making a butter and bread for their family and have no financial source to renew their cars.

12 OPERATIONAL INATTENTION ABOUT THE PROPER SETTING OF TRAFFIC LIGHTS TIMINGS OF STOP AND MOVE:

As you may know, the traffic lights of Tehran have timers to show the red and green light duration to regularize the traffic circulation and help the drivers and pedestrians as well; but malfunction of the timers which unexpectedly and unordinary decrease the numbers, causes very serious problems for drivers and pedestrians too; and causes accidents between the cars, cars and pedestrians and also unexpected traffic fines for drivers which violate the line.

13 CULTURAL BEHAVIOR WHICH SEEMS TO BE IMPROVING RECENTLY:

Cultural behavior is in relation to driver's habit of driving and also pedestrians violent to the driver's rights. Drivers habit is involving not driving in the lanes, illegally take overs, change directions without signal light and suddenly , zigzag driving , illegally speeds , parking in forbidden places , entering one way streets and alleys and no attention to pedestrian rights on zebra crossings talking by cell phones or checking the massages and so on.

Pedestrian's bad habits are mainly in crossing the streets when the traffic light is green for the cars and Create real dangers, both, for themselves and the drivers.

Fortunately in last decades the media warnings, billboards, direct and indirect traffic educations and in addition increasing the traffic fines have positive consequences in the cultural dimensions and culture of driving, however there is a long way to reach to the standard and optimum level.

14 CONCLUSION AND SUGGESTIONS:

The paper shows that lack of mobility in Tehran and its relevant Pathological deficiencies are multi-dimensional and the reasons are mainly physical, Technical (constructional), operational (manipulating) and cultural as well.

Uncontrolled population growth due to hierarchical migration from rural areas to the capital (Tehran) and also natural population growth(high birth rate) in between and tremendous expansion of the city (from six main city District in First Pahlavi era to 22 huge City districts now) which shows an exponential rate of growth in both population and city area, have engaged city management and authorities with the conditions that its control is very difficult and any possible prescriptions for it , is only a short prevention and relief and not a definite treatment.

The worst imagination of Tehran traffic and mobility pathology is when, the technical, operational, cultural and behavioral malfunctions and deficiencies, and even financial shortages be added to the ever growing metropolitan of Tehran.

Therefore, any improvement in population migration control, correction and improvement of traffic rules and regulations, traffic education of the people, alleviating traffic congestion nodes and obstacles, walkability improvement, providing better environment for walking and cycling and preserve the rights of citizenship for all the city inhabitants help to be more successful in diagnosis of incurable pathological mobility problems that we are now facing.

Then the optimum solution of the mobility and traffic issues in Tehran could be sought in serious and immediate cooperation of the inhabitants, city authorities, urban experts and real attention to the recommendation and comments of the city experts.

Then as the ultimate cure of the deficiencies is not an immediate task and take a long time to be done fundamentally. But short term treatments could be prescribed for the city, which seems to decrease some of the existing paralyses condition of mobility difficulties.

Design factors, location factors, users factors are among the factors which don't need any long term planning decisions for their improvements or corrections; and it is not necessary to consider specific management capacity buildings for them in a long term process.

Designers first of all must think to the easement of mobility users and pedestrian; and design streets, sidewalks and city furniture as friendly as possible. Street Designs idea should not be done in air , and should not be mandatory and obligatory, as well.

Location factors are very important, because of the conditions that dictate to the planners and designers and make a challenge to design accordingly. Here controlling the conditions and looking for some solutions, to work, in such a situations is a keen professional decision. That is, how to design despite the limitations of location conditions?

User's factors are behavioral, social and ethical facts. They refers to the understanding of the importance of mobility , its ease of circulation , the advantages and disadvantages of obeying the rules and regulation , and awareness that, the benefit of a well-designed and operated mobility systems distribute among the all community groups and not only an small part of them. On the other hand, it should has a cultural aspect and a well – formulated training program to be planned to teach the inhabitants in different age groups, the right way of urban mobility activities and the right and wrong of their behavior, in relation to the use of urban mobility dimensions.

Urban authorities view to the urban mobility's difficulties and urban management systems and its function should be changed and re- organized in the ways that consider the critical role of the mobility in the city, which is like the blood in the arteries of the human being bodies. Our urban management system in the city, needs to be renovated and equipped by the scientific and applied means of traffic and mobility monitoring, evaluating; and then implementing the necessary applicable strategies and approaches ; decisively, to set priorities to solve mobility problems one by one in a hierarchical basis and try to decrease the intensity of inhabitant's mobility deficiencies as soon as possible. Hopefully in most of the cases, they can be solved very easily and doesn't need very complicated and long term consulting or planning measures; however its implementation and constructional phases my take long times, e.g. building a bridge in a crowded intersection or removing traffic nodes by geometric correction of street's kerb, and, providing setbacks for the buildings, shops and so on.

It could be said that the diagnosis of the mobility problems and their categorization is half of the solution and inspire the likely solutions which could be selected to solve the problem. In addition the nature of the deficiencies require different approaches and strategies as the solutions, which range from the short time to long time solutions and some of them was suggested before .

Urban mobility issues have a complicated nature and require holistic and systematic solutions of all the stakeholders, authorities, urban managers, inhabitants, city experts, architects, urban planners and all beneficiaries to play their critical role in providing an integrated and comprehensive strategies and approaches to solve the mobility problems in a way that a real sustainable and transit – oriented transportation be planned in Tehran.

15 REFERENCES

(1) Allen , Heather; (2013); An Integrated Approach to Public Transport, Tehran, Islamic Republic of Iran; Case study prepared for Global Report on Human Settlements.

(2) Gallin,N;(2001); Quantifying Pedestrian friendliness guidelines for assessing pedestrian level of service; Road & Transport Research, Volume 10 ; No,1; pp.47-55.

(3) Khodabakhsh, Hasti;(2014);Reducing car use through new urban design schemes in western Tehran; Master Dissertation in Architecture; The Pennsylvania State University.

(4) Marcus, Peter; (1998) ;Sustainability is not enough; Environment & Urbanization ; Volume 10 ; No,2;pp.103-111.

(5) Motamed, Bahare ; Bitaraf , Azadeh ; (2016) ; An empirical assessment of the walking environment in a mega city: case study of Valiasr street , Tehran ; International Journal of Architectural Research; Volume 10 ; issue 3 ; pp. 76-99.

(6) Shoorcheh,Mahmood; Varesi, Hamid Reza; Mohammadi Jamal ; Litman, Todd(2016); Urban Growth Structure and Travel Behavior in Tehran City; Modern Applied Science;Volume 10; No 10; pp. 32-47.

(7) Zarghami, Esmaeil ;AzhdehFar,Shirin ;Toodeh Fallah ;Saeed(2015); The Relationship between Urban Sidewalks Design and Psychological Sense of Security; Journal of Civil Engineering and Urbanism;Volume5; Issue 3;pp.134-143.

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Transfer von Methoden der Aktionsforschung für urbane Mobilitätslabore am Beispiel von Mobilitätsexpeditionen

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1 ABSTRACT

Zwischen dem Stand der Forschung und der Praxis urbaner Mobilität ist eine deutliche Umsetzungslücke erkennbar, die Urbane Mobilitätslabore überbrücken wollen. Ziel ist es, Innovationen zu forcieren und sie in den Alltag der Menschen zu intergrieren. Urbane Mobilitätslabore erfordern dabei ein umfangreiches Methodenset aus Analyse, Kommunikation und Visualisierung, um die Bedürfnisse der Menschen zu verstehen, Innovationen in Testsituationen umzusetzen und zu vermitteln (vgl. Berger et. al. 2016b).

Die urbanen Mobilitätslabore bauen größtenteils auf dem Konzept des Reallabors auf. Reallabore wiederrum können als Fortsetzung der bereits verbreiteten Aktionsforschung gesehen werden, welche auf einem experimentellen Setting in einer iterativen Abfolge von Handlung, Reflexion und Planung fußt (vgl. Parodi et.al. 2016).

Im Rahmen der Sondierung[1] der UMLs wurden Methoden der Aktionsforschung für den Bereich der Mobilitätsforschung adaptiert und deren Anwendbarkeit im Kontext der Mobilitätslabore getestet. So wurden beispielsweise Mobilitätsexpeditionen als reflektierte Auseinandersetzung mit der lokalen Situation realisiert.

Im Rahmen der Publikation soll aufgezeigt werden, ob und wie sich diese Methoden der Aktionsforschung im Rahmen von UML-Prozessen bewähren. Hierzu werden zuerst die Methoden in ihrer Vorbereitung, Realisierung und Auswertung sturkturiert beschrieben. In einem zweiten Schritt werden die Anwendungsbeispiele gegenübergestellt und verglichen. Hierauf aufbauend können Verbesserungsansätze für den Einsatz der Methoden für die Zwecke der UML's formuliert werden.

Keywords: Reallabor, Mobilitätsexpedition, Methoden, Mobilitätslabore, Aktionsforschung

2 METHODEN DER AKTIONSFORSCHUNG UND REALLABORE

2.1 Was kann man unter Reallaboren verstehen?

Der Begriff des Reallabors ist eng an eine nach¬haltigkeitsorientierte Transformationsforschung (sustainable transition management) und For¬schungspolitik gebunden (vgl. Schneidewind 2014, Schneidewind/Scheck 2013, WBGU 2011). Urbane Mobilitätslabore orientieren sich deshalb auch an diesem Konzept und bewegen sich im Spannungsfeld zwischen Reallaboren und Living Labs.

We¬sentlich für Reallabore ist das Bestreben komplexe sozio-tech¬nische Grundlagen für Transformationsprozesse zu verstehen und Veränderungen einzu¬leiten. Angestrebt wird ein Wissen, das wesent¬lich auf das „impliziten Wissen" von Nutzerinnen und Nutzern aufbaut und mit dem wissenschaftlichen Wissen unterschiedlicher Disziplinen verknüpft wird. Im Vordergrund von in Reallaboren betriebene Transformationsforschung steht nicht die Diagnose von Ursachen oder das Postulieren von Theorien, sondern das Etablieren „überzeugender neuer Orientierungsangebote und

[1] Die Autorinnen und Autoren waren an der vom BMVIT geförderten Sondierung für zwei urbane Mobilitätslabore (UML) beteiligt. Insgesamt wurden acht Projekte zur Förderung ausgewählt und 2015 bis 2016, abgewickelt durch die FFG, durchgeführt. Parallel hierzu wurden von Seiten des BMVIT's und der FFG auch die Eckpunkte des Instruments „Innovationslabor" (vgl. Österreichische Forschungsförderungsgesellschaft 2016) weiterentwickelt und verfeinert. Im Jänner 2017 wurden von Seiten des Fördergebers fünf Labore ausgewählt, sie werden für die Dauer von vier Jahren gefördert (vgl. AustriaTech 2017). Weitere Informationen finden sich http://www.smart-mobility.at/initiativen/urban-mobilitylabs/.

Handlungskonzepte“ (WBGU 2011). Diese „Systeminnovationen“ können die Veränderung von Infrastrukturen, Institutionen, Nutzerinnen- und Nutzerverhalten und Bedeutungsaufladungen einschließen (vgl. Geels 2004).

Reallabore können anhand von sieben Charakteristika zusammengefasst werden: Forschungsorientierung, Normativität, Transdisziplinarität, Transformativität, Zivilgesellschaftliche Orientierung, Langfristigkeit und Laborcharakter (Parodi et.al. 2016b, aufbauend auf Parodi 2016a). Weiters können diese Punkte auch als Kriterien gesehen werden, ab wann bei einer Einrichtung/ einem Projekt von einem Reallabor im engeren Sinne gesprochen werden kann (vgl. Parodi et. al. 2016a). Ein Beispiel für ein Reallabor in diesem engeren Sinne ist GO-Karlsruhe. Das Kernelement des Forschungsprojekts der Hochschule Karlsruhe sind z. B. von Nutzerinnen und Nutzern[2] über eine Handy- sowie Web-Applikation erstellte Beiträge zum Thema Fußgängerinnen- und Fußgängerverkehr. Zusätzlich werden auch Methoden der Vor-Ort Beteiligung angewandt, um möglichst weite Teile der Nutzerinnen und Nutzer erreichen zu können (vgl. Hochschule Karlsruhe 2017 und Blaszczyk 2017).

2.2 Warum braucht es Reallabore für eine nachhaltige Mobilität?

Im Bereich der urbanen Mobilität findet sich eine Lücke zwischen der Forschung und der alltäglichen Praxis. Als ein Lösungsweg wird hierbei die aktive Einbindung von (potenziellen) Nutzerinnen und Nutzern in Innovationsprozesse, wie sie auch in Reallaboren stattfinden kann, angesehen. Vor allem bieten Reallabore, durch ihre klare Verortung in Quartieren, Stadtteilen, Städten oder Regionen, reale Kontexte und Situationen, in denen Mobilitätsinnovationen entwickelt und getestet werden können (vgl. Berger et. al. 2016). Sie bringen Forschungsprojekte sozusagen auf den Boden und helfen somit dabei, die angesprochene Lücke zwischen der Forschung und dem Mobilitätsalltag zu schließen. Zusätzlich können auch Lern- und Adaptionsprozesse ausgelöst werden (vgl. Bauknecht et al. 2015).

2.3 Welche Methoden kennzeichnen Reallabore?

Grundsätzlich kommen im Rahmen von Reallaboren eine Vielfalt an Methoden zur Anwendung. Diese reichen von Interviews und Gruppendiskussionen über Hackatons bis hin zu Methoden der Aktionsforschung. Die eingesetzten Methoden können hierbei in drei Bereiche eingeteilt werden (vgl. Berger et. al. 2016, nach Förster 2014).

- Kommunikation - das Ziel ist es eine Interaktion zwischen Akteurinnen und Akteuren herzustellen, es kann zwischen Methoden direkter (z. B. Workshops) und massenmedialer (z. B. Blogs, Flyer) Kommunikation unterschieden werden.
- Analyse – Methoden in diesem Bereich versuchen ein Thema systematisch zu untersuchen, im weitesten Sinne können quantitative, qualitative sowie auch nicht empirisch verstehende Forschungsmethoden hier zugeordnet werden.
- Visualisierung – in diesem Bereich geht es um die (gemeinsame) Erzeugung von Bildern im weitesten Sinne. Diese können sehr unterschiedliche Formen annehmen, z. B. Collagen, Bildstrecken, Karten etc.

Insbesondere Methoden der Aktionsforschung lassen sich zumeist mehreren Bereichen zuordnen bzw. können in ihrer Ausgestaltung einen Schwerpunkt setzen.

Das Konzept der Aktionsforschung versucht einen Prozess aufzubauen, in dem Aktion und Reflexion sowie Theorie und Praxis zusammengedacht werden können (vgl. Reason & Bradbury 2001). Den Ausgangspunkt für diesen partizipativen, iterativen Prozess aus Planung, Aktion und Reflexion stellen Probleme von Gruppen, Gemeinschaften oder Organisationen dar. Beispiele für Methoden der Aktionsforschung aus dem Mobilitätsbereich sind vor allem Formate in Bewegung bzw. mobile Methoden[3], z. B. Mobilitätsexpeditionen, Spaziergänge oder Bereisungen. Aber auch Workshops und Befragungen vor Ort, partizipative Prototypenentwicklung etc. finden in der auf das Thema der Mobilität bezogenen Aktionsforschung ihre Anwendung.

[2] Die Begrifflichkeit ist hierbei bewusst gewählt, da das Projekt bewusst auf Nutzerinnen- und Nutzerbeteiligung, und nicht wie in der Planung üblich Bürgerinnen- und Bürgerbeteiligung, gesetzt wird (vgl. Hochschule Karlsruhe 2017).

[3] Zur Unterscheidung zwischen mobilen und verorteten Methoden der Beteiligung in der Planung siehe Kirchberger 2017.

2.4 Warum eignen sich Methoden der Aktionsforschung besonders für den Einsatz in Reallaboren?[4]

Reallabore können als in der Tradition der Aktionsforschung stehend angesehen werden (vgl. Parodi 2016b). Es stellt sich die Frage, inwiefern Aktionsforschung und Reallabore ähnliche Abläufe und Forschungsprozesse beschreiben. Hierbei muss aber zwischen den Abläufen innerhalb eines Reallabors, der „Reallaborforschung“ (Parodi et.al. 2016b), und der Struktur rund um eben diese, sozusagen der Laborinfrastruktur, unterschieden werden. Oliver Parodi und seine Kolleginnen und Kollegen bezeichnen die Reallaborforschung als „… eine Form institutionalisierter Aktions- bzw. Interventionsforschung..“ (Parodi et.al. 2016b).

Zentrale Überschneidungspunkte zwischen dem Konzept der Aktionsforschung sowie des Ansatzes der Reallabore sind:

- die mehr oder weniger intensive Beteiligung der Betroffenen/Nutzerinnen und Nutzern
- das Setzen von konkreten Aktionen, die eine Veränderung anstoßen können
- die Arbeit vor Ort, im Raum
- der Ausgangspunkt bei alltagsweltlichen Problemen
- der Anspruch Innovationen bzw. Erkenntnisse im kleinen Maßstab zu testen

Methoden der Aktionsforschung können somit, wenn sie in ihrer Ausgestaltung auch gut auf die strukturellen Rahmenbedingungen sowie der Ausrichtung eines Reallabors (Räumliche Ebene, Akteurinnen und Akteure und Zielgruppen, Themenbereiche, Schlüssel-Stakeholder etc.) abgestimmt sind, einen Beitrag im Sinne der oben genannten Punkte leisten.

Da Prozesse innerhalb von Reallaboren zumeist nicht standardisierbar sind, benötigen die eingesetzten Methoden auch eine gewisse Flexibilität in der Ausgestaltung. Hierfür bieten sich Methoden der Aktionsforschung an, da sie ausreichend Spielraum für Anpassungen bieten.

3 MOBILITÄTSEXPEDITIONEN IN URBANEN MOBILITÄTSLABOREN

Wie zuvor bereits erwähnt eignen sich vor allem Methoden der Aktionsforschung, die auf der Bewegung im Raum basieren, für die Anwendung in der Mobilitätsforschung. Nachstehend werden zwei im Rahmen von Sondierungsprojekten zu urbanen Mobilitätslaboren realisierte Mobilitätsexpeditionen näher beleuchtet. Neben diesen waren die Sondierungsprojekte von einer Vielfalt an Methoden aus den Bereichen Kommunikation, Analyse und Visualisierung geprägt.

3.1 Urbane Mobilitätslabore in Graz und in der Stadtregion Bruck-Kapfenberg-Leoben

Im Rahmen einer Sondierungsphase waren die Autorinnen und Autoren an zwei Projekten zur Vorbereitung einer Einreichung urbaner Mobilitätslabore in Graz sowie der Stadtregion Bruck-Kapfenberg-Leoben beteiligt.

Die Projektkonsortien waren sehr unterschiedlich aufgebaut: In der Sondierung zum Mobilitätslabor teilen+tauschen waren bereits strategisch wichtige (über-)regionale Stakeholder Teil des Projektkonsortiums. Das Projektteam in Graz war hingegen auf die durchführenden Institutionen und Unternehmen beschränkt. In beiden Fällen waren Forschungseinrichtungen als auch private Unternehmen beteiligt, in Bruck-Kapfenberg-Leoben ergänzt um Partner aus der Verwaltung (siehe Fehler! Verweisquelle konnte nicht gefunden werden.).

Während das Urbane Mobilitätslabor (UML) in Graz neben dem stadtregionalen Aspekt („Mobilität über Stadtgrenzen“) der städtische Bereich eine wichtige Rolle spielt, versucht das UML Bruck-Kapfenberg-Leoben klar eine stadtregionale Perspektive einzunehmen. Thematisch lag der Schwerpunkt in Graz in der Personenmobilität, mit einem verstärkten Interesse an den Themen der Mobilitätsinformation sowie der Mobilität über die Stadtgrenzen. In der Stadtregion Bruck-Kapfenberg-Leoben bewegten sich die Themen sowohl in der regionsübergreifenden Personen- als auch der Gütermobilität. Diese wurden durch den Ansatz des Teilen und Tauschens verknüpft.

[4] Einen sehr guten kurzen Abriss über die Hintergründe und verwandten Konzepte zur Aktionsforschung, im Hinblick auf Reallabore, geben Oliver Parodi und seine Kolleginnen und Kollegen (vgl. Parodi et.al. 2016).

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In Graz wurden die Akteurinnen und Akteure im Rahmen der abgehaltenen Veranstaltungen verstärkt auch in eine aktive Rolle gebracht, während in Bruck-Kapfenberg-Leoben, auch bedingt durch die Auswahl der Teilnehmerinnen und Teilnehmer, diese tendenziell passiv eingebunden waren. Im Detail wird dieser Aspekt noch später beleuchtet werden.

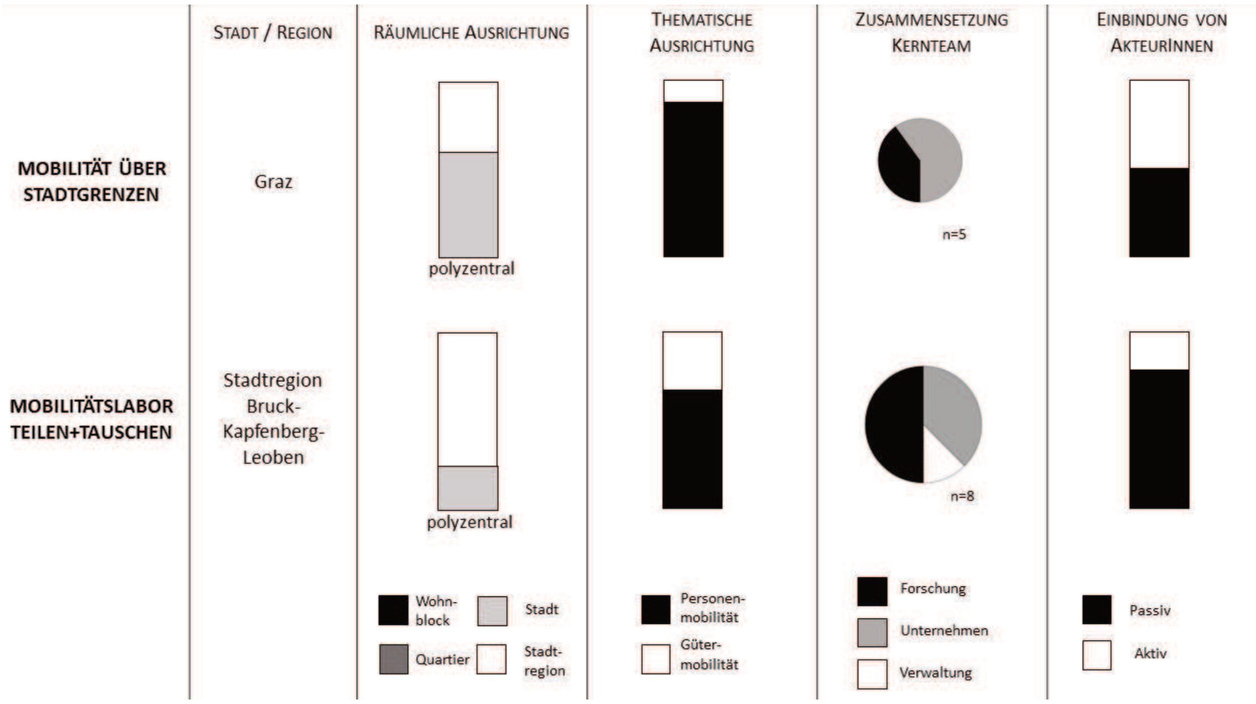

Abbildung 1 Ausrichtung der Mobilitätslabore Graz und Bruck-Kapfenberg-Leoben, adaptiert nach Berger et. al. 2017

3.2 Mobilität über Stadtgrenzen erleben – Aktionsforschung in der Stadtregion Graz

Im Rahmen des Sondierungsprojekts zu einem urbanen Mobilitätslabor wurden drei öffentliche Veranstaltungen („Treffpunkte Mobilität“) abgehalten. Es wurden dabei verschiedenste Methoden wie mental mapping, Workshops zu kollektiven, grafischen Mobilitätsprofilen oder Fragebögen kombiniert mit einer automatisierten kartographischen Auswertung eingesetzt.

Für den 2.Treffpunkt wurde die Methode der Mobilitätsexpedition ausgewählt, mit dem Ziel vor Ort partizipativ Erfahrungen zum Mobilitätssystem an der Stadtgrenze zu sammeln.

3.3 Mobilitätsexpedition Graz-Raaba-Hart – Freitag 16.Oktober 2015, 13:00 bis 17:30

3.3.1 Vorbereitung

Ziele

Das Projektteam definierte folgende Ziele für die Mobilitätsexpedition:

- Bewusstseinsbildung bei den Teilnehmerinnen und Teilnehmern (Veränderte Wahrnehmung des Verkehrssystems, …)
- Wie werden „Grenzen“ im Rahmen von Mobilität (nicht) wahrgenommen?
- Austesten unterschiedlicher technischer Geräte im Bereich der Sensorik „unterwegs“
- Partizipatives Testen des lokalen Verkehrssystems
- Beobachtung des Umgangs mit unterschiedlichen (digitalen und analogen) Hilfsmitteln im Bereich der Routenplanung, Fahrplanauskunft und Navigation

Analyse

Ausgehend von dem guten lokalen Wissen der Projektpartnerinnen und Projektpartner aus Graz wurden in einer desk research Mobilitätskorridore über die Stadtgrenze identifiziert. Einerseits wurde dabei das Augenmerk auf das Vorhandensein einer großen Vielfalt an Verkehrswegen (Schiene, Autobahn, innerstädtische Routen, Landstraßen, Radwege) gelegt. Anderseits wurde auch der Aspekt der raumstrukturellen Ausprägung des Stadtrands beleuchtet. Aufbauend auf diese erste Auswahl an potenziellen Räumen für eine Mobilitätsexpedition wurde durch das Projektteam die Achse Graz Murpark – Raaba – Hart als Lokalisierung für die Mobilitätsexpedition ausgewählt.

Art der Aufgabe

Die Teilnehmerinnen und Teilnehmer wurden in jeweils zwei Gruppen zu den Verkehrsmitteln zu Fuß gehen, öffentlicher Verkehr, Fahrrad und Privatauto eingeteilt. Jede Gruppe wurde von einer Person aus dem Projektteam begleitet und mit einem Aufgabenblatt mit allen wichtigen Details ausgestattet.

Die Aufgabe bestand darin, die Punkte B (Gemeindeamt Raaba) und C (Gemeindeamt Hart) ausgehend vom Punkt A (Murpark Graz) zu erreichen und unterwegs zugewiesene Mobilitäts-bezogene Aufgaben zu lösen (z. B. kaufen sie Obst ein, fotografieren Sie Graz von oben etc.). Ein Teil der Aufgaben war örtlich gebunden (z. B. holen sie eine Person von der Adresse St. -Peter-Hauptstraße 243, 8042 Graz ab).

Route und Ablauf

Die Wahl der Route sowie die dazu verwendeten Hilfsmittel waren Teil der Aufgabe. Zwischen den Treffpunkten in Raaba und Hart hatten die Gruppen freie Hand in der Auswahl der Wege. Der Raum ermöglichte auch verschiedenen Optionen für alle Verkehrsmittel, so kann man z. B. das Ortszentrum von Raaba durch Umsteigen mit verschiedenen Buslinien erreichen. Im Hintergrund waren von Seiten des Projektteams ungefähre Einschätzungen bezüglich der benötigten Zeit und wahrscheinlichsten Routenwahl notwendig, um die Gruppen der Mobilitätsexpedition in Raaba und Hart für eine Pause sowie den Abschlussworkshop zusammenführen zu können.

Alle Gruppen hatten einen gemeinsame Start- und Endpunkt, mit einer Einführung sowie Gruppenbildung zu Beginn sowie einer auf einer Karte verorteten Zusammenführung und Präsentation aller Ergebnisse in der Großgruppe als Abschluss.

Einladung

Zur Mobilitätsexpedition wurden vor allem bereits involvierte Stakeholder aus Politik und Verwaltung, Studierende sowie persönliche Kontakte aus dem Projektteam per E-Mail sowie kurz vor der Veranstaltung auch durch telefonische Nachfrage eingeladen.

3.3.2 Realisierung

Teilnehmerinnen, Teilnehmer und Gruppenbildung

Es fanden sich 40 Teilnehmerinnen und Teilnehmer mit sehr unterschiedlichen Hintergründen (z. B. Politik, Verwaltung, Studentinnen und Studenten, Netzwerkpartnerinnen und Netzwerkpartner) am Treffpunkt beim Murpark Graz ein. Für die anschließende Gruppenbildung wurde die anwesenden Personen gebeten, an diesem Nachmittag ein Experiment zu wagen und vielleicht ein Verkehrsmittel zu wählen, dass sie in ihrem durchschnittlichen Mobilitätsalltag nicht nutzen. Ein Teilnehmer wagte das Realexperiment und konnte so seine ersten Erfahrungen mit dem Bussystem an der Stadtgrenze machen, aufgrund von Verspätungen und Ausfällen aber leider im negativen Sinne.

Da sich das Wetter von seiner wechselhaften Seite zeigte, konnte nur eine Fußgängerinnen- und Fußgängergruppe gebildet werden. Als Ersatz war eine dritte Gruppe mit dem öffentlichen Verkehr unterwegs.

Tatsächliche Routengestaltung

Die Teilnehmerinnen und Teilnehmer nutzten eine breites Spektrum an Hilfsmitteln für die Auswahl der passenden Route: von analogen Hilfsmitteln wie Stadtplänen oder Fahrplanaushängen bis hin zu Fahrplanauskunfts- und Navigationsapps. Weiters wurde auch die Ortskenntnis als zentral bei der Routenplanung angegeben. Nur eine Gruppe erkundigte sich bei Ortskundigen über die beste Route.

Ergebnisse

Die Teilnehmerinnen und Teilnehmer identifizierten verschiedene Probleme im Verkehrssystem, die zum Teil auf die Herausforderungen einer stadtgrenzüberschreitenden Mobilität zurückzuführen sind. So wurde angemerkt, dass das Lösen eines Tickets nach Hart mit der richtigen Anzahl an Zonen eine Herausforderung darstellt oder die Radwegbeschilderung ab der Stadtgrenze nicht mehr einheitlich und leicht lesbar vorhanden ist. Die Fußgängerinnen- und Fußgängergruppe identifizierte einige Wegabschnitte, die als

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unangenehm empfunden wurden. Vor allem in der St.Peter Hauptstraße wurde der Busverkehr sehr durch den dichten Freitagnachmittag-Verkehr aufgehalten.

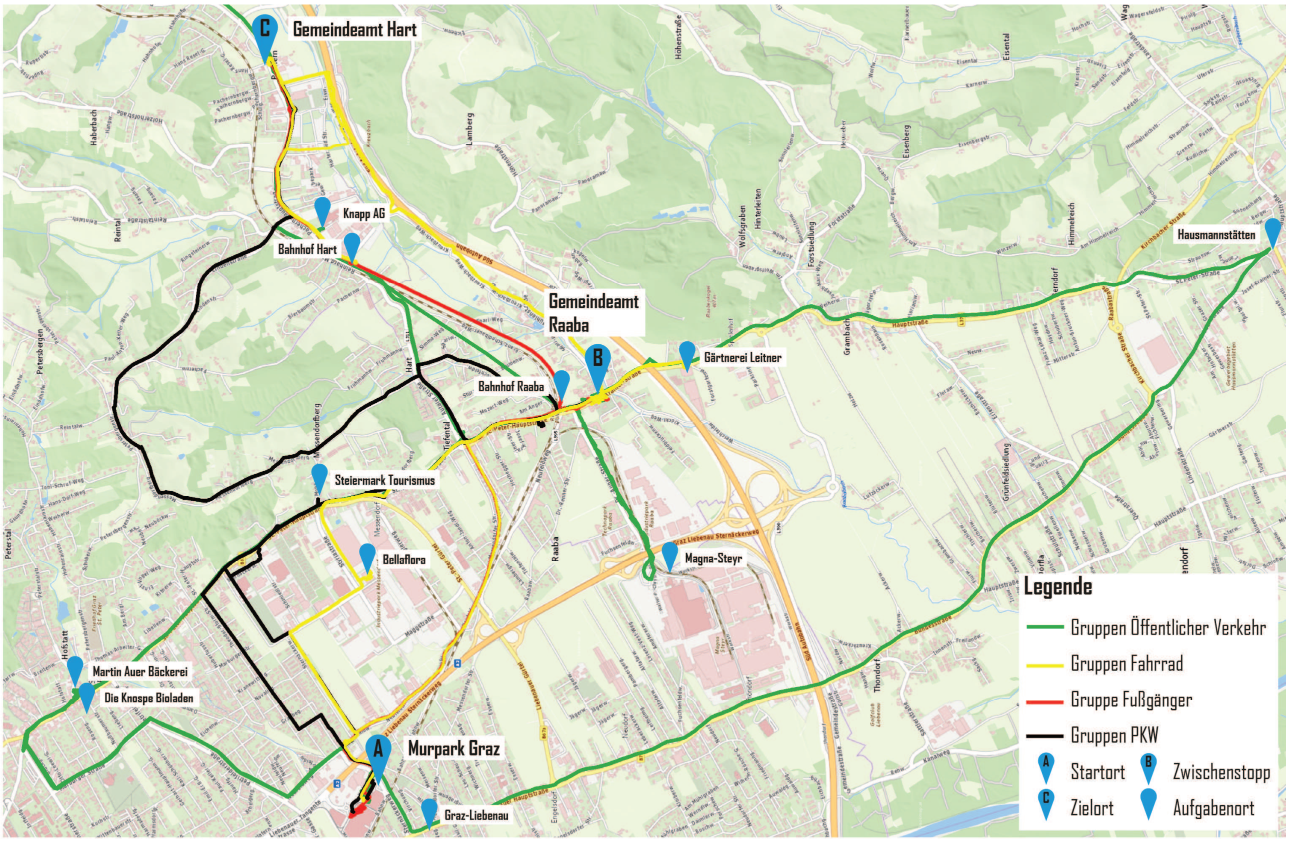

Abbildung 2 Zurückgelegte Routen nach Verkehrsmittel, Grundkarte: basemap.at

3.3.3 Dokumentation

Die Teilnehmerinnen und Teilnehmer waren aufgerufen ihre Eindrücke von der Mobilitätsexpedition auf verschiedenen Wege selbstständig festzuhalten:

- Schriftlich - anhand von Leitfragen auf vorbereiteten Notizzetteln
- Fotografisch - in freier Form, abgesehen von spezifischen Aufgaben
- Räumlich – einerseits händisch auf einem Plan, andererseits mithilfe von GPS-Aufzeichnungsgeräten
- Physisch – mithilfe von aussagekräftigen Fundstücken

Die gesammelten Materialien wurden im Rahmen eines Beitrags für ein Projekt-Booklet in Form einer Tabelle sowie einer Karte ausgewertet. Kriterien in der Tabelle waren z. B. die zurückgelegte Strecke oder die verwendeten digitalen oder analogen Navigationshilfsmittel.

Abbildung 3 Impressionen von der Mobilitätsexpedition in Graz, Raaba und Hart

3.4 Teilen und tauschen in Bruck-Kapfenberg-Leoben – Aktionsforschung unterwegs

Im Sondierungsprojekt Mobilitätslabor teilen+tauschen wurden zwei öffentliche Veranstaltungen durchgeführt. Anfang Dezember 2015 wurde eine Mobilitätsexpedition in der Stadtregion realisiert, diese wird anschließend auch umfassend beschrieben. Anfang Jänner folgte dann ein Visioneering-Workshop, in dem ausgehend von vier Zukunftsszenarien, unterstützt durch verschiedene Kreativtechniken, gemeinsam über eine Vision für die Güter- und Personenmobilität in der Stadtregion nachgedacht wurde. Weitere im Projekt eingesetzte Methoden waren z. B. leitfadengestützte Interviews sowie die Erstellung einer strukturierten Akteurslandkarte.

3.5 Mobilitätsexpedition Bruck-Kapfenberg-Leoben - Donnerstag 03.12.2015, 12:30 -17:30 Uhr

3.5.1 Vorbereitung

Ziele

Das Projektteam definierte folgende Ziele für die Mobilitätsexpedition:

- Aktivierung und Vernetzung relevanter Akteure in der Region
- Diskussion des Themas „Teilen und Tauschen" als Lösungsansatz für regionale Problemstellungen
- Diskussion von aktuellen und zukünftigen Herausforderungen im Bereich Güterverkehr und Logistik in der Region
- Identifikation von Projektideen und Potenzialen

Analyse

Aufbauend auf das Wissen aus der im Vorfeld zur Mobilitätsexpedition erfolgten Akteursanalyse wurde versucht zukünftige Themenfelder und bereits bestehende innovative Mobilitätslösungen in der Stadtregion zu verknüpfen. Weiter erfolgte eine desk-research zum öffentlichen Verkehrsangebot, um die Möglichkeit der Verbindung der geplanten Stationen durch Bus- und Zugfahrten abklären zu können.

Art der Aufgabe

Die Mobilitätsexpedition selbst wurde getrennt in die Gruppen Güterverkehr und Personenverkehr abgehalten, die Zuteilung erfolgte bereits im Vorfeld. Die Teilnehmerinnen und Teilnehmer waren vor allem bei den an den Stationen abgehaltenen Workshops zu den Themen Herausforderungen sowie Projektideen und Potenziale in der Mobilität in der Stadtregion gefragt sich aktiv einzubringen.

Route und Ablauf

Die Route wurde angepasst an die ausgewählten Stationen sowie die möglichen Verbindungen mit dem öffentlichen Verkehr geplant. Teilweise wurde für den Transport ein vom Verkehrsunternehmen MVG zur Verfügung gestellter Reisebus vorgesehen. Die Stationen wurden bewusst auf alle Städte der Stadtregion, mit einem Fokus auf Bruck/Mur und Kapfenberg, aufgeteilt. Der nachstehenden Tabelle ist der genaue Ablauf zu entnehmen.

Güterverkehr	**Personenverkehr**
Empfang und Anmeldung Stadt:Werk:Statt Bruck/Mur	
Transfer ① Busfahrt Bruck-Leoben Innenstadt	Transfer ① Busfahrt Bruck – MVG-Busgarage
Station ❶ Innenstadt Leoben Workshop zu Herausforderungen im Güterverkehr und der Logistik	Station ❶ MVG-Busgarage Workshop zu Herausforderungen im Personenverkehr
Transfer ② Busfahrt Leoben Innenstadt - Montanterminal Kapfenberg	Transfer ② Busfahrt Kapfenberg-Bruck Weitental JUFA
Station ❷ Montanterminal Kapfenberg Workshop zu Projektideen und Potenzialen	Station ❷ Bruck Weitental JUFA Workshop zu Projektideen und Potenzialen
Transfer ③ Montanterminal Kapfenberg – Bruck	Transfer ③ Fußweg Bruck Weitental JUFA – Bruck
Abschlussworkshop Stadt:Werk:Statt Bruck/Mur	

Tabelle 1 Ablauf der Mobilitätsexpedition in der Stadtregion Bruck-Kapfenberg-Leoben

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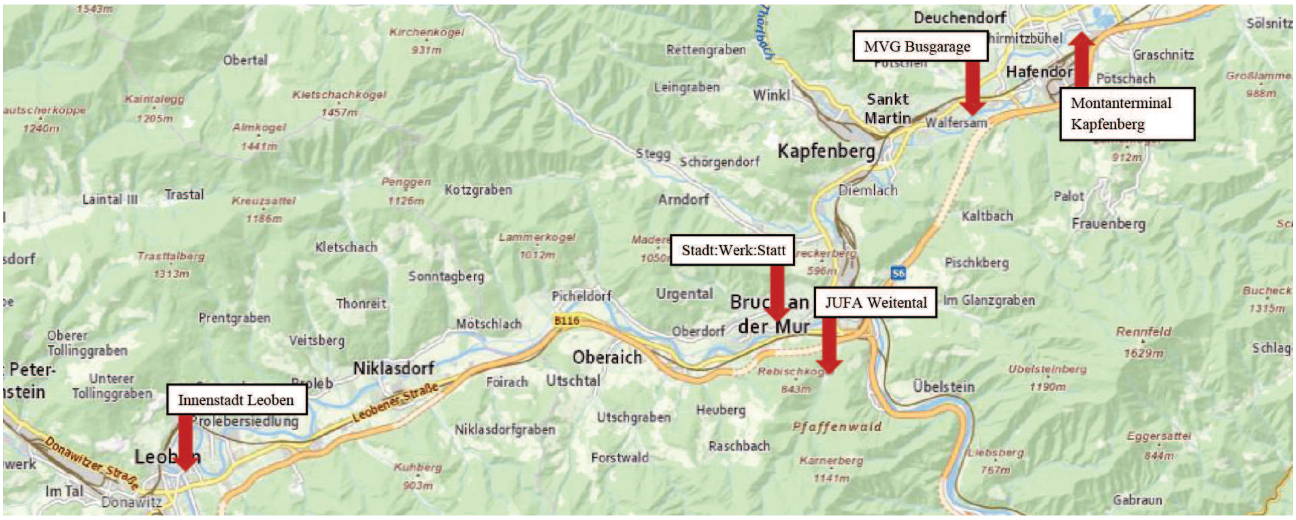

Abbildung 4 Verortung der Stationen der Mobilitätsexpedition in der Stadtregion Bruck-Kapfenberg-Leoben, Grundkarte: basemap.at

Einladung

Die Einladung erfolgte per E-Mail sowie persönlich im Rahmen der zuvor realisierten Interviews mit Akteurinnen und Akteuren. Eingeladen wurden vor allem strategisch relevante regionale Akteurinnen und Akteure sowie innovative Unternehmen aus den Bereichen Personenverkehr und Güterlogistik.

3.5.2 Realisierung

Teilnehmerinnen, Teilnehmer und Gruppenbildung

An der Expedition nahmen 20 Personen, vor allem aus Institutionen, Organisationen oder Unternehmen mit einem Sitz in den Städten Bruck und Leoben, teil. Einige wenige Teilnehmerinnen und Teilnehmer waren nicht angemeldet, und somit keiner Gruppe zugeteilt, sie konnten sich selbst einer Gruppe ihrer Wahl anschließen.

Tatsächliche Routengestaltung

Kurz vor der Veranstaltung wurde entschieden, alle Wege mithilfe von Reisebussen der MVG abzuwickeln. Das Risiko von Verspätungen oder dem Verpassen von Linienbussen war zu groß, im sehr dichten Zeitplan hätten sich Verzögerungen schnell auf die weiteren Programmpunkte ausgewirkt. So änderte sich die geplante Reihenfolge für die Gruppe Güterlogistik: zuerst wurde der Montanterminal Kapfenberg besucht, dann anschließend die Innenstadt von Leoben.

Abbildung 5 Impressionen von der Mobilitätsexpedition in der Stadtregion Bruck-Kapfenberg-Leoben

Ergebnisse

Als Herausforderung sehen die Teilnehmerinnen und Teilnehmer z. B. den Personenverkehr und die Güterlogistik in den dünn besiedelten Seitentäler der Stadtregion, vor allem auch hinsichtlich einer weiteren Schrumpfung in diesen Bereichen. Damit zusammenhängend ist der Ausbau von P&R Anlagen für Fahrräder und PKW noch nicht ausreichend vorangeschritten, was einen Umstieg auf öffentliche Verkehrsmittel häufig verhindert bzw. unattraktiv macht.

Als Lösungsansätze und Projekte wurde z. B. das Thema der Bewusstseinsbildung im Personenverkehr sowie auch Güterlogistik und die Idee eines mobilen Radverleihs für die Region eingebracht.

3.5.3 Dokumentation

Die Expedition wurde in einer Zusammenfassung hinsichtlich der Inputs sowie Workshopergebnisse textlich beschrieben. Weiter wurde ein Plakat mit den eingebrachten Herausforderungen und Projektideen sowie

3.6 Gegenüberstellung der Expeditionen

In beiden Anwendungsfällen ging der genaueren Planung und Entscheidung für die Methode vor allem der Wunsch innerhalb der Projektkonsortien voran, ein Format zu wählen, dass eine Arbeit vor Ort, im (Mobilitäts-)Raum ermöglicht. Dies ist auch als der Kern der Methode der Mobilitätsexpedition anzusehen: das Sammeln von Mobilitätserfahrungen sowie Reflektieren von bestehenden Wissens beim persönlichen Erleben von Mobilität vor Ort.

Folgende Spannungsfelder ergeben sich aus der Gegenüberstellung der Mobilitätsexpedition Graz-Raaba-Hart sowie Bruck-Leoben-Kapfenberg:

- Nutzerinnen- und Nutzerexpedition – Akteurinnen- und Akteursexpedition: Während die Teilnehmerinnen und Teilnehmer in Graz durch die gestellten Aufgaben stark in ihrer Rolle als Nutzerinnen und Nutzer des Mobilitätssystems teilnahmen, lag der Schwerpunkt in Bruck-Kapfenberg-Leoben bei der Abfrage des Wissens als AkteurIn, aus dem professionellen Hintergrund der teilnehmenden Personen heraus. Die Methode kann somit, je nach Ausgestaltung und vor allem Aufgabenstellung, bei den Teilnehmerinnen und Teilnehmern unterschiedlichste Blickwinkel auf ein und denselben Raum erzeugen.
- Aktive Teilnehmerinnen- und Teilnehmereinbindung – passive Teilnehmerinnen- und Teilnehmereinbindung: Mobilitätsexpeditionen können in der Ausgestaltung Elemente unterschiedlicher Art enthalten. Diese können mehr oder weniger einen aktiven Beitrag der Teilnehmerinnen- und Teilnehmererfordern, vor allem aber bei rein informierenden Elementen werden diese rein passiv eingebunden. Die Expedition in Graz enthielt hier zu einem überwiegenden Teil aktive Methodenbausteine, während in Bruck-Kapfenberg-Leoben verstärkt auch eine Vermittlung von Informationen z. B. über das Projekt, die bisherigen Ergebnisse oder Innovationen aus der Region stattfand.
- Raum als Thema – Raum als Impulsgeber: Das Vor-Ort sein kann einerseits, wie im Beispiel aus Graz, zur Feststellung von lokalen Problemen (z. B. „Der Gehweg ist in dieser Straße schlecht beleuchtet.“) dienen. Der Raum ist unmittelbar Objekt einer Diskussion. Andererseits können die Erlebnisse als Inspiration für die Formulierung von allgemeinen Beiträgen, Ideen etc. dienen. Der Raum, eine Situation, eine Erfahrung gibt einen Impuls für eine (gedankliche) Entwicklung.
- Konkret – Abstrakt: Dieses Spannungsfeld ist als mit dem zuvor genannten eng verknüpft zu betrachten. Die Beiträge der Teilnehmerinnen- und Teilnehmer in Graz waren sehr konkret und eben auf den Ort bezogen. Diese ergab sich so auch aus der Aufgabenstellung heraus. Eine abstrakte Diskussion über das Thema der Stadtgrenze im Kopf war zum Teil schwierig zu führen. In Bruck-Kapfenberg-Leoben hingegen war der Schritt hin zu konkreten Lösungsansätzen und Ideen für einen Großteil der Teilnehmerinnen- und Teilnehmer schwierig, die Diskussion wurde weiter auf einer abstrakteren, analysierend bewertenden Ebene geführt. Dieser Unterschied ist wie schon erwähnt auch auf die unterschiedlichen Ziele, Zielgruppen sowie deren Gestaltungsmöglichkeiten innerhalb der Mobilitätsexpeditionen zurückzuführen.

4 WAS MUSS BEIM EINSATZ VON METHODEN DER AKTIONSFORSCHUNG IN REALLABOREN BEACHTET WERDEN?

In diesem abschließenden Punkt soll versucht werden, Hinweise für den Einsatz von Methoden der Aktionsforschung im Kontext von urbanen Mobilitätslaboren bzw. Reallaboren zu geben. Ausgehend von den Erfahrungen bei der Anwendung der Methode der Mobilitätsexpedition in Graz sowie Bruck-Kapfenberg-Leoben, konnten folgende Punkte identifiziert werden:

- Eine umfassende Dokumentation, die auch die digitalen Möglichkeiten ausschöpft (z. B. Tonaufnahmen, GPS-Tracking, Film), kann vor allem für Methoden der Aktionsforschung als zentral angesehen werden. Viele Ergebnisse stellen sich als sehr flüchtig dar, z. B. Diskussionen vor Ort, die sich auf eine Atmosphäre im konkreten Moment bezieht etc. Eine gute Sicherung dieser

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Situationen kann einen wichtigen Beitrag zu Innovationsprozessen in Reallaboren darstellen, erfordert aber auch einen erhöhten Einsatz von Personal. Alternativ können aber auch die Teilnehmerinnen- und Teilnehmer selbst die Dokumentation durchführen und selbst zu Mitforschenden werden.

- Im Rahmen der Realisierung einer Methode sollte den Teilnehmerinnen- und Teilnehmern auch immer die Möglichkeit zur Reflexion über die Methode selbst gegeben werden. Nur so kann diese, im Sinne des Konzepts der Aktionsforschung, in einem iterativen Prozess auch immer wieder optimiert werden.
- In der individuellen Ausgestaltung von Methoden der Aktionsforschung gilt es eine Balance zwischen der möglichen Offenheit und einer Strukturiertheit in der Aufgabenstellung zu finden. In wieweit lässt man den Teilnehmerinnen- und Teilnehmern auch Platz für die eigene Interpretation der Aufgabe? Wie klar müssen Fragen formuliert sein, um konkrete Ergebnisse zu erhalten? Gerade in Reallaboren werden beide Extreme ihre Anwendung finden.
- Der zuvor angesprochene Punkt zeigt, dass Methoden der Aktionsforschung zumeist auch ein erhöhtes Maß an Flexibilität und Spontanität vom begleitenden Forscherteam verlangen. Es muss während der Anwendung von Methoden schnell reagiert und mit Unvorhergesehenem umgegangen werden.
- Bei Methoden der Aktionsforschung, die auf der Interaktion zwischen den Teilnehmerinnen- und Teilnehmern aufbauen, spielt die Gruppendynamik eine zentrale Rolle (vgl. Kirchberger 2017). Dessen muss man sich als ForscherIn bewusst sein und es gilt das Potenzial, dass diese wechselseitigen Beeinflussungen, neben den Problemen, bieten kann, auszuschöpfen. So kann die bewusste gegenseitige Konfrontation von Akteurinnen und Akteuren, z. B. Politikerinnen, Politiker, Bürgerinnen und Bürger, in einem hierarchielosen Setting, wie das in Methoden der Aktionsforschung durchaus herstellbar ist, spannende Dynamiken erzeugen. Diese gilt es wiederrum für anschließende Prozesse innerhalb von Reallaboren zu nutzen.
- Der Charakter des Experiments, des Unalltäglichen, stellt einen wichtigen Faktor für das Entstehen von Neuem dar. Es ermöglicht Personen neue Perspektiven einzunehmen und temporär ihre Denkmuster hinter sich zu lassen. Dieses auch über die eigene Komfortzone hinaus gehen gilt es auch beim Nacherleben von Mobilitätsalltagen im Raum als Methode zu erhalten und die Teilnehmerinnen- und Teilnehmer durchaus auch herauszufordern. Hierfür braucht es auch wieder die Bereitschaft zum Umgang mit Unvorhergesehenem.

5 REFERENCES

AUSTRIATECH: Urbane Mobilitätslabore – Forschung durch experimentelle Umgebungen wirksam machen. http://www.smart-mobility.at/initiativen/urban-mobilitylabs/vorstellung-urbane-mobilitaetslabore/. abgerufen am 16.06.2017

BAUKNECHT, D.; Brohmann, B.; Grießhammer, R.: Gesellschaftlicher Wandel als Mehrebenenansatz. TEXTE 66/2015. Dessau-Roßlau 2015

BERGER, Martin; DÖRRZAPF, Linda; BREITFUSS, Gert; POGLITSCH Michael; STICKLER, Andrea; SODL, Vanessa; REMELE, Elias: Begleitstudie Urbane Mobilitätslabore. Lernprozesse und Handlungsempfehlungen. Graz/Wien: BMVIT 2016: pp. 62, 45

BERGER, Martin; DÖRRZAPF, Linda; DORNER, Fabian; MITTEREGGER, Mathias: Urbane Mobilitätslabore als Katalysatoren für Innovation. In: Publikation zum Forschungstag der Fakultät für Architektur und Raumplanung 2017, pp. 72-73. Wien 2017

BLASZCZYK, Robert: Reallabor GO Karlsruhe, Vortrag im Rahmen der XI. Österreichische Fachkonferenz für Fußgängerinnen und Fußgänger in Klagenfurt am Wörthersee am 09.06.2017. Klagenfurt 2017

FÖRSTER, Agnes: Planungsprozesse wirkungsvoller gestalten. Wirkungen, Bausteine und Stellgrößen kommunikativer planerischer Methoden. Dissertation 2014. TU München

GEELS, Frank. W. (2004): Understanding system innovations: a critical literature review and a conceptual synthesis, In: Elzen, Boelie/Geels, Frank W./Green, Kenneth (Hg.) (2004): System innovation and the transition to sustainability: theory, evidence and policy , Cheltenham 2004. pp. 19-47. 19f

HOCHSCHULE KARLSRUHE: Projektbeschreibung Go Karlsruhe. http://www.imm.hs-karlsruhe.de/gokarlsruhe/projekt-3/#Projektbeschreibung, abgerufen am 16.06.2017

KIRCHBERGER, Christoph: Gemeinsam gehen. Der Spaziergang als Beteiligungsformat in Planungsprozessen. Diplomarbeit 2017 Technische Universität Wien. Wien 2017. pp. 26, 96, 105

PARODI, Oliver; BEECROFT, Richard; ALBIEZ, Marius et al.: Das Konzept „Reallabor“ schärfen. Ein Zwischenruf des Reallabor 131: KIT findet Stadt. In: GAIA 25/3, pp. 284-285. München 2016: pp. 285

PARODI, Oliver; BEECROFT, Richard; ALBIEZ, Marius ; QUINT, Alexandra; SEEBACHER, Andreas; TAMM, Kaidi; WAITZ, Colette: Von „Aktionsforschung“ bis „Zielkonflikte“. Schlüsselbegriffe der Reallaborforschung. journal paper 2016.

Karlsruhe: Institut für Technikfolgenabschätzung und Systemanalyse (ITAS), Karlsruher Institut für Technologie (KIT) 2016: pp. 9, 10

REASON, Peter; Bradbury, Hilary: Inquiry and Participation in Search of a World Worthy of Human Aspiration. In: Handbook of Action Research: Participative Inquiry and Practice. London, 2001: Sage 1

SCHNEIDEWIND, Uwe; SCHECK, Hanna (2013): "Die Stadt als „Reallabor "für Systeminnovationen." Soziale Innovation und Nachhaltigkeit. Springer Fachmedien Wiesbaden. 229-248.

SCHNEIDEWIND, Uwe (2014): Urbane Reallabore - ein Blick in die aktuelle Forschungswerkstadt, in: pnd/online (Planung neu denken), III/2014. Aachen 2014: pp. 1

ÖSTERREICHISCHE FORSCHUNGSFÖRDERUNGSGESELLSCHAFT: Leitfaden zur Förderung von Innovationslaboren. https://www.ffg.at/sites/default/files/allgemeine_downloads/thematische%20programme/Mobilitaet/instrumentenleitfaden_innovationslabor_20160525.pdf abgerufen am 16.06.2017

WBGU (Wissenschaftlicher Beirat der Bundesregierung für globale Umweltveränderungen): Welt im Wandel: Gesellschaftsvertrag für eine Große Transformation: Zusammenfassung für Entscheidungsträger. Berlin 2011

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reviewed paper

Transport Disadvantage and Extracurricular Activities: the Example of Secondary School Students of the City of Zagreb

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1 ABSTRACT

Nowadays, transport disadvantage is outspread phenomenon. It can influence people's needs and opportunities. Young people are considered transport disadvantaged part of the society. Secondary school students are young people with a great need for mobility but still, their mobility is also limited. Their dependence on other people in the aspect of transportation and public transportation greatly influence their everyday lives. Important segment of young people's lives are extracurricular activities. The aim of this paper is to investigate the impact of transport disadvantage on extracurricular activities of secondary school students of the City of Zagreb. Particular emphasis is on the difficulties in accessibility of extracurricular activities and how transport influences these activities. Research was conducted using quantitative and qualitative methods. The data were obtained through questionnaire survey of 826 secondary school students of secondary schools of the City of Zagreb. In order to deepen the research, interviews were performed through eight focus groups. Data analysis revealed that almost half of secondary school students involved in extracurricular activities expressed the attitude of having difficulties with accessibility of extracurricular activities and that over half of secondary school students involved in extracurricular activities responded that transport had impact on these activities. Significant correlations between the attitude of problem existence with accessibility of extracurricular activities and travel time needed to reach them, as well as between travel time to extracurricular activities and attitudes on the impact of transport on these activities were found. The existence of students not able to participate in extracurricular activities because of transportation was determined. All the results were supported by states collected through focus group research.

Keywords: mobility, city of Zagreb, secondary school students, extracurricular activities, transport disadvantage

2 INTRODUCTION

Today, extracurricular activities are considered as a valuable segment of young people's life by improving personal qualities. Young people who want and have the opportunity (primarily financial, but also time), can spend their time on various extracurricular activities, such as sports training, foreign language school, music school and other cultural, educational, sports and religious sections. Some authors emphasize multiple benefits of extracurricular activities. Students' involvement in those activities has an important role in developing good personal characteristics that could help later in life to avoid delinquent behaviour (Han et al., 2017). Also, participation in extracurricular activities helps students to discover, nurture and foster their talents and to develop personal character and competences. In addition, extracurricular activities could enrich students' experience, help to cope with stress, increase their employability and positively impact students' academic achievement (Siljkovic et al., 2007; Al-Ansari et al., 2016). In many cases, extracurricular activities are not near the place of residence, so attendance creates a need for travelling. For this reason, this segment of their life is also important for broader research, especially in the context of improvements, both transport and social policy.

Mobility and accessibility are the fundamental requirements of today's society (Hoyle and Knowles, 1998). People are transport disadvantaged if their mobility and accessibility are limited or impossible (Yigitcanlar et al., 2010; Rosier and McDonald, 2011; Gasparovic, 2016). Not owning, or not being able to drive a car (due to legal or other restrictions) is often listed as the main factor leading to transport disadvantage (Murray and Davis, 2001; Clifton and Lucas, 2004). There are also other factors involved, such as financial status and physical characteristics (such as gender or disability). Young people are often considered as transport disadvantaged social group (e.g. Murray and Davis, 2001; Stanley and Stanley, 2004; Dodson et al., 2004; Hurni, 2006; Hurni, 2007). Secondary school students (15 to 18 years old) are considered as the most exposed because they almost always have greater need for mobility and require to travel a longer distance to their school and leisure time activities than younger children (Fyhri and Hjorthol, 2009; Hopkins, 2010; Horton et al., 2011), therefore, secondary school students are in focus of this paper.

There are not many papers with focus on youth and transport disadvantage. This particularly applies to the relationship between extracurricular activities and transport, or transport disadvantage, as emphasized by some authors (e.g. Fyhri and Hjorthol, 2009; Lin and Yu, 2011). This is also the motive behind this work. Nevertheless, some of the papers study the interrelationship between transport and extracurricular activities, thereby indirectly studying the transport disadvantage. McWhannell and Braunholtz (2002) stressed that availability and the cost of public transport services influence children's choices of the type and timing of the extracurricular activities. Johansson (2006) examined mode choice for organized extracurricular activities among Swedish children. Tal and Handy (2008) examined influences on the mode choice of children attending football extracurricular activity. Winter (1994), Cullinane and Stokes (1998) and SEU (2003) found transport as a key factor that disables the youth in accessing educational opportunities, extracurricular activities, free time and social interactions. Currie (2007) stressed out that the problems of accessibility to educational activities, extracurricular activities and social interactions were most difficult for the youth living at the city periphery and in the rural areas.

3 METHODOLOGY

This research is based on the methods of surveying and interviewing. Before the main survey, a pre-test survey was performed to test the theoretical and empirical validity, reliability and applicability of the questions in the main questionnaire (suggested by Cohen et al., 2007). Main survey was conducted in seven secondary schools in the City of Zagreb. A total of 1053 students were surveyed (3% of the total number of secondary school students of the City of Zagreb). After the questionnaires were processed, 826 students remained (only students having residence in the City of Zagreb and students without a driver's licence were included). The survey lasted about 30 minutes. The questionnaire provided, among other issues, general information on the participants, as well as attitudes and opinions about the extracurricular activities, transport mode and travel time. The questionnaire provided students' opinions about difficulties with accessibility of extracurricular activities, about the impact of transport on their extracurricular activities, as well as about the problems they might experience due to transport when travelling to and from extracurricular activities.

In order to obtain in-depth information, this research also included focus groups interviews. Interviews were conducted in two secondary schools in the City of Zagreb within 8 focus groups. In each school, students were divided into four groups (8 to 10 students in each group) based on their age and gender. Group I consisted of female students in years 1 and 2. Group II consisted of male students in years 1 and 2. Group III consisted of female students in years 3 and 4, and Group IV of male students in years 3 and 4. Within each group, the dichotomy based on students' living location was pronounced (half of students living near the city centre and half living closer the city periphery). Interviews were performed in the presence the voice recorder, and the whole conversation with a particular group was recorded and then transcribed.

Although all students travelled to their extracurricular activities from their homes, it has been found during the research that in certain situations there were students attending their extracurricular activities not only from their homes, but also before or after school or, before or after some other extracurricular activity. In order to simplify data collection and analysis, the questionnaire examined only travelling from home to extracurricular activity since such a situation was present in majority of students. Also, in case of students attending several extracurricular activities, only one and the most distant activity was taken into consideration. In addition, it was decided that only one-way travel time (from their home to extracurricular activity) would be considered and it was assumed that the same time was needed to travel from extracurricular activity to home (preliminary studies showed no major deviations regarding the time that students needed to travel from their home to extracurricular activities and from extracurricular activities to home). Preliminary research showed that students usually used the same transport mode when they travelled to the extracurricular activity and back the home, therefore use of transport modes in one way (from their home to extracurricular activities) was investigated.

The Code of Ethics of Research with Children (2003) was fully abided by (suggested by Cohen et al., 2007). A permission for the research was obtained from the Ministry of Science, Education and Sport of the Republic of Croatia, from the principal of each school and (for interviewing) from students' parents. The survey was anonymous and voluntary.

The software SPSS Statistics 20.0 was used for data processing. Statistical correlation method (Pearson and Spearman correlation coefficient) and simple mathematical operations were used in this research. Spatial analysis was performed using the GIS software ArcInfo 10. As a basis for spatial analysis, data from the questionnaire was used, most preferably the address of the student. Spatial coordinates of student addresses are taken from the "Digital Orthophoto Layer 2012" (DOF 2012) of the GeoPortal of the "Zagreb Spatial Data Infrastructure" (City of Zagreb, 2012).

4 RESULTS AND DISCUSSION

Since attending extracurricular activities depends on different subjective and objective factors (e.g. motivation of a child, financial status of a family, etc.), survey found that 380 students attended this type of activity.

Students mostly used public transport to reach extracurricular activities (Table 1). They also travelled on foot or by bicycle (32.4%), which indicated that one third of students participated in extracurricular activities in the relative vicinity of their home. Also, less than 10% of students were taken by car by their parents or friends even though they had the possibility of using public transport. Use of other forms of transportation was negligible. The problems that students encountered while travelling were generally conditioned by the way of travelling (i.e. transport mode) to extracurricular activities.

Transport mode	Extracurricular activities	
	Number	Share (in %)
On foot, by bicycle	123	32.3
Taxi due to comfort and simplicity	1	0.3
Car, though they had the possibility of using public transport	33	8.7
Public transport	222	58.4
Car or taxi because they had no possibility of using public transport	1	0.3
Some other way	0	0
Total	380	100

Table 1: Travel needs of secondary school population in the City of Zagreb regarding the extracurricular activities (Source: survey).

Transport mode	Number of students participating in extracurricular activities	Number of students encountered difficulties with accessibility	Share (in %)
On foot, by bicycle	123	15	12.2
Taxi due to comfort and simplicity	1	0	0
Car, though they had the possibility of using public transport	33	15	45.5
Public transport	222	158	71.2
Car or taxi because they had no possibility of using public transport	1	1	100
Some other way	0	0	0
Total	380	189	49.7

Table 2: Relation between number of students participating in extracurricular activities and number of students encountered difficulties with accessibility of extracurricular activities (Source: survey).

Out of a total of 695 students who had opinion that they had transport-based difficulties with the accessibility of everyday activities due to transport, slightly more than 1/4 (27.2% or 189) of students thought that they had transport-based difficulties with the accessibility of extracurricular activities. Given that 380 students participated in extracurricular activities, it was a share of almost 50% (49.7%). Most of the problems students experienced travelling to extracurricular activities by public transport. Thus, more than 70% (71.2%) of students using public transport to reach their extracurricular activities stated that they had difficulties accessing extracurricular activities due to transport. Surprisingly, students who travelled to extracurricular activities by car claimed to have a big problem (they were driven by someone else, although they had the possibility to use public transport). Almost 50% (45.5%) of such students stated to have

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problems with the accessibility of extracurricular activities. This indicated that traffic jams affected accessibility, and thus was likely to increase the travel time to extracurricular activities. A little more than a ten percent of students (12.2%) attending extracurricular activities on foot or by bicycle expressed their attitude that transport affected accessibility of extracurricular activities.

Problems of access to life activities can also occur due to the time distance between residence location and the location of extracurricular activities. In regard to this issue, it was necessary to investigate how travel time to extracurricular activities had influenced the opinion of secondary school students about the existence of transport-based difficulties in accessing extracurricular activities. For this purpose, analysis of students who expressed attitude of the existence of problems with the accessibility of extracurricular activities was conducted. The obtained result indicated a slight, but statistically significant correlation between the opinion of having problems with the accessibility of extracurricular activities and the travel time (□ = -0.169; $p < 0.05$).[1] This is a slight, but statistically significant correlation, nevertheless it is obvious that it appeared systematically and as such, it may suggest that students travelling longer to their extracurricular activities encountered more often transport-based problems related to accessibility of extracurricular activities. This opened the possibility about a problem of extracurricular activities accessibility due to the distance.

The aforementioned analysis referred to the attitude of (non)existence of transport-based problems with the accessibility of extracurricular activities. However, it should be noted that transport, as a complex link between the origin and the destination, can have an impact (positive or negative) on a particular activity, so it was of interest to investigate how transport affected extracurricular activities. In order to investigate this issue, students' opinion about the transport problems encountered with regard to extracurricular activities were examined (Table 3). Although one might expected a higher share, slightly over half of the students (52.1%) who attended some form of extracurricular activity believed that transport affected the realization of extracurricular activities. The reason for this was the fact that students chose extracurricular activities that were located closer to their home. Two thirds of the students (67.2%) thought that transport rare (poor) or occasionally (moderate) affected extracurricular activities, while 32.8% of students thought that transport often (high) or almost always (very high) affected extracurricular activities.

Frequency/strength of the influence	Number of students	Share (in %)
Influence	198	52.1
Rare / poor	58	29.3
Occasionally / moderate	75	37.9
Often / high	47	23.7
Almost always / very high	18	9.1
No influence	182	47.9
Total	380	100

Table 3: Frequency and strength of the influence of transport on the extracurricular activities of secondary school students (Source: survey).

Distance to some activity may impact on the realization of the activity. Within this context, the relationship between the travel time to the location of the students' extracurricular activities and their opinion about the impact of transport on these activities was analysed. The obtained results showed correlation between these variables. Accordingly, it can be seen how opinion of students regarding the frequency/strength of impact of transport on extracurricular activities increased with the travel time needed to reach the activity (□ = 0.228, $p < 0.01$).[2] Students who spent more time travelling to the venue of the extracurricular activity claimed that transport more often and stronger influenced extracurricular activities when compared to students who spent less time travelling to these activities. This was slight, but statistically significant correlation indicating the possibility that the distance influenced the everyday life in a negative context. The result can be interpreted

[1] Variables related to the attitude on the existence of transport-based problems with the accessibility of specific activities are coded as follows: 1 – Yes, almost always (couple of times per week); 2 – Yes, often (once to twice per week); 3 – Sometimes (couple of times per month); 4 – Rarely (couple of times per year); 5 – Never.

[2] Variables related to the assessment of the frequency of influence of transport on specific activities are coded as follows: 1 – No influence; 2 – Poor influence / rarely influences; 3 – Moderate influence / occasionally influences; 4 – High influence / often influences; 5 – Very high influence / almost always influences.

as an assumption that students travelling longer to extracurricular activities had more problems with these activities in relation to students living closer to extracurricular activities.

Either I arrive too early or I late. The trams run great, but the buses could be more frequent. When I have a training at 4 (16 h), I have to leave home at 2:15 (14:15) because of the bus.

[How much time do you need to reach extracurricular activities?]

About an hour. (female student, 16 years, Sestine)

I'm training tennis and by the tram I would need 45 minutes to reach Velesajam. Then my coach who lives close drives me and I need 15-20 minutes to get there. (mal student, 18 years, Maksimir)

Transport did not affect attendance of extracurricular activities for students who had extracurricular activities close to their homes, especially if they were within walking distance radius.

Training venue is close to my home, so it (transport) doesn’t affect it.

[How far is it?]

15 minutes on foot. (female student, 15 years, Kvaternik Square)

It (transport) doesn’t affect it, because my extracurricular activity is 5 minutes far away. (female student, 15 years, Savica)

In case of students who had opinion that transport affected their extracurricular activities, the reasons for its impact were different, with some factors standing out (Table 4).

Way of influence	Number of students	Share
Late to extracurricular activities	73	36.9
Loss of time	53	26.8
Frequency of public transport	44	22.2
Traffic jams	18	9.1
Weather conditions	4	2.0
Bicycle paths	2	1.0
Organization of public transport system	2	1.0
Price of the public transport system	1	0.5
Help with studying	1	0.5
Total	198	100

Table 4: Ways in which transport influenced the extracurricular activities of students (Source: survey).

The most significant impact of transport on students’ extracurricular activities was reflected through being late (36.9%). Frequent traffic jams and inadequate frequencies of public transport were the most common reasons for this problem.

If we are late for a tram, then we are late for English. (female student, 17 years, Sveti Duh)

Time loss due to travel (26.8%) was another major problem. The reason was often traffic jams or public transport frequencies.

Yes, transport affects my trainings. I have them in Martinovka and it takes about an hour or so to get there, and by car I would reach it for 15 minutes. When I go from school I always miss the bus to Kvatric, and until I reach Kvatric, I wait for the ‘’five’’ (tram no. 5) that goes every 10-15 minutes and until I get to Martinovka it takes almost an hour. That's frustrating. (male student, 18 years, Kozjak)

Students using public transport sometimes had problems with its frequency (22.2%). This was due to the lack of harmonization of public transport in relation to extracurricular activities that take place through the whole day. This problem certainly had an impact on the organization of travelling to extracurricular activities, as well as the delay in their performance.

I go to drawing course at Zrinjevac Square. The problem is that the buses are rare, e.g. lines that go to Kvatric or Kaptol. They should be more frequent. (female student, 16 years, Kozjak)

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It affects my extracurricular activities because of bus schedules. I live in Malesnica and go to Crnomerec and wait for another bus for 20 minutes. And if there's some jam, and usually it is, then I'm late almost every time. (male student, 18 years, Malesnica)

Traffic jams caused many other problems, and students sometimes distinguished it as a separate problem (9.1%). This resulted in delays in extracurricular activities and additional travel time loss.

I'm late sometimes if I get into some traffic jam. The tram stops often at Vlaska Street, especially in the afternoon when people come back from work.(male student, 18 years, Maksimir)

Weather conditions also caused traffic problems thereby affecting extracurricular activities (2%). They were most prominent in winter or during rainy weather.

This affects my extracurricular activities. I have trained majorettes until recently and sometimes I was late when it was bad weather because of traffic jams and crowds. (female student, 18 years, Trnava)

Problems that affected to a lesser extent were lack of bicycle paths, organization of public transport (lack of direct connection between certain parts of the city, e.g. Stenjevac and Jarun) and the price of transport tickets if student had to use additional public transport carrier (e.g. Croatian Railways or some carriers driving outside the City of Zagreb, such as Samoborcek).

It is interesting that some students spent time travelling for studying or repeating school or extracurricular learning materials.

I use travelling to learn. I travel to my extracurricular activity for an hour or so, so I like to use it for beneficial. (female student, 18 years, Dubrava)

It has already been pointed out that 380 students participated in extracurricular activities, while 446 did not participate. The reasons for their non-participation were different, but there were also students who did not participate in extracurricular activities due to transport. Such students were in a particularly vulnerable position and were significantly transport disadvantaged.

I attended German courses until last year. Now, I can't attend 'cause I need half an hour to reach the course and I lose my learning time. And I lose quite a lot of time for it. (female student, 15 years, Retkovec)

I don't go to extracurricular activities because our bus goes every 45 minutes and if I'm late at 11 o'clock (23:00) I have to wait for the bus at 15 to 12 (23:45) and I'm scared to go so late to home, mom and dad are already sleeping. (female student, 15 years, Sesvete)

The total number of such students was 33, being 7.4% of the total number of students who did not attend any extracurricular activities, and 4.0% of the total number of all surveyed students. The main reasons for this situation were the time and/or spatial component (Table 5). Students thought that they would lose too much time for travelling and therefore, they would have to ignore other obligations. The common reason was great distance to extracurricular activities. Dependence on public transport and the inability to rely on others for transportation was reflected in the frequency of its occurrence. For those students, public transport operated too rarely, or they did not have the possibility of return home in the evening due to early termination of public transport. The poorer connectivity of certain parts of the city and the spatial distribution of public transport lines and stations within the organization of public transport also affected the ability to attend extracurricular activities.

Reasons	Number of students	Share (in %)
Loss of time	14	42.4
Great distance	10	30.3
Frequency of public transport	5	15.2
Organization of public transport system	4	12.1
Total	33	100

Table 5: Reasons for the inability to participate in the extracurricular activities due to transport (Source: survey).

For the named reasons it was also necessary to determine the spatial aspect of highly disadvantaged students, namely those, who could not attend extracurricular activities because of transport. Figure 1 shows that the vast majority of these students lived in neighbourhoods away from the city centre. It has to be noticed that most of these students lived in the southern part of the City of Zagreb, which is highly disadvantaged part of the City. These are the parts of the city where public transport operates less frequently than in wider city centre. There were students from the sub mountainous area of Zagreb, as well as from the far west and far east of the City, the parts usually characterized with lower number of public transport lines.

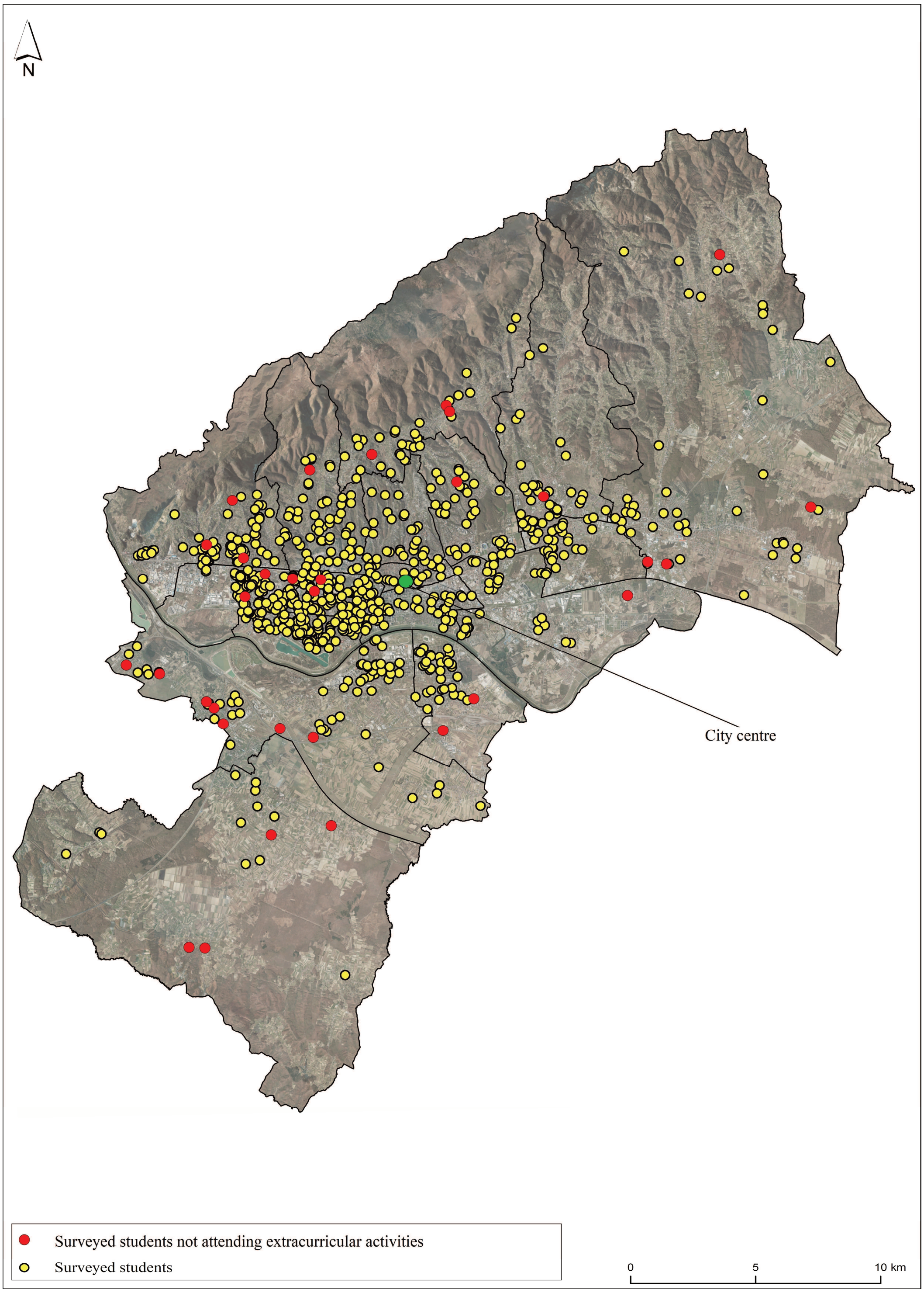

Fig. 1: Spatial distribution of secondary school students in the City of Zagreb unable to attend extracurricular activities because of transportation (Source: survey; DOF, 2012).

It has already been mentioned that transport could affect people's social interaction. It can be assumed that participation in some activities could increase the intensity of social interactions, and thus increase the number of friends. Therefore, it was of interest to investigate whether the participation in extracurricular activities affected students' social interactions and whether there was a difference between students who participated in extracurricular activities and the ones who did not participate due of transport. As a variable defining the intensity of social interaction, a number of good (close) friends was taken. Firstly, the relationship between engagement in extracurricular activities and the number of good friends was explored.

All the surveyed students were included in the analysis, meaning that the students that did not participate in extracurricular activities were also analysed. Correlation analysis showed that there was no statistically significant correlation between (non)attending extracurricular activities and the number of close friends ($r = 0.018$; $p > 0.05$).[3] On the other hand, if the analysis of the relationship between the weekly attendance of extracurricular activities and the number of good friends included only students engaged in the extracurricular activities, there was a slight but statistically significant correlation between these two variables ($r = 0.150$; $p < 0.01$). It can be assumed that students who attended extracurricular activities several times a week also had a greater number of good friends as friendships could be strengthen by more frequent attendance. Taken this fact into consideration, it was assumed that students who did not attend extracurricular activities because of transport had fewer good friends than those who attended these activities. For this purpose, data on the number of good friends between these two groups of students were compared, but there was no statistically significant correlation ($r = -0.060$; $p > 0.05$). The average number of good friends of students attending extracurricular activities was 7.2. The number of good friends of students who were not attending extracurricular activities due to transport was slightly higher and is 8.5, which may be the result of the student sample being examined. However, it is indicative that 23 out of 33 students (70%) who did not attend extracurricular activities had number of good friends below the average in comparison to students who attended extracurricular activities. Therefore, there were indications that there was a correlation between social interactions, i.e. the number of good friends and attending activities (in this case extracurricular activities). Still, the obtained sample of students not participating in the extracurricular activities because of transport was too small, thereby limiting the use of correlation analysis. They lived in the periphery of the City of Zagreb, so the aforementioned facts were a pledge for a potential future study of the impact of transport on extracurricular activities in specific city neighbourhoods with special emphasis on the peripheral areas of the city.

5 CONCLUSION

This paper discusses issues of interrelationship between transport disadvantage and one segment of everyday life of secondary school students, on extracurricular activities. Taken that secondary school students are often considered transport disadvantaged social group, research has shown that transport had a certain impact on their extracurricular activities. This was most evident in the problems that students experienced travelling to these activities. In addition, some students expressed their opinion that transport affected the accessibility of extracurricular activities. Students living in the peripheral parts of the City of Zagreb had most problems. It is particularly important to emphasize the existence of students who were not able to participate in any extracurricular activity due to transport.

Not so many studies deal with the interrelationship of transport disadvantage and everyday life of young people. In order to reduce the level of transport disadvantage and prevent social exclusion, more researches with multidisciplinary approaches are needed. In addition, issues of transport disadvantage and social exclusion should become part of social and transport policies. In the end, awareness about these problems should be raised in order to improve the quality of life and achieve the transport and social justice of all social groups.

6 REFERENCES

AL-ANSARI, Asim; Al-Harbi, Fahad; AbdelAziz, Wafaa; AbdelSalam, Maha; El Tantawi, Maha M.; ElRefae, Ismail: Factors affecting student participation in extra-curricular activities: A comparison between two Middle Eastern dental schools. In: The Saudi Dental Journal (ISSN 1013-9052), Vol. 28, Issue 1, pp. 36-43. Amsterdam, 2016.

CLIFTON, Kelly; Lucas, Karen: Examining the empirical evidence of transport inequality in the US and UK. In: Running on empty: Transport, social exclusion and environmental justice (ed. Lucas, K.). Bristol, 2004.

COHEN, Louis; Manion, Lawrence; Morrison, Keith: Metode istraživanja u obrazovanju (Research Methods in Education; In Croatian). Jastrebarsko, 2007.

COUNCIL FOR CHILDREN OF THE GOVERNMENT OF THE REPUBLIC OF CROATIA AND NATIONAL INSTITUTE FOR PROTECTION OF FAMILY, MATERNITY AND YOUTH. 2003. Eticki kodeks istrazivanja s djecom (Code of Ethics of Research with Children; In Croatian). Available from Internet: http://www.ufzg.unizg.hr/wp-content/uploads/2013/12/Eticki-kodeks-istrazivanja-s-djecom.pdf [Accessed 15 May 2017].

CULLINANE, Sharon; Stokes, Gordon: Rural Transport Policy. Amsterdam, 1998.

[3] Variables related to (non)attending extracurricular activities are coded as follows: 0 – I do not attend extracurricular activities, 1 – I attend one extracurricular activity; 2 – I attend two extracurricular activities; 3 – I attend three or more extracurricular activities.

CURRIE, Graham: Young Australians: No Way to Go. In: No Way To Go – Transport and Social Disadvantage in Australian Communities (eds. Currie, G., Stanley, J., Stanley, J.). Clayton, 2007.
DIGITAL ORTOPHOTO 2012 (DOF 2012), Geoportal of Zagreb infrastructure of spatial data. City of Zagreb. Croatia.
DODSON, Jago; Gleeson, Brendan; Sipe, Neil: Transport Disadvantage and Social Status: a review of literature and methods No. 5. Brisbane, 2004.
FYHRI, Aslak; Hjorthol, Randi: Children's independent mobility to school, friends and leisure activities. In: Journal of Transport Geography (ISSN: 0966-6923), Vol. 17, Issue 5, pp. 377–384. Amsterdam, 2009.
GASPAROVIC, Slaven: Theoretical postulates of transport disadvantage. In: Hrvatski geografski glasnik, Vol. 78, Issue 1, pp. 73-95. Zagreb, 2016.
HAN, Sehee; Lee, Joongyeup; Park, Kyung-Gook: The impact of extracurricular activities participation on youth delinquent behaviors: An instrumental variables approach. In: Journal of Adolescence (ISSN: 0140-1971), Vol. 58, pp. 84-95. Amsterdam, 2017.
HOPKINS, Peter: Young people, place and identity. New York, 2010.
HORTON, John; Kraftl, Peter; Tucker, Faith: Spaces-in-the-making, childhoods-on-the-move. In: Children and Young People's Spaces (eds. Foley, P.; Leverett, S.). Basingstoke, 2011.
HOYLE, Brian; Knowles, Richard: Modern Transport Geography, Second revised edition. Chichester, 1998.
HURNI, Anne: Transport and Social Disadvantage in Western Sydney: A Partnership Research Project. Parramatta, 2007.
HURNI, Anne: Marginalised groups in Western Sydney: The experience of sole parents and unemployed young people. In: No Way To Go – Transport and Social Disadvantage in Australian Communities (eds. Currie, G.; Stanley, J.; Stanley, J.). Clayton, 2007.
JOHANSSON, Maria: Environment and parental factors as determinants of mode for children's leisure travel. In: Journal of Environmental Psychology (ISSN: 0272-4944), Vol. 26, pp. 156-169. Amsterdam, 2006.
LIN, Jen-Jia; Yu, Tzu-Pen: Built environment effects on leisure travel for children: Trip generation and travel mode. In: Transport Policy (ISSN: 0967-070X), Vol. 18, Issue 1, pp. 246-258. Amsterdam, 2011.
MCWHANNELL, Fiona; Braunholtz, Simon: Young People and Transport. Edinburgh, 2002.
MURRAY, Alan T.; Davis, Rex: Equity in regional service provision. In: Journal of Regional Science (ISSN: 1467-9787), Vol. 41, Issue 1, pp. 577-600. Chichester, 2001.
ROSIER, Kate; McDonald, Myfanwy: The relationship between transport and disadvantage in Australia. Melbourne, 2011.
SOCIAL EXCLUSION UNIT (SEU): Making the Connections: Final Report on Transport and Social Exclusion. London, 2003.
STANLEY, John; Stanley, Jannet: Improving Public Transport to meet Community Needs: A Warrnambool Case-study. Bus Asociation Victoria and Warrnambool Bus Lines. Melbourne, 2004.
SILJKOVIC, Zeljka; Rajic, Visnja; Bertic, Daniela: Izvannastavne i izvanskolske aktivnosti (Extracurricular activities, In Croatian). In: Odgojne znanosti (ISSN: 1846-1204), Vol. 9, Issue 2, pp. 113-145. Zagreb, 2007.
TAL, Gil; Handy, Susan L.: Children's biking for non-school purposes: getting to soccer games in Davis, CA. In: Transportation Research Record (ISSN: 0361-1981), Vol. 2074, pp. 40-45. Washington, 2008.
WINTER, Ian: Young People Living on the Urban Fringe. In: Family Matters (ISSN: 1832-8318), Vol. 38, pp. 43-45. Melbourne, 1994.
YIGITCANLAR, Tan; Kushairi, Rashid; Dur, Fatih: Sustainable Urban and Transport Development for Transportation Disadvantaged: A Review. In: The Open Transportation Journal (ISSN: 1874-4478), Vol. 4, pp. 1-8. Sharjah, 2010.

reviewed paper

"Ugly Truth" about Social Participation on the Example of First Woonerf in Poland

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1 INTRODUCTION

Following article serves the purpose of executing a specialized analysis and evaluation of an urban project from theory of citizens participation point of view. It is a field of science, balancing between sociology, urbanism, economy and even politics. Urban project I chose as an example has been conducted within borders of Łódź, third biggest city in Poland. In june 2014 municipal council office on a single block of 6th Sierpnia street has finished first *woonerf* in Poland creating an unprecedential kind of public space in the country.

Original word *woonerven* comes from a dutch language and it has been adapted by english language and became a *woonerf*. Polish language does not allow to translate it easily and the English version is officialy in use, but also commonly used is a non formal transcription, urban courtyard.

According to definition from an Oxford Living Dictionary *woonerf* is „*a road in which devices for reducing or slowing the flow of traffic have been installed*". Quoted definition explains only technically what a *woonerf* is, but for full picture we need to identify the question *woonerf* is trying to answer.

In the begining of XIXth century, street was a different space than we can see nowadays according to Charles Montgomery in his recent book titled „Happy city: Transforming our lives through urban design". He recalled a memory of the street from before age of cars, *Through most of history, cities streets were available for everyone. Road was equally a marketplace, a playgroung, a park and yes also a thoroughfare, but without street lights, lanes painted on the ground or designated pedestrian crossings. Till 1903 no city even had a traffic code. Street was open for everyone, so everyone was using it. Street was quite a chaotic environment, covered with horse manure and cutted from time to time by speeding carriages, but as it goes with disorder, reigned on her some sort of liberty and freedom.* I would like to add this feeling to the definition, the idea to bring the street back to basics and return this lost space in the hands of citizens. *Woonerf* creates a new form of urban space in which everyone, cars, pedestrians, trams and cyclists move together in harmony. With priority for walking users, before forced to slow down motorized ones. *Woonerf* is the final product of reinventing small streets in downtowns all over the western World. The idea to take the street to the origins, when it was a space for citizens and for the city, and Technical Oxford Living Dictonary definition just states a tools to create it.

Case of the Polish *woonerf* became good experimental ground for different models of citizen participation. This article confronts participants of described process with each other in selective relations on all phases of the creation, allowing us to see advantages and disadvantages in all of the relations. As a basis for analysis I chose models from two existing publications, Sherry R. Armstein paper titled „A Ladder of Citizen Participation" from 1969 and „Public Participation in Planning: New Strategies for the 21st Century" by Judith E. Innes and David E. Booher from Institute of Urban and regional Development UC Berkeley published in 2000.

Process of rebuilding the 6th Sierpnia street started almost two years before the actual construction work began. Many stakeholders have been involved in the proces, as they have their rights and duties as well as goals and priorities. Each investment in changing public space using public funds requires conducting, defined by acts of law, tenders or consultations. This required order was revised in the analized example, in our case study consultation with citizens were not obligatory at this stage of the process. The need of organizing them ocure when initiators realized how strong might be the argument of support of the closest inhabitants in negotiations with Municipal Office. At the end many participants were involved in the proces of creation of the first *woonerf* in Lodz. By studying the relations between stakeholders we can gather the knowledge about science of social participation, communication planning, in the regional and local startegy of development planning processes.

Keywords: woonerf, city street, small public space, spcial participation, transport planning

2 METHODOLOGY

2.1 Model 1

Short essay was published in 1969 entitled „A Ladder of Citizen Participation” in Journal of the American Institute of Planners (JAIP). This essay was written to broaden the conciousness of politicians, architects, town planners and others. about opportunities in usage of a social participation. The article can be used as a guidance to distinguish forms of participation, represented by metaphorical rungs of the title „ladder of participation“. Article was an answer to rising need of involveing american society of the sixties, in local planning and decision processes related to their neighbourhood. Title „ladder“ was a way of graphic description of consecutive forms of the social participation and arranging them in order, according to amount of power in citizens hands. PArticipation forms have been divided into eight rungs in three groups. Group number one „nonparticipation” involves manipulation and therapy, group number two „tokenism” with informing, consultation and placation included, and group number three „citizen control”, containing rungs of partnership, delegation and citizen control. I will assign those categories to individual cases. To define on which rung of the ladder are particular relations between the stakeholders the *woonerf* case, from city administration side and from citizen and nongovernmental organization side.

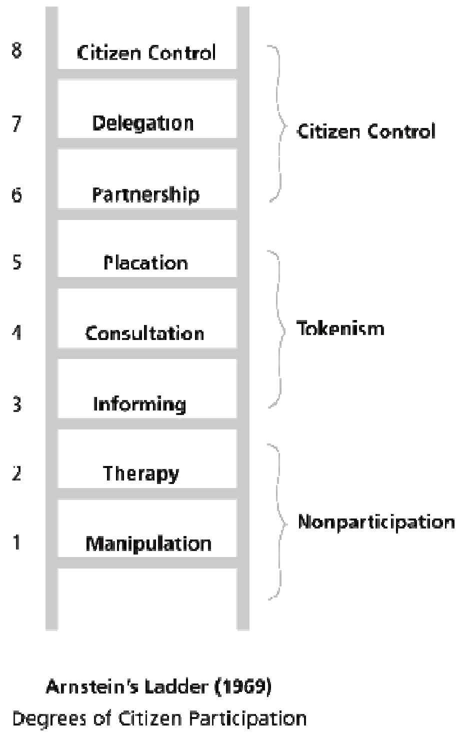

Fig. 1: Eight rungs of ladder of social participation.

2.1.1 Manipulation

Participation in illusory form, citizens are not sufficiently informed and have no possibilities to influence development proces. Strategic decisions are not being made according to citizens feedback.

2.1.2 Theraphy

Participation in use as a remedy, focused on healing the symptoms of social pathologies rather than repairing whats causes the pathologies first.

2.1.3 Informing

One way transfer of information about plans and strategies from powerholders to citizens. Basic first step for citizen participation in planning the development strategies. Lowest positive rung on proposed ladder.

2.1.4 Consultation

Form of participation allowing citizens to express their opinions, with no guaratee of influence on final decisions. In Poland it is defined and obligatory engagement of citizens in development process of acts of local plans and strategies.

2.1.5 Placation

In this form citizens actually participate in the process, as consultants and future users. They do not have guaranteed leverage in final decision making, however powerholders are more likely to listen and with proper technical support citizens can have real impact.

2.1.6 Partnership

More sophisticated form of placation, participants have the guaranteed impact on final decisions. Arrangement possible to achive only if non-governmental organizations are strong enough.

2.1.7 Delegation

Powerholders have less power in decision making process than citizens and starts with lower negotiation position while deciding about strategic movements.

2.1.8 Citizen Control

Higher, utopian form of participation. Society makes most of the decision during process leaving powerholders with less power in negotiations.

2.2 Model 2

In 2000 on an annual conference of Assiociation of Collegiate Schools of Planning the paper by Judith E. Innes and David E. Booher hes been presented,. It was aa attempt to summerize current means of social participation and an attempt to set development directions for XXI century. Article presents different approaches to participation in planning, based on case studies of cities in North America. Authors created their own model of evaluation for analysis and classification of executing social participation in real life. Model called „Four Models of Planning and Policy Making" can be unified and easily applied for our case evaluation. Table distinguishes four possible appraoches to planning processes depending on diversity of participants intrests and on interdependancy of those intrests.

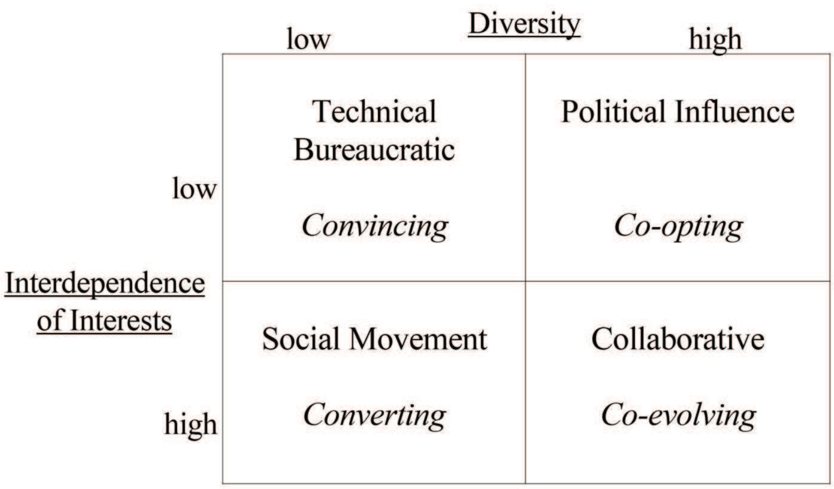

Fig. 2: Four Models of Planning and Policy Making.

2.2.1 Technical Bureaucratic – Convincing

In top left with low diversity and low interdependency of intrests we have got model called „Technical Bureaucratic – convincing" in which powerholders relay on countable and classifiable data. In this model decisions are made based on charts of predictions, growth or income. There is not much room left for citizens point of view. Consulting plans and strategies with citizens forces to gather and process significant amount of data which requires financial contribution and human resources. Underpayed and ordinary local

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groups and organisations do not have enough resources in dispose of. Participation is reduced to simple informing and placate conflicts of intrests post factum.

2.2.2 Political Influence – Co-opting

In top right window with high diversity and low interdependancy of intrests is properly located model of „Political Influence – co-opting", introduced originaly by Banfield in 1961. Approach in which planning and strategies are not a result emerged after consultations and analysis but are an outcome of backstage politicaly controled decisions. Conventional social participation is undesirable or even become a threat.

2.2.3 Social Movement – Converting

In bottom left window with low diversity and high interdependance of intrests we can find model of „Social Movement – Converting", when thriving and well managed non-governmental organization are able to affect powerholders. Organizations are focused on their targets and attract people with corresponding ideology, which is desirable, otherwise with too high diveristy of intrests/ideologies this model could not work. However actions based on strong ideology are not susceptible to arguments off other participants points of view. In this model there is a high risk of confrontation between sides making compromise harder to accomplish.

2.2.4 Collaborative – Co-evolving

In last, bottom right part window with high diversity and interdependance of intrests arrises model titled „Collaborative – co-evolving". Approach highly utopian, with dialog as most important element. Uninterrupted dialog between all participants, every participants intrests to be taken into consideration, all sides to be equally informed and only when all participants gain democratic consensus, dialog ends, these are elements which have to occur according to J. Innes and D. Booher to achive a full collaboration. Collaborative model is most desired one, with possibility to fullfill a variety of demands and most important needs of citizens. Co-working of many people with interdependant goals allows to gain more than working independant.

I eill use presented and described two models of classification, to analize the process of creating the first Lodz woonerf. First allowed me to define the degree of quality and conditions of social participation and secondly, the role of social participation in diverse approaches to planning processes relative to degree of diveristy and dependancy of intrests.

3 CASE STUDY

The idea was born in a head of a private citizen, not an employee of any kind of municipal department or non-governmetal organization. He graduated from the Technical University of Łódź and „borowed" a western european w*oonerf* solution, to apply into reality of Łódź city centre. He created a street rebuild proposal for the city centre, and presented it to city officials and street and transportation department representatives. Authorities had their hands tide up by Planning and Development Strategy for City of Łódź and transportation changes caused by an ongoing construction of Lodz New City Centre with new underground train and bus station. Arguments about superiority of the proposed *woonerf* solution was not suported by actually operating acts of law and accepted strategies. At this point *woonerf* originator supported by friends, small architect office and local non-attached organization, arranged a special meeting to consult undertaken project. Only citizens from closest neighbourhood has been invited and informed about this targeted consultation. But only documented and official support of interested tenants and inhabitants of 6 Sierpnia street could give basis for change the validated strategies for New City Center and change status of the street in transportation planing.

Outcome from consultation appeared beyond expectations. Concept for 6th Sieprnia street met full support from gathered citizens and local businesses owners. Report from this meeting was presented again to Municipal Office and transprtation departments representatives. Despite the positive results, officials could not change the budget for the current year. Thanks to a coincidence, year 2013, was the first year of new governmental programme, called civic budget. Specially reserved amount of public funds were to be designated on social and urban projects, which could be submitted and voted by all City inhabitants. Project for application has been made with cooperation with transportation department to make sure that all parts were going to be positively considered be authorities during projects evaluation phase. Final project was submitted to civic budget program. At this stage local media started to be inerested in *woonerf* idea for Łódź downtown. Also concept of new 6 Sierpnia street hit the first pages on social media websites and become highly recognizable while going through long process of acceptation and compatibilty with city strategies by sequent city departments. All departments have given green light to *woonerf*, with the exception of City Architect Office, which was not in favour of it. 6 Sierpnia street in his plans was going to become one of major inner city center streets leading to new central train station Łódź Fabryczna. Changing it to pedestrian area with reduced traffic flow, was not in City Architect plan for Łódź communication. Social media gone wired, Łódź activists and non-governmental organizations who were for this change took a lot of effort to create an open discussion about City Architect Office plans and to keep citizens informed.

City Architect Office could not ignore growing support for this street re-construction from majority of citizens. Not only for new appearance of future 6th Sierpnia street, but mainly because idea for this change met complete understanding. After few weeks of dialogue, Architect Office gave up and project was accepted for voting. Project ended up on a podium, another indirect signal of full suport for a new kind of public space from citizens. After two years of struggling reconstruction was finished and new 6th Sierpnia as a *woonerf* was opened for public.

4 METHODOLOGY IMPLEMENTATION

4.1 Originator – City Council Office relation:

4.1.1 Model 1

Through actions and determintion of originator in dialog with authorities we can place this relation on the sixth rung of participation ladder „parnership". Private person, not attached, propose a project, and it assumptions were not changed but only fitted for legislations and technical restrictions during final phase. We witness mature form of cooperation between open and friendly city office and well educated and informed, in other words, properly prepared private citizen.

4.1.1 Model 2

Same relations in second model we can assign as a special case of „social movement – converting". Special, because originator was working alone, at least at the begining,. Not as a established and well-funded organization, and still he managed to introduce this initiative, and negotiate it to an end, in almost original and unchanged form.

His relations with Transport Department was a bit different, we can desribe them by bottom right part of „four models of planning", collaboration – co-evolving. In contradiction to City Architect Office, no one had to change priorities or goals and interdependance of intrests was very high. Only through dialog as equals, carefull listening everyone's arguments, compromise can be reached.

4.2 Originator – citizens relation

4.2.1 Model 1

Despite honest and rightfull reasons for citizen consultation that has taken place during described process we can easily find sympthoms of lowest rung from our lader „manipulation". Consultation were not obligatory from legal point of view. Understanding pople needs and idea of how they imagine their street was not the purpose of these consultations. Consultations were only needed for their power as an argument with authorities. Original project have not erected on the basis of consultation, nor has it been changed after them. The only goal of this meeting was to intruduce to citizens and tenants finished solution and convince them to give approval. I would like to mention at this point, I am not saying *woonerf* is something, citizens do not need, after three years since first *woonerf* was opened without a doubt we can be sure it is needed and desired. Despite altruistic and positive reasons, consultations process ended up as a manipulation. Honest two way discussion was lost, because the imprtant part was only final score, having citizens for or against the change.

Another peculiar decision was how representants of Łódź citizens were chosen for the consult, who at the end decided of how reconstructed street will look like. For unknown reasons inhabitants and tenants invited and welcomed, were only those directly related to 6 Sierpnia street at that time. Decision was made, all Łódź citizens have been be represented by few closest ones, without considering the fact that not only them will be users of created space. Rest of Łódź was ignored, until *woonerf* needed suport in social media and voters in civic budget. We were witnessing tokenism in social participation. Tokenism with informative character followed by manipulative consultation when part of the society was given special decissive rights only by their accomodation address.

4.3 Non-attached ogranization – City Council Office relation

4.3.1 Model 2

While executive project after voting was emerging, transport department had full control over decisions about final shape of 6 Sierpnia street. At this point they realized the original concept has to be changed. During earlier stage of negotiations there were no obligations for modifying its shape, but eventually mechanisms of technical bureacracy – convincing from top left part of second model had taken over. Department goal was to make sure that project would not cost more than estimated in budget and simultanously ensure for all users undisturbed access and transit. Number of parking spaces overestimated on conceptual stage turned out to be impossible to achive. Ideological aspirations of involved organization had to be suppressed. Street has not became car free, Piotrkowska street, Łódź central and commercial passage road nearby, required delivery connection. Original project met reality and has to be trimed, but on this stage no additional consultaton has taken place to make sure of the suport form citizens.

4.4 City Architect Office – civic budget (citizens) relation

4.4.1 Model 2

One of most important stakeholder in our proces turned out to be only one in opposition to 6th Sierpnia street reconstruction. City Architect Office did not want to give up his plans of making transition street for new train station on other side of city centre. Even if this plan was almost impossible to achive from other unlinked reasons. This argument followed by full support from citizens and local media, traditional and social, with acceptation by Municipal Office made them change their decision, and project got green light for voting. City Architect Office until this stage worked according to political influence – co-opting. City Architect Office with high diversity and low interdependance of interests with other participants still stubbornly kept his original decision despite the inability to achive its assumptions. Decisions that has been made by politicians, as inside department planing proccess, without another consultation.

5 CONCLUSION

Summarizing, even if discussed process ended up with a positive outcome we can not ignore the fact, that showed methods of participation were not executed properly. By „properly", I mean considering every aspects and all possible participants equally. There were few sides involved in this discussion, everyone had something to gain and loose. We could distinguish elements of productive partnership, deliberate manipulation and tokenism „dressed up" in citizen consultation. Social movements with immense influence on political decisions and technical bureaucracy brought ideas back to reality. Process was partially inverted, in comparision with governmental, conducted strictly by acts of law, social consultation, because it was not an initiative started by public authority but by a non-attached citizen.

What can we deduce from analysed process for the future social participation development in planning? Firstly, social movement actions defenately increase the chance for citizens to induce reaction on powerholders. Effective scope of the impact of non-governmental organizations and their resources should be used in purpose of gathering as many followers as possible. Initiative of organization monitoring powerholders actions and supplying private individuals with knowlegde and resources should be supported and encouraged by the local authorities. It is in their best interests to cooperate with them to keep decisive power.

Secondly well informed citizens are able to make preferable, for them and for the city, decisions. Analysis of *woonerf* programme also shows us how innovatively comprehended mobility of the individuals can change the small public space in the city, how common goal brings strangers together through modern social media networks, and finally how people can collectively work together, when they know, their voice is going to be heard by openminded authorities. Small project of first *woonerf* helped citizens of Lodz feel united and make them a bit prouder of the city they live in.

Thirdly, civic budget proved to be an initiative worth keeping, where citizens can give their opinion about future trends and small contribution to appearance of their city. Furthermore process of creation of the first *woonerf* and medial storm around it, take place during the first year of the civic budget in Lodz and the first voting was properly popularized by it. Analyzed initiative gathered for the civic budget needed publicity which continues uninterupted to this day, getting more and more public every year since, with number of submitted projects constantly increasing. Tool originally provided for citizens by powerholders to keep them ostensibly happy, ultimately went out of control and gave the people power to sufficiently satisfy their needs in local scale. Civic budget became a tool which transformed spectators into initiators of changes in the city. On one hand powerholders are getting continous feedback from citizens about their needs, and on the other hand everyone can make a difference, reshape the city parts, help local institution or organize event to connect people.

Fourthly informed and consulted citizens, even if their opinion would not change already made plans, are at least not surprised by incomprehensible decisions of powerholders. This comfort makes them feel partially involved and included in city social life.

Fifth and last, not all initiatives should comes from powerholders. Private citizens can accurately spot a need or an oportunity to create something usefull and valuable for the rest of us. Administration should listen closely and carefully their own electorate.

6 REFERENCES

MONTGOMERY, Charles: Happy City: Transforming Our Lives Through Urban Design. Cracow , 2015.

ARNSTEIN, Sherry R.: A ladder of Citizen Participation. In: Journal of the American Institute of Planners, Vol. 35, Issue 4, pp. 216-224, July 1969.

INNES, Juduth E., BOOHER, David E.: Public Participation in Planning: New Strategies for the 21st Century. In: Paper prepared for the annual conference of the Association of Collegiate Schools of Planning,, November 2-5. Berkeley, 2000.

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🏆 *reviewed paper*

Urban Emotions and Realtime Planning Methods

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1 ABSTRACT

The Urban Emotions approach combines methods and technologies from Volunteered Geographic Information (VGI), Social Media, sensors and bio-statistical sensors to detect people's perception for a new perspective about urban environment. In short, it is a methodology for gaining and extracting contextual information of emotion by using technologies from real-time human sensing systems and crowdsourcing methods. "Real-time planning" describes a system in which planning disciplines get a toolset for a fast and simple creation of visualization or simulation from municipal geodata in a consistent workflow. This includes applications from Virtual Reality, Augmented Reality as well as the above mentioned combination of real-time humane sensors and urban sensing systems. Due to the fact, that a real existing city never corresponds with a laboratory situation, Virtual Reality can be one of the solutions to fill the gap for detecting people's perceptions concerning design, while filtering other unintended side effects. Insights and results from Urban Emotions project, granted by German Research Foundation and Austrian Science Fond, will be presented in this contribution. It is based on a German contribution, published earlier this year (Zeile 2017).

Keywords: walking, 360° cameras, people as sensors, virtual reality, cycling

2 REAL-TIME PLANNING

Real time planning and the development of simulation and visualization methods in urban planning was published in 2010 (Zeile 2010). This contribution gives a short overview, how new technologies support this approach contemporarily, and how they can be used in urban and spatial planning.

"Real-time planning is defined as a dynamic system, in which users be informed with an interactive experience concerning planning principles and issues" (Zeile 2013, p. 26). Urban planning should be improved through clearness, transparency and an easy understanding in a – if possible – three-dimensional environment (Zeile 2010, p. 106). A targeted and tailor-made data processing and data treatment especially build for use in urban and spatial context are the core elements of this method. „Not technology of presentation is the key, but technology has to support communication for a better understanding of planning goals and an implementation in urban areas. Urban planners need to have the skills to use this method and also must have an holistic knowledge in traditional planning methods and the use of technology for their daily work" (Zeile 2013, p. 26).

Another approach in this context is "Live Geography" (Resch et al. 2010b) with a "near real-time" (live) analysis of spatial data from sensor networks. All the essential components for a near real-time analysis were covered in this method: stationary sensors (Sagl et al. 2012), intelligent mobile sensors (Resch et al. 2010a) and sensor fusion mechanism for the integration of data (Resch 2012) as well as web data processing for real time decision support systems (Sagl et al. 2012). In conclusion, "Live Geography" is main core of "Urban Emotions-Approach" (Zeile et al. 2014). Previous studies, described as "emomaps", were also integrated in the "real-time-planning" approach (Zeile 2010, 216 pp.). Linking element is the so called "plan-communication" (Fürst and Scholles 2008, p. 198), an adopted method of the well-known "communication theory" (Shannon and Weaver 1949) for spatial planning. The contribution "Sich ein Bild machen" (Berchtold 2016) is one contemporary example of knowledge which workflows in using GIS are essential for planners today with a focus on applied urban GIS workaround.

To sum up, spatial analysis should visualise changes in spatial structures over time. Discussions concerning slow processes, but in case of urban environment, fast changes with their own dynamics, can be organized (better) with support of these tools.

3 DYNAMIC AND SPACE

In general, there is a simple difference in visualisation methods dealing with the aspect of "dynamics":

- Visualisation of dynamism of spatial processes

- Creating virtual environments

Dynamics of spatial processes work with data streams along a time axis – “gathering a (spatial) phenomena over time” (Streich 2011, p. 189) – also known as “spatial monitoring”. In virtual environments, users have the possibility to emerge immersive dynamic impression by using the so called “first person view” (FPV). Consequently, the following two chapters deal with these topics. A brief introduction to the theme field of Augmented Reality and Virtual Reality in urban planning and architecture can be found in Broschart (2013) and Höhl & Broschart (2015).

3.1 Virtual Reality

Well-known technology for representing dynamics from “ego perspective” is the Virtual Reality. Virtual reality methods (VR) represent models of real situations in a digital environment or even manipulate them for planning purposes. Origin VR concepts were – compared to today’s comprehension- not reduced to two senses “looking” and “listening”, but were more immersive seen in a more open context and integrated senses like “touching” via specially designed interfaces (Streich 2011, p. 229). In addition, former VR environments were characterised by high hardware requirements and special output devices (Wietzel 2007), whereas actual stereoscopic VR environments are using standard desktop computers and VR eyewear such as the Oculus Rift or HTC Vive, out of the box customer products. Even low budget systems, the so called card-boards, can turn a smartphone into a VR glass, which can be used in planning processes and in a multidirectional communication process with citizens (Dübner 2014). New optical systems such as 360° cameras as well as available 3D city models i.e. based on Google Earth can create a virtual, immersive environment in a fast workflow (Folz et al. 2016). Especially GoPro360° camera seems to be suitable for a quick setup of existing situations. Omni Rig is a synchronized, six camera array, which stitches the collected clips in an automatic post-processing to a virtual 360° movie.

The following combinations have proven to be successful and suitable for "real-time planning":

- Sketchup, Unity Engine, and Oculus Rift (Dübner 2014),
- Sketchup with Kubity (Folz et al. 2016)
- Standalone VR without glasses, creation with City Engine and visualisation via Lumion (Broschart 2013; Buschlinger et al. 2016)
- Youtube 360 ° -VR (Folz et al. 2016), which is a kind of precursor to virtual reality

Especially Unity3D-Game Engine offers a good to handle workflow to create virtual 3D-models for VR-glasses out of (municipal) geodata or out of architectural drawings.

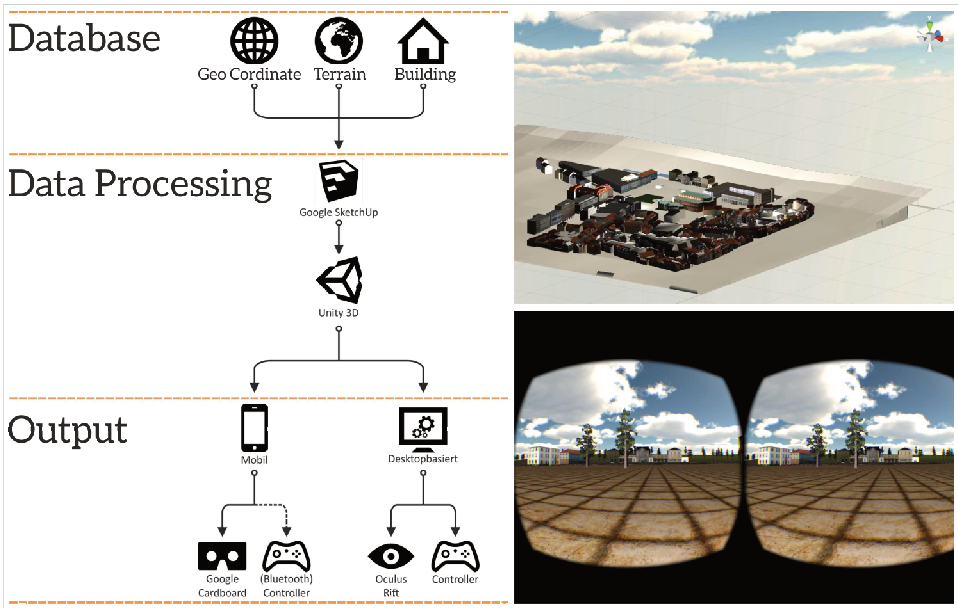

Fig. 1: Exemplary workflow via Unity3D (left) as well as the integration of the 3D model into Unity and as a binocular representation in Oculus Rift (Zeile 2017).

The engine processes almost all known 3D-formats, and also supports technologies like bump mapping, texture mapping and ambient occlusion (Unity Technologies 2017). A simplified workflow about integration of a 3D city model into Unity game engine as well as its output to a VR device is shown in figure 1.

A characteristic for planning processes is that there is usually not "one way" or the blueprint for an always perfect VR visualization. In many cases, a try-out of new techniques for new planning approaches is necessary. A mentionable example for this “adoptive approach” is the workflow of modelling with City Engine and Lumion (fig. 2). This workflow was tested in the "Urban Cable Cars" project, which deals with different visualisation tools for communication processes during the planning stages of integrating a cableway in urban areas. It started with the idea of a simple photomontage of the design impacts of the cableway to the city. Like always in iterative processes, new requests came up, requests like photorealistic films, virtual reality as well as mixed reality technologies seemed to be an adequate instrument (Fig.3). Thus, it was essential to develop a method which allows to implement all requirements with the same data and less additional processing steps quickly (fig. 2).

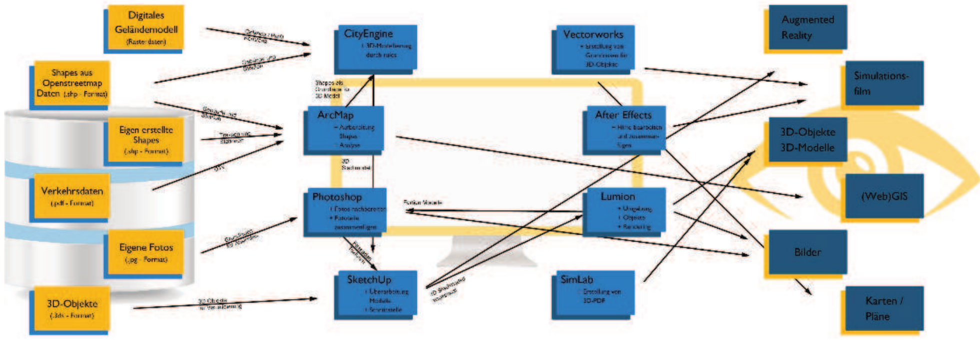

Figure 2: Processing of digital (geo-) data during the Urban Cable Cars project (BUSCHLINGER et al., 2016).

Figure 3: 3D city model of the city of Konstanz, generated in CityEngine (1) and visualized as a real-time model with planning-relevant content in Lumion (2), mixed reality film from a car (3) (BUSCHLINGER et al 2016).

3.2 Augmented Reality

In contrast to Virtual Reality methods, in which all content is captured and visualized digitally, Augmented Reality overlays digital content with reality. A complex modelling of the whole physical environment can be avoided in an ideal case. Real situations are equipped with additional digital information, so that all the objects can interact and communicate with CPU. So, a digital sketch of a new building can be overlaid in real time with a real situation through superimposition, like in a traditional photomontage (Streich 2011, p. 229).

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The reality is thus "expanded" or "enriched". Milgram & Colquhoun refer to Augmented Reality as the "computer-assisted superposition of human sense perceptions in real time" (Milgram and Colquhoun 1999; Zeile 2010, p. 28). AR systems superimpose the reality with visual, acoustic and haptic information in real time (Höhl 2009, p. 10). "According to these methods, it is no longer necessary to model the complete environment, but it is theoretically conceivable to project only the virtual model of the project into the real existing reality. Through this interaction between virtual and real elements, the degree of abstraction of the representation for the interested viewer diminishes, so he can get quickly into the scenery " (Broschart et al. 2013).

A system for the representation of augmented content consists of four elements (Höhl 2009; Zeile 2010; Broschart 2013):

- render unit, i.e. a computer with software that processes and visualises the data,
- a tracking system that can locate the user/viewer in the virtual space. Depending on the system, this positioning can be done via satellites, a virtual coordinate or via an image comparison with the environment,
- recording sensor, usually a camera system as well as
- a display component.

Particularly in the dynamic market of display system, four systems have been developed which are suitable for real-time planning:

- Optical See Through (OST), with the well-known representatives such as Google Glasses or Microsoft HoloLens.
- Video See Through (VST), as in principle the HTC Vive or Oculus Rift, if the real situation is recorded with a camera and the possibility of overlaying with virtual content is given.
- Projected Augmented Reality (PAR), in which virtual information is projected onto a surface.
- Monitor AR (MAR), where either a monitor or a mobile display is used to display the virtual content, in example on a smartphone or tablet.

Due to the high availability of smartphones and tablets, a number of apps have emerged which can display these contents. However, the disadvantage every app needs its own programming environment, the mechanism of creation, georeferencing and display of information is quite different. One solution for this purpose is the RADAR platform, based on the ALOE environment (Memmel et al. 2010; Memmel 2015a, 2015b). Via a central backend, all information with geo-coordinates can be collected and exported to apps like Junaio, LayAR or Wikitude via a corresponding pipeline including the augmented model in L3D format (Fig. 4).

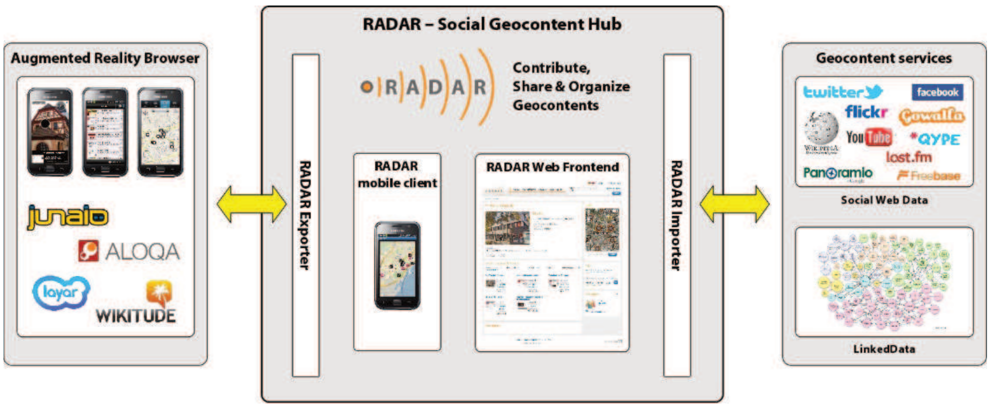

Fig. 4: Structure of the RADAR Social Geocontent Hub including an export option to Augmented Reality Browsers (Memmel and Groß 2011)

A short presentation of suitable software solutions for spatial planning and architecture, evaluated by Broschart (2013), follows up, including software like Layar POI, Layar Vision, AR Media and Sightspace3D.

Layar POI is something like the "classic" augmented reality app for smartphones, which detects the position of the viewer using GPS coordinates. It is possible to stream informations, audio and video files as well as 3D models from the server (Fig.5,1). On the other hand, Layar Vision works independently of GPS signal: the position of the viewer is detected solely by image recognition mechanisms (image markers). The app scans the environment via the camera sensor permanently and provides augmented content as soon as the marker is detected (Fig.5,2). A disadvantage is that this technique only works at predefined viewing angles and is also dependent on light intensity, contrast and season. Both versions can only stream the content, local storage is not possible. This gap fills AR Media, where a local storage on tablet or smartphone is possible. Almost all common 3D formats can be exported and visualised with the help of a QR code and marker representation (Fig. 5,4). Sightspace3D also saves 3D models locally, but users have to position the model on the screen manually. In principle, every model can be displayed at the desired location and moved in real-time on the tablet (Fig.5 (3)).

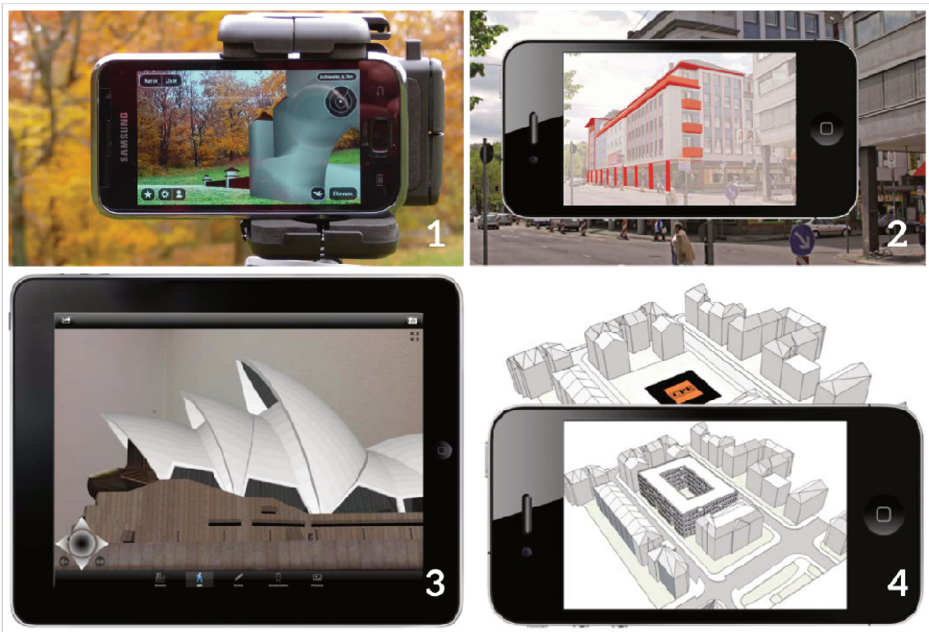

Fig. 5: AR-Software Solution: Layar POI (1) with GPS positioning, Layar Vision marker-based position recognition (2), Sightspace 3D with manual positioning via screen (3) and AR Media with local stored 3D files and marker based recognition (4). (Zeile 2017; with figures from Broschart 2013)

The most important issue using these technologies is, that planners need to think about the planning principles and targets before the decision of one visualisation method. Not the technologically “nice2have”, but a suitable and resource saving workflow is the key for a successful project. For textual information a simple GPS-based solution is sufficient. With increasing details and complexity the requirements for the visualisation methods arise also.

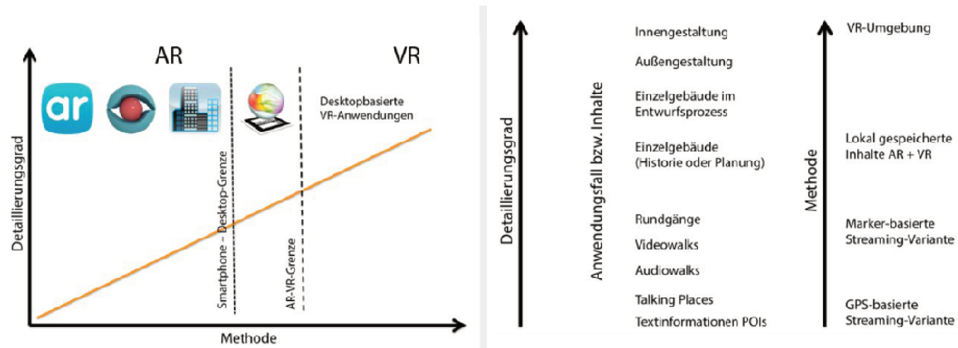

Fig. 6: Overview of the estimated workload of AR and VR technologies for the potential use in real-time planning (Broschart 2013, 62, 63)

However, all presented methods are examples of first-person-view. Laymen can interpret ambiance of new generated spaces and situations much better than on traditional 2D drawings or 3D stills. Translation of

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design and the immersive experience of city support communication processes in spatial planning (Petschek and Lange 2004).

3.3 Urban Emotions & Urban Sensing

Another option to visualise urban datasets in a dynamical way are "people centric urban sensing systems" (Campbell et al. 2006). In combination with Volunteered Geographic Information (VGI) (Goodchild 2007), it is possible to collect, analyse and to share data from users.

The project "Urban Emotions" (development of methods for production of contextual emotion information in spatial planning with the help of human sensory assessment and crowdsourcing technologies in social networks) takes up this approach precisely as well as the discussed topics in previous sections. To keep in mind: the objective is to do "real-time planning" and how to combine approaches of citizens as sensors with virtual environments.

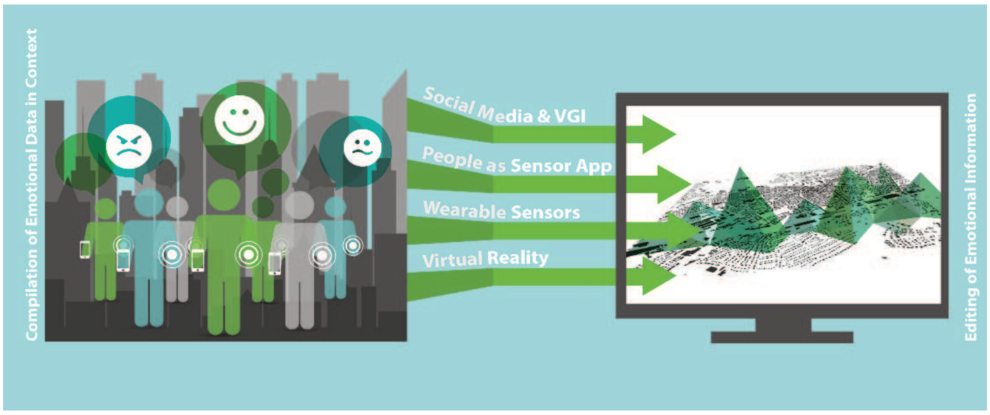

Fig. 7: Schematic overview of the Urban Emotions project, which will combine approaches from VGI, the use of wearables and VR approaches into a real-time planning system.

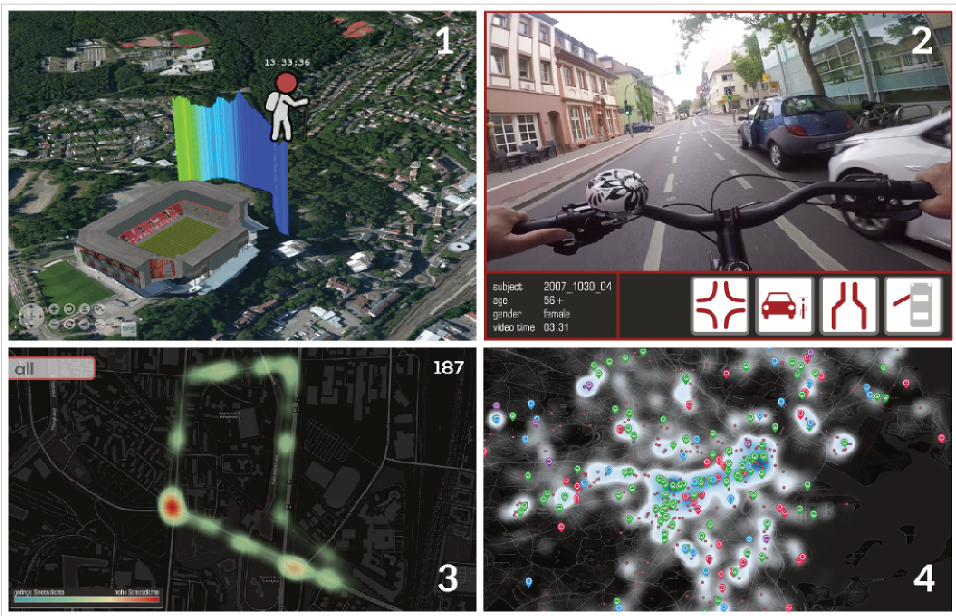

Fig. 8: Visualization of a test-run using skin conductivity in "Geovisualizer" (1); camera recording during a test-ride (2), aggregated datasets as a heatmap (3), labelled Twitter feeds of emotions (4) (Zeile 2017; Groß and Zeile 2016b; Resch et al. 2016)

If "people as sensors" are integrated into a project - as a measuring tool -, the question is: Which measuring system is the right one? The range spreads from simple survey to the evaluation of social media data as well as collecting and analysing biostatical data. An overview of technologies available for recording vital/ biostatistical data is provided by Kanjo et al. (2015). Kreibig (2010) gives an overview, how vital data correlate in detection of emotions. For use in public space, the approach to use simple data of the autonomous nervous system for the identification of negative excitation - defined as an emotional construct of anger and anxiety (Kreibig 2010) - the parameters "skin conductivity" and "skin temperature" are suitable (Rodrigues da Silva et al. 2014): If skin conductivity increases and the skin temperature decreases shortly after, people feel a negative arousal, well-known as “stress". After a geolocalisation of these “stress spots”, planners get maps which indicates potential locations in the city, which should be checked by planners in case of a "wicked problem" (Rittel 1973) (Figure 8 (1)). In combination with cameras, recording an “ego perspective”, individual runs of test persons can be examined for the stress-trigger (Fig. 8 (2)). A Kernel Density Calculation aggregates all data (Figure 8 (3)) and provides a first indication of hotspots of planning interventions (Zeile et al. 2016). In combination with an evaluation of social media like Twitter feeds (Summa 2015; Resch et al. 2016), additional information can enriched the planning process (Fig. 8 (4)). The topic of cycling, as a new / rediscovered concept of mobility is also suitable for "Urban Emotions" research (Höffken et al. 2014; Groß and Zeile 2016a). However, the intention is not to replace traditional planning methods but rather providing a new kind of indicator system for an “early warning system”.

4 CONCLUSION / OUTLOOK

The above-mentioned techniques are additional components for the detection and visualisation of spatial phenomena as well as design tasks within the context of urban planning. They can improve knowledge of spatial processes and make them intelligible during communication with citizen. As already pointed out, these workflows are not intended to replace formal processes, but can support context of informal procedures. Weighing has to take into account all available sources and information in planning process, so, according to the author’s opinion, even relevant social media data, if it can be easily processed, has to be one factor for consideration. Legal aspects like the question of using only clear names in digital communication in digital public panels or the issue if only residents have the right of an expression of opinion concerning a local task have to be discussed in the future.

In a broader sense, biostatistical data could also become relevant issue in the weighing process in the future. For example if all followers of “Quantify Self” movement provide their biostatistical data, this would be at least also a source of consideration within planning processes. With one limitation, that the provided data will be used for the detection of urban deficiencies. Anyway, there is no doubt that personal data have to be protected and all relevant privacy issues have to receive attention.

5 ACKNOWLEDGEMENT

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6 REFERENCES

Berchtold, M. (2016). Sich ein Bild machen: Die Rolle von GIS als Werkzeug bei Aufgaben in Räumen mit unklarer Problemlage. Dissertation. Karlsruhe: Karlsruher Institut für Technologie (KIT).

Broschart, D. (2013). ARchitektur: Die Fortentwicklung der Visualisierungs- und Kommunikationsmethoden in der Architektur und Stadtplanung. Master Thesis. Technische Universität. http://cpe.arubi.uni-kl.de/wp-content/uploads/2014/11/ARchitektur_Daniel_Broschart.pdf.

Broschart, D., Zeile, P., & Streich, B. (2013). Augmented reality as a communication tool in urban design processes. In M. Schrenk, V. Popovich, P. Zeile, & P. Elisei (Eds.), REAL CORP 2013 (pp. 119–126). Rome.

Buschlinger, S., Henn, M., Leidecker, H., Wahrhusen, N., & Zimmer, D. (2016). Urban Cable Cars: Kommunikation und Visualisierungen im Planungsprozess urbaner Seilbahnen am Beispiel der Stadt Konstanz. Projektbericht TU Kaiserslautern | CPE. http://zeile.net/wp-content/uploads/2016/11/UrbanCableCars.pdf.

Campbell, A. T., Eisenman, S. B., Lane, N. D., Miluzzo, E., & Peterson, R. A. (2006). People-centric urban sensing. In Proceedings of the 2nd annual international workshop on Wireless internet (p. 18). Boston, Massachusetts: ACM.

Dübner, S. (2014). Virtual Reality im Planungsprozess: Anwendung am Beispiel des Bahnhofareals in Neustadt an der Weinstraße. Master Thesis. http://cpe.arubi.uni-kl.de/wp-content/uploads/2013/11/MSC_Duebner_Virtual.pdf.

Folz, S., Broschart, D., & Zeile, P. (2016). Raumerfassung und Raumwahrnehmung – aktuelle Techniken und potenzielle Einsatzgebiete in der Raumplanung. In M. Schrenk, V. Popovich, P. Zeile, P. Elisei, & C. Beyer (Eds.), REAL CORP 2016: Proceedings/Tagungsband (pp. 541–550). Wien.

Fürst, D., & Scholles, F. (Eds.). (2008). Handbuch Theorien und Methoden der Raum- und Umweltplanung. Dortmund: Verlag Dorothea Rohn.

Goodchild, M. F. (2007). Citizens as sensors: the world of volunteered geography. GeoJournal, 69(4), 211–221.

Groß, D., & Zeile, P. (2016a). EmoCyclingConcept – Potenziale der emotionalen Stadtkartierung. In J. Strobl, B. Zagel, G. Griesebner, & T. Blaschke (Eds.), AGIT: Journal für Angewandte Geoinformatik (pp. 273–278, Vol. 2). Berlin, Offenbach: Wichmann Verlag.

Groß, D., & Zeile, P. (2016b). EmoCyclingConcept – Smart and Safe Mobility – Workshop. In M. Schrenk, V. Popovich, P. Zeile, P. Elisei, & C. Beyer (Eds.), REAL CORP 2016: Proceedings/Tagungsband (pp. 237–242). Wien.

Höffken, S., Wilhelm, J., Groß, D., Bergner, B. S., & Zeile, P. (2014). EmoCycling – Analysen von Radwegen mittels Humansensorik und Wearable Computing. In M. Schrenk, V. Popovich, P. Zeile, & P. Elisei (Eds.), Real CORP 2014 (pp. 851–860). Wien.

Höhl, W. (2009). Interaktive Ambiente mit Open-Source-Software: 3D-Walk-Throughs und Augmented Reality für Architekten mit Blender 2.43, DART 3.0 und ARToolKit 2.72. Vienna: Springer Vienna.

Höhl, W., & Broschart, D. (2015). Augmented Reality in Architektur und Stadtplanung. GIS.Science(1), 20–29.

Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: a review. Biological psychology, 84, 394–421 (2010). doi:10.1016/j.biopsycho.2010.03.010

Memmel, M. (2015a). RADAR Whitepaper. http://www.dfki.uni-kl.de/radar/RADAR_whitepaper_en.pdf.

Memmel, M. (2015b). Socially Enhanced Access to Digital Resources: PhD Thesis. TU Kaiserslautern: Kaiserslautern.

Memmel, M., & Groß, F. (2011). RADAR - Potentials for Supporting Urban Development with a Social Geocontent Hub. In M. Schrenk, V. Popovich, & P. Zeile (Eds.), REAL CORP 2011 (pp. 777–784). Essen, Wien.

Memmel, M., Wolpers, M., Condotta, M., Niemann, K., & Schirru, R. (2010). Introducing a Social Backbone to Support Access to Digital Resources. In M. Wolpers, P. A. Kirschner, M. Scheffel, S. Lindstaedt, & V. Dimitrova (Eds.), Sustaining TEL: From Innovation to Learning and Practice: 5th European Conference on Technology Enhanced Learning, EC-TEL 2010, Barcelona, Spain, September 28 - October 1, 2010. Proceedings (pp. 560–565). Berlin, Heidelberg: Springer Berlin Heidelberg.

Milgram, P., & Colquhoun, H. (1999). A taxonomy of real and virtual world display integration. In Y. Ohta & H. Tamura (Eds.), International Symposium on Mixed Reality 1999.: Mixed reality : merging real and virtual worlds. (pp. 1–26, Vol. 1). Berlin: Springer.

Petschek, P., & Lange, E. (2004). Planung des öffentlichen Raumes - der Einsatz von neuen Medien und 3D-Visualisierungen am Beispiel des Entwicklungsgebietes Zürich-Leutschenbach. In M. Schrenk (Ed.) (pp. 569–572). Wien.

Resch, B. (2012). People as sensors and collective sensing -contextual observations complementing geo-sensor network Measurements. Advances in Location-Based Services, 1–12.

Resch, B., Blaschke, T., & Mittlböck, M. (2010a). Distributed web-processing for ubiquitous information services - OGC WPS critically revisited. In Proceedings of the 6th International Conference on Geographic Information Science (GIScience2010). Zürich.

Resch, B., Blaschke, T., & Mittlböck, M. (2010b). Live Geography - Interoperable Geo-Sensor Webs Facilitating the Vision of Digital Earth. In International Journal on Advances in Networks and Services (3 (3&4), pp. 323–332).

Resch, B., Summa, A., Zeile, P., & Strube, M. (2016). Citizen-centric Urban Planning through Extracting Emotion Information from Twitter in an Interdisciplinary Space-Time-Linguistics Algorithm. In Urban Planning, (Vol. 1(2), pp. 114–127). Lissabon: Cogitatio Press.

Rittel, H. W. J. (1973). Dilemmas in a General Theory of Planning. Policy Sciences, 4(2), 155–169.

Rodrigues da Silva, A. N., Zeile, P., Aguiar, Fabiola de Oliveira, Papastefanou, G., & Bergner, B. S. (2014). Smart sensoring and barrier free planning - project outcomes and recent developments. In N. N. Pinto, J. A. Tenedório, A. P. Antunes, & J. R. Cladera (Eds.), Technologies for Urban and Spatial Planning: Virtual Cities and Territories (pp. 93–112). Hershey PA: IGI Global.

Sagl, G., Blaschke, T., Beinat, E., & Resch, B. (2012). Ubiquitous geo-sensing for context-aware analysis: exploring relationships between environmental and human dynamics. Sensors (Basel, Switzerland), 12(7), 9800–9822.

Shannon, C. E., & Weaver, W. (1949). The mathematical theory of communication. Urbana: University of Illinois Press.

Streich, B. (2011). Stadtplanung in der Wissensgesellschaft: Ein Handbuch (2nd ed.). Wiesbaden: VS Verl. f. Sozialwiss.

Summa, A. (2015). Emotion recognition from microblogs in the urban context with spatio-temporal information. Master Thesis. Ruprecht-Karls-Universität, Heidelberg.

Unity Technologies. (2017). Unity - Manual: Graphics Reference. https://docs.unity3d.com/Manual/GraphicsReference.html. Accessed 12 June 2017.

Wietzel, I. (2007). Methodische Anforderungen zur Qualifizierung der Stadtplanung für innerstädtisches Wohnen durch Mixed Reality-Techniken und immersive Szenarien. PhD Thesis. Kaiserslautern.

Zeile, P. (2010). Echtzeitplanung: Die Fortentwicklung der Simulations- und Visualisierungsmethoden für die städtebauliche Gestaltungsplanung. Dissertation. TU Kaiserslautern. http://kluedo.ub.uni-kl.de/volltexte/2010/2497/index.html.

Zeile, P. (2013). Echtzeitplanung. Planerin, 2013(1), 26–28.

Zeile, P. (2017). Echtzeitplanung – Dynamische Systeme in der Stadtplanung. In T. H. Kolbe, R. Bill, & A. Donaubauer (Eds.), Geoinformationssysteme 2017: Beiträge zur 4. Münchner GI-Runde (1st ed., 78-89). Berlin: Wichmann, H; Wichmann Verlag.

Zeile, P., Resch, B., Exner, J. P., Sagl, G., & Summa, A. (2014). Urban Emotions - Kontextuelle Emotionsinformationen für die Räumliche Planung auf Basis von Echtzeit- Humansensorik und Crowdsourcing-Ansätzen. In J. Strobl, T. Blaschke, G. Griesebner, & B. Zagel (Eds.), Angewandte Geoinformatik: Beiträge zum AGIT-Symposium Salzburg (pp. 664–669). Salzburg.

Zeile, P., Resch, B., Loidl, M., Petutschnig, A., & Dörrzapf, L. (2016). Urban Emotions and Cycling Experience – enriching traffic planning for cyclists with human sensor data. In A. Car, T. Jekel, J. Strobl, & G. Griesebner (Eds.), GI_Forum 2016: Journal for Geographic Information Science (Vol. 1, pp. 204–216, Vol. 1). Wien: Verlag der Österreichischen Akademie der Wissenschaften.

reviewed paper

Urbane Photovoltaikproduktion auf österreichischen Großparkplätzen: ein Beitrag zu nachhaltiger Energieversorgung, zukünftiger Elektromobilität und Bewusstseinsbildung bei Entscheidungsträgern/-innen

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1 EINLEITUNG

Die Photovoltaikbranche erlebte in den vergangenen Jahren stetige Zuwachsraten im zweistelligen Prozentbereich (International Energy Agency 2014; European Photovoltaic Industry 2014).

Dennoch stößt der Ausbau der Photovoltaik zunehmend auf Grenzen, da die Nutzung von Photovoltaik zur Energieproduktion viel Platz beansprucht und in Konkurrenz mit traditionellen Nutzungen wie Siedlungswesen, Landwirtschaft, Tourismus, Naturschutz etc. steht, was dazu führt, dass Photovoltaikenergie nur dort produziert werden kann, wo ausreichend Platz verfügbar ist. Dies ist umso zutreffender, je weniger Raum für die verschiedenen Nutzungsansprüche zur Verfügung steht. Für die Photovoltaiknutzung bedeutet dies, dass eine Nutzung auf Flächen mit starkem Nutzungsdruck schwierig ist, es sei denn eine multifunktionale Nutzung ist möglich.

Die Eignung ländlicher Freiflächen zur Photovoltaiknutzung ist bereits gut erforscht (Bundesamt für Naturschutz 2012; Bundesamt für Naturschutz und Technische Universität Berlin 2013; Knoll Planung & Beratung 2011; Naturschutzbund Deutschland und BSW-Solar 2005; Stadt Wien 2013). Weit weniger gut ist die Photovoltaiknutzung im Siedlungsgebiet untersucht, da diesen Gebieten, mit Ausnahme horizontaler Dachflächen, ein allgemein zu geringes Potenzial attestiert wird (Hunter und Baldwin 2013; Genske et al. 2009). Hier ist anzumerken, dass vor allem in urbanen Bereichen der Fokus der Potenzialanalysen auf öffentlich verfügbaren Flächen liegt und Potenziale auf privaten Flächen erst gar nicht in die Berechnungen Einzug finden. Eine Flächenkategorie, die derzeit in Österreich kaum im Zusammenhang mit der Photovoltaikproduktion beachtet wird, ist jene der Großparkplätze. Studien geben Auskunft über die Potenziale der vereinzelten Nutzung dieser Flächen (Strauss et al. 2009; Neumann et al. 2012; Tulpule et al. 2013; Chukwu und Mahajan 2014; Serrano-Luján et al. 2015), doch gibt es derzeit keine Übersicht über die Anzahl von möglicherweise geeigneten Parkplätzen in Österreich, noch über die damit verbundene Bedeutung für heimische Photovoltaikunternehmen und die nachhaltige österreichische Stromproduktion.

Durch die Mehrfachnutzung der Parkplätze zur Energieerzeugung und zur niederschwelligen Verwendung (Abstellfläche für PKWs), können Synergieeffekte bei ursprünglich konkurrierenden Flächennutzungen erzielt werden. So bedeutet eine mehrdimensionale Nutzung verfügbarer Fläche auch eine Vermeidung von zusätzlicher Flächenversiegelung, die vor allem für Österreich und Europa ein anhaltendes Problem darstellt (Heinrich-Böll-Stiftung et al. 2015). Weiter wird dadurch ein Mehrwert für die Nutzerinnen und Nutzer (z. B. zusätzlicher Komfort durch Beschattung), sowie für Verwalterinnen und Verwalter (z. B. geringere Betriebserhaltungskosten, zusätzliche Einnahmen aus der Energieproduktion, neue Dienstleistungen) der Fläche geschaffen, was zu erhöhter Akzeptanz in siedlungsnahen Gebieten führen kann.

Bislang gibt es keinen Überblick über Möglichkeiten einer energieorientierten Bewirtschaftung von Großparkplätzen in Österreich und deren potenziellen Beitrag zur Energiewende und zur Stärkung der heimischen Photovoltaikindustrie. Weiter ist bislang nicht bekannt, für welche Branchen sich durch eine Hebung des Erwartungspotenzials auf Großparkplätzen neue Entwicklungsmöglichkeiten öffnen.

Dieses Paper trägt zur Identifikation von zur Energienutzung geegneten Großparkplätzen in Österreich bei. Hierfür wurden sämtliche Großparkplätze (Parkplätze > 600 m²) untersucht und basierend auf Langzeitdaten (klimatologisch, atmospärisch) und aufgrund der räumlich umgebenden Infrastruktur (3D-Gebäude) analysiert.

Keywords: Photovoltaik, Synergie, mehrdimensionale Nutzung, Erwartungspotenzial, urbane Parkplätze

2 METHODE

Die Analyse des Photovoltaikpotenzials auf Großparkplätzen erfordert neben der Berücksichtigung klimatischer und physikalischer Einflüssen auch eine Berücksichtigung räumliche Aspekte:

2.1 Klimatische und physikalische Einflüsse

2.1.1 Physikalische Grundagen

Um die Energieproduktion einer Fläche beurteilen zu können, wird die darauf tatsächlich auftretende Sonnenleistung herangezogen. Ausgegangen wird von der durchschnittlichen elektromagnetischen Strahlungsleistung der Sonne, die durch Schwankungen in der Sonnenaktivität um bis zu ±0,1 % schwankt. Durch die Exzentrizität der Erdumlaufbahn verändert sich dieser Wert um weitere ±3,67 % im Jahresverlauf. Die dann auf die Atmosphäre auftreffende durchschnittliche Leistung ist als Solarkonstante mit 1370 W/m² definiert (Kaltschmitt et al. 2013, S. 49 f.).

Durch die Atmosphäre reduziert sich die auf der Erdoberfläche tatsächlich auftreffende Strahlung. Die wesentlichen Faktoren sind dabei:

- Absorbtion und Rückstrahlung durch die Atmosphäre
- Luftmasse
- Absorption und Rückstrahlung der Wolken

Die Summe aus der direkten und der diffusen Strahlung, die am Boden auftrifft, ist die Globalstrahlung

2.1.2 DSSF - Down-welling Surface Short-wave radiation Flux

Die verwendeten DSSF-Daten basieren auf Messungen des EUMETSAT Satellitensystems und liegen in einer zeitlichen Auflösung von 30 Minuten und einer räumlichen Auflösung von etwa 3,0 x 3,0 km vor und wurden mit der „Cloudy Sky Method“ (Gautier et al. 1980; Brisson et al. 1999) berechnet.

2.1.3 Datenbasis für die Analyse

Alle relevanten Parkplätze wurden entsprechend ihrer Lage der nächstgelegenen DSSF-Koordinate zugeordnet. Alle Datensätze, die sich auf nicht zugeordnete Koordinaten (Datenpunkte in deren Umkreis kein relevanter Parkplatz liegt) beziehen, wurden entfernt. Von den 1.107.351 Koordinaten des gesamten Datensatzes liegen 4.729 innerhalb Österreichs und 2.121 (44,85 %) davon in der Nähe von relevanten Parkplätzen.

2.2 Räumliche Aspekte

2.2.1 Parkplätze

Die in der vorliegenden Studie verwendeten Geometrien der Parkplätze wurden im Februar 2016 aus dem OpenStreetMap-Datensatz exportiert (Geofabrik 2016). Im Rahmen der Studie wurden Parkplätze größer 600 m² als Großparkplätze definiert und weiter berücksichtigt. Die Parkplätze wurden weiter nach ihrer Urbanität gefiltert. Hierfür wurden die Geodatensätze SINUS (Peterseil et al. 2004) und Urban Atlas (European Environment Agency 2012) verwendet.

2.2.2 Sparten und Branchen der Österreichischen Wirtschaftskammer

Für die Einteilung und Strukturierung der österreichischen Unternehmen wurde der Branchenbaum der Wirtschaftskammern Österreichs (WKÖ 2016) verwendet. Dieser weist insgesamt 1.214 Branchen in 93 Fachverbänden bzw. 7 Sparten aus (Stand 02/2017). Basierend auf den Datenpunkten der WKÖ konnten 2 Kernindikatoren berechnet werden:

- Häufigkeitsrelevanz: Branchen die in Relation zu allen Parkplätzen in der Summe ihrer Distanzpunkte häufig vorkommen (häufig aber nicht zwingend nahe).
- Relative Nähe: Branchen die in Relation zu Parkplätzen besonders nahe von Parkplätzen vorkommen unabhängig von der Anzahl der Häufigkeit (dem Auftreten), wobei nicht relevanten Branchen gefiltert wurden (nahe aber nicht zwingend häufig).

2.2.3 Schattenberechnung

Neben den klimatischen Einflüssen ist die Beschattung der größte weitere Einflussfaktor (Hofierka und Suri 2002, S. 2) auf die Energiewerte einer Fläche. Sie kann entsprechend ihrer Quelle unterteilt werden:

- Fernverschattung – Schatten, die durch das Gelände entstehen
- Nahverschattung – Schatten, die durch Objekte (v.a. Gebäude und Vegetation) entstehen.

Die Fernverschattung konnte in der vorliegenden Studie nicht berücksichtigt werden. Bei der Nahverschattung konnten umliegende Gebäude, nicht aber die Vegetation mitberücksichtigt werden. Die Gebäude in diversen Pufferbereichen der Parkplätze wurden je nach Bundesland unterschiedlichen Quellen entnommen:

Bundesland	Gebäudequelle	Pufferbereich
Burgenland	DKM	1500 m
Kärnten	Basemap	1500 m
Niederösterreich	Basemap	1500 m
Oberösterreich	Basemap	1500 m
Salzburg	Basemap	1500 m
Steiermark (ohne Graz)	DKM	150 m
Steiermark (Graz)	DKM	500 m
Tirol	DKM	1500 m
Vorarlberg	Basemap & OSM	1500 m
Wien	Baukörpermodell	-

Tabelle 1: Datenquellen und Einzugsbereiche der Gebäude

Die Gebäudehöhen wurden aus der Differenz von Oberflächen- zum Geländemodell berechnet und von den Landesregierungen zur Verfügung gestellt.

2.3 Potenzialberechnung

Dreier (2000) beschreibt die Abschätzung möglicher Beiträge eines Energieträgers am Beispiel der Biomasse und definiert unterschiedliche Stufen von Potenzialen. Ziel ist die Ermittlung des Erwartungspotenzials bzw. auch dem „ausschöpfbaren Potenzial“. Über das theoretische Potenzial (theoretisches Maximum) wird ein technisches Potenzial (Reduktionen durch begrenzende Faktoren wie z. B. Verschattung, PV-Zelleffizienz) und von diesem Ausgehend das Erwartungspotenzial errechnet. Das Erwartungspotenzial berücksichtigt eine gewisse maximale Flächennutzung mit PV-Paneelen, die in vorliegender Studie mit 40 % festgelegt wurde.

Das Ergebnis gibt berücksichtigt keine Vernverschattung, Verschattung durch Vegetation, Ausrichtung, oder Neigung der PV-Module.

3 ERGEBNISSE

3.1 Charakteristik der untersuchten Parkplätze

Tabelle 2 zeigt einen Überblick über die geographische Lage und Verteilung, sowie über die durchschnittlichen Größen der zur Analyse verwendeten Parkplätze, pro Bundesland.

Insgesamt wurden 15.245 Großparkplätze mit einer Fläche über 600 m² analysiert. Die durchschnittliche Parkplatzgröße in Österreich beträgt in etwa 2.502 m² (Min. 600 m², Max. 107.246 m², Median 1.504 m²) und befindet sich im Mittel auf 441 m Seehöhe (Min. 116 m, Max. 2.264 m, Median 393 m).

Mehr als die Hälfte der untersuchten Parkplätze befindet sich in lediglich drei Bundesländern. So sind knapp ein Viertel (3.570; 23,4 %) der Parkplätze im flächenmäßig größten Bundesland Niederösterreich, gefolgt von Oberösterreich (2.911; 19,1 %) und der Steiermark (2.495; 16,4 %) zu finden. Auch bezogen auf die Gesamtflächengröße der Parkplätze zeigt sich eine ähnliche Verteilung auf die Bundesländer Niederösterreich (23,7 %), Oberösterreich (18,4 %) und Steiermark (16,5 %).

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Pro Quadratkilometer Landesfläche zeigt sich eine deutliche Konzentration von Großparkplätzen im Bundesland Wien (2,77 Parkplätze/km²), sowie, wenn auch mit großen Abstand, in den Bundesländern Vorarlberg (0,26 Parkplätze/km²) und Oberösterreich (0,24 Parkplätze/km²).

Im Durchschnitt ist in Österreich pro 5,5 km² ein Großparkplatz verfügbar, wobei es auch hier deutliche Unterschiede zu erkennen gibt (pro 0,36 km² in Wien – pro 8,82 km² in Kärnten).

	Landesfläche (km²)	Anteil der Landesfläche am Staatsgebiet (%)	Anzahl der Parkplätze pro Bundesland (n)	Anteil an der Summe der Parkplätze (%)	Summe der Parkplatzfläche pro Bundesland (km²)	Anzahl der Parkplätze pro km² Landesfläche	Parkplatzdichte pro Bundesland (in km² pro Parkplatz)	Anteil an der Gesamtfläche der Parkplätze (%)	mittlere Parkplatzgröße pro Bundesland (m²)	mittlere Seehöhe der Parkplätze pro Bundesland (m)
Burgenland	3.962	4,7	584	3,8	1,61	0,15	6,78	4,2	2.764	228
Kärnten	9.538	11,4	1.081	7,1	2,90	0,11	8,82	7,6	2.686	572
Niederösterreich	19.186	22,9	3.570	23,4	9,02	0,19	5,37	23,7	2.528	289
Oberösterreich	11.978	14,3	2.911	19,1	7,00	0,24	4,11	18,4	2.406	404
Salzburg	7.156	8,5	1.210	7,9	2,90	0,17	5,91	7,6	2.396	661
Steiermark	16.403	19,6	2.495	16,4	6,28	0,15	6,57	16,5	2.516	452
Tirol	12.640	15,1	1.563	10,3	3,99	0,12	8,09	10,5	2.554	784
Vorarlberg	2.590	3,1	683	4,5	1,45	0,26	3,79	3,8	2.117	575
Wien	415	0,5	1.148	7,5	2,98	2,77	0,36	7,8	2.593	191
Österreich	**83.868**	**100**	**15.245**	**100**	**38,1**	**0,18**	**5,50**	**100,0**	**2.502**	**441**

Tabelle 2: Überblick über Anzahl, Größe, Verteilung und Seehöhe der untersuchten Parkplätze. n = 15.245, grau hinterlegte Zellen = Bezug auf Gesamtanzahl der Parkplätze in Prozent

3.2 Solarpotenzial

Tabelle 3 bietet eine Übersicht über das theoretische, das technische und das Erwartungspotenzial zur photovoltaikorientierten Nutzung von Großparkplätzen in Österreich. Das theoretische Solarpotenzial aller österreichischen Großparkplätze entspricht ca. 92,1 TWh Energie pro Jahr (Terrawattstunden) und beschreibt die Menge an Energie die ohne jegliche Abschläge (atmosphärisch, physikalisch oder räumlich) auf den jeweiligen Parkplätzen, in 3 m Höhe auftrifft.

Das technische Solarpotenzial berücksichtigt im vorliegenden Fall sowohl atmosphärische, physikalische (Wolken) und räumliche (Gebäude) Einflüsse und beträgt in etwa 42,4 TWh.

Da der Wirkungsgrad der Photovoltaikzellen in Standardmodulen nicht das gesamte auftreffende Sonnenlicht in Energie umwandeln kann, kommt es zu einer weiteren Reduktion der potenziell zu erntenden Energiemenge auf insgesamt 8,5 TWh Energie pro Jahr.

Abschließend muss noch der potenzielle Bebauungsgrad der Flächen berücksichtigt werden, womit ein potenzielles zu erwartendes Solarpotenzial (Erwartungspotenzial) von ca. 4,2 TWh Energie pro Jahr zur Verfügung steht.

Bundesland	Theoretisches Solarpotenzial (GWh)	mittlere Verschattung (1 = 100 %)	Technisches Solarpotenzial (GWh)	Technisches Solarpotenzial (20 % Effizienz in GWh)	**Erwartungspotenzial (GWh)**
Burgenland	4.070	0,53	1.967	393	**193**
Kärnten	7.389	0,54	3.435	687	**337**
Niederösterreich	21.683	0,53	10.222	2.044	**1003**
Oberösterreich	16.298	0,55	7.534	1.507	**739**
Salzburg	6.718	0,55	3.065	613	**301**
Steiermark	15.505	0,56	7.042	1.408	**691**
Tirol	9.688	0,44	4.378	876	**430**
Vorarlberg	3.440	0,44	1.559	312	**153**
Wien	7.289	0,42	3.155	631	**310**
Österreich	**92.080**	**0,45**	**42.357**	**8.471**	**4.157**

Tabelle 3: Überblick über das theoretische, technische und zu erwartende Solarpotenzial bei der Nutzung von Photovoltaikanlagen auf Großparkplätzen in Österreich

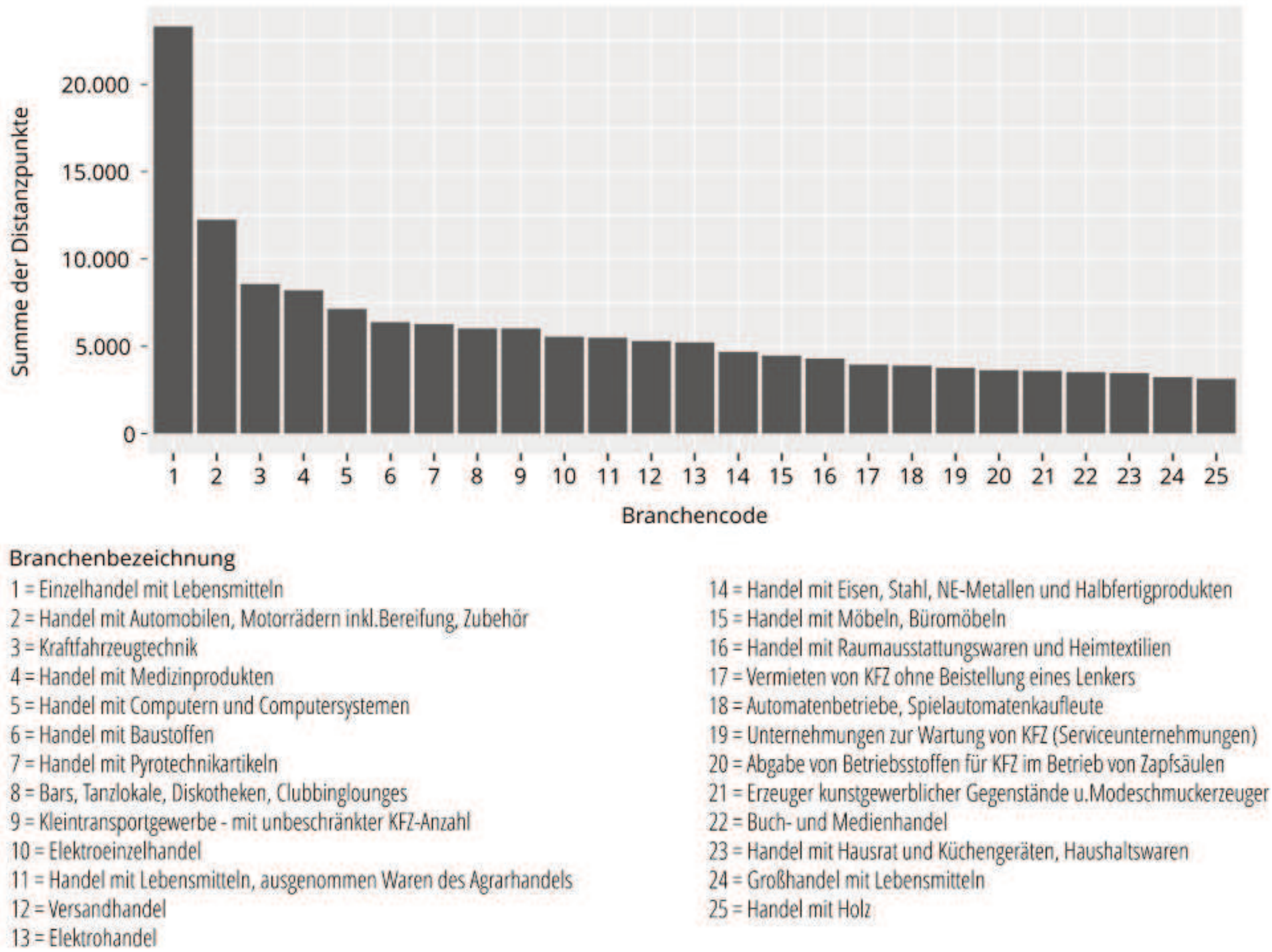

Abbildung 1: Verteilung der Summe der Distanzpunkte auf die Branchen der Österreichischen Wirtschaftskammer (TOP 25)

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3.3 Relevanz des solaren Erwartungspotenzials für Österreichs Wirtschaft

Um die Bedeutung der Ergebnisse für einzelne Sparten und Branchen der österreichischen Wirtschafte zu ermitteln, wurden sowohl die ermittelten Entfernungen (Distanzpunkte) pro Branche aufsummiert. als auch die Relevanz der Summe der Distanzpunkte in Abhängigkeit zur Anzahl des Vorkommens ermittelt.

Abbildung 1 zeigt die TOP-25-Ränge aus dem Ergebnis der Aufsummierung der Distanzpunkte nach Branchen (Häufigkeitsrelevanz). Es ist zu erkennen, dass vor allem Branchen der Sparte Handel in den oberen 25 Rängen verweilen. Die Branche des „Einzelhandel(s) mit Lebensmittel“ zeigt sich als relevanteste, weil am häufigsten vorkommende Branche mit der insgesamt größten Nähe zu den untersuchten Parkplätzen. Auf Rang 2, doch bereits mit deutlichem Abstand, befindet sich die Branche des Automobil- und Motorradhandels. Erneut mit deutlichem Abstand folgen auf Rang 3 die Branche „Kraftfahrzeugtechnik (Sparte Gewerbe und Handwerk) und auf Rang 4 die Branche „Handel mit Medizinprodukten“ (Sparte Handel).

Abbildung 2 zeigt die relative Nähe der Branchen in Abhängigkeit vom Vorkommen. Es werden jene Branchen dargestellt, die, wenn sie vorkommen, im Durchschnitt eine große Nähe zu den Parkplätzen aufweisen, unabhängig von ihrer Häufigkeit des Vorkommens. In den TOP-25-Rängen ist ein deutlicher Spartenmix zu erkennen. Die ersten drei Ränge zeigen deutlich unterschiedliche Ausprägungen. So kommt die Branche der „Automatenbetriebe“ im Durchschnitt am nächsten zu den untersuchten Parkplätzen vor. Dicht gefolgt von der Branche der „Kraftfahrlinienunternehmungen“ (Sparte Transport und Verkehr) und bereits mit Abstand der Branche des „Einzelhandel(s) mit Lebensmitteln“ (Sparte Handel). Die Häufigkeit der Vorkommen unterscheidet sich deutlich untereinander.

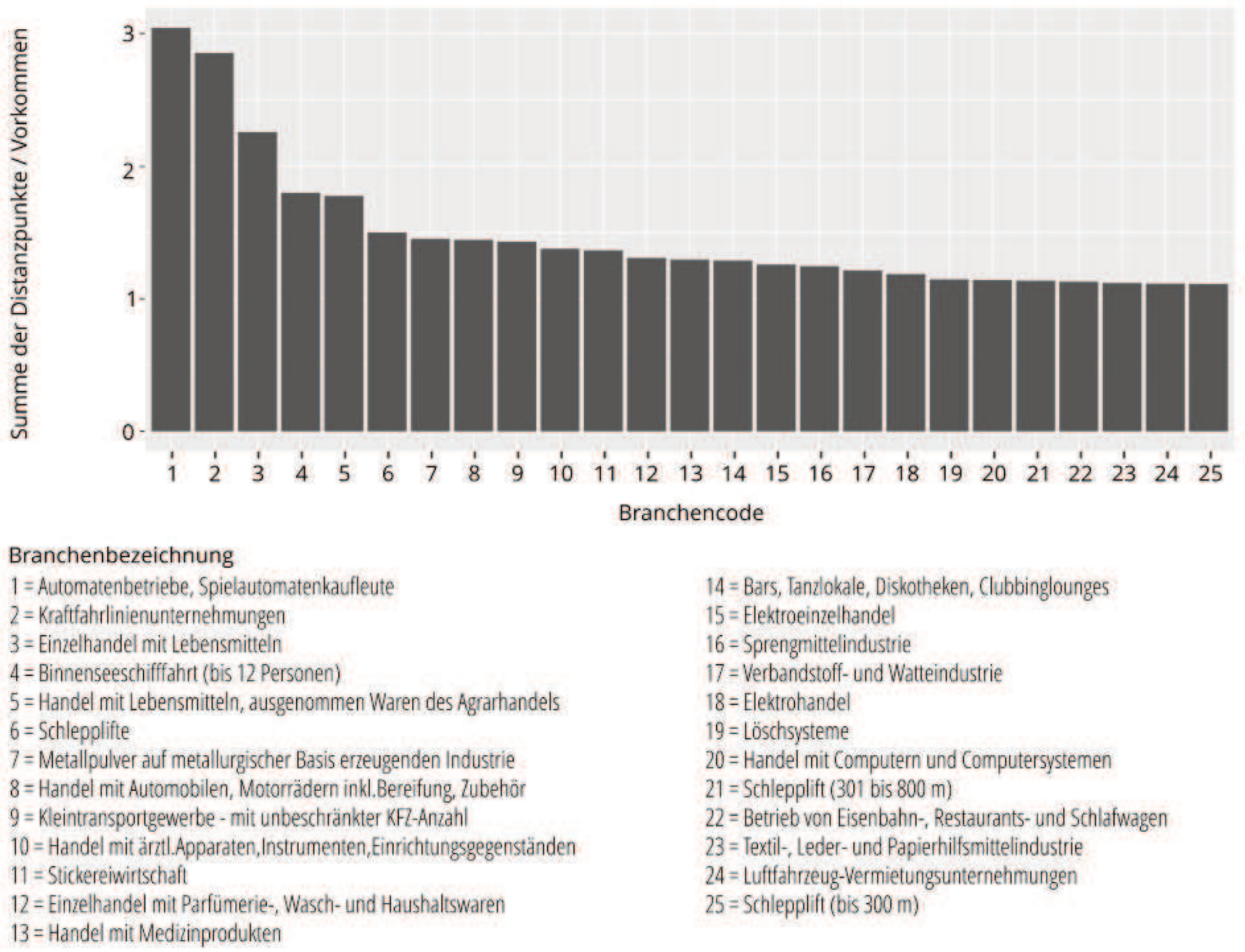

Abbildung 2: Verteilung des Verhältnisses der Summe der Distanzpunkte pro Anzahl des Vorkommens auf die Branchen der Österreichischen Wirtschaftskammer (TOP 25)

Tabelle 4 zeigt Branchen die innerhalb der ersten 25 Ränge sowohl in Abbildung 1, als auch in Abbildung 2 liegen. Damit werden Branchen identifiziert, die sowohl in großer Anzahl, als auch in großer Nähe zu Parkplätzen vorkommen.

Sparte	Branche	Vorkommen (Anzahl)	relative Nähe (Summe der Distanzen/Anzahl)	Summe der normierten Distanzpunkte
Handel	Einzelhandel mit Lebensmitteln	10.335	2,256	23.313,389
Handel	Handel mit Automobilen, Motorrädern etc.	8.473	1,446	12.248,008
Handel	Handel mit Medizinprodukten (z. B. Apotheken)	6.345	1,294	8.213,335
Handel	Handel mit Computern und Computersystemen	6.259	1,141	7.143,105
Tourismus und Freizeitwirtschaft	Bars, Tanzlokale, Diskotheken, Clubbinglounges	4.672	1,289	6.023,485
Transport und Verkehr	Kleintransportgewerbe - mit unbeschränkter KFZ-Anzahl	4.207	1,430	6.017,589
Handel	Elektroeinzelhandel	4.414	1,259	5.555,552
Handel	Handel mit Lebensmitteln, ausg. Waren des Agrarhandels	3.094	1,775	5.492,356
Handel	Elektrohandel	4.397	1,187	5.219,181
Tourismus und Freizeitwirtschaft	Automatenbetriebe, Spielautomatenkaufleute	1.279	3,042	3.891,058

Tabelle 4: Übersicht über Branchen aus den TOP 25 mit großer Nähe zu Parkplätzen und häufigem Vorkommen (n=474)

4 ENERGIEPARKPLÄTZE DER ZUKUNFT

Die vorliegende Studie zeigt, dass mit der Energiegewinnung auf bestehenden Großparkplätzen in Österreich ein Beitrag von 4,2 Twh Energie pro Jahr geleistet werden kann (Parkplätze > 600 m²; Potenzial in 3 m Höhe). Nicht mit berücksichtigt wurden aktuelle Entwicklungen zur Kombination von Straßenbelägen und Photovoltaik, da zum Untersuchungszeitpunkt keine zuverlässigen Kennzahlen verfügbar waren.

Aktuell beträgt der Beitrag der Photovoltaikenergie in Österreich insgesamt lediglich 0,9 Twh/a, was in etwa 0,9 % am Bruttoendenergiebedarf entspricht (Biermayr 2016, S. 7). Um den langfristigen Umstieg auf ein nachhaltiges Energiesystem mit 100 % erneuerbarer Energie erreichen zu können, muss der Beitrag der Photovoltaik zur Energiewende in den kommenden Jahren deutlich steigen.

Veigl (2015) berechnet den potenziellen Energiebedarf Österreichs mit insgesamt 164 Twh/a (2030) und 212 Twh/a (2050). Unter der Voraussetzung, dass die Energie zu diesen Berechnungszeitpunkten ausschließlich aus erneuerbaren Energiequellen stammt, beträgt der Beitrag der Photovoltaikenergie am Bruttoendenergieverbrauch dann 12,7 Twh/a (7,7 %; 2030) bzw. 30 Twh/a (14 %; 2050). Bei einer vollständigen Realisierung des Erwartungspotenzials würden ca. 33 % (2030) bzw. 14 % (2050) des Photovoltaikanteils am Bruttoendenergieverbrauch durch die Energiegewinnung auf versiegelten, urbanen Parkplätzen stattfinden (ungeachtet der Berücksichtigung neuer Entwicklungen wie bspw. PV-Beläge, bzw. neu entstehender Parkplatzflächen). Um das Ziel zu erreichen ist, bezogen auf 2015, bis 2030 die 11,4 fache und bis 2050 die 26,1 fache Photovoltaikleistung in Österreich zu installieren.

Fechner et al. (2016, S. 49) berechnen, dass die benötigten Flächen (~174 km²) durchaus auf Gebäuden (Dächer, Fassaden) bereitgestellt werden könnten. Eine intensive Nutzung der Dachlandschaften zur Energiegewinnung könnte sicherlich einen großen Beitrag leisten. Doch neben der Tatsache, dass aufgrund einer Erweiterung bestehender statischer Normen (ÖNORM B 1991-1, 2017) eine Vielzahl an theoretisch günstigen Dächern auf Gewerbe- und Industriehallen wegen statischer Probleme für eine Photovoltaikproduktion uninteressant wurden, zeigen sich bei Projekten auf urbanen Flachdächern steigende Nutzungskonkurrenzen zwischen der Energieproduktion, dem Naturschutz, Interessen das Stadtklima betreffend (UHI; Urban Heat Island) und der Lebensmittelproduktion (Urban gardening).

Neben der Nutzungskonkurrenz in den Dachlandschaften zeigen sich in den vergangenen Jahren vermehrt rechtliche Herausforderungen im Zusammenhang mit historisch sensiblen Gebieten (z. B. VGH Baden-Württemberg 2011; Bayerischer Verwaltungsgerichtshof 2015), die immer deutlicher die Grenzen des Entwicklungspotenzials der urbanen Photovoltaik aufzeigen.

Urbane Parkplatzflächen eignen sich zur Bewirtschaftung mit Photovoltaiküberdachungen aus mehreren Gründen: Einerseits weil die bereits versiegelte Fläche vorhanden ist und es keine zusätzliche Flächeninanspruchnahme benötigt. Andererseits aber auch, weil durch die energetische Nutzung mit Photovoltaik weitere Nutzungen auf ein und derselben Fläche möglich werden. So kann auf der bislang als Stellplatz genutzten Fläche, neben der zusätzlichen Energieproduktion, auch Komfort für Nutzerinnen und Nutzer entstehen. Im Sommer kann eine Photovoltaiküberdachung auf Parkplätzen die Nutzerinnen und Nutzer vor großer Hitze (z. B. in den Fahrzeugen) bzw. auch vor Niederschlägen schützen. Im Winter wird Schutz vor Schnee und Eis geboten und erspart somit Eiskratzen und Schneekehren bei tiefen Temperaturen. Aus Sicht des Betreibers könnten potenziell Kosten für Räumdienste (z. B. Schneeräumung) reduziert werden. Die Nutzung von Parkplätzen zur Energieproduktion zeigt daher aus verschiedenen Perspektiven ein großes Synergiepotenzial und schafft keine neuen räumlichen Nutzungskonkurrenzen.

4.1 Energieparkplätze als Beitrag zur Elektromobilität

Vor dem Hintergrund der Entwicklung eines lebendigen Marktes für Elektromobilität (BMLFUW und BMWFJ 2009), können lokale Energiedienstleistungen angeboten werden und so bspw. während eines Einkaufs, oder auch über Nacht Fahrzeug aufgeladen werden. Probst (2014, S. 10 f.) berechnet, dass 1 Mio. Elektrofahrzeuge mit einer jährlichen Laufleistung von 15.000 km und einem durchschnittlichen Verbrauch von 0,2 kWh/km im Jahr in etwa 3 Twh Energie benötigen. Umgelegt auf das errechnete Erwartungspotenzial der vorliegenden Studie (4,2 Twh/a) könnte somit ein Äquivalent des Energiebedarfs von über 1,39 Mio. Elektrofahrzeuge auf Parkplätzen gewonnen werden. Insgesamt sind in Österreich derzeit 6,7 Mio. Kraftfahrzeuge unterwegs (Statistik Austria 2017). Vorausgesetzt, dass langfristig nur noch Elektrofahrzeuge unterwegs wären und sich die Gesamtanzahl durch verbesserte Angebote im öffentlichen Verkehr stabilisiert, entspräche das 20,7 % der Kraftfahrzeuge.

Systeme von Elektrotankstellen sind bereits im Umlauf und sollen in den kommenden Jahren deutlich ausgebaut werden. Allerdings werden die aktuellen Systeme häufig mit dem regulären Strommix (Mix aus konventionellen, erneuerbaren bzw. auch nuklearen Energieträgern) versorgt und schneiden daher in ihrer CO_2-Bilanz ungünstig ab.

4.2 Voraussetzungen für eine großräumige Entwicklung von Energieparkplätzen

Um großräumig Parkplätze in Energieparkplätze umzuwandeln bzw. auch neu entstehende Parkplätze nach dem Prinzip der Energieparkplätze zu entwickeln, benötigt es neben einer hohen lokalen sozialen Akzeptanz, auch gestaltungsorientierte Grundprinzipien die einen sensiblen Umgang mit dem Raum gewährleisten und Konzepte zur gleichberechtigten Nutzung der Parkplatzflächen zur Umweltkommunikation und/oder Energieernte.

Folgende grundlegende Aspekte können eine großräumige Umsetzung von Energieparkplätzen unterstützen:

4.2.1 Planung und Beteiligung

Das Betätigungsfeld der Energieparkplätze zeigt ein großes Potenzial zur inter- und transdisziplinären Zusammenarbeit verschiedenster Fachdisziplinen (Stadtplanung, Landschaftsplanung, (Energie-)Raumplanung, Architektur etc.) und eröffnet neue Möglichkeiten für eine partizipativ orientierte Planung (Mitbestimmung und -gestaltung durch Bürger).

Da die untersuchten Parkplatzflächen ausschließlich in besiedelten Gebieten liegen, bietet sich neben der Miteinbeziehung der lokalen Bevölkerung in die Planungsstruktur auch eine finanzielle Beteiligung an Projektvorhaben an. Scherhaufer et al. (2017) zeigt die Bedeutung einer gleichberechtigten Einbindung der lokalen Bevölkerung in die Entwicklung von Energieprojekten und sieht darin einen entscheidenden Schritt für eine lokale Akzeptanz und damit für eine potenzielle Realisierung.

4.2.2 Akzeptanz

Es gibt derzeit allerdings kaum Informationen darüber wie sich die lokale Bevölkerung eine Energiewende in ihrer direkten Umgebung, ihrem Wohn-, Arbeits- und Freizeitumfeld vorstellt. Die Entwicklung von Photovoltaikprojekten auf Parkplatzflächen soll keineswegs als eine bloße Überdachung vorhandener Flächen mit PV-Elementen verstanden werden.

Es jedoch ist unklar ob gestalterische Maßnahmen, technische Kennzahlen (z. B. Anlagenleistung), oder geplante vor Ort angebotene Energiedienstleistungen für eine erhöhte Akzeptanz entscheidend sind. Aktuell findet im Rahmen eines von der FFG und dem BMVIT geförderten Forschungsprogramms mit dem Titel „Synergiepotenziale zwischen Stadtplanungszielen und Photovoltaiknutzung auf Freiflächen" (Syn[En]ergy 2017) eine Untersuchung der Bedeutung unterschiedlicher Aspekte in der lokalen Entwicklung von Photovoltaikanlagen auf urbanen Freiflächen statt. Der Fokus liegt hierbei neben den ökonomischen und technischen Potenzialen auch auf gestalterischen Aspekten zur synergieorientierten Nutzung urbaner Freiräume. Erste Ergebnisse werden Ende 2017 erwartet.

4.2.3 Gestaltung

Bisherige Transitionen von Parkplätzen in Energieparkplätze zeigen vielfach eine Lücke in ihrer Ausgestaltung und Raumadaption. Beruhend auf dem Prinzip der Energiemaximierung werden vornehmlich technische (Frei-)Räume mit wenig Verweilpotenzial geschaffen. Lediglich Designstudien gehen hier einen Schritt weiter und zeigen Mögliche Entwicklungen auf.

Die zukünftige Gestaltung von Energieparkplätzen soll (Frei-)Räume schaffen, die in der Lage sind mehr zu leisten, als bloß Energie zu produzieren und als Stellplatz zu fungieren, wobei selbst diese beiden Basissynergien bereits einen Erfolg darstellen.

Um Energieparkplätze qualitativ aufzuwerten können gestalterische Aspekte einen wesentlichen Beitrag leisten:

- Höhe der PV-Überdachung: Die Höhe einer PV-Überdachung soll sich sowohl an der Umgebung orientieren, als auch eine gewisse Mindesthöhe nicht unterschreiten. Als Mindesthöhe gilt ein Maß, indem Nutzerinnen und Nutzer sich nicht von der PV-Überdachung eingeengt fühlen. Einer gefühlten Einengung könnte ein Zusammenspiel aus Höhe, Schattenwurf und Gestaltung der Unterseite entgegen wirken und so zu einer qualitativen Aufwertung führen.
- Schattenwurf: Abhängig von der Transparenz der PV-Module, dem Abstand der PV-Elemente auf den Modulen zueinander und der Dichte der Module (Anzahl/m²). Der Schattenwurf kann durch seine bewusste Gestaltung positiv zum Erleben einer Anlage beitragen und die Aufenthaltsqualität erhöhen.
- Gestaltung der Unterseite der PV-Überdachung: Es macht den Eindruck, dass bei vielen PV-Anlage auf Parkplätzen die Gestaltung an ihrer Unterseite aufzuhören scheint. Doch gerade die Unterseite der PV-Überdachung ist jener Bereich der möglicherweise von den Nutzerinnen und Nutzern besonders intensiv wahrgenommen wird und daher besonderer Aufmerksamkeit bedarf.
- Materialwahl: Die Materialwahl der Ständerkonstruktion kann entscheidend für die Wahrnehmung, die Wuchtigkeit der Gesamtkonstruktion sein. Hierbei wird in vielen Fällen mit den Standardmaterialien (Stahl) gearbeitet. Um das der technischen Prägung einer PV-Überdachung entgegen zu wirken, könnten „weichere" Materialien und Ständerkonstruktionen entscheidend sein.
- Vegetation: Vegetation und PV-Überdachungen müssen sich keineswegs untereinander ausschließen. Zu beachten ist, wo auf der Parkplatzfläche welche Vegetation sinnvoll ist. Höhere Gehölze an der Nordseite (NNW-NNO) eines Parkplatzes können einen positiven Beitrag zur Gesamtwahrnehmung einer PV-Anlage leisten und die Leistung der Anlage nicht beeinträchtigen. In den übrigen Bereichen kann sich die Vegetation an Lichtausparungen in der PV-Überdachung orientieren (bzw. umgekehrt). Neuere PV-Systeme können mit kleinräumiger Beschattung bereits intelligent umgehen, so dass bei einer Teilverschattung einzelner Module nicht das gesamte Modul in seiner Leistung gedrosselt wird.
- Retention: Da das auf den PV-Überdachungen auftreffende Regenwasser nicht, wie vom Parkplatz ablaufendes Regenwasser speziell gereinigt werden muss (ÖNORM B 2506-1, 2013; ÖNORM B

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2506-2, 2012), sondern direkt weiterverwendet werden kann, sollten Energieparkplätze das auftreffende Regenwasser sammeln und damit umliegende Biotope versorgen können. Dies entlastet die örtlichen Kanäle und Kläranlagen.

- Biotopgestaltung: Eine weitere Möglichkeit die Fläche der Energieparkplätze aufzuwerten ist die bewusste Konzipierung von Trittsteinbiotopen für bestimmte Tierarten. Diese Biotope könnten an für die Photovoltaik ungünstigen Orten entstehen und einen Beitrag zum Naturschutz in urbanen Räumen leisten.

4.2.4 Bewusstseinsbildung

Urbane Parkplatzflächen unterscheiden sich in ihrer Form, Lage, Umgebung und Größe deutlich voneinander. Manche Parkplätze eignen sich daher besser zur Energieproduktion als andere. Doch auch Parkplätze mit einer geringeren Energieausbeute können einen wichtigen Beitrag zur nachhaltigen Energiewende leisten. So könnten beispielsweise energetisch wenig effiziente Parkplätze an neuralgischen Punkten, an Orten mit viel Personenaufkommen etc. als Bewusstseinsindikatoren fungieren. Hier könnten beispielsweise Energiedienstleistungen für die breite Masse angeboten werden (Handy-Aufladestationen, Getränkekühlung etc.). Auch könnten die Leistungen der Städte im Zusammenhang mit der Energiewende sichtbar kommuniziert werden (z. B. LED-Wände mit Themenschwerpunkten). Weiter könnte es so zu einem System an bewusstseinsbildungs- und energieeffizienzorientierten Anlagen in unterschiedlichen Stadtbereichen kommen. Um einen unkontrollierten „Wildwuchs“ an Anlagen des einen, oder des anderen Typs vorzubeugen, könnten Konzepte zur Eignungszonierung entstehen, die in Verbindung mit Förderinstrumenten eine Entwicklung steuern könnten.

4.2.5 Branchen

Die erstmalige Abschätzung der Relevanz einzelner Sparten und Branchen im Rahmen dieser Studie ermöglicht eine gezielte Ansprache einzelner Branchen zur Hebung des Erwartungspotenzials. Damit könnten Rahmenbedingungen zukünftig speziell auf Bedürfnisse, beispielsweise des Einzelhandels mit Lebensmittel, des Elektrohandels, oder des Handels mit Automobilen, abgestimmt werden. Existierende Förderprogramme könnten Nischen für bestimmte Branchen mit hohem Realisierungspotenzial entwickeln und die verantwortlichen Entscheidungsträgerinnen und Entscheidungsträger direkt adressieren.

4.2.6 Verwaltung

Seitens der öffentlichen Verwaltungen könnten Leitfäden zum energieorientierten Umgang mit urbanen Parkplatzflächen entstehen und bestimmte grundlegende Aspekte zur Planungsvoraussetzung erhoben werden. So könnte die Vergabe finanzieller Unterstützungen zur Projektrealisierungen bspw. an trans- und interdisziplinär arbeitende Projektteams, Einbeziehung der Bevölkerung, Anteilsmöglichkeiten der Bevölkerung, besondere gestalterische Berücksichtigung lokaler Gegebenheiten, Bereitstellung von bestimmten Energiedienstleistungen, Nutzung bestimmter Materialien, Mindestdurchlässigkeit von Sonnenlicht etc. geknüpft werden. Zusätzlich könnten mit der Realisierung des errechneten Erwartungspotenzials langfristige Entwicklungsstrategien (SmartCities, Energieregion, Vorzeigeregion, Nachhaltige Stadt etc.) in ihrer Außendarstellung unterstützt werden. Der Energiewandel könnte dadurch ein „Gesicht“ bekommen und die lokale Bevölkerung in ihrer Vorstellungskraft über zukünftige Entwicklungen unterstützen. Aus touristischer Sichtweise könnte dadurch auch die Positionierung als innovative, umweltfreundliche, erneuerbare Energien unterstüt-zende und nachhaltige Stadt unterstützt werden und zusätzliche Besuchersegemente attraktivieren.

5 LITERATURVERZEICHNIS

Austrian Standards. (2017): ÖNORM B 1991-1: Eurocode 1 – Einwirkungen auf Tragwerke - Teil 1-1: Allgemeine Einwirkungen - Wichten, Eigengewicht, Nutzlasten im Hochbau - Nationale Festlegungen zu ÖNORM EN 1991-1-1 und nationale Ergänzungen. Online verfügbar unter: https://shop.austrian-standards.at/action/de/public/details/592218/OENORM_B_1991-1-1_2017_02_01.

Bayerischer Verwaltungsgerichtshof. (2015): Beeinträchtigung des überlieferten Erscheinungsbilds eines Baudenkmals. Online verfügbar unter: http://www.gesetze-bayern.de/Content/Document/Y-300-Z-BECKRS-B-2015-N-46412?hl=true&AspxAutoDetectCookieSupport=1.

Biermayr, P. (2016): „Erneuerbare Energie in Zahlen 2016: Entwicklung in Österreich auf Datenbasis 2015“. Ministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.

BMLFUW, B. für L.F., Umwelt und Wasserwirtschaft und BMWFJ, B. für W., Familie und Jugend. (2009): „Energiestrategie Österreich“. Online verfügbar unter: http://www.energiestrategie.at/initiative-ziele [Zugegriffen am: Jänner 15, 2013].

Brisson, A., Le Borgne, P., und Marsouin, A. (1999): „Development of algorithms for Surface Solar Irradiance retrieval at O&SI SAF Low and Mid Latitudes Presentation and content“. Météo France/SCEM/CMS.

Bundesamt für Naturschutz. (2012): „Energielandschaften - Kulturlandschaften der Zukunft? Workshop 1: Energiewende – Fluch und / oder Segen für unsere Landschaften?“ Online verfügbar unter: http://www.bfn.de/0610_energielandschaften-01.html.

Bundesamt für Naturschutz und Technische Universität Berlin. (2013): „Energielandschaften - Kulturlandschaften der Zukunft? Workshop 2: Energiewende = Energielandschaft - Die Neugestaltung der Landschaft?“

Chukwu, U.C. und Mahajan, S.M. (2014): „V2G parking lot with pv rooftop for capacity enhancement of a distribution system“. IEEE Transactions on Sustainable Energy 5(1):119–127.

Dreier, T. (2000): Ganzheitliche Systemanalyse und Potenziale biogener Kraftstoffe L. für E. und A. T. U. M. IfE, Hrsg. Herrsching: E und M, Energie-und-Management-Verl.-Ges.

European Environment Agency. (2012): „Copernicus Land Monitoring Service - Local Component: Urban Atlas“. Online verfügbar unter: http://land.copernicus.eu/user-corner/technical-library/urban-atlas-mapping-guide.

European Photovoltaic Industry. (2014): „Global Market Outlook: for Photovoltaics 2014-2018“.

Gautier, C., Diak, G., und Masse, S. (1980): „A Simple Physical Model to Estimate Incident Solar Radiation at the Surface from GOES Satellite Data“. Journal of Applied Meteorology 19(8):1005–1012.

Genske, D.D., Jödecke, T., und Ruff, A. (2009): Nutzung städtischer Freiflächen für erneuerbare Energien ein Projekt des Forschungsprogramms „Experimenteller Wohnungs- und Städtebau“ (ExWoSt) des Bundesministeriums für Verkehr, Bau und Stadtentwicklung (BMVBS) und des Bundesamtes für Bauwesen und Raumordnung (BBR) Bundesministerium für Verkehr, Bau und Stadtentwicklung und Bundesinstitut für Bau-, Stadt- und Raumforschung im Bundesamt für Bauwesen und Raumordnung, Hrsg. Berlin: BMVBS [u.a.]. Online verfügbar unter: http://nbn-resolving.de/urn:nbn:de:0093-SO0309R159 [Zugegriffen am: Juli 2, 2013].

Geofabrik. (2016): „OpenStreetMap Data Extracts“. Online verfügbar unter: http://download.geofabrik.de/ [Zugegriffen am: Juni 1, 2017].

Heinrich-Böll-Stiftung, IASS, I. for A.S.S., BUND, B. für U.N.D., Le Monde diplomatique, und GLOBAL 2000. (2015): „Bodenatlas 2015 - Daten und Fakten über Acker, Land und Erde“. Bodenatlas No. 1, Online verfügbar unter: https://www.global2000.at/bodenatlas2015 [Zugegriffen am: Februar 5, 2015].

Hofierka, J. und Suri, M. (2002): „The solar radiation model for Open source GIS: implementation and applications“. In Proceedings of the Open source GIS-GRASS users conference. S. 51–70.

Hunter, C. und Baldwin, J.G. (2013): „The Financial Viability of Solar Photovoltaic Canopies as Urban Climate Change Mitigation: An Analysis of the Potenzial Utilization of Public Space in Boston, Massachusetts“. Energy and Environment Research 3:p158.

International Energy Agency. (2014): „Renewable energy“. Online verfügbar unter: http://www.iea.org/aboutus/faqs/renewableenergy/ [Zugegriffen am: Februar 4, 2015].

Kaltschmitt, M., Lippitsch, K., Müller, J., Reichert, S., Schulz, D., und Schwunk, S. (2013): Erneuerbare Energien: Systemtechnik, Wirtschaftlichkeit, Umweltaspekte M. Kaltschmitt, W. Streicher, und A. Wiese, Hrsg. Berlin, Heidelberg: Springer Berlin Heidelberg. Online verfügbar unter: http://dx.doi.org/10.1007/978-3-642-03249-3_6.

Knoll Planung & Beratung. (2011): „Photovoltaik in der Landschaft - Steuerungsstrategie für Photovoltaik-Freiflächenanlagen aus der Sicht des Naturschutzes und der Raumordnung“.

Naturschutzbund Deutschland und BSW-Solar. (2005): „Kriterien für naturverträgliche Photovoltaik-Freiflächenanlagen“. Online verfügbar unter: http://imperia.verbandsnetz.nabu.de/imperia/md/content/nabude/energie/solarenergie/nabu-kriterien-solarparks-2012.pdf.

Neumann, H.-M., Schär, D., und Baumgartner, F. (2012): „The potenzial of photovoltaic carports to cover the energy demand of road passenger transport“. Progress in Photovoltaics: Research and Applications 20(6):639–649.

Peterseil, J., Wrbka, T., Plutzar, C., Schmitzberger, I., Kiss, A., Szerencsits, E., Reiter, K., Schneider, W., Suppan, F., und Beissmann, H. (2004): „Evaluating the ecological sustainability of Austrian agricultural landscapes - the SINUS approach“. Land Use Policy 21(3):307–320.

Photovoltaik Austria. (2014): „Daten & Fakten“. Kernbotschaften. Online verfügbar unter: http://www.pvaustria.at/daten-fakten/ [Zugegriffen am: Februar 4, 2015].

Probst, A. (2014): Auswirkungen von Elektromobilität auf Energieversorgungsnetze analysiert auf Basis probabilistischer Netzplanung. Monographie. Stuttgart: Universität Stuttgart. Online verfügbar unter: http://www.uni-stuttgart.de/ieh/forschung/dissertationen/Diss_Probst.pdf.

Scherhaufer, P., Höltinger, S., Salak, B., Schauppenlehner, T., und Schmidt, J. (2017): „Linking patterns of acceptance and non-acceptance with the claims of environmental justice: A case study on wind energy expansion in Austria“. Energy Policy (accepted).

Serrano-Luján, L., García-Valverde, R., Espinosa, N., García-Cascales, M.S., Sánchez-Lozano, J.M., und Urbina, A. (2015): „Environmental benefits of parking-integrated photovoltaics: A 222 kWp experience“. Progress in Photovoltaics: Research and Applications 23(2):253–264.

Stadt Wien, M. der S.W., Magistrat 20-Energieplanung. (2013): „Photovoltaik- und Solarwärme-Anlagen auf Freiflächen“. Online verfügbar unter: https://www.wien.gv.at/stadtentwicklung/energieplanung/publikationen/#studien [Zugegriffen am: Jänner 14, 2015].

Statistik Austria, B.S.Ö. (2017): „Kraftfahrzeuge - Bestand“. Online verfügbar unter: http://www.statistik.at/web_de/statistiken/energie_umwelt_innovation_mobilitaet/verkehr/strasse/kraftfahrzeuge_-_bestand/index.html [Zugegriffen am: Juni 12, 2017].

Strauss, D., Fehr, R., und Cain, A. (2009): „Vehicle Surfaces: A Parking Lot PV Solar Energy Power Generation System“. Online verfügbar unter: http://papers.sae.org/2009-01-2870/ [Zugegriffen am: Jänner 12, 2015].

Syn[En]ergy. (2017): „Syn[En]ergy – Synergiepotenziale zwischen Stadtplanungszielen und Photovoltaiknutzung auf Freiflächen“. Online verfügbar unter: http://synenergy.boku.ac.at/ [Zugegriffen am: Juni 13, 2017].

Tulpule, P.J., Marano, V., Yurkovich, S., und Rizzoni, G. (2013): „Economic and environmental impacts of a PV powered workplace parking garage charging station“. Applied Energy 108:323–332.

Veigl, A. (2015): „Energiezukunft Österreich: Szenario für 2030 und 2050“. No. 1, Online verfügbar unter: http://www.wwf.at/de/view/files/download/showDownload/?tool=12&feld=download&sprach_connect=2970.

VGH Baden-Württemberg. (2011): Beeinträchtigung des Erscheinungsbildes einer als Kulturdenkmal geschützten Kirche durch Photovoltaikanlage; Bedeutung des Klimaschutzes als Staatsziel; kirchliches Selbstbestimmungsrecht und Glaubensfreiheit. Online verfügbar unter: http://www.landesrecht-bw.de/jportal/?quelle=jlink&docid=MWRE110002944&psml=bsbawueprod.psml&max=true&doc.part=L&doc.norm=all [Zugegriffen am: Mai 19, 2016].

Wirtschaftskammer Österreich. (2016): „Branchenbuch österreichischer Unternehmen: WKO - Firmen A-Z“. Online verfügbar unter: https://firmen.wko.at/Web/SearchComplex.aspx [Zugegriffen am: Juni 9, 2017].

Using Different Data Sources for New Findings in Visualization of Highly Detailed Urban Data

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1 ABSTRACT

Measurement of infrastructure has highly evolved in the last years. Scanning systems became more precise and many methods were found to add and improve content created for the analysis of buildings and landscapes. Therefore the pure amount of data increased significantly and new algorithms had to be found to visualize these data for further exploration. Additionally many data types and formats originate from different sources, such as Dibits hybrid scanning systems delivering laser-scanned point clouds and photogrammetric texture images. These are usually analyzed separately. Combinations of different types of data are not widely used but might lead to new findings and improved data exploration.

In our work we use different data formats like meshes, unprocessed point clouds and polylines in tunnel visualization to give experts a tool to explore existing datasets in depth with a wide variety of possibilities. The diverse creation of datasets leads to new challenges for preprocessing, out-of-core rendering and efficient fusion of this varying information. Interactive analysis of different formats of data also has to have several approaches and is usually difficult to merge into one application.

In this paper we describe the challenges and advantages of the combination of different data sources in tunnel visualization. Large meshes with high resolution textures are merged with dense point clouds and additional measurements. Interactive analysis can also create additional information, which has to be integrated precisely to prevent errors and misinterpretation. We present the basic algorithms used for heterogeneous data formats, how we combined them and what advantages are created by our methods.

Several datasets evolve over time. This dynamic is also considered in our visualization and analysis methods to enable change detection. For tunnel monitoring this allows to investigate the entire history of the construction project and helps to make better informed decisions in the preceding construction phases or for repairs.

Several methods are merged like the data they are based on enabling new ways of data exploration. In analyzing this new approach to look at heterogeneous datasets we come to the conclusion that the combination of different sources leads to a better solution than the sum of its parts.

Keywords: tunnel monitoring, heterogeneous data, visualisation, infrastructure, rendering

2 INTRODUCTION

The assessment and monitoring of tunnels and associated underground structures is the very core field of application of Dibit Messtechnik GmbH. Due to their needs, new methods for data representation and visualization had to be found. Visualization is the core field of VRVis. These two companies developed a long-term partnership in research and development for technologies needed for visualization of linear underground buildings. Over the years the need of Dibit to integrate additional data sources into high-performance 3D visualizations grew. Besides that, they wanted to integrate measurements from different tools. Another important point is to load and display raw data coming directly from laserscans such as point clouds. This combination of various heterogeneous data sources allows a more reliable visual analysis and leads to better informed decision. Every data type imposes different requirements for visualization demanding different solutions. After the integration of this highly heterogeneous information we realized the challenges which have to be met for the combination of these data types, which are further aggravated because performance and precision is crucial for our users.

Our solution for these problems described in this paper, is an approach that precisely combines several data types. After a short overview of related work, which handles similar problems, we analyze the different data types currently available in our application and the needs we had to meet, to visualize them. Based on this information we finally show the data combination, how we met emerging challenges, which techniques helped and how our solution enables the efficient and reliable exploration of heterogeneous datasets.

3 RELATED WORK

Our work is based on a long-time project described by Ortner et al. (2010). The basic concept is still the same but especially the acquisition of data has evolved significantly. The representation of point clouds was taken from other works (Hesina et al., 2009, Leitner and Hesina, 2011) where the visualization of huge LIDAR datasets is explained.

Ortner et al. (2016) presented a design study which shows the usage of multiple views for tunnel crack analysis. Based on this results they created a solution to support experts in tunnel maintenance tasks. Multivariant datasets were combined with a 3D-visualization to handle these complex problems efficiently.

It was surprising for us to find such a small amount of similar work. Especially research in tunnel visualization seems to be relatively rare. One example we found was presented by Stent et al. (2013), where they presented an automated system for visual changes in tunnel linings. It is basically used for maintenance of tunnels and shows a relatively cheap system for inspection which is able to reduce the workload. While our system fulfils a similar task with a higher amount of preparation, it is still more versatile and therefore not only usable for monitoring changes but also to analyze the construction of underground structures and handle additional information.

Figueiredo et al. (2014) present a Web application for the visual exploration of a cave model with decimated details. For the calculation of size or distances between objects, relevant for the user, the base model is used for higher precision. This work shows some of the problems of high resolution datasets of underground structures in a visualization application.

4 DATA SOURCES AND VISUALIZATION

We use several data sources in our application and therefore we need to describe the main data types in detail for deeper understanding. Our main 3D-models of tunnel scans are Ordered Point Clouds (OPCs), while unordered point clouds were added later with the requirement to combine it with the rest of the existing data. Vector based objects are needed for interaction and measurements. The overall impression, especially for presentations, can be improved by adding auxiliary 3D objects. Additionally, simple 3D objects are created to display geometry for analytical purposes such as cutting planes.

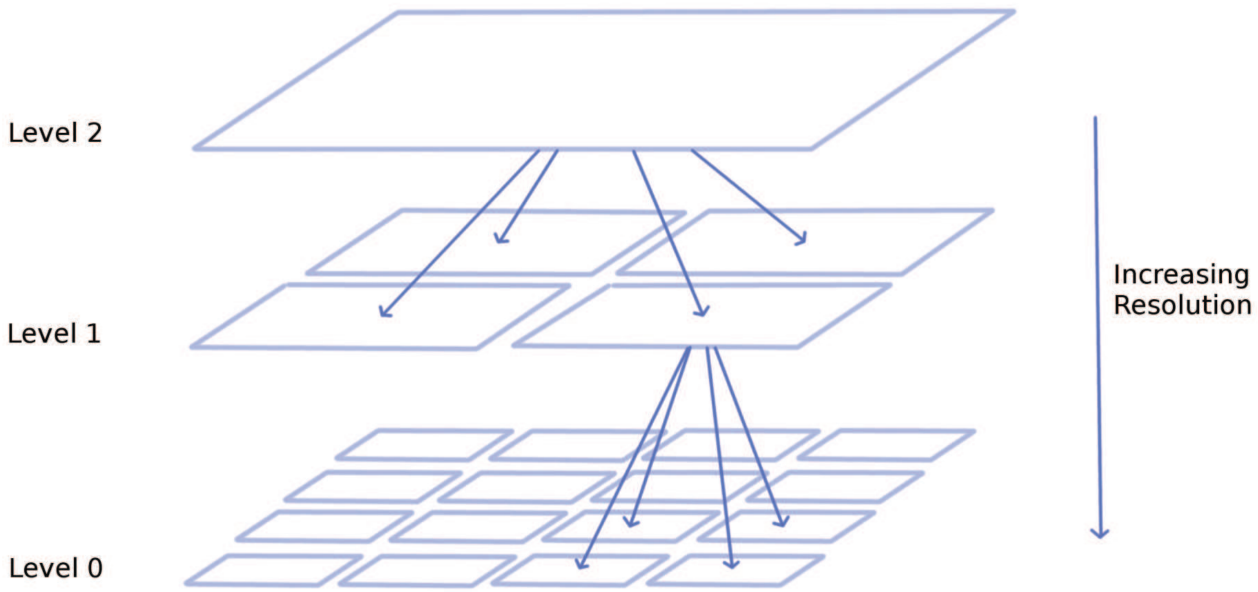

Fig. 1: Schematic LoD-Structure: Higher Levels with less detail encompass several lower level patches of higher detail

4.1 Ordered Point Cloud (OPC)

The OPCs are created from state of the art vision sensors like laser scanners as described by Ortner et al (2010). Camera images and laser scans are unified into the OPCs which are basically high tessellated 3D-meshes with high resolution textures. Tunnel data of several kilometers lengths with details in millimeter accuracy is created this way. Therefore a Level of Detail (LoD) approach (Luebke et al, 2002) is used to feed the render application with a manageable amount of data. In this way the whole dataset can be explored without any loss of information while only important data is shown which leads to proper performance.

For the beforementioned rendering techniques the whole dataset is already preprocessed in a special structure for the LoD-approach as described by Ortner et al (2010). The datasets are far too big for the graphics memory and therefore out-of-core data management is used. This means, that a strategy is created to decide, which parts of the data has to be shown and what amount of detail is required by the user. The data is split and every higher level of detail block includes the space of four lower levels with more data, as shown in Figure 1. Meanwhile the algorithm also decides, which data can be removed from memory to prevent that the needed amount of memory exceeds the existing resources.

In the last few years the power of computers highly increased but the algorithms created for this approach are still important. Scanning techniques have improved and with them, the amount of detail also increased. Therefore it is essential to use an optimized approach to meet continuously growing data volumes. Especially with the addition of more data types, performance requirements of our main data sources, the OPCs, has to be fulfilled without decreasing the possibilities of other, high resolution data like unordered point clouds.

4.2 Unordered Point Clouds

Laser scanners usually create irregular point clouds. No meta-information is added and therefore only positions of the points are known besides some color information and sometimes data of the reflection or classification of points. Many scans we got for visualization contain at least several million points. To explore such datasets efficiently in real-time, some preprocessing steps are needed. Still unprocessed point clouds are commonly used, because their acquisition is relatively fast and easy. The visualization still shows basic details without the need of highly advanced preprocessing algorithms as for OPCs. Without some steps to create an optimized data structure, presentation limits are easily reached.

Our approach for point rendering is loosely based on the work of Hesina et al. (2009) and Leitner and Hesina (2011). The whole point clouds are subdivided into blocks with an octree-approach to be prepared for LoD rendering similar to the scematic in Figure 1. Therefore the highest level with least details covers a larger area with the same amount of points than lower levels which only represent a part of its space. In this way the blocks seem to have a complete set of points when looked at from higher distances with details increasing when coming closer. When the camera in our rendering comes closer to a point block, the LoD-approach simply accumulates points of the lower levels. In this way exploration of the whole dataset is possible because only relevant data is rendered.

We use point sprites in our approach which is an efficient way to render points with current graphics cards as quads or, as in our example, as circles (Frank Luna, 2006). The main advantage of point sprites is that they need only a coordinate for visualization and the size of these sprites can be changed in the shader which is used to reduce the gaps between points. During preprocessing the average distance between points is calculated to set a point size value.

The rendering of point clouds is nearly as effective as the usage of OPCs. Still they are inferior because without informations of neighboring elements, many measurement techniques cannot be used on unordered point clouds. Additionally OPCs are visually richer and therefore easier to explore for the user. They can hold an increased amount of details based on high resolution textures which cannot be mapped onto point clouds which only use color values per point. Textures are well supported in current graphics cards to gain details for the visualization of datasets. Besides that, meshes are much easier to handle for many interactions such as measurements.

4.3 Vector based objects

In the presented approach geometry is not only used for the representation of existing objects but also for measurements and annotations. It is possible to select points on an OPC and check the distance directly or find it with a projection on the tunnel surface. For an improved visibility, geometrical tubes are used instead of lines to prevent them from disappearing inside other objects. Additionally, the line thickness depends on the distance from the camera so that the apparent thickness remains constant.

External data can also be specified as vector based objects and represented in the same way. If they are available as 3D datasets their coordinates are simply added, while 2D datasets are mapped onto surfaces with the beforementioned method. Different data types are handled with the same methods and lead to a high variety of sources which can be used in the application.

One issue with this polygonal approach is, that 3D tubes are many small geometries which can lead to performance problems. Therefore we use an algorithm to pack this high number of small parts into managabeable groups with bigger chunks of gemoetry which are easier to handle for the hardware but do not change anything for the user.

Besides measurements, the vector based objects can be used as markings to highlight cracks and building characteristics directly in the software or by external tools. It improves the possibilities to explore existing analysis, create new ones or present it in 3D space for visual verficication of tunnel irregulartities.

4.4 Smaller, additional data types

For interaction and presentation additional objects are needed. Therefore, 3D objects of well known data formats such as VRML can be imported. Traffic signs, lights or similar objects can be included into the tunnel for a more realistic impression.

3D objects are also used for further interaction and measurement methods. Cutting planes for OPCs create exact measurements along the tunnel axis. These cuts create polylines on the tunnel surface as mentioned in the chapter before.

Another important task is achieved by 2D reference profiles to find differences between the planned tunnel and the analyzed construction phase. This is accomplished by comparing the reference profile to tunnel profile slices of the 3D laserscans.

Finally a minimum clearance outline can also be integrated to find out, if objects like trains fit through a tunnel to prevent collisions.

4.5 Comparison of data types

The data types described include several advantages and disadvantages which have to be adressed for using them efficiently. Experts have to decide which data type is suitable for the users needs. Table 1 presents an overview of the main advantages and disadvantages of the different data types mentioned before.

Data type	Advantages	Disadvantages
Ordered Point Clouds (OPCs)	- fast rendering - completely meshed surface for precise measurements and selections - better details with high-resolution textures	- time consuming preprocessing
Unordered point clouds	- easy to acquire - fast render preparation	- points are more difficult to interpret - no surfaces for calculations and measurements
Vector based objects	- fast rendering and creation - visually clear visualization - user can create it easily in the application	- limited in use - manual preparation required
Common 3D objects	- wide variety of uses - easy to render - simple integration for additional details	- manually costly created or just already existing basic objects - usually not geo-referenced by default (manually set)

Table 1: Summary of advantages and disadvantages of the different, described data types

5 VISUAL COMBINATION OF DATA

Our main contribution is the combination of complex data in a software for visual exploration. Challenges are met with special techniques which lead to many advantages of this approach. In the end an application was created to meet the requirements of users for the analysis of tunnels during construction and for maintenance. The used techniques and advantages are decsribed first and demonstrated in our application description afterwards.

5.1 Challenges

While the basic visualization of the mentioned data is common knowledge for computer graphics specialists, the combination of the sources leads to additional challenges and problems. Keeping precision is already difficult for huge datasets. Common graphics cards use floating point precision only and therefore local coordinate systems have to be used for every dataset in the application. Every visualized dataset has to use their own coordinate systems to prevent floating point precision problems (Johnson and Hansen, 2004). The challenge is to find a way to join all datasets and keep the information in each of them while showing everything together.

The usage of the techniques described before leads to possible performance problems for combined datasets. It is easier to show a single huge dataset because the resource usage has not to be shared with so many functions in the application and is easier to handle. The memory management is the second significant challenge which has to be met for our requirements.

The next big challenge worth mentioning is the combination of interaction possibilities. Every dataset has to use its own kd-tree, a spatial data structure for efficient picking of objects in the application (Akenine-Möller et al., 2008), for interactive selection of its parts by the user. Communication between several data handling modules is also important to combine measurements across data sets. Combining of datasets also aggregates some interaction problems which occur with the usage of localized coordinate systems and different performance saving techniques. Calculations have to be done for every interaction to transfer the global data to the local coordinate systems and vice versa.

Additionally the same type of data may come from completely different sources. Preprocessing can be difficult if they differentiate in details. OPCs are properly prepared for rendering while other pointclouds are often just a bunch of coordinates without any further information but can also have colors or metadata for every point. Vector datasets which can be imported as vector based objects may come from different tools and therefore vary in detail. 3D models also originate from a wide variety of design software which leads to the same problems.

5.2 Techniques

The beforementioned challenges are handled in our work with different techniques. The basic approaches of high performance data visualization are still intact as mentioned in the chapter before but are tweaked in some details. Resource management is essential for all visualization modules presented. If any component of the solution does not work optimally, the whole system suffers from a severe decline in usability. Our approach keeps seperate parts as focused as possible and only unifies elements, where it is needed to create a seemless exploration experience for users.

For rendering all datasets at the same time a scenegraph is used. It is a higher-level tree structure which includes not only geometry, but also textures, transformations, levels of detail, render states, light sources and usually some more render information (Akanine-Möller et al, 2008). This way every part has its own properties and shaders but basic functions are the same for a larger substructure. For example the data handling of unordered points is highly different from OPCs or common 3D objects and therefore it is important to be able to handle the different types of geometry separately. In the presented approach a special scenegraph is used which handles semantic and rendering aspects cleanly separated (Tobler, 2011). It allows dynamic changes of every data type and adding new objects or nodes during runtime without influencing other parts of the visualization. Among other things, this scengraph is optimized to deal with out-of-core rendering of large scenes and multi-view rendering which is needed in our application.

All data is geo-referenced which leads to coordinates with a high number of digits. To keep precision and still use float values in the graphics card, datasets are split into blocks, where each has a local coordinate

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system and inherits an offset matrix into the global coordinate system. Individual blocks are rendered locally with the offset for the correct position. Users need the geodata for their tasks. Therefore every measurement and calculation is done in double precision and the offset is added or removed. This is especially difficult when common operations take place over several blocks. The selection of a part of a surface on an OPC or in a point cloud often has another local coordinate system and such differences have to be addressed to keep selections precise and consistent.

Another performance factor is the use of highly optimized out-of-core implementations, to stream data saved from the hard-disc directly into our application. Multiple threads handle separate datasets individually. The graphics card gets data to visualize while additional information is kept outside memory. It is prepared in a preprocessing step before or parallel in another thread at runtime. Data is subdivided into renderable blocks with their own, local coordinate system as mentioned before. Metadata is also created for LoD-decision hierarchies and kd-intersection trees.

5.3 Advantages

It is often emphasized that the combination of different data sources leads to more results than the mere sum of the parts. In the presented approach many examples are found to validate this statement.

The mixture of different tunnelscans leads to the most obvious advantage of the presented application. Unsorted point clouds from simple 3D-laserscans can be validated when they are exactly fitted into an OPC dataset of the same object. Other parts which are not preprocessed as a mesh and created with other scanners can easily be added to gain more information of a region inside a tunnel, to expand or update existing data. Datasets which are easier to acquire can be used for comparison with the complete current scans and to find changes on surfaces or in the geometrical structure.

The inclusion of vectorized polygonal data is essential for documentation of abnormalities and problems on the tunnel surface. It is also important for the ability to handle data of external tools to give users more flexibilities.

The tunnel surface can be analyzed by the usage of 2D-profiles on the tunnel axis. The comparison with the reference can bring additional insights of the boring and all other construction processes. The usage of a minimum clearance outline helps to detect potential collision hazards in the safe virtual environment of our application.

Several types of geometry like cutting planes also bring new, partly unexplored methods to measure distances on the tunnel surface which is often difficult but at least expensive in reality.

The use of 3D-models of real objects which might be added to the scene, supports planning of construction processes and might prevent unnecessary worksteps in the real tunnel.

Every data acquired in the virtual representation can save time and working hours. Expensive blocks of roads or railway tracks can be minimized without a loss of safety because of the high precision of the data which can be explored in real-time.

5.4 Solution description for visualizations and interaction

Visualization applications are usually easier to show than to describe. The application described in this paper is based on, as mentioned, the work of Ortner et al (2010) but highly extended. The main datasets are still OPCs as described in chapter 4.1. A 3D visualization needs a tunnel axis as basis to unify OPCs with other datasets. The data is shown relative to the tunnel axis and the navigation is bound to it, too.

Preprocessing is needed for some datasets before usage and can be started directly in the software. After preparations have been finished, the data is directly integrated into the visualization. The biggest datasets added to the usally huge OPCs, are often point clouds. For the user they are just added in a convenient way and as soon as the preprocessing is finished, the combined data is shown in the application.

The whole application works on usual computers with default graphics cards. All images are created inside the application where datasets can be explored in real-time. It shows the techniques described in sector 5.2 working together smoothly. Advantages described in sector 5.3 are shown in the following examples.

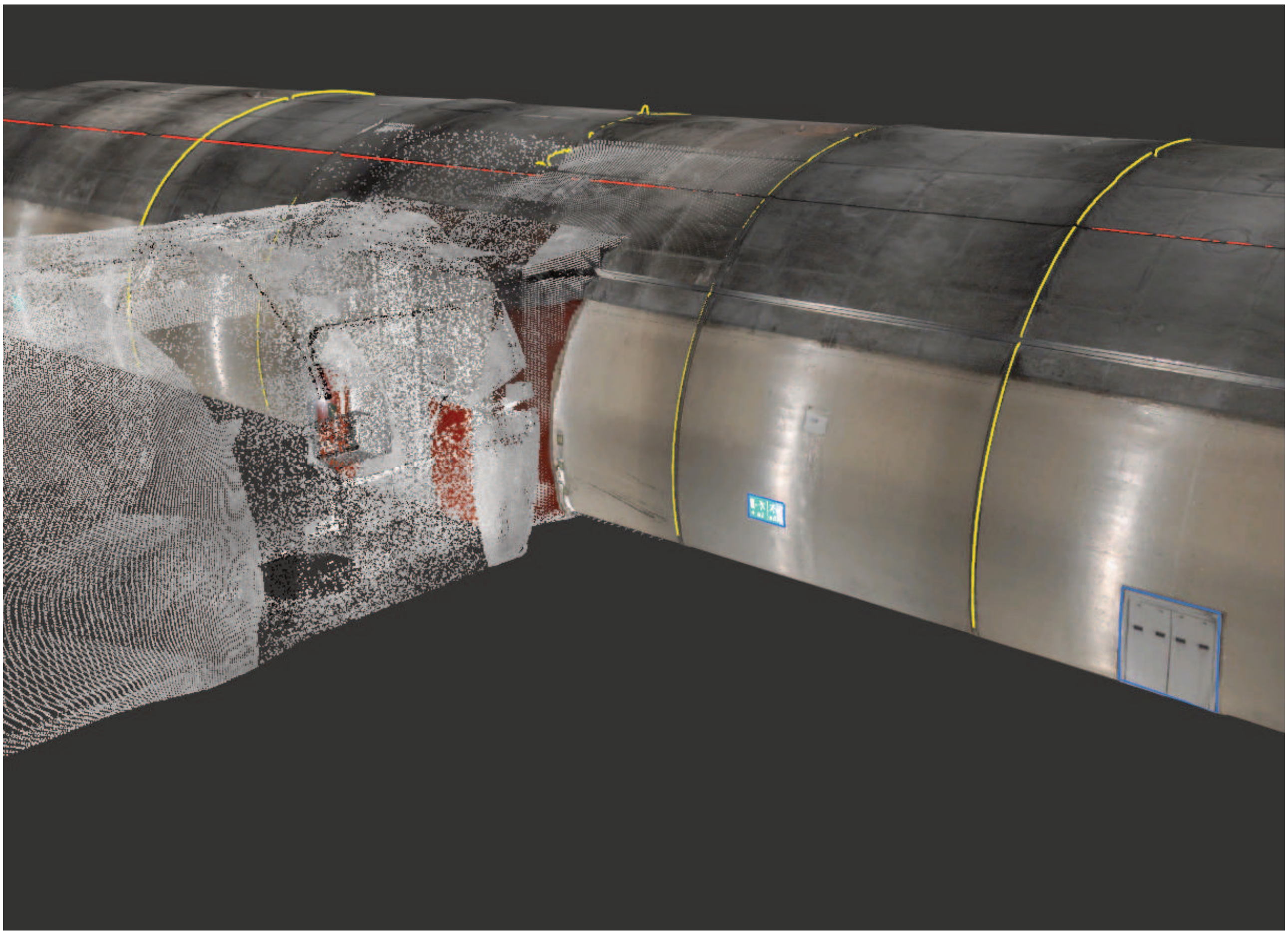

Figure 2: combination of OPC tunnel surface and point rendering

After such preparation, interactive visualization is possible. Figure 2 shows a laser scan from outside the tunnel combined with a side tube as an unordered point cloud. The section, where the two scans fit together is clearly visible. Additionally tunnel sections, the emergency exit sign and a door are marked with vectorized data in this figure. This shows the high precision of our approach for the combination of different data sources. The OPC datasets are created completely different from the point clouds which were added much later and still fit perfectly. Vectorized data give more information and highlight important structures while fitting seamlessly into the whole visual representation of the tunnel.

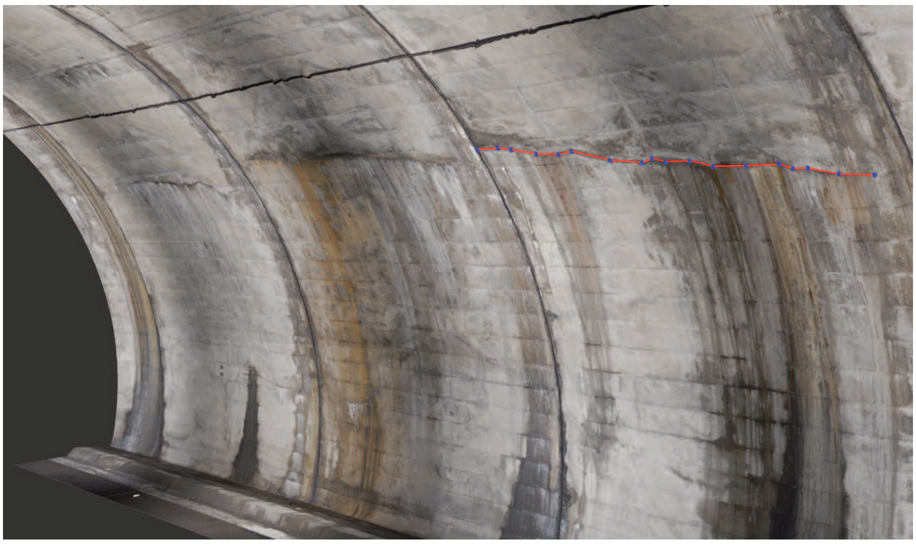

Figure 3: usage of vectorized data for crack tracing

Besides the use for highlighting, existing structures like mentioned before, vectorized data can also be created during runtime. Figure 3 shows the marking of a crack on the tunnel surface. The user defined lines

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are mapped directly onto the wall and kept for documentation. The use of tubes for vectorized data is also shown in this way. The selection on the surface created a line which perfectly fits onto the tunnel and would disappear in the visualization without the usage of tubes as described before. With the presented approach the visual representation of the line is differentiated and clearly identifyable from any direction.

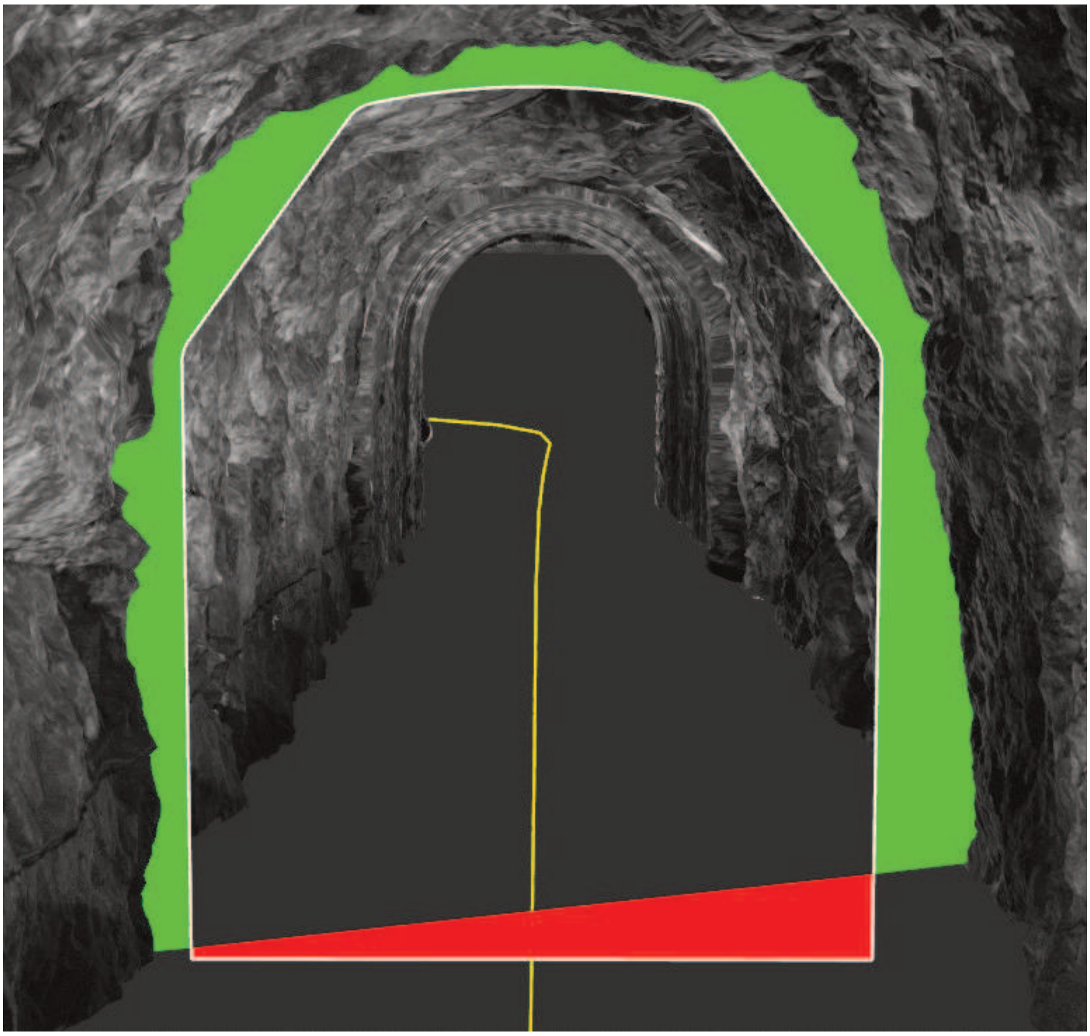

Figure 4: minimum clearance outline inside an early tunnel construction step

Figure 4 shows a minimum clearance outline inside a tunnel. The section on the plane, which does not belong to the outline, is highlighted, to recognize, how much space is between it and the tunnel surface. It is used to simulate if for example a train would fit through this tunnel without collision. Especially close collisions would not be noticed by the naked eye and therefore the visualization helps the user to identify possible threads.

Figure 5 shows an unordered point cloud with some measurements. Simple billboards are used for visualizing the distance between the clicked points. The structure is clearly identifiable but still not as precise as OPCs. The measurements can only be done betweeen points due to the lack of a surface. Still the addition of vectorized data helps to retrace measurements and shows the width of structures at a glance.

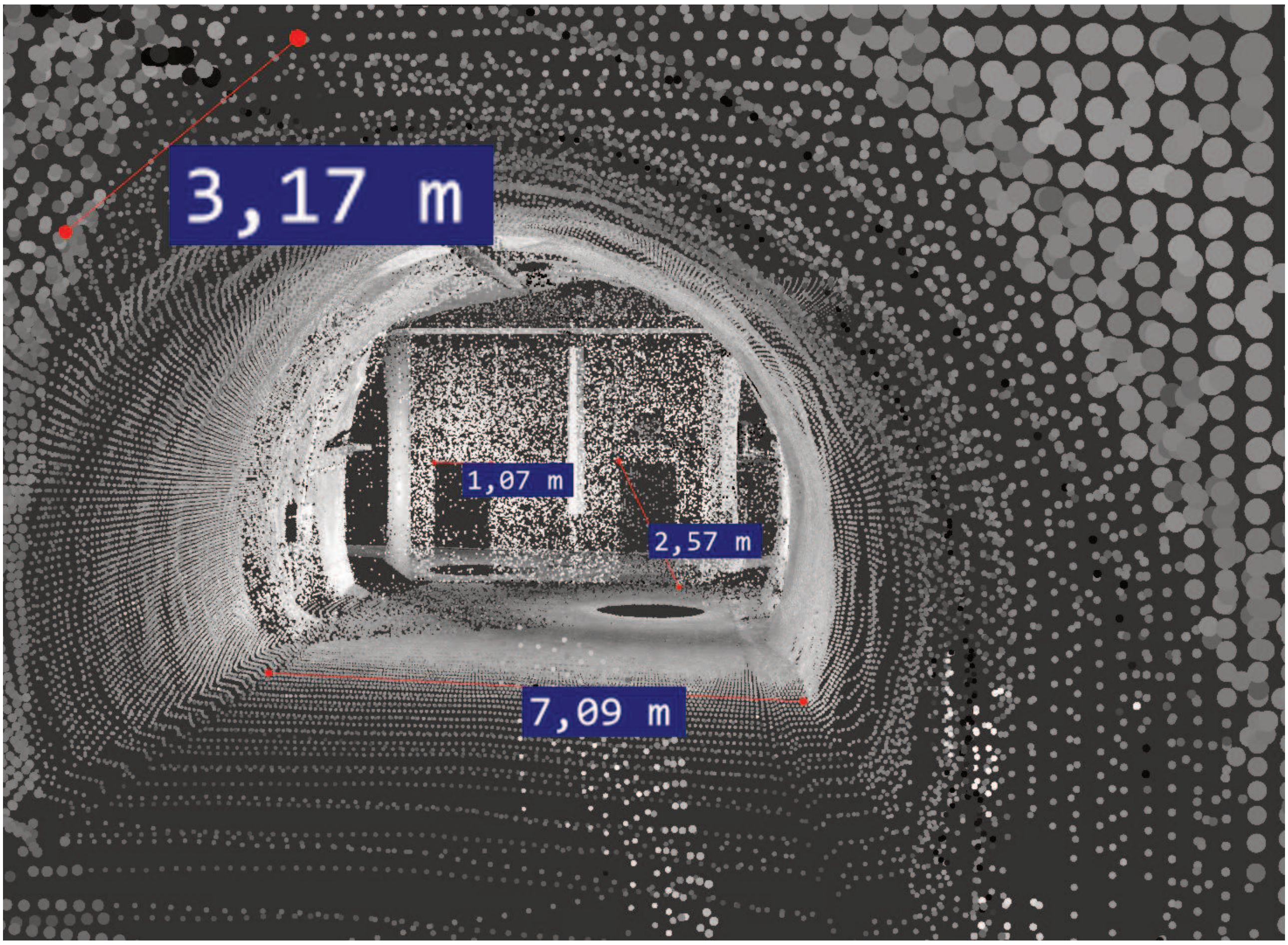

Figure 5: distance measurement in an unprocessed point cloud

These are some examples of the usage of the combination of data sources in our visualization application. Further possiblities were already described before and reach from usage of planes or surface structure for additional measurement and annotations to mainly optical improvements of the datasets.

6 CONCLUSION

We presented an application enabling a high-performance visualization of combined heterogenuous data sets resulting from tunnel construction projects. The integrated visualization of various data types in a consistent geospatial virtual environment allows a more efficient and reliable analysis than investigating the data sets separately by different tools.

Flexibility is one of the main advantages for the users of the presented work. Besides efficient real-time exploration, data comparison and interactive measurements leads to a working environment enabling an accurate and reliable visual analysis. Support of as many data sources as possible helps to serve a wide variety of experts with their tasks.

Still there are many interesting topics for research and development. Tunnel experts and geologists use our work together with a wide variety of other tools, which create new datasets. Not every data format can be supported and expending the range to more types is still possible. Flexibility will keep growing with new requirements from users.

Finding structures in unordered point clouds would lead to improved possibilities and could minimize the disadvantages of this data type compared to OPCs. This is still far from trivial and needs much more research and would still not fully meet the requirements to create a mesh out of every type of unordered point clouds.

Users asked for the integration of billboards for a wide variety of tasks. In this way geo-referenced photos of the tunnel can be integrated for further comparisons. Meta information might also be included in 3D rendering with a similar technique.

Visualization of tunnel deformation with textures or maps which are used as base for displacements in the shader might lead to additional insights into the alterations between tunnel phases and several construction steps.

Performance is still an important issue for improvements. Continous Level of Detail approaches and the reduction of vertices without a loss of detail might be reached with the usage of hardware tessellation algorithms.

The possibilities for improvement seem limitless and our work for tunnel experts might show possibilities for the analysis of other areas of urban planning and maintenance.

7 ACKNOWLEDGEMENTS

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8 REFERENCES

Akanine-Möller, T., Haines, E., Hoffmann, N., "Realtime-Rendering", A.K. Peters Ltd., 3rd Edition, Natick, MA, USA, 2008

Figueiredo, M., Rodrigues, j. I. de J., Silvestre, I., Veiga-Plres, C. C., "Web3D Visualization of High Detail and Complex 3D-mesh Caves Models", in Proceedings 18th International Conference on Information Visualization (IV), Paris, 2014

Hesina, G., Leitner, B., Mantler, S., Brimmer, F. ,"Infrastructure Acquisition and 3D Virtual Integration, in Proceedings of REAL CORP 2009, pp. 253-259, Vienna 2009

Johnson, C., Hansen, C., "Visualization Handbook", Academic Press, Inc., Orlando, FL, USA, 2004

Luebke, D., Reddy, M., Cohen, J., Varschney, A., Watson, B., Huebner, R., "Level of Detail for 3D Graphics", Morgan Kaufmann, 2002

Leitner, B. Hesina, G, "Zusammenführung und Interaktive Analyse von hochauflösenden 3D-Geodaten", in Proceedings of the Symposium und Fachmesse für Angewandte Geoinformatik (Agit), Salzburg, 2011

Luna, F., "Introduction to 3D Game Programming with DirectX 9.0c-A Shader Approach", Wordware Publishing Inc., 2006

Ortner, T., Paar, G., Hesina, G., Tobler, R., Nauschenegg, B., „Towards True Underground Infrastructure Surface Documentation", In: REAL CORP 2010 Proceedings, pp. 783-792. Vienna 2010.

Ortner, T., Sorger, J., Piringer, H., Hesina, G., Gröller E., "Visual Analytics and Rendering for Tunnel Crack Analysis - A Methodoligical Approach for Integrating Geometric and Attribute Data" in The Visual Computer (Journal), Volume 32, issue 6, pp 859-869, New York, 2016

Stent, S., Gherardi, R., Stenger, B., Soga, K., Cipolla, R., "An Image-Based System for Change Detection on Tunnel Linings", MVA 2013

Tobler, R. F, Separating Semantics from Rendering: "A Scene Graph based Architecture for Graphics Application", in The Visual Computer, Special Issue of Computer Graphics International (CGI), New York, 2011

Wenn die Orientierung versagt – unterwegs mit Menschen mit Demenz

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1 ABSTRACT

Im Projekt „Demenz in Bewegung“ wird die außerhäusliche Mobilität von Menschen mit Demenz erforscht. In Österreich leben an die 130.000 Personen mit Demenz, wobei sich beobachten lässt, dass sich sowohl die Personen mit Demenz, als auch ihre Zu- und Angehörigen aus dem gesellschaftlichen Leben und der außerhäuslichen Mobilität mit fortschreitender Krankheit zunehmend zurückziehen. Um diesem Phänomen entgegenzuwirken und allen Personen außerhäusliche Mobilität zu ermöglichen,werden die Mobilitätsbedürfnisse und -erfahrungen von Menschen mit Demenz untersucht.

Die empirischen Forschungen werden im direkten Kontakt mit Menschenmit Demenz durchgeführt sodass sieihre Erfahrungen, Wünsche und Bedürfnisse bei ihren Wegen im öffentlichen Verkehr direkt einbringen können. Nachdem in der wissenschaftlichen Literatur mehr auf die Ausgestaltung von Innenräumen eingegangen wird und Erkenntnisse zur Gestaltung des öffentlichen Freiraumes für Menschen mit Demenz weitgehend fehlen, liefert dieses Forschungsprojekt erste wissenschaftliche Grundlagen für den deutschsprachigen Raum. es nehmen 27 Personen mit Demenz an dem Forschungsprojekt teil. Der empirische Teil des Projekts selbst ist in drei Teilbereiche aufgeteilt: Narratives Interview, Begehunsstudie und einer Usability Studie. Um die Ergebnisse der partizipativen Mibilitätsforschung für verschiedene verkehrsplanerische Berufsgruppen aufzuarbeiten, werden – in partizipativen Dialogen mit Stakeholdern – Handlungsempfehlungen erarbeitet und den jeweiligen Gruppen präsentiert.

Keywords: öffentlicher Verkehr, öffentlicher Raum, Inklusion, Personenmobilität, Demenz

2 STAND DES WISSENS

In Österreich lebten 2014 Schätzungen zufolge 130.000 Personen mit Demenz, aufgrundeines kontinuierlichen Altersanstiegs in der Bevölkerung wird bis zum Jahr 2050 von einerVerdoppelung des Anteils ausgegangen. Zwei Drittel der Menschen mit Demenz sind Frauen. Dies ist u.a. auf die höhere Lebenserwartung von Frauen und das erhöhte Erkrankungsrisiko imhohen Alter zurückzuführen (Höfler, Sabine et al.: 2015).80 Prozent der Menschen mit Demenz leben in Österreich zuhause.

Die häufigste Demenzform ist die Demenz bei Alzheimer’scher Erkrankung. Auch wennwissenschaftliche Forschungen sowie Fachexpertinnen und -experten zunehmend von „cognitive disorders“, individuellen Verläufenoder „Phasen“ (Fercher, Petra; Sramek, Gunvor: 2013) und weniger von „Stadien“ der Demenz sprechen,wird in der klinischen Praxis Demenz oft in drei Schweregrade (Mini-Mental-StateExamination MMSE) eingeteilt: Bei „leichter Demenz“ treten zeitliche und örtlicheOrientierungsprobleme auf, Vergesslichkeit, Probleme bei komplexen Aufgaben und einhäufiges Verleugnen von Defiziten. Bei „mittelschwerer Demenz“ sind die betroffenenPersonen zu Zeit und Ort desorientiert, haben Probleme bei Alltagsverrichtungen wie z.B.Körperpflege, Langzeitgedächtnis ist beeinträchtigt und es können Angst, Unruhe, Apathieusw. auftreten. Die „schwere Demenz“ ist durch lückenhafte Erinnerung,Persönlichkeitsveränderungen, Verkennen nahestehender Personen, Verlust desSprechvermögens sowie fortschreitende Immobilität gekennzeichnet (Sepandj, Asita: 2015, 4ff). Eine andere Einteilung des Fortschritts der Demenz kommt von Naomi Feil und Vicki de Klerk-Rubin (2013). Hier werden vier Phasen definiert: „Phase I“ beschreibt die beginnende Demenz und ist charakterisiert durch eine mangelhafte Orientierung und Unzufriedenheit sowie Ungeduld, den Personen ist oft selbst bewusst, dass sie vergesslicher werden, leugnen dies jedoch meist oder schieben ihre Vergesslichkeit auf andere, auch sind sie oft nicht in der Lage über Gefühle zu reden; „Phase II“, auch „mittlere Demenz“ genannt, ist durch eine zeitliche Verwirrtheit und Reisen in die Vergangenheit gekennzeichnet, das Kurzzeitgedächtnis verblasst mehr und mehr; in der „Phase III“, der fortgeschrittenen Demenz, werden Bewegungen wiederholt und ersetzen teilweise die Sprache, die Personen sind kaum mehr in der Lage den Zusammenhang von längeren Sätzen zu verstehen; die „Phase 4“ bzw. „schwere Demenz“ steht für den Rückzug der Person nach innen und zunehmende Bewegungseinschränkung.

Sich selbstverständlich bewegen zu können, ist der Schlüssel für jegliche Formen des sozialenMiteinanders und einer selbstbestimmten Lebensführung – auch bei Menschen mitdementieller Beeinträchtigung und deren An- und Zugehörigen. Allerdings kommt es bei Personen mit Demenz und ihren Zu- und Angehörigen im fortschreitenden Prozess zu einem Rückzug aus verschiedenen gesellschaftlichen Bereichen. Bedingt durch diesen Rückzug wird auch die außerhäusliche Mobilität stark eingeschränkt und es kommt zu einer Isolation der Personen. Anja Rutenkröger (2014, 4ff) fasste aktuelle wissenschaftliche Untersuchungen zusammen und kam zum Schluss: Bewegungreduziert das Risiko an Demenz zu erkranken um 30 bis 50 Prozent. Bewegung kann kognitiveFunktionen bei bereits erkrankten Personen signifikant verbessern (Rutenkröger, Anja: 2014, 7). Mit diesem Ergebnis bestätigte sie den Befund, der bereits 2008 in der Ausgabe von DeSSorientiert „Let´s move –Bewegung und Demenz“ (Demenz Support Stuttgart: 2008) publiziert wurde.

Um einerseits Menschen mit Demenz und den Zu- und Angehörigen die selbstständige Mobilität zu ermöglichen und andererseits mit der Förderung der Mobilität und der Bewegung das Risiko an Demenz zu reduzieren, ist es notwendig und eine bedeutende gesellschaftliche Aufgabedie (sozialen, räumlichen und technischen) Umwelten so zugestalten, dass Personen mit Demenz nicht verletzt oder stigmatisiert werden (Heimerl, Katharina: 2015, 268f).

In den vergangenen Jahren wurde dieser Frage nach der gesellschaftlichen Teilhabe von Menschen mit Demenz und wie diese ermöglicht werden kann, nachgegangen. Eine Perspektivenverschiebung wurde mit der Konzeption von Demenz als Behinderung bewirkt:Es stehen nun nicht die Defizite der Betroffenen im Mittelpunkt, sondern es werden die Wechselwirkungen zwischen den individuellenKompetenzen und den Umweltbedingungen reflektiert. Dabei rücken die strukturellenBedingungen, welche Menschen mit Demenz behindern, ins Zentrum (vgl. Gronemeyer, Reimer:2013). Diese Sichtweise wurde auch in der 2015 von der österreichischen Bundesregierung inAuftrag gegebenen und ausgearbeiteten „Demenzstrategie. Gut leben mit Demenz“übernommen, in der auf die UN-Behindertenrechtskonvention Bezug genommen wird. Ziel derDemenzstrategie ist demgemäß ein Abbau der einstellungs- und umweltbedingten Barrieren,welche Menschen mit Demenz an der vollen, wirksamen und gleichberechtigten Teilhabe ander Gesellschaft hindern (Juraszovich, Brigitte et al.: 2015).

3 RAUM- UND UMFELDGESTALTUNG

Studien zur Raumgestaltung von Einrichtungen für von Demenz betroffenen Personenbeschäftigen sich v.a. mit der Gestaltung und Ausstattung des Innenraumes. Bei der Innenraumgestaltung werden Tipps zu kontrastreichem Mobiliar, Beleuchtung, Sicherheit im Bad und in der Küche um die Verletzungsgefahr bei der täglichen Routine zu mindern(Bowes, Alison et al.: 2014), keine Reizüberflutung durch überfüllte Räume undErinnerungsräume schaffen mit wohl bekannten Einrichtungsgegenständen (Leuthold, Urs: 2009) ausgesprochen. Maria Maier et al. (2014) haben die Ausstattung in Krankenhäuser auf ihre Demenzfreundlichkeit untersucht und allgemeine Empfehlungen zur Inneneinrichtung gegeben.Einige wenige Studien gehen auf die Nutzung des Gartens, die durch Rundwege, die das Umherwandern fördern, angeregt werden kann, ein. (Radzey, Beate:2014) Teimann, Sonia (2015) empfiehlt für Pflegeheimeeinen eigenenGarten, der möglichst nahe den Wohnräumen der Bewohnerinnen und Bewohner gelegen ist und der viele Sitzgelegenheiten bietet. Wichtig ist, dass der Garten keinen direkten Zugang zur Straße hat. (Tyll, Susanne; Bank Petra: 2012). Um die Sinne anzuregen, können Objekte wie ein Wasserlauf oder Hochbeete zum Gärtnern (Teimann, Sonia: 2015) sowie duftende Pflanzen (Tyll, Susanne; Bank Petra: 2012) eingeplant werden. Vor allem der Einsatz von bekannten Pflanzen, die auch deutlich den Verlauf der Jahreszeiten widerspiegeln, wird in einer Studie von Trudi Beck (2012) empfohlen. Eingangsbereiche von Pflegeheimen sollten laut Felix Bohn (2014) deutlich erkennbar und im Idealfall auch an der Gebäudestruktur erkenntlich sein.

Auch im technischen Bereich werden einige Produkte/Programme für Menschen mit Demenz angeboten. Unter den verschiedenen Apps für Smartphones oder Tablets finden sich zum Beispiel folgende Funktionen wieder (Stand: März 2017): Selbsttest (z.B. iMMST, BrainCheck, Dementia Test – Dr. Jey), Gedächtnisspiele (z.B. Sea Hero Quest, Sprichwortquiz, Memory Check), Erinnerungsfunktionen (CareZone, MindMate), Einrichtungsplaner (Dementia-Friendly Home App), Informationsapp (Alzheimer Demenz Pocketcards, Fakten Demenz, DemenzProfi), Hilfe und Benachrichtigung für Notfälle (B-cared), Organisation und Informationen für die Pflege (Pflege.kompakt Demenz/Schmerz) und Apps zur Ortung der Person bzw. mit Geofencing-Funktion (Hol mich App, Demenz-App, Walk Navi).

Eigene Geräte mit Ortungsfunktionen (über GPS oder GMS) gibt es in vielen verschiedenen Ausführungen, so wissen Angehörige immer wo die Personen mit Demenz sich gerade aufhalten. Die meisten Geräte bieten ebenfalls eine Geofencing-Funktion, darüber kann ein bestimmtes Gebiet bzw. ein Bereich, wie z.B. 500 Meter um den Wohnort der Person mit Demenz, als „sicher“ angegeben werden.Sollte die Person diesen Bereich verlassen, wird eine Angehörige bzw. ein Angehöriger (oder mehrere) darüber informiert. Des Weiteren sind die Geräte meist mit einem Notfallknopf ausgerüstet, so kann die Trägerin bzw. der Träger des Gerätes in Notfallsituationen Kontakt zu den Angehörigen aufnehmen. Die Geräte, die diese Funktionen beinhalten, sind entweder Tracker, Armbänder, Seniorinnen- und Seniorenhandys, Armbanduhren oder auch Smartphones.

Eine Lücke ist allerdings im Bereich des öffentlichen Raums vorhanden. In diesem Bereich gibt es keine Forschungsarbeiten, welche die Orientierung von Menschen mit Demenz untersuchen oder Gestaltungsnotwendigkeiten im Außenraum, auf der Straße oder im Stadtteil aufzeigen.

4 DAS FORSCHUNGSPROJEKT „DEMENZ IN BEWEGUNG“

Im Projekt „Demenz in Bewegung“ (gefördert vom BMVIT Programm „Mobilität der Zukunft“) wird die außerhäusliche Mobilität von Menschen mit Demenz erforscht und dem Unterwegssein im öffentlichen Raum und den Alltagswegen der Personen mit Demenz nachgegangen. Folgende Forschungsfragen werden behandelt: Welche subjektive Bedeutungen hat Mobilität für Menschen mit Demenz? Wie sehen der Bewegungsalltag und die Bewegungsmuster von Menschen mit Demenz im öffentlichen Raum mit Fokus auf die Nutzung der öffentlichen Verkehrsmittel aus? Was fördert bzw. hindert die außerhäusliche Mobilität? Wie nutzen Menschen mit Demenz öffentliche Verkehrsmittel? Welche Unterstützung bzw. Hürden gibt es bei der Nutzung von öffentlichen Verkehrsmitteln bzw. den Hin- und Rückwegen von den Haltestellen in die Wohnungen für Menschen mit Demenz?Wann und warum hört jemand auf hinauszugehen?Welche technischen Maßnahmen (z.B. aus der Verkehrsinformation, derVerkehrstelematik) sind notwendig, um Menschen mit Demenz die Mobilität außer Hauszu ermöglichen? Welche Usability-Anforderungen ergeben sich an (informationsgestützte)Verkehrstechnologien aus Sicht von Menschen mit Demenz sowie deren An- undZugehörigen?Welche sozialen Interventionen (z.B. kompetente Begleitung) sind notwendig, umMenschen mit Demenz die Mobilität außer Haus zu ermöglichen?Welche zentralen Schlussfolgerungen und Empfehlungen zur Unterstützung der außerhäuslichen Mobilität von Menschen mit Demenz lassen sich für die Berufs- und Personengruppen generieren, die für die Planung und Gestaltung von öffentlichenVerkehrsmitteln und Räumen befasst sind?

Das Projektkonsortium setzt sich aus folgenden Institutionen zusammen:

- IFF – Institut für Palliative Care und OrganisationsEthik, Universität Klagenfurt, Wien, Graz
- B-NK – Büro für nachhaltige Kompetenz, Wien: Ingenieurbüro für Landschafts- und Verkehrsplanung sowie Unternehmensberatung mit Schwerpunkten Gender- und Diversityforschung
- CS Caritas Socialis, Wien: Tageszentren, stationäre und mobile Betreuung von älteren Menschen und Sterbenden
- Wiener Linien: Anbieter von öffentlichen Verkehrsdienstleistungen (Bus, U-Bahn, Straßenbahn) in Wien

5 ETHISCHE ÜBERLEGUNGEN UND AUSWAHL DER TEILNEHMERINNEN UND TEILNEHMER

Den ethischen Grundsätzen der Shottish Dementia Working Group(2014) entsprechend forscht das Projektteamnicht über,sondern mitMenschen mit Demenz. Menschen mit Demenz kommen selbst zu Wort, da sie als Expertinnen und Experten zum Unterwegssein im öffentlichen Raum auf ihren Wegen begleitet und befragt werden.In der Zusammenarbeit mit dieser vulnerablen Personengruppen sind forschungsethischeÜberlegungen von zentraler Bedeutung (Hopf, Christel:2000; Bioethikkommission: 2013; Alzheimer Europe: 2001). Aus diesem Grund wurden bereits im Vorfeld der empirischen Untersuchungen ethische Überlegungen angestellt und ein Ethikantrag bei der Ethikkommission des Landes Kärnten eingereicht. Nach dempositiven Bescheid der Kommission wurde der Kontakt zu den Menschen mit Demenz über Türöffnerinnen und Türöffner gesucht.

Die Ein- und Ausschlusskriterien an der Teilnahme des Projektes erleichterten den Gatekeepern die Auswahl der Personen. Als Grundlage der Kriterien wurde die Validation nach Naomi Feil (Feil, Naomi; de Klerk-Rubin, Vicki: 2013) herangezogen, in der vier Phasen der Demenz beschrieben sind. Teilnehmende sollen sich dabei in der Phase I befinden und weisen demnach oft eine mangelhafte Orientierung, Vergesslichkeit, Probleme bei komplexen Aufgaben, Verleugnen von Demenz, Ungeduld und Distanziertheit auf. Ebenfalls herangezogen wurde der Mini-Mental-State-Examination (MMSE), wobei Werte von 20-26 optimal für die Teilnahme sind. Menschen mit Demenz verfügen in dieser Phase zudem über die Fähigkeit Entscheidungen abwägen und kommunizieren zu können, was für das Unterschreiben der Einwilligung notwendig ist.

Die Forscherinnen selbst nahmen an einer Validationsschulung bei der Expertin Petra Fercher teil, um sich mit den Spezifika beim In-Kontakt-Treten sowie bei der personzentrierten Kommunikationmit Menschen mit Demenz vertraut zu machen. In der Schulung wurden die Charakteristika von Menschen mit beginnender Demenz thematisiert sowieTipps für einen respektvollen und angenehmen Umgang mit den Teilnehmenden gegeben. Diese wurden in Form von Rollenspielen zusammen mit der Expertin vertieft. Um den Menschen mit Demenz bestmöglich entgegenzukommen, wurden die Interviews, Begehungsstudien und Usability Studien an deren Tagesrhythmus angepasst und die Dauer je nach Tagesverfassung individuell bestimmt.

6 DURCHFÜHRUNG DES FORSCHUNGSPROJEKTES „DEMENZ IN BEWEGUNG“

Die Teilnehmenden können sich in ein bisdrei Teilbereiche des Projektes einbringen: Narrative Interviews, der Begehungsstudie und der Usability Studie.

In den narrativen Interviews erzählen Menschen mit Demenz ihren Alltag, sprechen über ihre Mobilität früher und heute und artikulieren Probleme, mit denen sie im öffentlichen Raum konfrontiert sind.In der Begehungsstudie begleiten die Forscherinnen die Personen mit Demenz zu Fuß oder mit den öffentlichen Verkehrsmitteln auf ihren Alltagswegen. Dabei hält eine Forscherin mittels teilnehmender Beobachtung während des Gehens bzw. Nutzens von öffentlichen Verkehrsmitteln Barrieren und Probleme fest, während die zweite Forscherin mithilfe von leitfadengestützten Interviewfragen validierend die Erfahrungen, Hürden, Orientierungspunkte und unterstützenden Faktoren erhebt. Bei den gemeinsamen Wegen konnten Orientierungsmerkmale, Strategien, Bedürfnisse und Barrieren festgestellt werden, welche für die Menschen mit Demenz hilfreich bzw. hinderlich sind. Wesentliche Erkenntnisse über die Orientierung im öffentlichen

Raum werden zudem in der Usability Studie gesammelt. In dieser werden Menschen mit Demenz gebeten, kleine Orientierungsaufgaben mit Hilfe von Wiener Stadtplänen und Bezirksplänen sowie mit Hilfe von Fahrplänen der Wiener Linien zu lösen. Die befragten Personen erzählen und zeigen auf, wie sie ihre Wege zu Hause aus planen und welche Hilfsmittel für diese Planungen verwendet werden. Ebenfalls in der Usability Studie wird erhoben, welche am Markt befindlichen technischen Geräte Personen mit Demenz unterstützen können und wie Menschen mit Demenz gegenüber diesen neuen Technologien und Hilfsmitteln eingestellt sind.

Das Ziel des Projektes ist es mittels der empirischen Erhebungen Grundlagenwissen zu generieren und darauf aufbauend konkrete Handlungsempfehlungen für die verkehrsplanerische Praxis zum „Umgang mit Menschen mit Demenz Fokus Unterwegs Sein mit öffentlichen Verkehrsmitteln und im öffentlichen Raum" zu entwickeln. Die Handlungsempfehlungen werden für Fachplanerinnen, Fachplaner, Entscheidungsträgerinnen und Entscheidungsträger, die mit Belangen der öffentlichen Verkehrsmittel, der Verkehrsinfrastruktur sowie der Stadtplanung befasst sind, für Mitarbeiterinnen und Mitarbeiter von Verkehrsunternehmen, wie Buslenkerinnen und Buslenker, Straßenbahnfahrerinnen und Straßenbahnfahrer, U-Bahn-Fahrerinnen und U-Bahn-Fahrer und dem Personal der U-Bahn-Aufsicht sowie der Forschungs- und Entwicklungscommunity, die an der Schnittstelle Verkehr/außerhäusliche Mobilität und Ambient Assisted Living (AAL) tätig sind und technologische und/oder kommunikationsbasierte Produkte und Services in den Bereichen Verkehrsinformationstechnologie, Verkehrstelematik,Verkehrssystemen etc. für die Zielgruppe Menschen mit Demenz entwickelt.




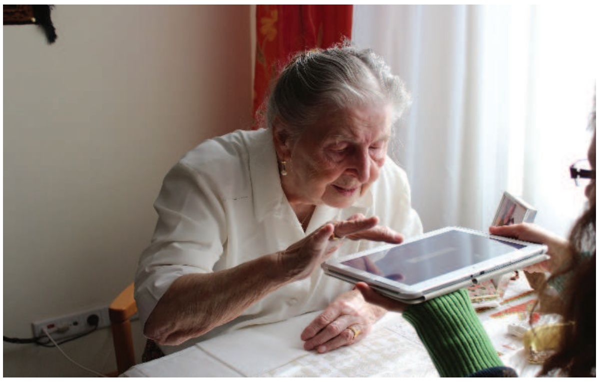

Abbildung 1 bis 4: Impressionen aus der Begehungsstudien bzw. der Usability Studie, Fotocredit: B-NK GmbH

7 ZWISCHENSTAND ZU DEN ERGEBNISSEN

Hier werden kurz die wichtigsten Ergebnisse zum Stand Juni 2017 dargelegt.

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Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER

7.1 Teilnehmerinnen und Teilnehmer

Insgesamt waren an der Studie bislang 27 Menschen mit Demenz beteiligt, darunter 16 Frauen und 12 Männer. 23der Teilnehmerinnen und Teilnehmer nahmen am narrativen Interview teil, 15 an der Usability Studie und 14 an der Begehungsstudie. Das kalendarische Alter der Beteiligten lag zwischen 48 und 92 Jahren. Die Wohn- und Pflegesituation der Teilnehmenden unterteilte sich in Personen in Pflegeheimen, Tageszentren, Wohnhäusern und zu Hause lebende mit und ohne externer Betreuung. Dabei war zu beachten, dass die Personen in den unterschiedlichen Wohnsituationen ihre Umgebung unterschiedlich gut kannten. Dies wirkte sich vor allem bei der Begehungsstudie auf die Zielwahl und den Radius des Spazierganges aus.

Die Teilnehmenden an der Studie wurden mit Hilfe von Expertinnen bzw. Experten, die als Türöffnerinnen und Türöffner und Kontaktpersonen ausgesucht und angesprochen. Vertreterinnen und Vertreter der beteiligten CS-Betreuungseinrichtungen wurden gebeten,Personen anhand der Demenzphasen nach Naomi Feil (s.o.) vorzuschlagen. Dies ermöglichte eine breite Vielfalt an teilnehmenden Personen. Nach ausführlicher Information über das Projekt wurde den Teilnehmenden eine Einverständniserklärung vorgelegt. Mit der Unterschrift bestätigten die Personen, dass sie freiwillig an der Studie teilnehmen und jederzeit abbrechen konnten. Außerdem wurde den Personen die Wahl gelassen wie mit Fotografien und dem Zeigen von Gesichtern umgegangen wird und ob sie mit der Verwendung eines Aufnahmegerätes einverstanden waren.Erst nach der Unterschrift und einer ausführlichen Erklärung der geplanten Aktivitäten wurde die eigentliche Studie gestartet und das Aufnahmegerät eingeschalten. In den meisten Fällen bewährte sich eine kurze Zeit des Kennenlernens, in dem ungezwungen über Alltägliches geplaudert wurde, bevor mit den studienbezogenen Fragen angefangen werden konnte. Aufbauend auf das Vertrauen und die entgegengebrachte Wertschätzung konnten die Personen zum Teil leichter und offener über ihr Missgeschicke, Geschichten über Orientierungslosigkeit und ihre Probleme sprechen. Das empathische Zuhören und Eingehen auf die Bedürfnisse und Gefühle der Person war während der ganzen Studie wesentlich, um die Erzählenden nicht bloß zu stellen und so unangenehme Situationen zu vermeiden. Dies beinhaltete auch die Verwendung des Begriffs „Demenz" in einer, auf die teilnehmende Person abgestimmten Benennung der Krankheit (z. B. „Vergesslichkeit").Rückblickend gesehen freuten sich alle Teilnehmerinnen und Teilnehmer als Expertinnen bzw. Experten wahrgenommen zu werden und über ihr Leben, ihren Alltag und ihre Beobachtungen im öffentlichen Raum berichten zu können. Es erfolgt eine Fokussierung der Darstellung der Ergebnisse aus der Begehungsstudie.

7.2 Orientierung

Die Frage der Orientierung [„Woran erkennen Sie, dass es sich hier um diese Gasse handelt?Was ist typisch für diese Gasse, dass Sie wissen, dass Sie hier wohnen? Woran orientieren Sie sich, wenn Sie in der Stadt unterwegs sind?"] konnte von den Teilnehmenden teilweise nur schwer beantwortet werden. Orientierung wird nicht immer bewusst wahrgenommen und hinterfragt, sondern scheint im Alltag „ganz von alleine" zu funktionieren. Dies deutet darauf hin, dass andere als bewusste Mechanismen, wie z.B. implizite mentale Pläne oder Körpergedächtnis („embodiment") für gelingende Orientierung hohe Bedeutung haben. Im Allgemeinen konnten Unterschiede zwischen den Personen in Abhängigkeit von der Wohnsituationen erkannt werden. Allen gemein waren Orientierungspunkte, wie markanten Gebäude, Geschäfte oder Bäume. Bei genauer Beobachtung zeigte sich, dass sich manche Personen stark an den Straßenschildern orientierten.

Eingehend auf die Einflüsse der Wohnsituation kannten besonders die Teilnehmerinnen und Teilnehmer aus Tageszentren die Umgebung des Zentrums überhaupt nicht bis kaum. In diesen Fällen wurde die Begehungsstudie ohne bestimmtes Ziel durchgeführt und die Umgebung gemeinsam erkundet. Sehr interessant zu beobachten war es, diePersonenan für sie unbekannten Orten nach den Orientierungspunkten zu fragen. Nach einer gewissen Zeit des aufmerksamen Hin- und Herschauens erwähnten die Personen die oben angeführten Punkte (Gebäude, Bäume, Straßenschilder etc.). Die meisten Personen orientierten sich zudem an der Himmelsrichtung. Dabei zeigten die Personen in allen Fällen in die richtige Richtung, um wieder zurück zum Tageszentrum zu gelangen. Auf der anderen Seite gab es auch Situationen, in denen die Personen die Orientierung völlig verloren. In diesen Fällen unterstützten die Forscherinnen das Wiederfinden der Orientierung mit Anregungen, wie z. B. das Aufsuchen eines Planes bei der nächsten Haltestelle.

Im Gegensatz zu den Personen in Tageszentren orientierten sich Personen, welche zu Hause, im Wohnhaus oder in Pflegeeinrichtungen lebten,anhand eines „mentalen Plans", welcher in ihren Köpfen abgespeichert war. Dabei war die Umgebung bis zu einer gewissen, nicht sichtbaren Grenze gut erkundet und eingeprägt.

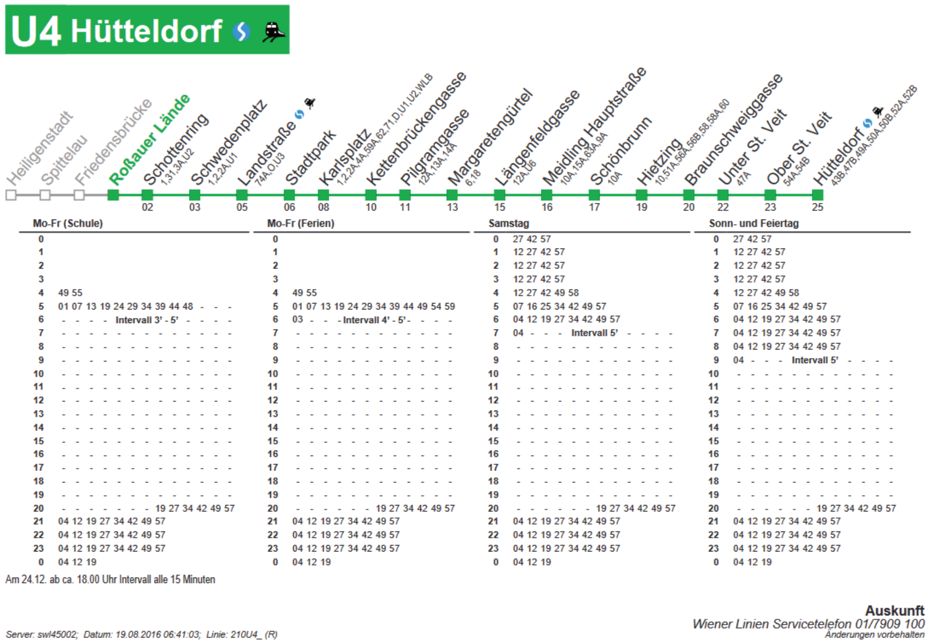
In diesem Radius fühlten sich die Personen sicher und hatten fixe Route, die öfters bis täglich abgegangen wurden.

Ausgehängte Fahr- und Umgebungspläne bei verschiedenen Haltestellen von öffentlichen Verkehrsmitteln wurden von den Personen als wenig hilfreich wahrgenommen. Ebenso schwer zu beantworten war die Frage, wie neue Wege in eine unbekannte Umgebung, in der die Personen zuvor noch nie gewesen war, geplant werden. Nichtsdestotrotz gaben einige der Teilnehmerinnen und Teilnehmer an, sich mit Karten im Vorfeld neue Wege anzusehen und sich diese gut einzuprägen. Andere wiederum können diese kognitiven Prozesse kaum bewusst erläutern. Im Rahmen der Usability Studie wurden Bezirks- und Stadtpläne gemeinsam betrachtet, mit dem Ziel herauszufinden, an welchen Punkten sich Menschen mit Demenz am Plan orientieren. Dazu wurden jeweils die Bezirkspläne der Wohnorte gewählt und die Teilnehmerinnen und Teilnehmer wurden gebeten, die eigene Wohnung, Einkaufsmöglichkeiten und Haltestellen der öffentlichen Verkehrsmittel zu finden. Bei Personen in Pflegeheimen wurde der Wohnbezirk der letzten Wohnung herangezogen. Die meisten Teilnehmenden lasen die großen Straßennamen und markant eingezeichnete Flächen, wie Parkanlagen oder größere Gebäude. Anhand dieser charakteristischen Aspekte grenzten die Personen ihr Suchfeld ein oder fuhren mit den Augen oder dem Finger die größeren Straßenzüge entlang.

In Bezug auf die Benützung von öffentlichen Verkehrsmitteln sprachen die Personen sehr gut auf den U-Bahn Netzplan an, wobei die Farbe der U-Bahn Linien für die meisten Teilnehmenden kaum eine Rolle spielte. Hingegen konnten die Fahrpläne der öffentlichen Verkehrsmittel durchgehend nicht gelesen werden.

Abbildung 5: U-Bahn-Netzplan von Wien. Quelle: http://www.stadt-wien.at/uploads/pics/u-bahn-netzplan_Wiener_Linien_07.jpg

Das Lesen der Fahrpläne, die sich in jeder U-Bahn-Station befinden, stellte die meisten Personen vor eine große Herausforderung. Wie bereits erwähnt, spielten für die meisten Teilnehmerinnen und Teilnehmer Farben keine große Rolle. Orientierung erfolgt auf Basis anderer Informationen, oft stehen Gewohnheiten und daher (lange) Übung im Vordergrund.



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Am 24.12. ab ca. 18.00 Uhr Intervall alle 15 Minuten

Auskunft
Wiener Linien Servicetelefon 01/7909 100
Änderungen vorbehalten

Server: swl45002; Datum: 19.08.2016 06:41:03; Linie: 210U4_ (R)

Abbildung 6: Fahrplan der U-Bahn-Linie U4 in der Station Roßauer Lände. Quelle: https://www.wienerlinien.at/media/download/2017/Linie_U4_201651.pdf

Wie in Abbildung 6 ersichtlich ist die Station, in der der Plan aufgehängt ist, grün eingefärbt und in fetter Schrifthervorgehoben. Die Stationen, die das Verkehrsmittel als nächstes anfährt, sind in schwarzer Farbe und die bereits passierten Stationen in grauer Farbe abgebildet. Bei der Begehungsstudie wurde dieser Fahrplan herangezogen, um mit der Person mit Demenz einerseits den Standort und andererseits die gewünschte Fahrtrichtung zu ermitteln. Es zeigte sich, dass es für die Befragten meist schwierig war, die Farben und deren Bedeutung zu erfassen. Daher hatten sie Probleme die Fahrpläne richtig zu lesen und zu verstehen. Die Pläne stifteten Verwirrung und halfen nicht die richtige Richtung zu finden.

Im Usability Test „zuhause“, bei dem auch diese Pläne vorgelegt wurden, gab es einige Personen, die die Fahrpläne aufgrund ihrer früheren beruflichen Tätigkeit oder aufgrund der alltäglichen Anwendung ohne Probleme lesen konnten und sich mit den Darstellungen und Informationen bereits vertraut waren.

7.3 Strategien gegen das „Verloren gehen“

Im Laufe der Gespräche kristallisierten sich einige Strategien heraus, mit denen Personen verhindern „verloren zu gehen“ oder Strategien, wie sie bei Orientierungslosigkeit reagieren.

Eine der Strategien ist das„Einstudieren“ des Weges und der Route im Vorfeld. Dafür werden Pläne von der Stadt Wien (Bezirksplan, Stadtplan, etc.) und Netzpläne des öffentlichen Verkehrs zu Hilfe genommen, aber auch das Serviceangebot der Wiener Linien und der ÖBB bei den Schaltern aktiv genutzt. Die Wege werden genau durchdacht und in einzelnen Fällen sogar geübt, also der Weg wird an einem Tag vor dem Termin abgefahren und intensiv eingeprägt. Eine sehr oft erwähnte Strategie ist das Fragen anderer Passantinnen und Passanten. Wenn Personen mit Demenz die Orientierung verlieren, fragen sie zum Teil mehrere andere Personen hintereinander nach dem Weg. Pläne werden in der Regel eher selten mitgeführt oder aufgehängte Pläne im öffentlichen Raum nicht verwendet. Als Hilfe für die Orientierung werden keine Online-Kartenmaterialien oder Applikationen verwendet, sondern das Telefonieren mit Zu- und Angehörigen, welche dann aus der „Ferne“ durch den öffentlichen Raum führen.

Es konnte auch eine gewisse Ungeduld bei einigen Personen beobachtet werden. Eine„Zielstrebigkeit“ treibt die Personen an immer weiter zu gehen und im Gehen die Umgebung nach dem Ziel abzusuchen.

Eine sehr einfache und klare Strategie ist das immer „gerade aus gehen“. Dabei werden alle Abbiegungen vermieden und der Weg muss sich nicht gemerkt werden. Ähnlich ist die Strategie des Unterwegsseins im bekannten Umfeld. Dabei erkundeten die Personen ihre Umgebung bis zu einer gewissen Grenze. Innerhalb des selbstgezogenen Radius kennen sich die Personen gut aus und fühlen sich sicher beim selbstständigen Unterwegssein. Eine weitere Strategie ist das Umkehren bis zu einem bekannten Punkt und das nochmalige Starten. Diese Strategie setzt allerdings voraus, dass die Person den Weg zurückfindet um sich von dort nochmals zu orientieren. Durch dieseStrategien kann der öffentliche Raum noch benutzt werden. Allerdings erzählten auch einige Personen, dass sie das Unterwegssein alleine vermeiden und nicht mehr ohne Begleitung nach draußen gehen.

Allgemein wurde der Wunsch nach einer Begleitung bei Spaziergängen oder bei alltäglichen Wegen artikuliert. Die Gründe hierfür sind verschieden und reichen von Stürzen bei starken Windverhältnissen, zu dem fehlenden Gefühl der Sicherheit beim alleine Unterwegssein, klare Strukturen und Regeln in verschiedenen Institutionen, die ein Spazierengehen verbieten, Barrieren wie Treppen, die alleine nicht überwunden werden können, bis zu mangelnden Motivation nach draußen zu gehen.

Es konnte beobachtet werden, dass es für manche Forschungsteilnehmerinnen und Forschungsteilnehmer unangenehm war, über Defizite zu sprechen. Sie präsentieren sich in der Forschungssituation als kompetente Personund Gesprächspartnerin bzw. -partner. So wurde (v.a. von männlichen Teilnehmern) von ihren (beruflichen) Leistungen aus der Vergangenheit berichtet. Das auch, wenn konkret nach der Gegenwart gefragt wurde. Es wurden zum Teil geschickt Schlagwörter dem Gespräch entnommen oder auf eben gesehene Objekte hingewiesen, um wieder zu einem Themengebiet zu gelangen, in der die Person kompetent ist. So konnte die Person von Defiziten, die das heutige Leben betreffen, ablenken und unangenehmen Fragen, denen sie nicht Folge leisten konnten, ausweichen.

7.4 Wunsch öfters unterwegs zu sein

Wie bereits im oberen Abschnitt erwähnt, wurde von allen Teilnehmerinnen und Teilnehmern der Wunsch nach einer Begleitung durch andere Personen auf ihren Wegen geäußert. Durch verschiedene Erlebnisse oder Hindernisse wie Stürze oder Barrieren im öffentlichen Raum, fühlten sich viele befragte Personen unsicher und wünschten sich eine Unterstützung. Die Realität sieht allerdings anders aus. Knappe Personalressourcen und enge Zeitkapazitäten erlauben es den Mitarbeiterinnen und Mitarbeitern von Pflegeeinrichtungen oder anderen Hilfsdiensten kaum, die Menschen mit Demenz in den Einrichtungen oder auch von zu Hause weg auf Spaziergänge zu begleiten. Aus diesem Grund sollten Angebote und Möglichkeiten ausgearbeitet werden, da einerseits die Bewegung das Risiko an Demenz zu erkranken um 30 bis 50 Prozent reduziert (Rutenkröger, Anja: 2014) und andererseits der Isolation von Personen mit Demenz aktiv entgegengewirkt wird.

7.5 Wünsche an den öffentlichen Raum

Neben dem Wunsch einer Begleitung für ihre Wege wünschten sich die Teilnehmerinnen und Teilnehmer Sitzmöglichkeiten und ruhige begrünte Plätze. Besonders Sitzplätze waren in der Stadt für ältere Personen eine Erleichterung auf ihren Wegen, um sich zwischendurch kurz ausrasten zu können. Auf der anderen Seite führt ihr Fehlen dazu, dass Personen ihre Wege nicht für eine kurze Pause unterbrechen können und ihr Unterwegssein drastisch einschränkt. Sitzgelegenheiten werden auch aktiv ausgewählt, um sich am öffentlichen Leben zu beteiligen und unter Leuten zu sein.

Ein sehr oft benannter Wunsch bezog sich auf die Aufenthaltsqualität von öffentlichen Freiräumen. Die Personen gaben an, sich einen ruhigen Ort zu wünschen, an dem kein Autoverkehr ist, sie das Grün der Vegetation genießen können und sich auf einer Bank gemütlich ausrasten können.

Ein weiterer Wunsch der befragten Forschungsteilnehmerinnen und Forschungsteilnehmer richtet sich an die Bodenbeläge. Diese sind ein wichtiger Aspekt, um die Teilnahme von Personen mit Gehschwächen, die auf einen Rollator, Rollstuhl oder Gehstöcke angewiesen sind,zu ermöglichen. Daher benötigen diese Personen für eine problemlose und barrierefreie Benützung des öffentlichen Raums ebene und fugenloseBodenbeläge.Gepflasterte Wege sind mit Hilfsmitteln mit Rädern schwer zu befahren, da die Räder stark vibrieren und um ruhig fahren zu können, ein gewisser Druck auf das Hilfsmittel ausgeübt werden muss. Des Weiteren spüren besonders Personen im Rollstuhl oder mit Rollatoren das Quergefälle von Gehsteigen, da das Hilfsmittel stark in eine Richtung abdriftet. Mit Krafteinwirkung kann das Hilfsmittel gerade ausgefahren werden.

Eine weitere Barriere stellen Gehsteigkanten dar, über die Rollstühle und Rollatoren nicht ohne zusätzliche Kraftanstrengung gerollt werden können. So wurde bei Personen mit Rollatoren beobachtet, wie die Personen diese aufheben mussten, um sie wieder auf den Gehsteig rollen zu können.

Abbildung 7: Frau hebt ihren Rollator über die Gehsteigkante; Fotocredit: B-NK GmbH

7.6 Technische Hilfsmittel

Für die Orientierung wurden von einigen Personen Pläne verwendet. Überhaupt nicht zum Einsatz kamen bei Personen mit Demenz technische Geräte und Applikationen, um Wege zu planen oder bei Orientierungslosigkeit den Weg wiederzufinden. Die Untersuchungen zeigten allerdings, dass die meisten Menschen technische Geräte ablehnen und nur in sehr seltenen Fällen ein Seniorinnen und Senioren-Mobiltelefon besitzen. Dieses wurde allerdings zu meist vergessen und bei den Spaziergängen nicht mitgenommen. Im Alltag verwendeten die Personen ihr Seniorinnen- und Senioren-Mobiltelefon hauptsächlich zum Telefonieren.

DieGründe für den fehlenden Gebrauch von technischen Hilfsmittelnreichen von Technikscheue über fehlende Informationen, bis hin zu Bedenken der falschen Bedienung und entstehender Mehrkosten. Zudem lebten die meisten Teilnehmenden in einer Zeit, in der es keine technischen Geräte gab und diese entweder nie oder erst am Ende ihrer Berufstätigkeit für die alltägliche Berufsarbeit verwendet wurde. Daher wollten viele Teilnehmerinnen und Teilnehmer keine Applikationen auf dem Tablet-Computer ausprobieren.

8 AUSBLICK

Aufbauend auf den Auswertungen werden die Ergebnisse in Round-Tables mit Zu- und Angehörigen reflektiert und in einem Wissenschafts-Praxis-Beirat weiterentwickelt. Im Jahr 2018 werden konkrete Handlungsempfehlungen in partizipativen Diaolgen mit verschiedenen Stakeholder Gruppen erarbeitet.

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10 REFERENZEN

Alzheimer Europe (Hg.) (2011): Ethics of dementia research. Online verfügbar unter http://www.alzheimer-europe.org/Ethics/Ethical-issues-in-practice/2011-Ethics-of-dementia-research/(language)/eng-GB, zuletzt geprüft am 23.08.2016.

Beck, Trudi (2012): Bedürfnisgerechtes Wohnen für Menschen mit Demenz in der Brühlgut Stiftung Winterthur. Evaluation. Hg. v. Züricher Hochschule für Angewandte Wissenschaften. Online verfügbar unter http://www.age-stiftung.ch/fileadmin/user_upload/Projekte/2009/00030/2012_Age_I_2009_00030.pdf, zuletzt geprüft am 25.08.2016.

Bohn, Felix (2014): Altersgerechte Wohnbauten. Planungsrichtlinien. Der Schweizer Planungsstandard. Hg. v. Schweizerische Fachstelle für behindertengerechtes Bauen. Zürich. Online verfügbar unter http://www.age-stiftung.ch/fileadmin/user_upload/Publikationen/Hilfsmittel_und_Werkzeuge/Planung_altersgerechter_Wohnungen.pdf, zuletzt geprüft am 25.08.2016.

Feil, Naomi; Klerk-Rubin, Vicki de (2013): Validation. Ein Weg zum Verständnis verwirrter alter Menschen. 10., durchges. Aufl. München, Basel: E. Reinhardt (Reinhardts gerontologische Reihe, Bd. 16).

Bowes, Alison; Dawson, Alison; Greasley-Adams, Corinne; McCabe, Louise (2014): Good practice in the design of homes and living spaces for people with dementia and sight loss. In: Alzheimer's & Dementia 10 (4), S. P570. DOI: 10.1016/j.jalz.2014.05.933.

Gronemeyer, Reimer (2013): Das 4. Lebensalter. Demenz ist keine Krankheit. München: Pattloch.

Heimerl, Katharina (2015): Ethische Herausforderungen für die Sorgenden von Demenzerkrankten. In: Imago Hominis. Demenz als ethische Herausforderung i. Unter Mitarbeit von Johannes Bonelli und et al. Wien: IMABE • Institut für medizinische Anthopologie und Bioethik (Quartalsschrift für Medizinische Anthropologie und Bioethik, Heft 4), S. 267–276.

Hopf, Christel (2000): Forschungsethik und qualitative Forschung. In: Uwe Flick, Ernst von Kardorff und Ines Steinke (Hg.): Qualitative Forschung. Reinbek bei Hamburg: Rowohlt Taschenbuch Verlag, S. 589–600.

Juraszovich, Brigitte; Sax, Gabriele; Rappold, Elisabeth; Pfabigan, Doris; Stewig, Friederike (2015): Demenzstrategie. Gut leben mit Demenz. Abschlußbericht – Ergebnisse der Arbeitsgruppen. Hg. v. Gesundheit Österreich GmbH. Wien. Online verfügbar unter https://www.sozialministerium.at/cms/site/attachments/7/7/5/CH3434/CMS1456747615394/demenzstrategie.pdf, zuletzt geprüft am 05.08.2016.

Leuthold; Urs (2009): Gestaltung von Innenräumen für Demenzkranke. Empfehlungen für Institutionen und Baufachleute. Hg. v. Kanton Bern und Stadt Bern. Bern. Online verfügbar unter http://www.alz.ch/tl_files/PDFs/Varia/FA_Broschuere_Gestaltung%20von%20Innenraeumen%20fuer%20Demenzkranke_Stadt%20Bern_2009_d.pdf, zuletzt geprüft am 25.08.2016.

Maier, Maria; Denz, Christina; Neuss, Marco; Ettenreich, Martina; Rings, Julia; Kumsta, Violeta et al. (2014): Nebendiagnose Demenz im Akutkrankenhaus. Einsatzpotentiale innovativer Licht-, Kommunikations- und Planungstechnologien für eine alters- und demenzsensible Architektur. Modul II - Ausstattung PAtientenzimmer / Nasszelle / Handlauf. Hg. v. TU München. Online verfügbar unter http://www.ebb.ar.tum.de/fileadmin/w00bii/www/Forschung/Modul_II.pdf, zuletzt geprüft am 06.10.2016.

Radzey, Beate (2014): Bewegung braucht Bewegungsräume. In: demenz DAS MAGAZIN (22), S. 7–9.

Rutenkröger, Anja (2014): Bewegung trotz(t) Demenz. Körperlich aktiv oder inaktiv sein - Was sind die Konsequenzen. In: Demenz Support Stuttgart gGmbH (Hg.): Let´s move II - Bewegung und Demenz. Unter Mitarbeit von Ulrike Fischer. Stuttgart (DeSSorientiert, Nr 2/14), S. 4–10. Online verfügbar unter http://www.demenz-support.de/Repository/dessorientiert_2014_02_sportbewegung.pdf.

Scottish Dementia Working Group (Hg.) (2014): Core principles for involving people with dementia in research. Innovative practice (5). Online verfügbar unter http://dementiavoices.org.uk/wp-content/uploads/2014/06/Involving-people-with-dementia-in-research1.pdf, zuletzt geprüft am 11.06.2017.

Sepandj, Asita (2015): Krankheitsbild Demenz. In: Bundesministerium für Gesundheit und Sozialministerium (Hg.): Österreichischer Demenzbericht. 2014. Wien, S. 4–8.

Teimann, Sonia (2015): Urbanes Therapeutikum. Erste demenzfreundliche Raumstudie belegt Wirksamkeit von Außenräumen. In: Pro Alter 47. Jg. (02). Online verfügbar unter http://www.fliedner.de/de/leben_im_alter/das_dorf_wohnen_im_alter/pro_alter15_kda_urbane_raeume.pdf, zuletzt geprüft am 02.08.2016.

Tyll; Susanne (2012): Wohnanpassung bei Demenz. Informationen für Menschen mit Demenz und ihre Angehörigen. 3. Auflage. Hg. v. Kuratorium Deutsche Altershilfe. Köln (Demenz-Service, Nr. 10). Online verfügbar unter http://www.demenz-service-nrw.de/tl_files/Landesinitiative/Die%20Landesinitiative/Veroeffentlichungen/Band%2010%20WEB%20Version.pdf, zuletzt geprüft am 24.08.2016.

About the Challenged Notion of "Curve of a City": the Example of the Pilgrimage of Lourdes (France)

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1 ABSTRACT

The French urban planner Marcel Poete set out the notions of "city's curve" and "mysticism" of the city (around the 20s). The city's curve is the history of the city: in general, there is the beneficial influence of some Power, during a long time. And the "mysticism" is when the values of the city are displayed by monuments everywhere. These notions are no more valid. Today the success of a city depends on good governance: the city has to play games in a better way than the rival cities. And the rules of the games are the same everywhere. The "mysticism" is no more fashionable because of two phenomena: (1) the artifying of cities (2) what we call the "meaningless and seductive city", referring to the works of Baudrillard (according to him, the disappearance of sense triggers "cool seduction").

Lourdes is an interesting example: the city's curve perfectly explains the past of this city, but not the present.

We conclude examining the consequences of the two phenomena concerning these topics:

- How the artified center of the large cities is fashioned by diverse "historical styles"
- "Airbnbizing" of some cities in southern Europe.

Keywords: religious space, historical centre, pilgrimage, Lourdes, France

2 INTRODUCTION

The French city planner Marcel Poete wrote his book "Introduction à l'urbanisme" ("Introduction to city planning") to analyze the processes of the evolution of cities. The goal was "urban art", that is to say the art of composing the urban landscapes. In some way he was the French Patrick Geddes (Calabi, 1997). Even if it is uneasy to sum up this rich book, one can retain two main ideas, the "mysticism" of cities and the "city's curve":

- The "mysticism" of cities is when an abundance of monuments express (display) the values of these cities. The model is the city of the Hellenistic era, which was beautiful, symmetrical, with the monuments displaying a deep sense of urban life (at least, it is resented in this way, by people in Occidental countries, for centuries).
- The city's curve is the evolution of the city during History. The city is a living organism (which is nascent, grows then declines). The explanations given by Poete are subtle and diverse: the Road (on land, on rivers, on seas), trade, intellectual factors (knowledge), spiritual factors (religion), technology, rivalry of cities, networks of cities, politics …The author plays with the idea that the history of cities is the universal History, the history of the world, or the history of civilization.

Even if today the historians and geographers have made progress in the field of the history of cities, the Poete's book deserves attention because the idea of studying the evolution of cities in a systematic way was set out for the first time. Also, the book attempts to deal with the topic, taking into account the spiritual side (culture, values, and symbols) and the material side (economy). Here we refer to the book of the French philosopher Castoriadis ("The imaginary institution of the Society"). He argues that in any social phenomenon are implied two ontologies: (1) the "historical/social ontology" concerns the values, the symbols and finally the "radical imaginary" which ultimately explains and fashions the Society (even if it is arbitrary and elusive) and (2) the "ensemblist/identitary ontology", which concerns concrete economic activity (to classify materials, tasks, tools, to count etc.). Any theory concerning the city should take into account the two ontologies. That is why we propose a criticism of the Poete's notions ("mysticism" and the "city's curve") which gives a role to the social imaginary, while taking into account the economy.

There are two new phenomena which concern "culture" (the social imaginary) and are compatible with the capitalist economy:

- The "artified" city. The centers of the large cities are deeply changed by the artifying of daily life. All the places should be nice décor. Art pervades all the daily life: architecture, fashion, graphical arts, music …

- The "meaningless and seductive city". According to the French sociologist Baudrillard, the meaning disappears for several reasons: (1) the TV and the use of replicated reasoning: so simplification and false clarity destroy the meaning (2) the manipulation of signs by advertising and propaganda. But the end of meaning is not void, it triggers the "cool seduction" in the consumers' society. "Cool seduction" means vertigo, ecstasy and inertia. Often the destruction of the past and the scenarizing in cities, trigger destruction of meaning and seduction, both.

The plan of this paper is the following:

- We resume the topics of the Poete's "mysticism" and "city's curve", criticizing them
- We deal with the example of the pilgrimage of Lourdes (France)
- We conclude about the consequences of these new phenomena, artifying of the cities and the "meaningless and seductive city", today.

3 ON THE POETE'S "MYSTICISM" OF THE CITIES

A source of this notion of "mysticism" of the cities is the book of the French historian Fustel de Coulanges, "La cité antique" ("The ancient city"). He insisted on the importance of religion in the ancient Greek and Roman city. He was influential around 1900, in France. But in Occidental countries one has often imitated the Hellenistic style, at the time of Renaissance, of the French Revolution and the Empire, or in the USA around 1900, at the time of the City Beautiful movement. Indeed, "inspiration" is more relevant than imitation. The French writer André Malraux, in his book "Le musée imaginaire" ("The imaginary museum") quotes a story about the famous Italian sculptor Canova. Seeing real ancient Greek statues for the first time (in the British Museum, at London, around 1800) he told: "but it is not that that I have imitated". In any way, the idea of "mysticism" of the cities leads to a neo monumentality which is not fashionable at the time of individualism, consumers' society and artifying of the city. Indeed, it is half forgotten. For instance, there is a project in Mumbai (India) of building a 100 meters high statue of Shivari.[1]

Another source of the notion of "mysticism" is totality in the works of the French sociologists Durkheim and Mauss. Durkheim studied the rites of Totemism in his book "Les formes élémentaires de la religion" ("The elementary forms of religion"). Periodically the people of the clan meet together in long lasting feasts. The goal is to mobilize the energy of the clan, again. It is the "mana". According to Durkheim the "mana" is the Society itself, its Totality, the collective meaning of the Cosmos and the life in the clan. It is also the energy of individuals. Durkheim deals with the question: "Is there something similar in the modern societies?" The answer is that only at the time of the French Revolution (when the Festival of the Supreme Being was organized in Paris) there was something similar. While the French Revolution has not changed Paris very much, one made a plan, the "plan des artistes" ("the artists 'plan"), the artists being architects and engineers, according to which Paris would have been covered with monuments, crossed by beautiful "axes" etc. It illustrates the "mysticism" of cities. According to Poete, the Hellenistic city brought political unity, displaying the will of the Monarch through many symbols in the city. In the case of the "artists' plan", the values which could have been displayed are Progress of Man, Liberty, Independence and Greatness of the Nation etc.

Of course, it was not in the intention of Poete to impose values to the populace, through symbols displayed in the city. At the opposite, he wanted to know the processes of the evolution of cities to be able to adapt the "urban art" to the spontaneous evolution of the city, avoiding following a dogma.

It is also the argument of the German philosopher Adorno in "The jargon of authenticity": one cannot know that one has to believe. In other words, either one knows, either one believes. An urban planner's doctrine cannot state what the populace has to believe in. Or it evokes the hope of Castoriadis that the "radical imaginary" evolves towards less Transcendence and more autonomy.

In any case, the "mysticism" of the city (or the Durkheim's Totality) recalls the time when the collective will was imposed to all. It is the opposite of the individualism in the consumers' society.

[1] Shivari was the founder of the Maratha Empire. The capital city was in Pune, in the State of Maharashtra. He struggled against the Mughols, who were Islamic. He was a Hinduist.

4 ON THE CITY'S CURVE

The idea of a city's curve is no more relevant. From the point of view of economy, a city is a fragment in the spatial division of labor, which concerns the entire world. In the past, some power could generate consensus during a long time, affording stability, therefore success and prosperity. The curve is the history of this power, its successes and its decline. But now the cities, in competition, play games. Success depends on strategy and chance. The rules of the game are the same everywhere.

One no more speaks of beneficial power, but of efficient governance. The local particularities still exist, but are fashioned in the context of artifying of cities, alongside the same lines, everywhere. The goals are those of the consumers' society: individualism, satisfaction of desires thanks to consumption (the consumers choosing global brands)…

The example of the pilgrimage of Lourdes (France) is useful to show how the notion of city's curve is relevant to explain the past, but not to describe the present.

5 THE EXAMPLE OF THE PILGRIMAGE OF LOURDES

The scheme of the city's curve fits well to explain the city of Lourdes in the past. It is less relevant today. The development of the pilgrimage corresponds to the "revival" of the Catholic Church in the 19 th century. Before, there has been another revival, from the time of the Counter Reformation to 1750. It has been perfectly analyzed by the German historian Von Ranke, who is considered as the first modern historian, in "History of the Popes: their church and States". It is an example of "historical curve", the causes of which were: (1) the strong and canny power of Popes and Jesuits at this time (2) the initial impetus of the Counter Reformation (3) a financial strategy , the Popes getting revenue from their States (4) a political choice, intervention to defend Catholic Religion everywhere it was threatened. The Church succeeded in restoring Catholic Religion in countries like France, the South of Germany, Poland and Austria …

In the case of Lourdes, all starts in 1858, when a young shepherdess saw the Virgin several times. Then the pilgrimage developed quickly, thanks to several factors:

- The Assomptionists brought a strong leadership
- It was the start of railways, and books and newspapers diffused the narrative about Lourdes and photos
- The site was well planned. The Church bought land, churches were built. If they are not beautiful (the basilica built in first was criticized by the writer J K Huysmans, because of its ugliness) it is integrated in the "collective imaginary" and has become "authentic"
- The narrative about Bernadette and miracles thanks to the intervention of the Virgin in Lourdes was a success

What one can call a "religious space" was created.

One can define a "religious space". We take into account the ideas of Roger Caillois in "L'homme et le sacré" ("Man and the sacred") and Durkheim.

A "religious space" involves:

- The separation between the "sacred space" and the "secular space". Any contagion from one to the other is prevented. There are "negative rites" according to Durkheim, preventing contact between the two ("lustration rites").
- The "sacred space" is planned to allow rites, ceremonies, that is to say the liturgy
- A narrative allows to make the "sacred space" attractive for believers.

The history of the pilgrimage of Lourdes has been well documented by French authors like Zola and J K Huysmans. Also, the sociologist Gabriel Le Bras has studied the evolution of Catholic faith in France at different times.

A first crisis, called "modernist crisis" occurred after the First World War, triggered by quarrels on this topic: what should be the answer of the Church, concerning the progress of Science, and the changes in the values of Society (more and more materialistic and individualist) while the behaviors evolve? An answer was afforded by the philosopher Blondel, in a famous article. His point of view was: to cope with the difficulties

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caused by a changing world, the Church should develop its Tradition, which is rich, more than stick to the dogmas. The philosopher proposed to give distinct roles to the Church and to the secular institutions: the Church has the "speculative" role, that is to say, the Values and Faith[2] and the secular institutions are in charge of the material life.

Finally, what happens today?

The narrative is less successful, and the separation sacred/secular is threatened:

- The Blondel's trade off does not work. The Church wanted to let the material life to Science. The idea was that the miracles were checked by doctors. The "Bureau des constatations" ("The office of observations") was created, the mission of which was to present the (possible) miracles (miraculously healed persons) to many doctors, who give their advice. It resulted in the shrinking number of recognized miracles (today, only two in twenty years). As says Mgr Perrier (who was the bishop of Lourdes) in his book "Lourdes in history: Church, culture and society from 1858 to today": "all holds together". That is to say: the site and its prestige, the narrative, the miracles and the pilgrimage itself, all holds together. If the narrative fails, because there are no more frequent miracles (which were seen by the pilgrims and commented), the pilgrimage itself is threatened.
- The separation between the "religious space" and the "secular space" becomes blurry. Lourdes is a nice city, in beautiful settings, and attracts tourists. They like the spectacle of the pilgrimage. The contact between sacred and secular, Religion and Science is meaningless, therefore … seductive (according to Baudrillard). The contact is triggered by the tourists themselves, and it is a spectacle they like. In some sense, what is called "post catastrophe tourism" (when tourists visit a site after a catastrophe) is the tourism of today: tourists like the spectacles which are meaningless and seductive. Many cities scenarize the "surprises" which occurred in the past. Paris is fascinating because of the spectacle of many historical surprises: (1) the catastrophic end of the Ancien Régime at the time of the French Revolution and the Empire (2) the catastrophic end of the Second Empire (3) the two World Wars … Rome can fascinate with the Counter Reformation, its decline at the time of the Age of Enlightment, then the revival in the 19 th century and finally the awkward skates of today… Lourdes has "only" to display the passage from a secluded village to a prosperous city, the signs of the Church's revival in the 19 th century and the questions of today… But it is enough to fascinate many tourists.

6 CONCLUSION

In a city, there is always coexistence of the two Castoriadis's ontologies, the "historical/social" and the "ensemblist/identitary". Take the example of Paris. The reader knowing Paris has perhaps noticed that at the metro station Port Royal one sees two axes crossing one another: (1) an "aesthetic" axis made up of the Observatory, the Fontaine de l'Observatoire, the Luxembourg garden and the Luxembourg Palace. This axis was part of the "plan des artistes" (Halbwachs, 1920). It is monumental and nice, full of symbols. Also, the streets around the Observatory have been changed at the time of the French Revolution (2) a "useful" axis, crossing Paris from the South to the North (Boulevard Saint Michel) dating from the Second Empire. At the time of the Second Empire, the priority was not the embellishment of the city, even if the Opera House, squares and parks date from this time.[3] The building of large boulevards was decided by Hausmann just when it became necessary, because of the activities in the quarters that these boulevards linked one another (Halbwachs, 1920).[4] Clearly, the economy was the priority.

[2] Notice that the distinction speculative / material is not the distinction between "historical / social ontology" and "ensemblist / identitary ontology". The Church uneasily accepts the notion of social imaginary. This notion is used by anthropologists and sociologists. For the Church, the imagination of human beings is influenced by the true messages of the Christ. The soul is where the Good and the Evil struggle. But the believers are in a particular situation: they have access to the messages from the Christ and the Church, which allow redemption.
Adorno is right in opposing believers and thinkers.

[3] Marcel Poete noticed that the Avenue de l'Opéra is without backdrop at the end which is opposite to the Opera House. Or it would be the Hotel du Louvre. A first building was built in 1858 when the world' fair occurred (the hotel was built very quickly, the workers working during the night, thanks to electrical light used for the first time).

[4] However the buildings alongside these boulevards were nicer than the old buildings in the streets remaining unchanged. This has been studied by Halbwachs.

What shape does the coexistence of the two ontologies take today?

It is no more the Poete's "mysticism" (many monuments displaying the values of the city). The city is no more explained by its "curve" (a strong power makes the city prosperous during a long time). The centers of the large cities are artified. There the "historical/social" ontology is more visible. In the suburbs and the mid-sized cities, one imitates the centers of the large cities, and the "ensemblist/identitary" ontology is more visible. The consequence is that people there go to the centers of large cities to benefit from a nice décor, and have fun and entertainment.

We conclude by two remarks:

There is a role of the meaningless and seductive city.

Take the example of these old churches in the USA which were moved stone by stone. It is not in accordance with that Viollet Le Duc[5] claimed: the settings of a monument making it nicer. But it is fascinating.

There are several "historical styles" involved in the artifying of cities, like in the tableau below.

Historical style	Personalities	Domain
History of imitations	Tarde[6]	History of styles
History of aesthetic values	Viollet Le Duc	Historical truth
History of social milieus	Taine[7]	History of Art
History of "surprises" (scenarizing appearance and disappearance of powers)	Baudrillard	Vertigo, mise en abyme, "cool seduction"

Table: the "historical styles" in the artified centers of large cities

The meaningless and seductive city is when the contrasts in the past, or the contrasts between past and present, are scenarized. For instance, an ancient backdrop, modern architecture and contemporary art are displayed (in the same site).

In some cities of Southern Europe (Barcelona, cities in the Po valley in Italy) the inhabitants fear the impact of tourism on their city.[8]

This could be called "airbnbizing": old buildings are destroyed, new buildings are built, the rents raise, residents leave the center of the city, traffic grows and the networks are saturated, in some places the traditional shops ate closed and replaced by fast food restaurants, gift shops… They are aware that tourism has a devastating impact on a city, and the tourists themselves (who know that tourism is the cause of an upheaval in the city landscape) will accept because the meaningless city is also seductive. Of course, the authentic city landscape is lost. But something else appears, which is attractive. The flow of tourists should not slow because of its impact on the city landscape. At the opposite, it could grow.[9]

7 REFERENCES

BAUDRILLARD, Jean. De la séduction ("On seduction"). Galilée. Paris (1988).

CALABI Donatella. Marcel Poete et le Paris des années vingt : origines de l'histoire des villes. L'Harmattan. Paris (1998).

CASTORIADIS Cornelius. L'institution imaginaire de la société (« The imaginary institution of the Society »). Seuil. Paris (1999).

PERRIER Jacques. Lourdes dans l'histoire : Eglise, culture et société de 1858 à nos jours. L'Harmattan. Paris (2015).

POETE Marcel. Introduction à l'urbanisme (« Introduction to urban planning »). Sens et Tonka. Paris (2000).

HALBWACHS Maurice. Les plans d'extension et d'aménagement de Paris avant the 19 ème siècle. In La Vie Urbaine, pages 3 – 28. Paris (1920).

DURKHEIM Emile. Les formes élémentaires de la vie religieuse (« The elementary forms of religious life »). Garnier. Paris (2015).

[5] Viollet Le Duc is a French architect who set out a theory on the "historical truth" in architecture.

[6] He was a French sociologist. He wrote "Les lois de l'imitation" (The "laws of imitation"). According to him, "history is the history of imitations".

[7] He was a French philosopher. According to him, the evolution of Art is explained by the diverse social milieus.

[8] He was a French sociologist. He wrote "Les lois de l'imitation" (The "laws of imitation"). According to him, "history is the history of imitations".

[9] Even in Paris, some regulation concerning the platforms like Airbnb has been decided.

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Alternate Pedestrian Routes in the Cities

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1 ABSTRACT

In 2014 the UN World Urbanization Prospects The Revision report has presented that 54% of the world's population has lived in cities. And accorting to the forecast made in the report in 2050, this rate will be 66%. So the cities of the future will have to face significant demographic and sociological problems because besides moving into the city various ethnic and religious groups according to the characteristic of the western countries the urban population shows an aging trend. And in addition the increasing number of the disabled people whose mobility even in a crowded city must be ensured. Therefore the public spaces will play an even more significant role in the cities life because this is the "space" in every city where regardless of gender, age, religion, qualification, etc. all social classes can be found. This is especially true for the public squares and parks where people can not only meet with each other from the different social groups but they can dialogue with each other as well; actively or passively relaxing, having fun, etc. All of this can significantly contribute so that these groups could get know each other (Thompson, 2002). However the public spaces of the cities including the squares and parks looking at their size are bounded. So for the expansion of the public spaces alternative routes could serve as opportunity. Therefore it's not accidental, that the National Development and Regional Development Concept 2030 of Hungary counts with the increasing of the alternative routes roles. According to the concept with the variability and rapidity of globalization processes, the transport infrastructure networks – because of their bounded nature – primarily with the alternative routes and with the ensuring of different modes of transport are they able to compete.

However there is a question what pedestrians mean under alternative route? Are they using such a route and if yes for what purpose?

Keywords: walking, pedestrian, route, alternate, city

2 METHODOLOGY

To find out what pedestrians think about the alternative routes and how they use them an online survey has been made in 2015. The online survey was held between July 16 and October 5 in 2015 which during 101 people were asked. Looking at the gender of the respondents 53% were female and 47% male (Fig. 1).

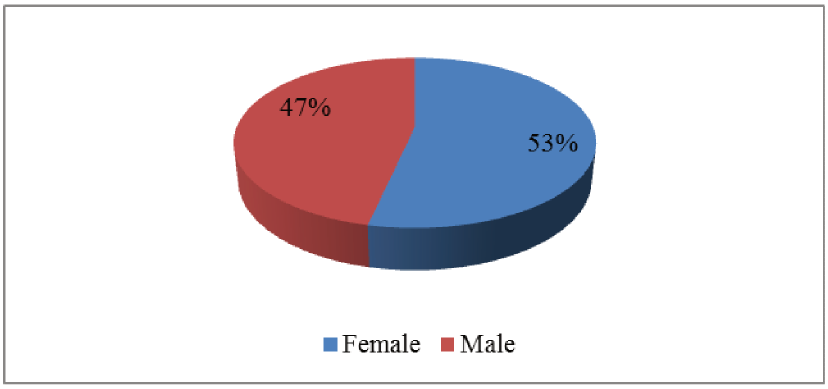

Fig. 1: The gender rate of the respondents

Looking at the highest graduate qualification 72% had Collage/University degree, 20% Secondary School, 5% Grammar school, 2% Vocational school, and 1% Primary school degree, and nobody marked the Vocational training school (0%) (Fig. 2).

According to the employment 68% of the respondents were Employed as a subordinate, 9% Employed in a senior position, 8% Contractor, 6% Student, 4% Pensioner, and 2% Unemployed (Fig. 3). Three people have marked the other category where 2 people wrote maternity leave and 1 person "Agent".

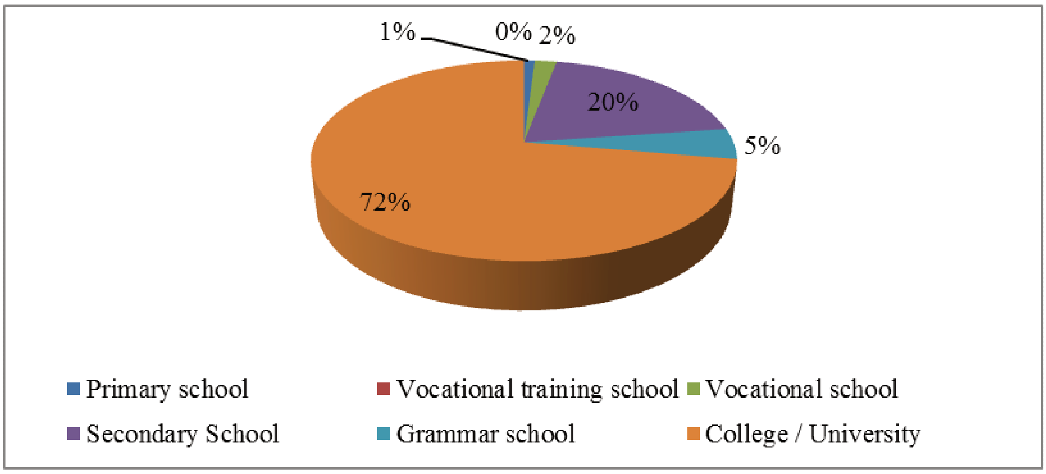

Fig. 2: The rate of the respondents according to the highest graduate qualification

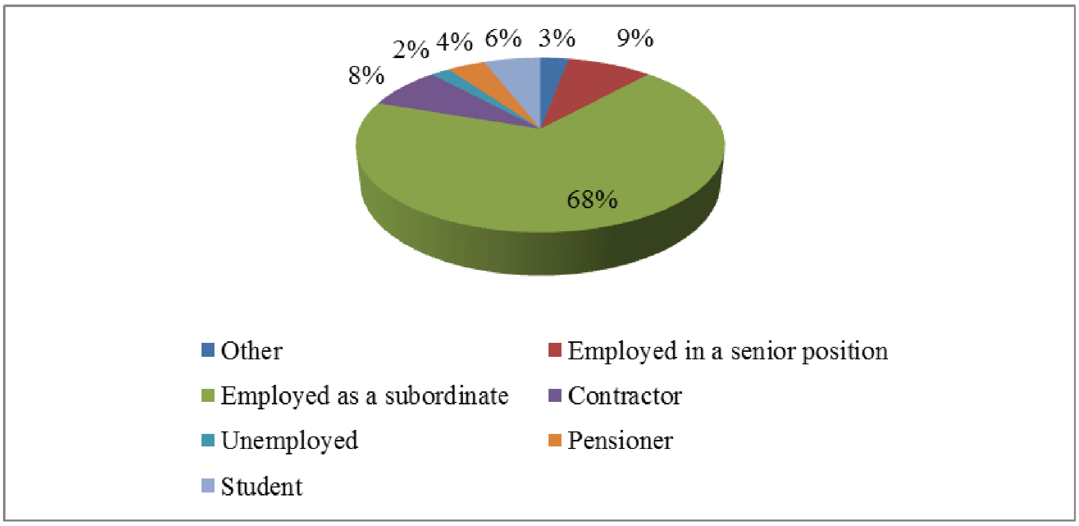

Fig. 3: The rate of the respondents according to employment

According to the age in a highest proportion between the 21 and 30 years, and the 31 and 40 years age group has represented themselves in the research equally with 38% (Fig. 4.). The other age groups have filled out the questionnaire in a significantly lower number. Therefore between the 41 and 50 years 9%, the 51 and 60 years 7%, the 14 and 20 years and the 61 and 70 years age groups in a 4% rate. From two age groups failed to take samples: the age under 14 and age over 70. The reason for this could be that the research hasn't raised the attention of the young generation and the elders using the internet in a low rate.

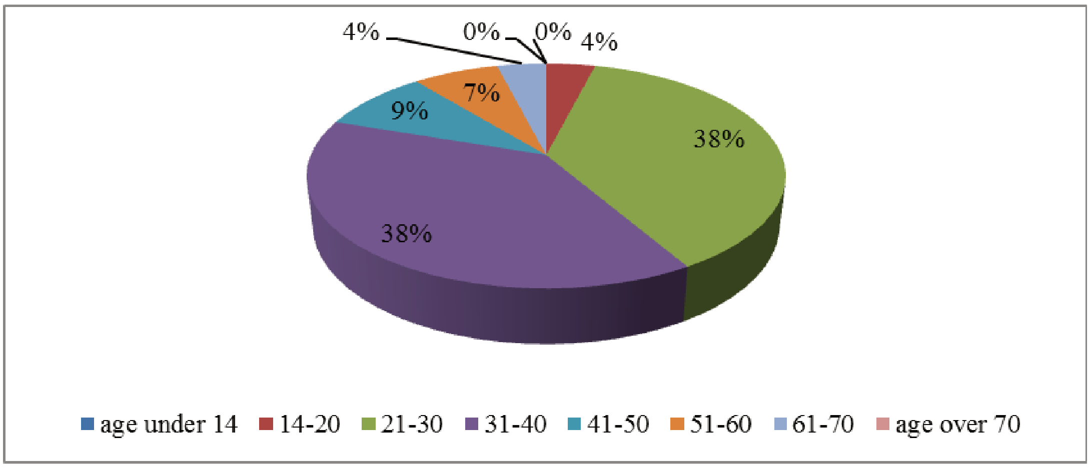

Fig. 4: The rate of the respondents by age

3 THE ASPECTS OF THE SURVEYED ROUTE CHOICE

In the first question the respondents has to answer how they approach their workplace or school form home the most often. The most people have marked the car but in the second place surprisingly they indicate the bicycle instead of public transport (Fig. 5). With 15% the Bus was only the third in a row, which was followed with 11% the walking. The other category choose 6% where two people wrote the train and one people the scooter another one “by bus and/or on foot” and two people “by train and on foot”.

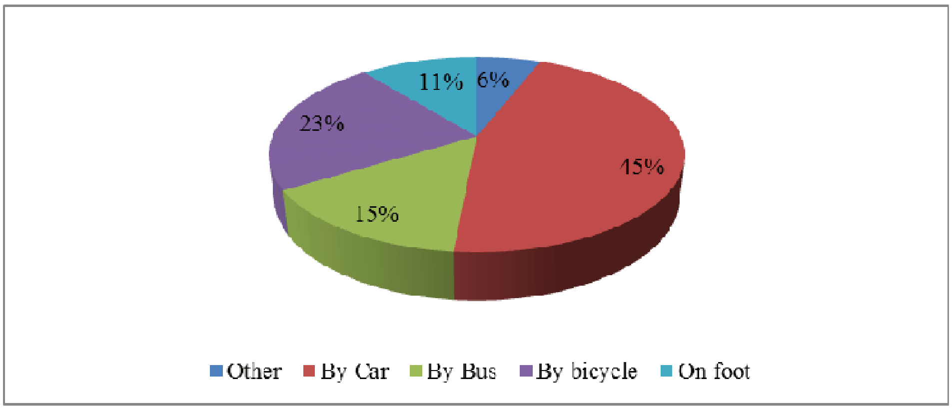

Fig. 5: The rate of the most common approaches to the workplace / school of the respondents

Then the respondents had to be justified why they choosing the route which they the most commonly use between their home and workplace or school. All of this the respondents could mark more than one answer to the defined categories. Among the reasons the most highlighted was the “shortest way” which has been marked more than three quarters of the of respondents (76,2%) (Fig. 6). The other categories even not reached 20% so the second most nominated "safe" was chosen by only 15%. The “By public transport (eg bus) is the shortest one” 13% the “It leads through pleasant environment (plants, fountain, street furniture, etc.)” 11% of the respondents have marked. The “on the way are important Business, shop, etc.” and the “I've always travelled on that route, never thought of any other” answer by 10% and the “your friends / colleagues are also choosing it” and the other categories were also selected by 3%. Within the other category the other three aspects of the route choice were “This is the only way”, “Faster, even if it’s not shorter” and the “Lowest traffic”. It turned out clearly that the large part of the respondents choose the shortest route between their workplace and their school. All this supports the former researches of pedestrian movements which according the pedestrians always choose the shortest route to achieve their destination (Helbing et al., 2001) (Daamen, 2004).

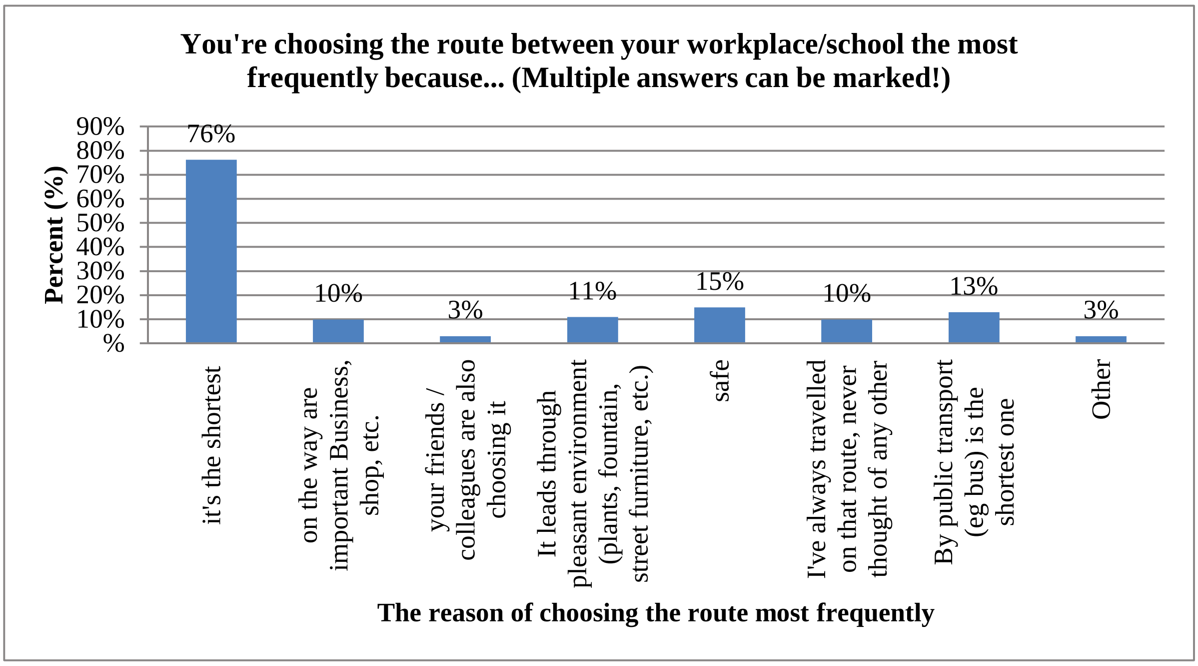

Fig. 6: The reason for choosing the most frequently the route between the home and workplace/school of the respondents

4 THE ASPECTS OF THE ALTERNATIVE ROUTE CHOICE

It arises the question if someone walks on foot then in every case he chooses the usual (shortest) route to achieve his destination or in certain situations alternative routes may also be considered. From the answers it turned out that more than half of the surveyed (48%) usually choose an alternative route when he walks (Fig. 7).

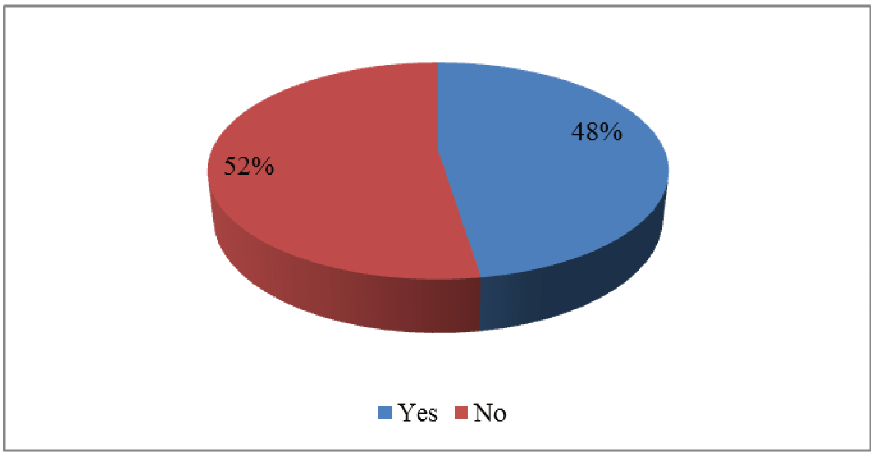

Fig. 7: The rate of the respondents alternative route choice in the case of pedestrian traffic

Then the respondents in a short text answer had to justify that in what kind of cases they choosing an alternative route. The most people wrote that if their time allows or if they have something to do. But many people also mentioned that if the weather is nice or he walks. Summary, it can be said that most of the respondents choose alternative paths if there is an intermediate destination between their starting point and the end goal that is outside their usual route. Typically, they are all done this on foot and in good time.

After all this it was interesting to see that what kind of public space types the surveyed walking through when they are on foot. In the two-thirds of the answers (66%) the park has been marked which from not far stays away the public space (59%) (Fig. 8). All this confirms that for people are especially important the parks and public spaces around them (Madden, 2008). Interestingly, the third most marking received

the underpass (41%), which is only 18% less form the square. The 25% chose the overpass, 22% the alley, and 18% the inner courtyard and the other category 3 people where the "Anything" the "I do not" and the "industrial railroad, embankment, industrial area" were included as justifications.

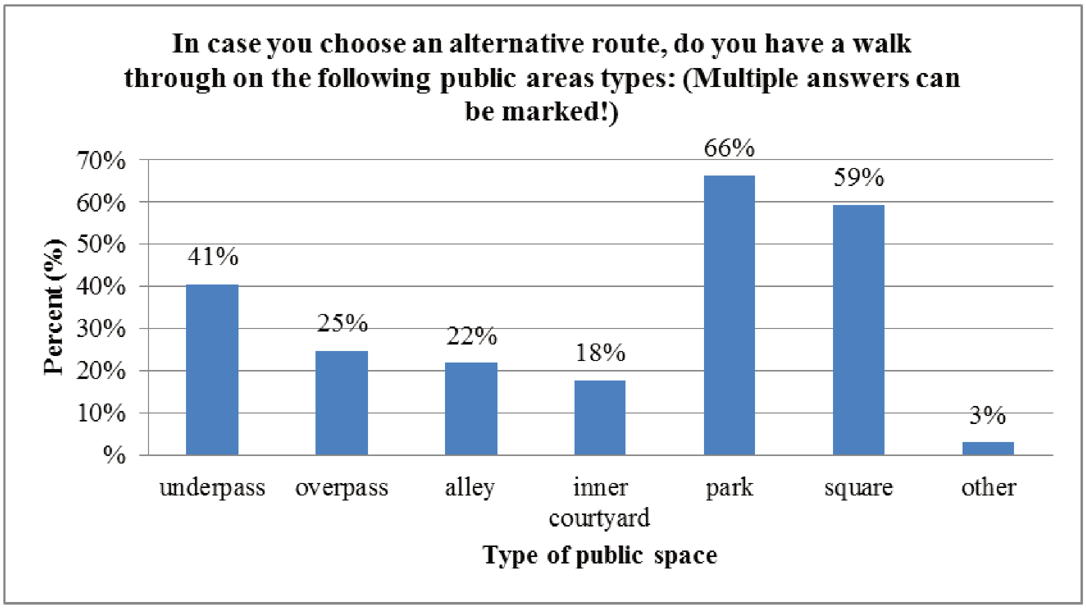

Fig. 8: Public space types affected as alternative routes by the respondents

Based on the previous chapter, it is also possible to say that people on foot are also tying walking through in a pleasant environment when they choosing an alternative route. Because vegetation, relaxation, and water have also a prominent role in public spaces and parks. (Thompson, 2002) Therefore it wasn't surprising that the respondents have marked the categories “Provides the fastest route to achieve your goal” (54%) after then 44% “It leads through a pleasant environment (eg. park, square, pedestrian street, etc.)” to the question on what kind of aspects they choose an alternative route (Fig. 9). But it wasn’t surprise the fastest route either because as it was shown in Fig. 6. the most people choose it to reach his goal. But what is should be definitely noticed is that the “It's located in a safe environment” (31%) and “The route affects important stores / shops / institutions (eg. school)” categories in the same proportion nearly one third of the respondents have chosen. Interestingly, it was more important for the surveyed to reach their goal quickly and in a pleasant environment such as the route should be safe or to affect some institution or business. At this question also three people have chosen the other category where the “Healthy, due to movement fresh air is needed before and after work" the “I don’t” and the “Avoid road closure” was given as additional aspects.

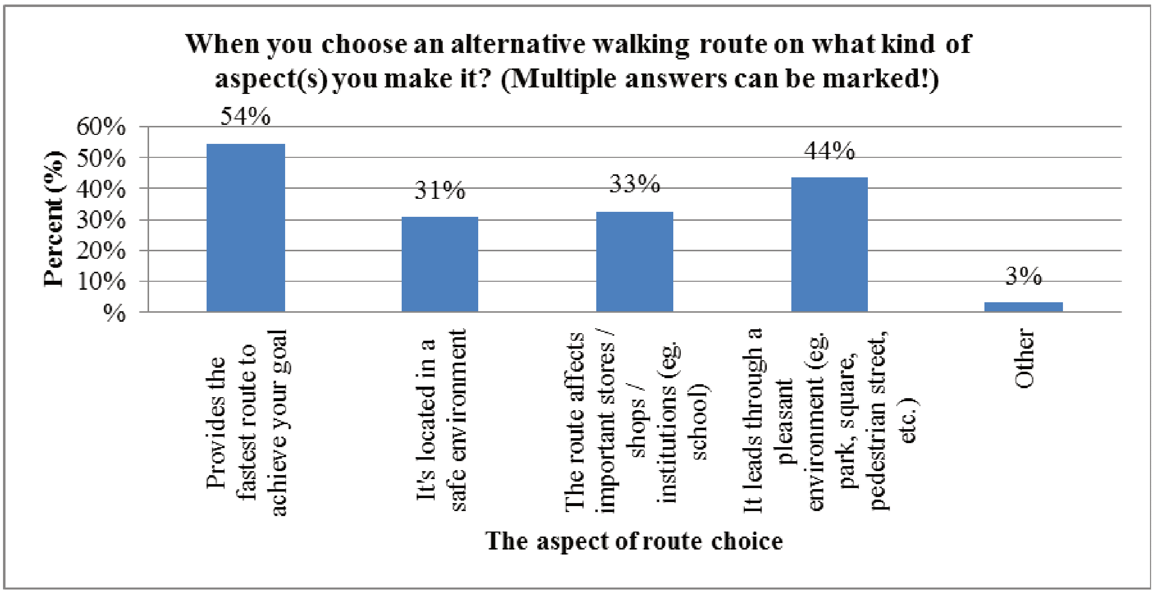

Fig. 9: The aspects of alternative route choice of the respondents

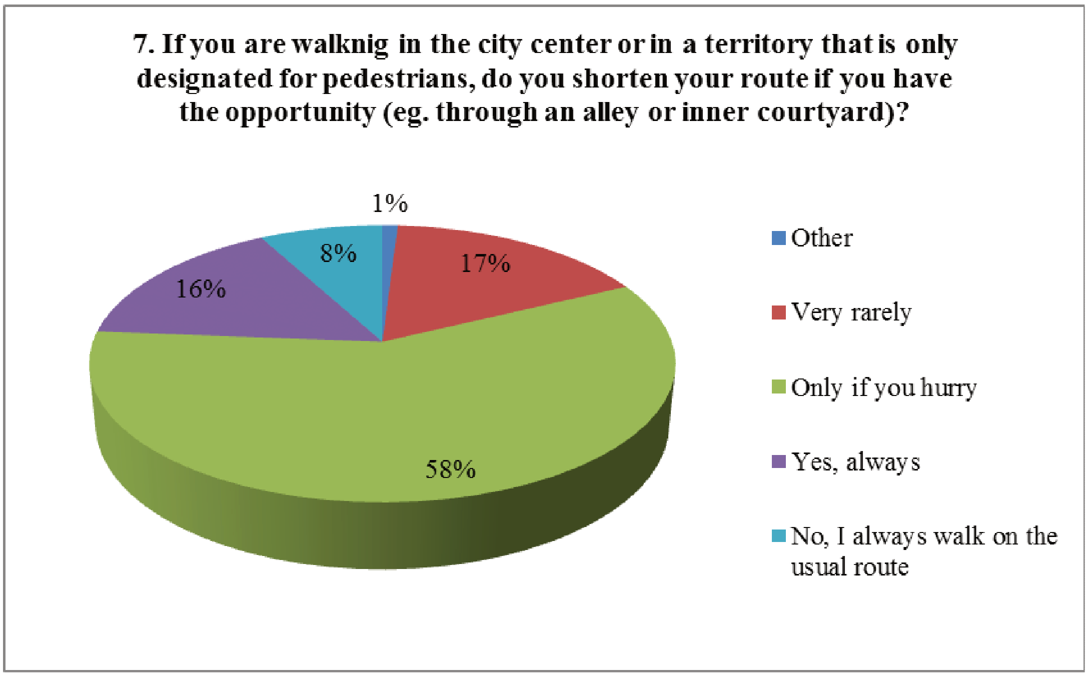

Fig. 10: The reason for route shortening of the respondents in the case of pedestrian traffic

As an analysis of the shortest route, pedestrian movement and alternative route choice, in the last question the respondents had to answer, if they are on foot in the city center do they usually shorten their route, if it’s possible for example through an alley or an inner courtyard. From the results it turned out that more than half of the respondents (58%) only in that case if they are in hurry somewhere. From this significantly lagging behind, but nearly the same proportion were of those who always shortened their route (16%) and those who

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rarely (17%). Only 8% answered that they always walking on their usual route and 1 person have marked the other category.

5 CONCLUSION

According to the results of the online survey most of the respondents choose an alternative route to achieve his destination if:

- the alternative route shortens his route
- it leads through a pleasant environment
- there is an intermediate destination between the starting and ending goals
- primarily walks on foot

However as it was shown in Figure 5. most of the respondents travels between they workplace and home next to the car often with a bicycle. So in most cases outside of the pedestrians the bicyclists can also use in a significant number the alternative routes.

Therefore based on the results of the survey, the cities should strive to ensure such alternative routes to the inhabitants which connect important nodes, provide a pleasant environment and function as an intermediate destination. Such routes can be primarily the public open spaces, the inner courtyards and the parks which providing traffic opportunities not only for pedestrians and bicyclists but they also have many other features. In the case of public spaces and the inner courtyards such features are the shops, and the restaurants with terrace which playing an important role in how significant the pedestrian traffic in the given part of the city (Gehl, 2014) (Jóna, 2013). Besides that these can also serve as an intermediate destination providing an interesting and diverse environment. But the same is true of the parks where the playground or the sports field can fill the same function, and in a lot of parks are a smaller café, restaurant or even a shop. However for both is particularly important ensuring the appropriate green space. This is especially true of parks where it’s essential to have a diverse and rich flora. However, for pedestrians to discover, these routes should be introducing it to the inhabitants. One way to do this is can be the replacement of the pavement cover, which can better highlight the routes that allows pedestrians to provide another route to reach their destination. The placement of information boards can also help this as well as the designation of new bike trails. But in the case of the Smart Cities the use of the different applications could significantly contribute the promotion of the alternative routes. Because if someone is looking for a particular business through his smartphone the application can not only show where it’s closest to him, but also on which route can get there the fastest. Therefore on the track of these routes it’s worth developing alternative routes or even transform the route itself. For example in many cities in the city center a bigger car park has been removed or a road with car traffic was transformed into a public open space for pedestrians (Gehl, 2014). And on these squares and roads restaurants, cafes, terraces, shops, etc. have been established, which thanks to the volume of the pedestrian traffic have increased significantly. But the opening of the buildings with an inner courtyard for the pedestrians has generated similar traffic (Jóna, 2013). With this the city has become much more liveable and these routes have become popular among the inhabitants. Therefore the cities of the future could remain liveable, and sustainable should be strive to create the appropriate alternative routes based on the results of the survey.

6 REFERENCES

DAAMEN, Winnie: Modelling Passenger Flows in Public Transport Facilities. The Netherlands, 2004.

GEHL, Jan: Élhető városok. Budapest, 2014.

HELBING, D., MOLNÁR P., FARKAS I.J., BOLAY K.: Self-organizing pedestrian movement. In: Environment and Planning B: Planning and Design, Vol. 28, Issue 3, pp. 361–383. Great Britain, 2001.

JÓNA, László: Pedestrian Traffic and the Closed Inner Courtyards in the 21st Century. In: Acta Technica Jaurinensis, Vol. 6, Issue 4, pp. 52–70. Győr, 2013.

MADDEN, Kathleen: Hogyan varázsoljunk újjá egy közteret? Kézikönyv jól működő közösségi terek létrehozásához. Budapest, 2008.

THOMPSON, Catharine Ward: Urban open space in the 21st century. In: Landscape and Urban Planning, Vol. 60, Issue 2, pp. 59–72. Amsterdam, The Netherlands, 2002.

CentropeMAP – interaktive grenzüberschreitende Datenanalyse

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1 ABSTRACT

Die Centrope-Region vereint die grenznahen Gebiete zwischen den Staaten Österreich, Slowakei, Ungarn und Tschechien. Um grenzüberschreitende Aufgabenstellungen in der Planung zu erleichtern, wurde im Jahr 2005 CentropeMAP ins Leben gerufen. Hierbei handelt es sich um ein Geoportal, das Datensätze aus den aneinander grenzenden und in der Centrope-Region vereinten Landesteilen in einer gemeinsamen Oberfläche darstellt und somit eine grenzüberschreitende Betrachtung erlaubt.

Auf CentropeMAP aufgebaut ist das interaktive grenzüberschreitende Statistikinformationssystem CentropeSTATISTICS, mit dessen Hilfe Bevölkerungs-, Wirtschafts- und Landnutzungsdaten innerhalb der Centrope-Region, d. h. grenzüberschreitend zwischen vier Staaten, verglichen, analysiert und graphisch dargestellt werden können.

CentropeSTATISTICS konzentriert sich auf Daten auf Gemeindeebene und unterscheidet sich hierdurch wesentlich von übrigen grenzüberschreitenden Statistikportalen, die oftmals nur grob nach NUTS-3- oder NUTS-2-Regionen gegliederte Zahlen anbieten. Dadurch ist auch eine kleinräumige Betrachtung sinnvoll möglich.

Ab Herbst 2017 wirde CentropeSTATISTICS eine Gemeindevergleichsfunktion anbieten. Hierbei können Daten zu einer oder mehreren Gemeinden direkt gegenübergestellt oder selbst gebildete Regionen analysiert werden – selbstverständlich grenzüberschreitend.

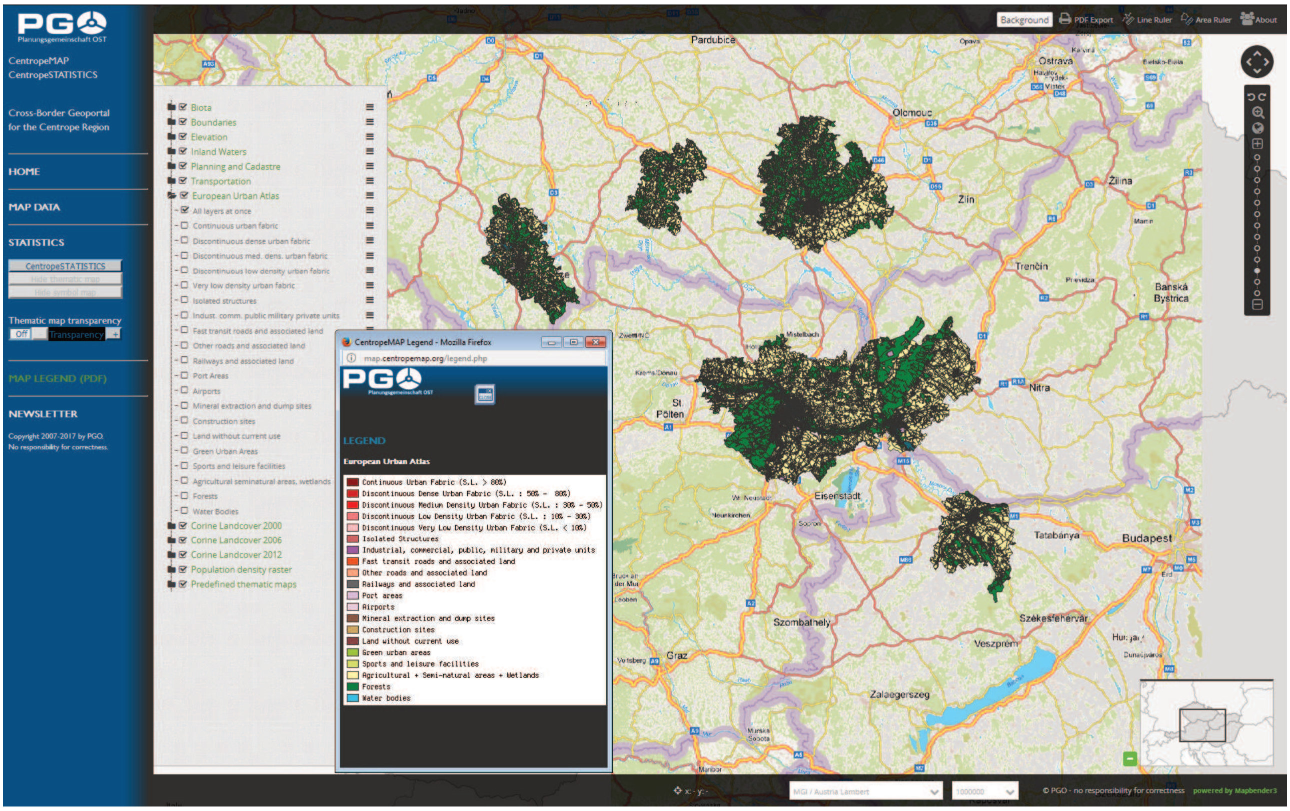

Abb. 1: Das Geoportal CentropeMAP.

Keywords: grenzüberschreitend, Geoportal, Datenbank, Statistik, Centrope

2 HINTERGRUND

2.1 Entstehung von Centrope

Centrope ist eine im Jahr 2003 künstlich geschaffene Region. Politiker und Wirtschaftstreibende aus Österreich, Ungarn, der Slowakei und der Tschechischen Republik beschlossen in Kittsee die Gründung dieser Region, um die jahrzehntelangen gesellschaftlichen und wirtschaftlichen Nachteile, die die Gebiete nahe des Eisernen Vorhangs erdulden mussten, rascher wieder wettmachen zu können.

Die Centrope-Region liegt in den Staaten Österreich (Wien, Niederösterreich, Burgenland), Tschechische Republik (Jihočeský, Jihomoravský), Slowakei (Bratislavsky, Trnasky) und Ungarn (Győr-Moson-Sopron). Ihre Gründung erfolgte 2003 durch den Vertrag von Kittsee im Rahmen eines INTERREG-IIIA-Projekts. In dieser Zeit wurde das Pilotprojekt „Basiskarte Centrope“ von der Planungsgemeinschaft Ost (PGO) initiiert, einer gemeinsamen Organisation der Länderverwaltungen Burgenland, Niederösterreich und Wien zur Abstimmung, Koordination und Vorbereitung raumplanerisch relevanter Fragen in der österreichischen Länderregion Ost. In diesem Pilotprojekt galt es, Geodaten aus allen Teilregionen zusammenzutragen und auf einem gemeinsamen Datenträger allen interessierten Partnern aus der Region zur Verfügung zu stellen. Jedoch war diese Datensammlung zu wenig präsent und schwierig aktuell zu halten.

2.2 Entstehung von CentropeMAP

Nachdem sich die „Basiskarte Centrope“ aufgrund ihres ausschließlichen Auskommens mit Offline-Datenbeständen nicht durchsetzen konnte, wurde 2005 CentropeMAP/STATISTICS durch die Initiative der Planungsgemeinschaft Ost ins Leben gerufen und wird in Zusammenarbeit mit den Statistik- und GIS-Stellen der Länder Burgenland, Niederösterreich und Wien sowie Partnern der Centrope-Region laufend ergänzt und weiterentwickelt.

In der mehr als zehnjährigen Projektlaufzeit hat sich eine ausgezeichnete Kommunikations- und Austauschbasis der Partner etabliert. Das ist insbesondere den regelmäßigen nationalen und internationalen Workshops zu verdanken, in denen der Stand der Technik diskutiert, neue Ideen ausgetauscht und Datenbestände harmonisiert werden.

CentropeMAP ist eine internetbasierte Anwendung und benötigt daher keine Softwareinstallation, sondern ist auf jedem handelsüblichen Rechner mit Internetanschluss lauffähig.

3 WAS MACHT CENTROPEMAP EINZIGARTIG?

3.1 Grenzüberschreitende Datenverfügbarkeit

CentropeMAP konzetriert sich auf Daten, die für die Raumplanung und verwandte Fachgebiete von Interesse sind. Zur Verfügung stehen

- zahlreiche räumliche Informationen: Grenzen, Naturraum, Gewässe, Verkehr, Landnutzung etc.;
- statistische Daten zu den Themen Demographie, Migration, Bildungsstand, Wirtschaft/Arbeitsmarkt etc.;
- Zeitreihen, wodurch auch die Entwicklung der Region leicht nachvollziehbar ist.

CentropeMAP bezieht seine Geodaten direkt von den Servern der datenhaltenden Stellen. Es sind dies GIS-Stellen der österreichischen Bundesländer Wien, Niederösterreich und Burgenland, das österreichische land- und forstwirtschaftliche Rechenzentrum LFRZ, geoland.at, ITS Vienna Region, die Europäische Umweltagentur, die Tschechische Umweltinformationsagentur CENIA, die tschechischen Kreise Jihomoravský und Vysočina und die slowakische Umweltagentur SAZP. Ungarische Geodaten sind leider aufgrund einer von den Gepflogenheiten der übrigen Partnerländer abweichenden Geodatenpolitik nicht kostenlos verfügar; ein Ankauf wäre zwar grundsätzlich möglich, dies würde aber den Prinzipien von CentropeMAP widersprechen, das Angebot ausschließlich mittels frei verfügbarer Daten (Open Government Data) zu bestreiten.

3.2 Statistikdaten auf Gemeindeebene

Die Statistikdaten in CentropeSTATISTICS werden direkt von den statistischen Ämtern der Partner Wien, Niederösterreich, Burgenland, Tschechische Republik, Ungarn und Slowakei zur Verfügung gestellt. Es handelt sich hierbei mehrheitlich um Bevölkerungsdaten, die in Zeitreihen ab dem Jahr 2002 bzw. 2008 zur Verfügung stehen und jährlich aktualisiert werden. Diese Daten werden ergänzt durch diverse Ergebnisse der Volkszählung 2011, die die letzte herkömmlich durchgeführte Volkszählung gewesen sein wird, da künftige Zählungen nicht mehr mittels Erhebungsbögen durchgeführt werden, sondern als Registerzählung durch Auswertung anderer bereits vorhandener Daten (z. B. Melderegister). Österreich hat schon die Volkszählnug 2011 erstmals als Registerzählung durchgeführt.

Fast der gesamte Statistikdatenbestand in CentropeSTATISTICS bildet die Gemeindeebene ab. Dies hat den Vorteil, dass vor allem in Grenznähe sehr kleinräumige Analysen möglich sind, was bei der vier Länder übergreifenden Centrope-Region naturgemäß einen hohen Stellenwert einnimmt. Aber auch abseits der Grenzgebiete erlaubt die feine Auflösung (3.506 Gemeinden im Vergleich zu lediglich 18 NUTS-3-Regionen in der Centrope-Region) eine detaillierte Betrachtung der Region; Statistikdaten dieser Genauigkeit für vier Länder gleichzeitig sind ein einzigartiges Angebot, das es in dieser Form nicht einmal im öffentlichen Bereich des europäischen Statistikportals Eurostat gibt.

3.3 Datenharmonisierung

Eine Harmonisierung von Geodaten ist europaweit im Zuge der Umsetzung der INSPIRE-Richtlinie im Laufen. Dieser Prozess geht zwar voran, jedoch sehr langsam, sodass er noch keine für CentropeMAP nutzbaren Ergebnisse gebracht hat. Wir beobachten den Fortschritt von INSPIRE jedoch kontinuierlich und sind technisch darauf vorbereitet, allfällig verfügbare gesamteuropäisch harmonisierte Datenbestände übernehmen zu können.

Im Statistikbereich ist die Datenharmonisierung auf Gemeindeebene eine besondere Herausforderung. Daten aus den Partnerregionen dürfen nur dann in eine gemeinsame Tabelle übernommen werden, wenn sie auf gleiche Art und Weise erhoben bzw. verarbeitet wurden. Dies ist bei Bevölkerungsdaten noch recht einfach zu bewerkstelligen. Sobald es jedoch in andere Bereiche wie Arbeitslosenstatistik oder Haushaltsgröße geht, treten unmittelbar Probleme auf, da die Begriffe „arbeitslos“ oder „Haushalt“ in den unterschiedlichen Ländern nicht kongruent sind, sondern einander teilweise erheblich unterscheiden. Auch sind die Erhebungsmethoden verschieden, beispielsweise werden in manchen Ländern Arbeitslosendaten nach Stichtagen gebildet, in anderen Ländern wiederum nach Monats- oder Jahresmittelwerten.

Bisweilen ist es möglich, durch Aggregation von Daten diese Unterschiede zu eliminieren, jedoch ergeben sich dadurch mitunter Daten mit relativ geringer Aussagekraft, da die Abweichungen in den Definitionen zu stark sind.

Bei der Abbildung von Daten auf Gemeindeebene sind auch die Anforderungen des Datenschutzes besonders zu beachten. Bei Kombination verschiedener Merkmale wären vor allem in Gemeinden mit sehr geringer Bevölkerungszahl (im niederen zweistelligen Bereich) Rückschlüsse auf Einzelpersonen möglich, weshalb einige Daten auf der Gemeindeebene nicht länderübergreifend zur Verfügung stehen. Dennoch bekennt sich CentropeSTATISTICS zur Arbeit mit Gemeindedaten, da nur diese Daten eine detaillierte Betrachtung in regionalanalytischen Maßstäben ermöglichen.

4 WAS KANN CENTROPEMAP?

4.1 Fünfsprachige Website

Seit Projektbeginn steht mit http://www.centropemap.org/ eine fünfsprächige Website (Englisch, Deutsch, Tschechisch, Slowakisch, Ungarisch) zur Verfügung, die einen Überblick zur Region und zu den Inhalten von CentropeMAP und CentropeSTATISTICS bietet. Die Geo- und Statistikdatenportale sind jedoch nur in englischer Sprache verfügbar, das Handbuch zu CentropeSTATISTICS wird in Deutsch und Englisch angeboten. Technisch ist die Implementierung zusätzlicher Sprachen vorbereitet; bei Bereitstellung entsprechender finanzieller Mittel für eine Übersetzung können jederzeit weitere Sprachversionen eingespielt werden.

4.2 Kartendarstellung

Über das Geoportal CentropeMAP können nicht nur sämtliche eingebundenen Geodatenlayer aus allen vier Partnerländern angezeigt, sondern auch die in CentropeSTATISTICS eingepflegten Statistikdaten als thematische Karten visualisiert werden. Die Wahl der Darstellung läuft in wenigen Schritten ab, erfordert

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aber ein wenig Vorwissen aus dem Bereich GIS bzw. Kartographie, um sinnvollen Output erzeugen zu können. Daher gibt es auch zum schnellen Nachschlagen und für Benutzer ohne kartographische Vorkenntnisse vordefinierte thematische Karten, die direkt aus dem Menübaum heraus abgerufen werden können. Mit CentropeSTATISTICS lassen sich jedoch vielfältige weitere thematische Karten erstellen; hierbei kann auch auf eigene Berechnungen zurückgegriffen werden – die Auswahl beschränkt sich nicht nur auf die in der grenzüberschreitenden Statistikdatenbank vorgegebenen Tabellenspalten.

4.3 Diagrammdarstellung

Die in der grenzüberschreitenden Datenbank CentropeSTATISTICS vorhandenen Daten können auch in Diagrammform dargestellt werden. Mit wenigen Mausklicks ist die Erstellung von Säulen-, Balken-, Kreisdiagrammen und ähnlichen Darstellungsformen möglich. Da vor allem demographische Daten als jährliche Zeitreihe vorliegen, eignet sich die Diagrammdarstellung optimal zur Visualisierung von Bevölkerungsveränderungen in den letzten 15 Jahren.

Die Diagramme sind entweder als direkt am Bildschirm angezeigte Grafikdateien verfügbar oder als PDF inklusive der für die Diagrammerstellung verwendeten Statistikdaten in Tabellenform.

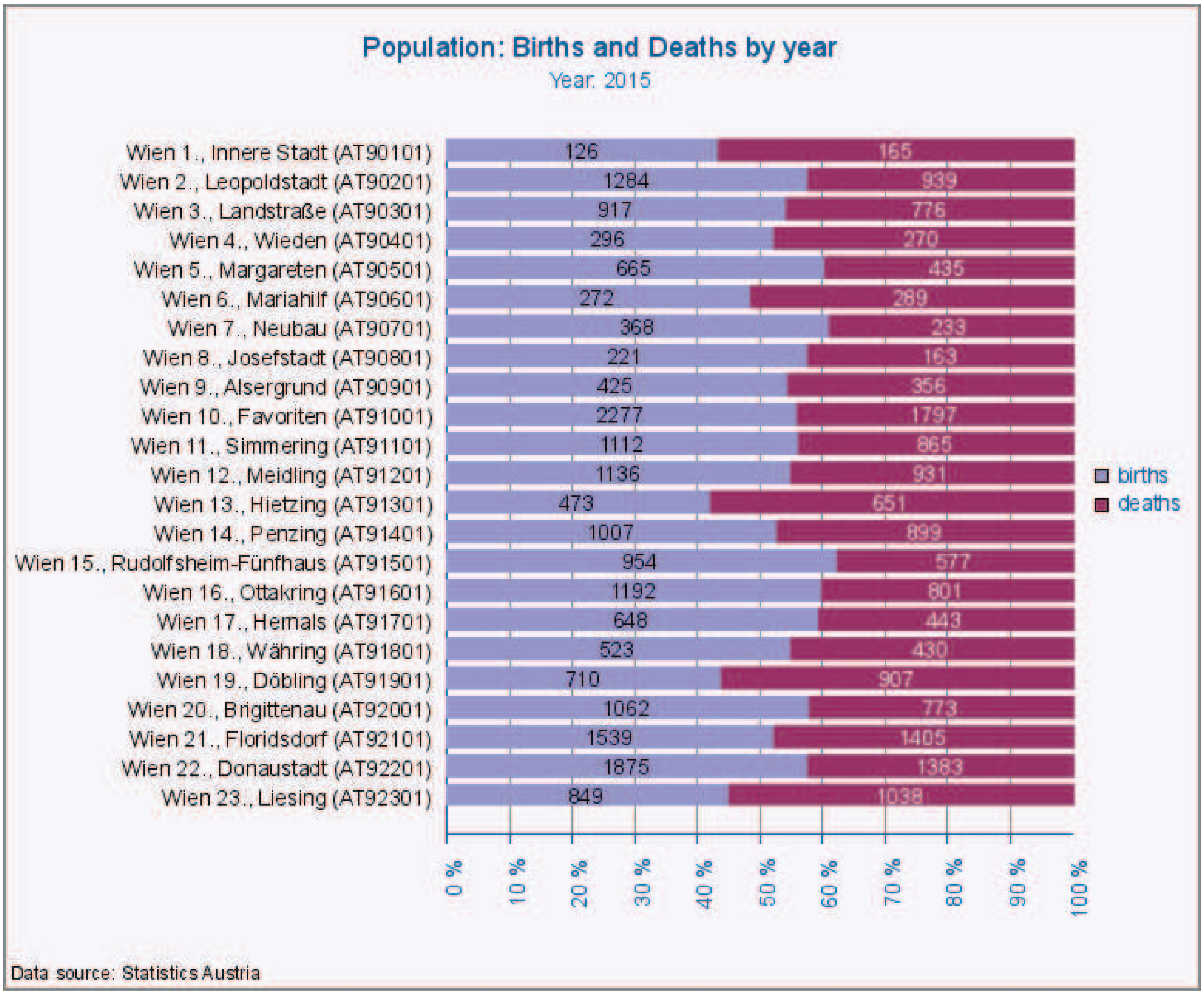

Abb. 2: Diagramm: Geburten und Sterbefälle 2015 für die Wiener Gemeindebezirke.

4.4 Datenimport und Datenexport

Alle Daten in CentropeSTATISTICS sind nicht nur innerhalb des Geo- und Statistikdatenportals ohne Einschränkung verfügbar, sondern sind auch zum Download bereitgestellt. Alle Tabellen können wahlweise im CSV- oder Excel-Format heruntergeladen werden. Die Weiterverwendung außerhalb von CentropeSTATISTICS ist mit entsprechender Quellenangabe gestattet.

CentropeSTATISTICS bietet auch die Möglichkeit, zusätzlich zu den vorgegebenen Tabellen temporär eigene Tabellen zu erstellen. Diese Tabellen können mit Daten aus CentropeSTATISTICS befüllt werden und eignen sich somit zur Berechnung von Indikatoren, für die man Daten mehrerer Tabellen benötigt. Zusätzlich können auch eigene Daten importiert werden, die in der benutzerdefinierten Tabelle mit CentropeSTATISTICS-Daten kombiniert und ebenfalls für die Karten- oder Diagrammerstellung verwendet werden können.

4.5 Ausblick – neu ab Herbst 2017: Gemeindevergleich

Ab Herbst 2017 wird CentropeSTATISTICS mit einer neuen Funktion aufwarten können. Ähnlich wie bei den meisten nationalen Statistikportalen wird es auch hier die Möglichkeit geben, verschiedene Daten zu einer Gemeinde auf einen Blick betrachten zu können und zu Vergleichszwecken die Daten einer weiteren Gemeinde direkt gegenüberstellen zu können. Die Bedienung erfolgt in fünf simplen Schritten:

- Auswahl des Vergleichsmodus,
- Auswahl der Gemeinde(n) oder Bildung einer benutzerdefinierten Region,
- Auswahl der gewünschten Indikatoren,
- Auswahl der gewünschten Zeitreihe (Jahreszahlen),
- Ausgabe der Daten.

Anders als bei den nationalen Statistikportalen ist dies bei CentropeSTATISTICS selbstverständlich grenzüberschreitend möglich. Die Daten werden, so weit verfügbar, als Zeitreihe dargestellt; die Ausgabe erfolgt sowohl als Diagramm als auch als Tabelle.

5 WEBLINK

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Changing Structures Induce Changing Behaviour: Streetscape Revitalisation and Human Mobility

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1 ABSTRACT

The preceding contributions of Frey and Emberger in this workshop prepare the theory-based path from the layer-based model of human behaviour to the acting principles of a human-centered design of urban spaces, streetscapes and transport structures.

Designing transport infrastructures and urban streetscapes poses an ethical challenge for the human being a part of a socio-technical regime. Not only are humans of course in every stage of life and health every-day users of these designed structures, some also act as planning agents of the very same – either as planners or in a public participation. Densely intertwined with the ethics question of properly designing urban mobility structures is the question on where and how to start the change of structures. Overcoming mental barriers among planners and decision makers as well as users not yet accustomed to a changed streetscape pose a considerable challenge for shaping society's dynamically evolving urban transport regimes.

Human mobility behaviour is subject to "fast" adaptability, if change management techniques are applied, ie. comprehensive information is available on a wide scale beforehand of the intervention. As large scale sporting events of the past have shown, such quasi-permanent transformation (closures for vehicular traffic) evoke the transport system's flexibility in reacting on such events: mobility patterns adapt.

Because this paper claims to provide a synopsis of evidence and examples of changes in behaviour due to changed structures, it culminates with four sets of examples following these main lines of thought:

(1) Example: Active modes friendly settlement structures

(2) Example: Commuting infrastructure

(3) Example: Parking place pricing and and locations

(4) Example: Rredifining road space usage

We conclude with highlighting the behavioural flexibility of mobility, the impacts of such behavioural changes from the urban dwellers' perspectives and the importance of making such changes conceivable beforehand.

Keywords: Planning; Structures; Behavioural change; Mobility, transport planning

2 INTRODUCTION

Infrastructural design poses ethical challenges on engineers in special and on society in general (Brezina and Frey, 2013). These challenges range from small-scale application of fair share policies to large-scale ubiquitous access policies (Brezina et al., 2014). Thus questions of well-being ("Is it a good place to live?"), justice ("Who get's the benefits and who the harm?"), sustainability ("How long can this place last?"[1]) and legitimacy ("Who should make decisions about the places?") need to be thoroughly addressed when it comes to designing streetscapes fit for the future (Kirkman, 2010). Streetscape revitalisation policies have been discussed and applied in the last decades for improved liveability and sustainability of once strongly car-oriented streetscapes (Brezina, 2005, Buehler and Pucher, 2011, Schopf and Emberger, 2013, Topp and Pharoah, 1994). In recent studies, car-free urban space design has also received attention under an alternative perspective, eg. its role in shaping first and last mile decisions (Tight et al., 2016).

The model of "structures inducing mobility data" was introduced more than a decade ago (Knoflacher, 2001a, 2007) and recently enhanced to include planning and education (Frey, 2014). In its latest shape, the model links planning (and the education of stakeholders therein) with the measured data through the structures and the behaviour that these induce. The concept of mental barriers describes the phenomenon in a

[1] We consider it crucial to point out that sustainability is not a matter of duration alone but needs to include a qualitative component as well: Cultural, economic and ecological sustainability.

society that a large body of knowledge on existing and sought-for solutions to improve conditions for active means of transportation exists, but lacks real-life implementation (Brezina and Castro Fernandez, 2017). Although this model enables a good understanding of the planning system, still a great number of decision-makers exist which have mental barriers to apply this knowledge to design sustainable transport systems properly.

Looking at policies which transform urban streetscapes in favour of active modes offers another enlightening perspective. Humans have become as much a product of technology as technology is a product of humans (Dries, 2004). Fig. 1 depicts an individual's energy consumption on the basis of embededness in a socio-technological regime during periods of time and with different delimitations (Brezina, 2010). For example, the fourteen-fold difference between a cycling human and a human fully embedded in the technological age is clearly visible. So changing structures for a changed behaviour is also reflected in reduced energetic density.

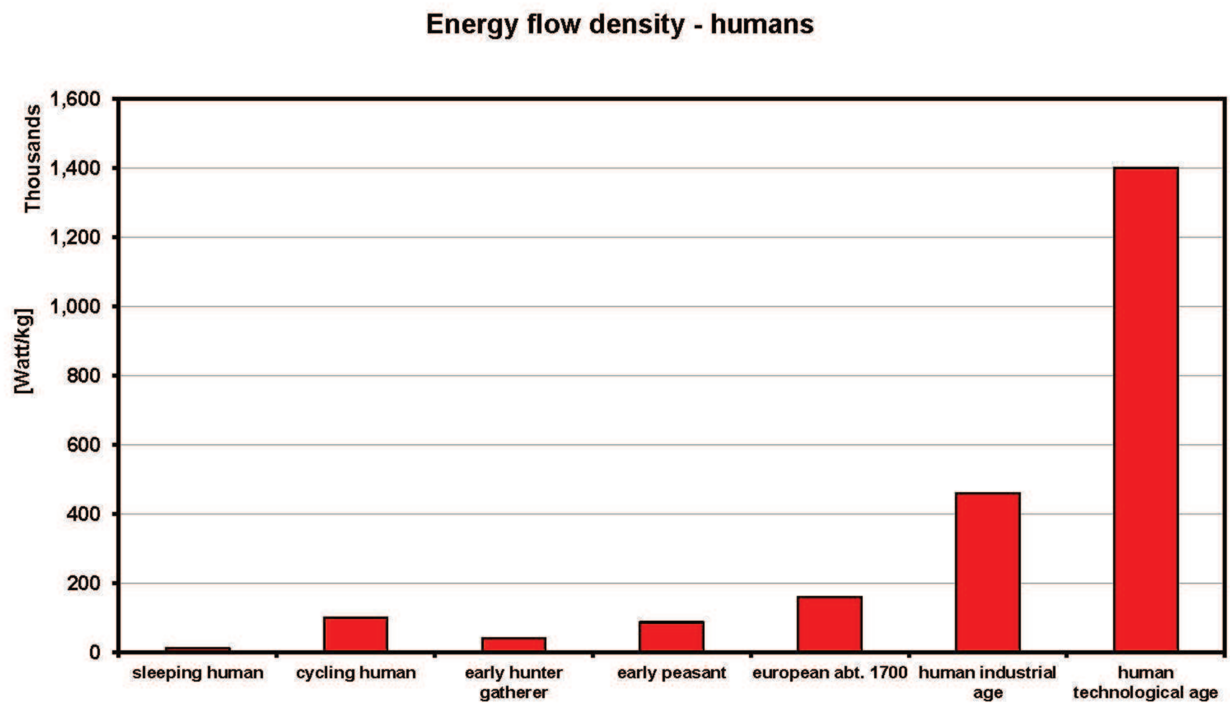

Fig. 1: Intensity of human energy consumption in a socio-technological regime during periods of time and with different delimitations. (Brezina, 2010) based on (Chaisson, 2001).

In contrast to wide spread popular belief, human behavioural patterns are subject to high adaptability. Therefore short-term individual as well as mid-term disruptions in transport regimes can not only be absorbed but used purposefully. It appears that wide spread and early-on distributed information on forthcoming changes plays a vital role in smoothly shaping transport regime transitions (Frey et al., 2010, Tennoy et al., 2017).

On the individual level human behavioural adaptability is clearly observable – subject to very different physical structures. A survey of cyclists' traffic light behaviour in five settings with differing cycling-friendliness (see Fig. 2) illustrates the adaptability of human mobility behaviour: the less cycling-friendly the infrastructure is, the lower is the rate of traffic rule adherence (Brezina and Hildebrandt, 2016). The five surveyed settings were: 1 – Cycling path crosses one car lane; 2 – Cycling path crosses more than one car lane; 3 – Push-button traffic light for cyclists; 4 – Cycling path crosses pedestrian path and 5 – Cumulation point of cycling crashes after red light violation. Clearly visible is the low traffic rule adherence rate (~ 70 % from dark brown until yellow) with setting three, where cyclists had to push a button and wait for receiving green light permission to continue their ride.

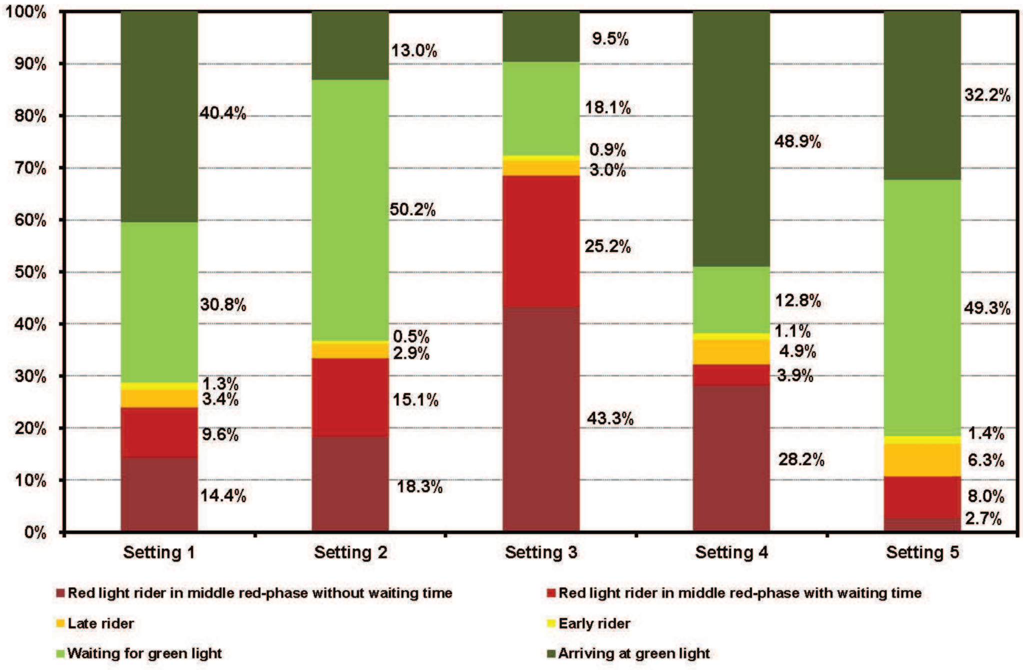

Fig. 2: Bicycle rider behaviour at five traffic light settings, from red light riding to waiting for green light (Brezina and Hildebrandt, 2016).

On the other hand, on a systemic level, it is necessary to understand streetscape revitalisation as change management within a civic and urban environment. This need for an accompanying long-term engagement asks for a variety in public involvment (before, during and after the reconstruction) and for interaction with planning departments and authorities on different levels and with different civic stakeholder groups (Lokar, 2015).

3 EXAMPLES

In this section we show four examples to delimit the application – knowingly or uncnciously – of evolutionary-based planning principles for influencing human mobility behaviour by alteration of underlying structures.

3.1 Example 1: Active mode friendly settlement structures

First-off, let us take a view on the impact of dwelling and mobility provision on mobility behaviour as living conditions are considered to be crucial for people's mobility choices (Knoflacher, 2007, Schwanen and Mokhtarian, 2005).

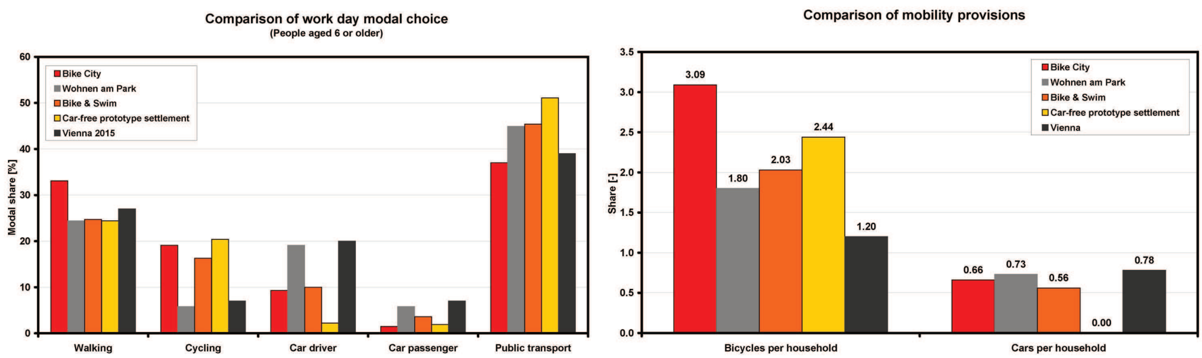

Fig. 3: Bicycle and car ownership per household (left) and modal share (right) of different settlements and Vienna in comparison. Data: (Mensik et al., 2012).

Fig. 3's left side shows bicycle and car ownership of Vienna's "Bike City", "Bike & Swim" and the "Car-free prototype" settlements and compares the results with one other typical settlement ("Wohnen am Park") and the City of Vienna. The mentioned settlements have been built with enabling the idea of car-reduced

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living in mind. Therefore reduced or no ("Car-free prototype settlement") car parking is provided and alternative forms of mobility are highly favoured, either by built form and/or by organizational matters. In the "Bike City" more than twice as much bicycles are available as mobility choice than in the total city itself. The right side of Fig. 3 illustrates the results: work day modal choice of inhabitants aged six years or older. Clearly active modes (+ 6 % walking and + 13 % cycling) are well developed, while the use of cars, either as drivers (- 18 %) or as passengers (- 5,5 %), is significantly smaller. It was shown in an environmental study (Ornetzeder et al., 2008) that car-free living reduces transport-induced CO2 emissions through permanently induced travel changes, the latter being ascribed to improved social contacts.

3.2 Example 2: Commuting infrastructure

Secondly a radial representation of commuting flows for nine corridors into Vienna based on a dual modal share (cars vs. public transport) is given. The data stem from the year 2010 and are structured in corridors by presence or absence of high capacity infrastructures, ie. motorways and/or commuter railways (S-Bahn). Such a structured depiction (Fig. 4) clearly illustrates the wide spread impact of infrastructure decisions on mobility behaviour of commuters. While the provision of a motorway and commuter rail establishes a 71 % to 29 % proportion in favour of private cars, the decision to restrain from building a motorway and providing commuter-rail only instead results in a proportion of 53 % to 47 % (car vs. rail). The decision to provide neither frequent and reliable rail-bound public transit services nor a motorway strongly deforms the proportion in favour of private cars to 79 % to 21 % (car vs. rail). Although the last two corridors ("Gänserndorf" and "Klosterneuburg") do provide public transport, bus lines and a regional rail service, such services are not as capable as commuter rail and thus attract less people away from using cars.

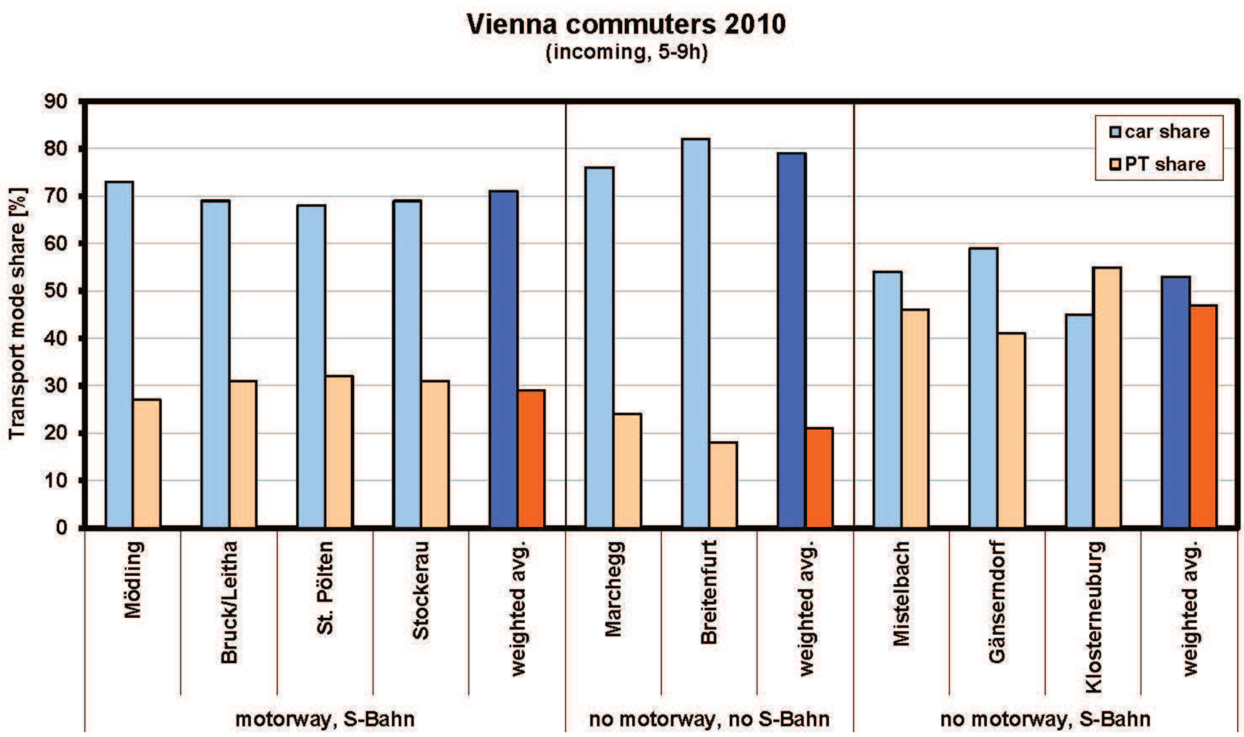

Fig. 4: Modal share along different corridors in/out of Vienna. Data: ÖBB, Statistik Austria.

3.3 Example 3: Parking place pricing and and locations

3.3.1 Effects of parking place pricing

While built environment is an important part of "structures", the monetary duties for usage of public land for mobility purposes are as well. A study (Shoup, 1997) carried out in British cities illustrates the effect of doubling the price of parking on modal share (Fig. 5). Firstly the total number of trips decreased, while secondly a shift by three to 15 percentage points can be observed from car trips to those undertaken by bus, rail and walking.

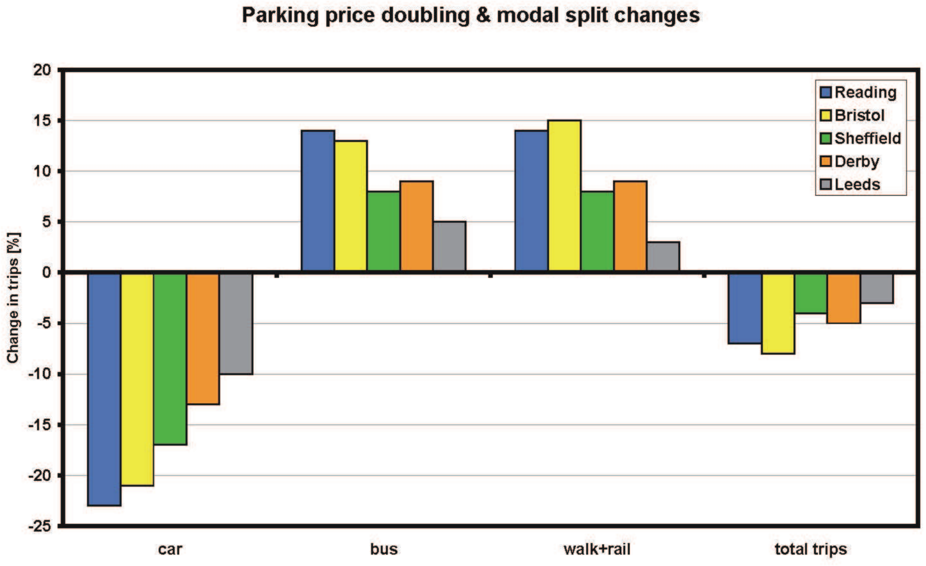

Fig. 5: Impact of parking fees on mobility and mode changes in UK cities. Data: (Shoup, 1997).

3.3.2 Effects of parking place location

Another interesting investigation, carried out by the Vienna University of Technology (Emberger and Knoflacher, 1995), shows the relation between car mode choice and distance to/from the parking place for the city of Vienna. (see Fig 6).

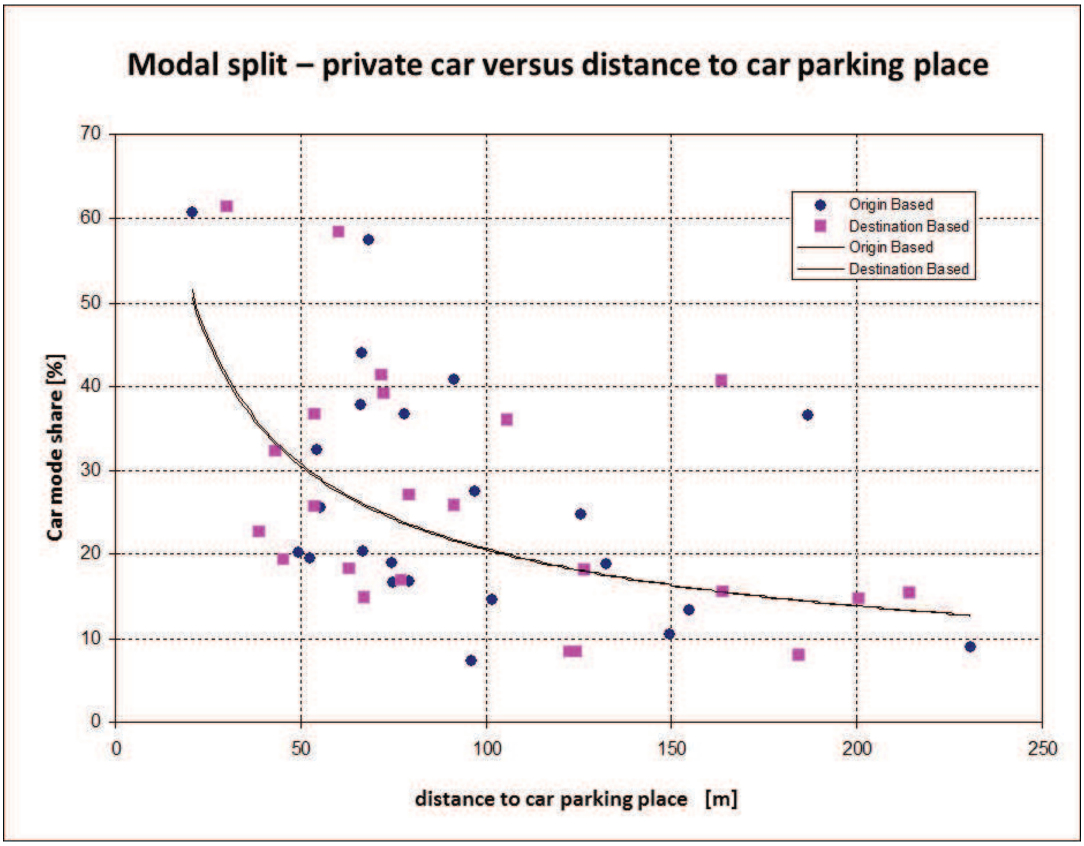

Fig 6: Private car mode choice in relation to parking distance in Vienna (Emberger and Knoflacher, 1995). Data: household surveys of 1986 and 1992.

On the x-axis of Fig. 6 one can see the distances from parking place either from/to the trip's origin or destination. Every dot represents the average distance for one of Vienna's 23 districts. Clearly visible is the average distance of less than 250 meters. The majority of Viennese inhabitants park their car less than 100 meters away either from their home or from their destination. By contrast, the average distance to the next public transport stop in Vienna is about 250 to 300 meters, which is – internationally seen – a very good

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value. On the y-axis the modal split value for car use in the corresponding district for all trips in the data sample is plotted.

As can be seen in Fig 6, the percentage of car usage in Vienna decreases with increasing car parking distance from/to origin/destination. When a car parking place is located close to the origin/destination, the car mode share is well above 30 %. In cases where the car parking place is further away – say 200 meters – less than 20 % are using the car anymore. This empirical evidence strongly indicates that the distance to/from the parking space has a strong influence on the mode choice (especially in an urban context like Vienna).

Furthermore, it is common sense in transport planning that every trip either made by public transport or car starts/ends with walking. Therefore the distance to (origin) and from (destination) the parking space (car trip) or to/from the public transport stop plays a very important role within the intra-personal mode choice. In other words, it can be said from a systemic point of view that there is no systemic difference between a public transport stop and a car/bike parking place. Both are the interface between walking and motorized (mechanized) means of transport. Although a public transport stop and a parking place resemble each other from a systemic point of view, the treatment in transport planning science was/is completely different (Emberger and Pfaffenbichler, 2017).

For example, looking at the past development of settlement structures reveals that nearly in all cultures and societies car parking places are located as close as possible to the origins (housing) and destinations (shopping centers, office buildings, factories, etc…). This is due to the fact that in nearly all countries guidelines exist, which provide regulations for the provision, number and location of parking places (for an overview of worldwide parking regulation see (Jittrapirom and Emberger, 2011)). These guidelines were developed to avoid car parking in public space but have had the unintended side effect that the distance between car parking places and public transport stops developed in different ways. Car parking places tend to be located as close to trip origins/destinations as possible, whereas public transport stops are allowed, depending on the type of public transport, to be between 300 meters (bus, tram) and 2,000 meters (light rail) away from trip origins/destinations.

Summing it up: the distance to/from a parking place/public transport stop is one of the most important parameters to influence individual mode choice and should therefore be used extensively in transport planning to foster sustainable transport behaviour.

3.4 Example 4: Redefining road space usage

Ljubljana, the capital of the Republic of Slovenia has been undergoing a significant transformation of urban space for the last decade (Lokar, 2015). In Sept. of 2013 the core link of the city's main Slovenska street was transformed from a motorized traffic thoroughfare to a pedestrianised space where city buses are allowed as only motorized guests. The implementation of this closure for private traffic – and concurrent opening for active modes – lead to a general decline in traffic volumes in the adjoining network links. As Fig. 7 shows, only at one road link an increase of traffic loads occurred, while at all other links a decrease of traffic volume took place.

Our selected examples illustrate the efficacy of streetscape design as a means of changing behaviour by changing structures. But decision-makers are still too often impaired by mental barriers too strong to allow for an audacious pursue of consistent streetscape revitalisation. But the internet provides best practise databases for mutual learning and inspiration with a large selection of case studies: for example at http://www.urb-i.com/ some 3,000 before/after pictures of urban streetscape transformations in North and South America, Europe, Asia and Australia can be found. Photos, taken at nearly identical viewpoints (either in-situ or via Google Streetview) illustrate very well the streetscape transformations and make these transformations conceivable in real world situations and with people, where it was not possible yet.

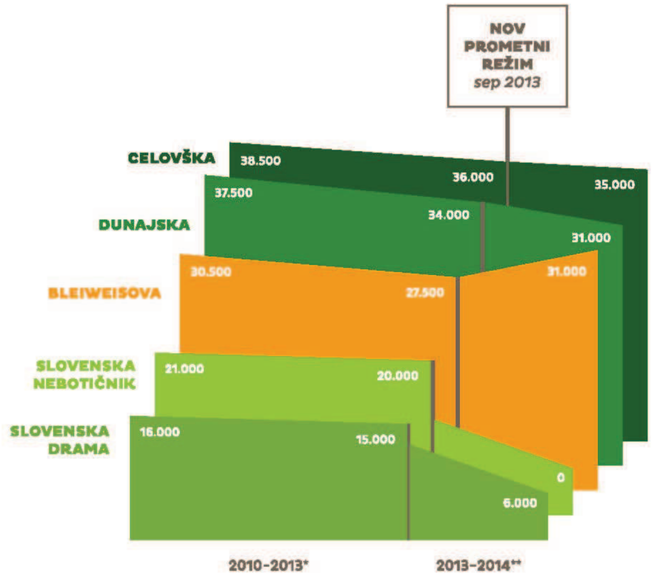

Fig. 7: Impact of central Slovenska street section closure for private car traffic in Sept. of 2013 on average volumes in adjoining street sections. Source: City Administration of Ljubljana. Note: Slovenska's Neboticnik final value of zero should leave no vertical segment.

4 CONCLUSION

In many countries, policy documents on all public administration scales (Emberger, 2017) have put as an important objective a more sustainable transport system on their agenda.

A lot of good streetscape revitalisation projects are already implemented and realized around the world. Unfortunately many more of them exists only on paper because of the (mental) barriers immanent at the responsible authorites. But their fear to reduce traffic capapity through the suggested streetscape redesign have been proven numerous times to be in vain.

In this paper, we have presented four examples of transport system's flexibility. The application of evolutionary-based planning principles to urban streetscape (re)design, either in a deliberate manner or unconsciously, improves the transport system's flexibility and changes the transport system towards sustainability. The visualisation/documentation of implemented streetscape redesigns, as done at http://www.urb-i.com/ is an important repository for all transport planners around the world. We think it is important to make such substantial transport regime changes conceivable (Knoflacher, 2001b) by collecting and making available such good, existing, real life examples to overcome the still existing mental barriers within transport planners, decision makers , media and the general public.

5 REFERENCES

BREZINA, T.: Mödling - Flächenhafte Verkehrsberuhigung - Ruhe für ein großes Siedlungsgebiet. In: Lebendige Fische schwimmen gegen den Strom. Festschrift für Prof. Hermann Knoflacher zum 65. Geburtstag und zu 30 Jahren Ordinarius für Verkehrsplanung, Technische Universität Wien, Institut für Verkehrsplanung und Verkehrstechnik, Wien, pp. 83-90. 2005.

BREZINA, T.: The impacts of technology on growth: Studies of agriculture and steel. in: Technology in Society, Vol. 32, Iss. 4/2010, pp. 312-323. 2010.

BREZINA, T. and CASTRO FERNANDEZ, A.: Cycling related mental barriers in decision-making – the Austrian context. In: AKÜNAL-ÖCALIR, E.V. and KNOFLACHER, H. (Eds.), Engineering Tools and Solutions for Sustainable Transportation Planning, IGI Global, pp. 58-75. 2017.

BREZINA, T. and FREY, H.: Zur Ethik in der Planung. in: zoll+, Vol. 22, Iss. 05/2013, pp. 24-27. 2013.

BREZINA, T., FREY, H., EMBERGER, G. and LETH, U.: Teaching ethics to transport engineers – The rationale behind and practice at Vienna Univ. of Technology. Paper presented at the 3rd International Conference on Road and Rail Infrastructure CETRA 2014, LAKUSIC, S. (Ed.) Split, HR: Department of Transportation, University of Zagreb. pp. 867-873. 2014.

BREZINA, T. and HILDEBRANDT, B.: Where do cyclists run red lights? An investigation into infrastructural circumstances. Paper presented at the ICTTE - International Conference on Traffic and Transport Engineering, COKORILO, O. (Ed.) Beograd, Srbija: City Net Scientific Research Center Ltd., Beograd. pp. 109-114. 2016.

BUEHLER, R. and PUCHER, J.: Sustainable Transport in Freiburg: Lessons from Germany's Environmental Capital. in: International Journal of Sustainable Transportation, Vol. 5, Iss. 1, pp. 43-70. 2011.

CHAISSON, M.: Cosmic evolution - The rise of complexity in nature. Cambridge, Mass.: Harvard University Press. 2001.

DRIES, C.: Technik als Subjekt der Geschichte? Technik- und Gesellschaftsphilosophie bei Günther Anders. Darstellung und Kritik. Philosophische Fakultät, Albert-Ludwigs-Universität, Freiburg/Breisgau, 132. 2004.

EMBERGER, G.: National transport policy in Austria - from its beginning till today. in: European Transport Research Review, Vol. 9, Iss. 1, pp. Article 6 (p. 1-16). 2017.

EMBERGER, G. and KNOFLACHER, H.: Sustainable Development - Öko-City, Projektgruppe 1: "Mobilität in der Stadt" (Stadt und Verkehr). Band 3: Mobilitätsverhalten der Wiener Bevölkerung. Durchgeführt im Auftrag der Wiener Internationalen Zukunftskonferenz (WIZK). 1995.

EMBERGER, G. and PFAFFENBICHLER, P.C.: Equidistance: Evidence of the Influence of Parking Organization on Mode Choice. In: AKÜNAL-ÖCALIR, E. and KNOFLACHER, H. (Eds.), Engineering Tools and Solutions for Sustainable Transportation Planning, IGI Global, pp. 129-150. 2017.

FREY, H.: Wer plant die Planung? - Widersprüche in Theorie und Praxis. Paper presented at the Real CORP 2014, SCHRENK, M., POPOVICH, V.V., ZEILE, P. and ELISEI, P. (Eds.), Wien, pp. 783-791. 2014.

FREY, H., LETH, U., MAYERTHALER, A. and BREZINA, T.: Predicted congestions never occur. On the gap between transport modeling and human behaviour. Paper presented at the Transport Problems, ? (Ed.) Katowice: ? 8.-11.06.2010, pp.? 2010.

JITTRAPIROM, P. and EMBERGER, G.: Off-street residential parking organisation - a review of current practices. Paper presented at the The 9th International Conference of Eastern Asia Society for Transportation Studies, 2011, Vol. 8, pp. 16. 2011.

KIRKMAN, R.: The Ethics of Metropolitan Growth - The Future of our Built Environment. New York, London: Continuum International Publishing. 2010.

KNOFLACHER, H.: Verkehr - das A und O aller Globalisierung der Weltwirtschaft. in: GAIA, Vol. 10, Iss. 2/2001, pp. 89-96. 2001a.

KNOFLACHER, H.: Wie die Trendumkehr der Verkehrsentwicklung denkbar machen? in: ÖIAZ - Österreichische Ingenieur- und Architekten-Zeitschrift, Vol. 146, Iss. 5-6/2002, pp. 190-193. 2001b.

KNOFLACHER, H.: Grundlagen der Verkehrs- und Siedlungsplanung: Verkehrsplanung. Wien: Verlag Böhlau. 2007.

LOKAR, B.: Making cycling again part of Ljubljana's DNA. In: ZUKAL, H.J. and BREZINA, T. (Eds.), Ringvorlesung SS 2014: Radfahren in der Stadt – Ausgewählte Vorträge, Vol. 1/2015, Institut für Verkehrswissenschaften, TU Wien, Wien, pp. 35-46. 2015.

MENSIK, K., SZEILER, M., SCHUSTER, M., STEINACHER, I. and TOMSCHY, R.: Fahrradfreundliche Wohnbauten - Forschungsbericht. in: Wiener Wohnbauforschung, Auftrag des Magistrats der Stadt Wien, MA 50 Referat Wohnbauforschung und internationale Beziehungen Wien, 18., Wien, 195. 2012.

ORNETZEDER, M., HERTWICH, E.G., HUBACEK, K., KORYTAROVA, K. and HAAS, W.: The environmental effect of car-free housing: A case in Vienna. in: Ecological Economics, Vol. 65, Iss. 3, pp. 516-530. 2008.

SCHOPF, J.M. and EMBERGER, G.: Die Straße, die Fußgänger und die Stadtentwicklung - Straße als Lebensraum. in: dérive. Zeitschrift für Stadtforschung, Vol. 50, Iss. 1-3/2013, pp. 4-9. 2013.

SCHWANEN, T. and MOKHTARIAN, P.L.: What affects commute mode choice: neighborhood physical structure or preferences toward neighborhoods? in: Journal of Transport Geography, Vol. 13, Iss. 1, pp. 83-99. 2005.

SHOUP, D.C.: Evaluating the effects of cashing out employer-paid parking: Eight case studies. in: Transport Policy, Vol. 4, Iss. 4, pp. 201-216. 1997.

TENNOY, A., CASPERSEN, E., HAGEN, O.H., LANGELAND, P.A., LANDA MATA, I., NORDBAKKE, S., SKOLLERUD, K.H., TONNESEN, A., WEBER, C., ORVING, T. and AARHAUG, J.: BYTRANS: Effects and consequences of capacity reduction in the Bryn tunnel - per 2016 (Summary). in: TOI Report, Institute of Transport Economics (TOI), Oslo, 15. 2017.

TIGHT, M., RAJÉ, F. and TIMMS, P.: Car-Free Urban Areas: A Radical Solution to the Last Mile Problem or a Step Too Far? in: Built Environment, Vol. 42, Iss. 4, pp. 603-616. 2016.

TOPP, H. and PHAROAH, T.: Car-free city centres. in: Transportation, Vol. 21, Iss. 3, pp. 231-247. 1994.

E-Participation – a Collaborative Approach

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1 ABSTRACT

In late 2016 we conducted a survey with citizens in the German-speaking region. The aim of the survey was to investigate the relationship between citizens and politics and to figure the possibility of an online participation tool out. Our research is based on an online survey in which we received 155 answers from different countries, constituting that interest in politics is based on living environment, age and municipality size. The survey further showed that today's landscape of participation tools and forms is not enough for modern standards. Time as limiting factor decreases the political engagement of citizens, another restricting factor is the political-party-system. Most citizens are not able to identify themselves with only one specific political party. For some decisions they follow the one on other issues they follow the other party. Vocita is a tool developed for political issues. Based on a surveytool its target is to connect citizens to their municipalities and to create a new form of engagement. By giving the people a voice Vocita aims to democratize the political system.

Keywords: E-participation, public administration, consultation, decision making, ICT

2 E – CITIZEN PARTICIPATION – A BACKGROUND REVIEW

Governments are responsible for enhancing their citizens' possibility to participate. Due to the United Nations Public Administration Country Studies, this right on participation can be found in 150+ countries worldwide. Furthermore, some governments do not have the technological knowledge or the financial depots to fund solutions to complex problems alone, they need their citizens' help. However, with the use of modern information and communication technologies, new and cheaper solutions can be found. A new possibility of reaching citizens and communities has arrived (United Nations, 2014).

By using modern ICTs, governments are able to provide a new way of communicating with their citizens. Citizens are now able to engage easily and solutions can be detected together. Based on this foundation, the United Nations (2014) define e-participation as "the process of engaging citizens through ICTs in policy and decision-making in order to make public administration participatory, inclusive, collaborative and deliberative for intrinsic and instrumental ends." (p.61)

Although e-participation is a growing field of interest in recent years it is important to mention that conventional types of communication cannot be substituted. Offline media like paper communication, face-to-face meetings, phone calls et cetera are as important as in former years. Nonetheless, to reach all groups within a community an online approach is needed (United Nations, 2014).

There are still some officials preventing e-participation to flourish while others have already recognized that a sustainable development can only be achieved with citizens' engagement.

Generally a three level model is used to describe e-participation. Based on the pillars of e-information, e-consultation and e-decision-making a continuum from "active" to "passive" engagement is described. By getting on the active side of the continuum the complexity of a suitable solution is getting bigger. Due to this e-information as first pillar is the most common one.

E-information is a passive form of engagement and could be described as a one-way communication. Political institutions provide information online for the citizens. Examples are homepages of these institutions, Facebook pages or groups and online media. Nevertheless e-information is a very important part in the participation process. Without the possibility of providing information the following steps of consultancy and decision-making cannot be fulfilled. 95% of all countries already use e-information to communicate with their citizens. This pillar can be seen on all levels of institutions, independent of municipality, city or state.

E-consultation is an active form of the participation process. The institutions take advantage of the knowledge the citizens have and try to make it useable for policies, services and different projects. This special form of crowdsourcing is more complex than the pure information of people. However, the occurring results can have strong impacts on the future of a society (United Nations, 2016). For e-consultation Social media is mentioned to be important, because of the easy accessibility and the low costs.

The third pillar is e-decision-making, which aims for giving the citizens the power to decide online about future trends. This online decision-making process is very restricted and comes with major technical issues left to be resolved, resulting in only few countries already supporting e-decision-making. Nevertheless, this is the holy grail of e-participation and it should be the visionary aim (United Nations, 2014). Only 38 countries have mentioned that the outcomes of an e-consultation process lead to new decisions. An issue occurring within the decision-making process is the question on how the processes are planned and executed (United Nations, 2016).

In the recent two decades participation changed and further developed strongly. Starting from only conventional forms of offline participation, meanwhile first online tools were introduced. Different institutions are developing their own types of participation to get the greatest advantage out of those new tools. However, it still remains a problem to develop strategies for e-participation, which is mentioned as an important part before introducing different tools.

The first step should always be an analysis and the creation of a vision, as well as the aim that should be reached. Based on this analysis, a fitting tool can be identified. The second step mentioned by the United Nations is to ensure that legal frameworks are appropriate for the tools used. The following important move for institutions is to check if the human resources needed are all available. Knowledge on digital topics, social media and so on are necessary.

The citizens' motivation to participate is a crucial factor. In former years we could observe a stronger drive for participating in decisions - and a lot may have lead to much better results, if the affected ones were asked. Leaders often use the argument that people are not interested, however a study (Spiegel, 2012) shows that people´s interest increase with the possibility to participate. So 83 % of 1.000 asked mentioned to be higher interested in political decisions if they can participate on the topic.

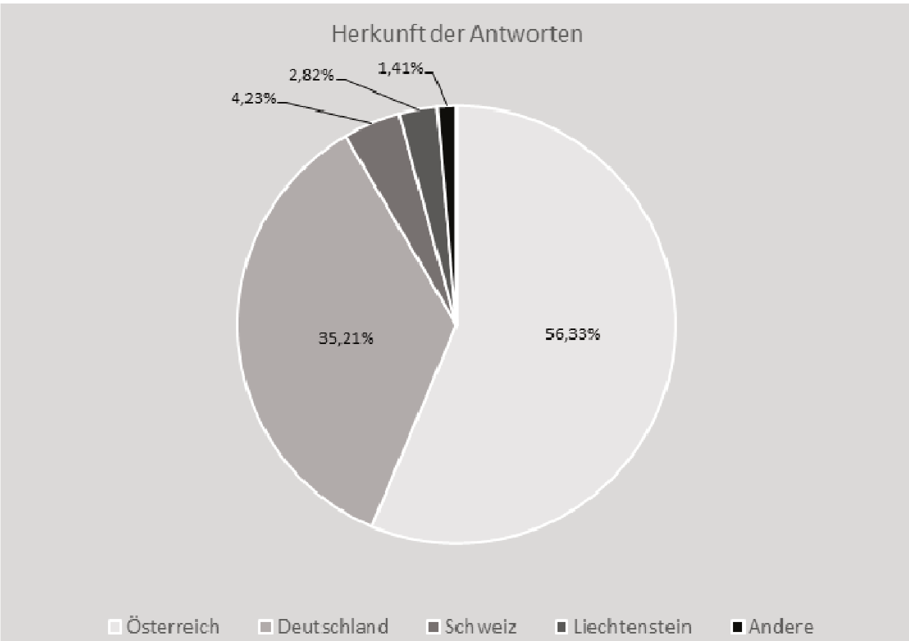

Figure 1: Distribution of Answers

3 METHODOLOGY

For this study the team conducted an online survey with Surveymonkey. The survey was distributed among several online media and different communication forums in the German-speaking area. A total amount of 213 answers could be gathered. After deleting incomplete surveys, a basis of 155 answers were useful for the statistical analysis.

Correspondent to gender distribution we could reach 55% men and 45% women, whereas 50% of the answers came from urban regions and the other half could be gathered from rural areas.

Austrian citizens, followed by 26% (fig. 1) from Germany, provide 53% of all answers. Switzerland and Liechtenstein are represented by 14% and 7% of all answers. Data collection started in early October 2016 and lasted two weeks.

4 RESULTS AND DISCUSSION

Our survey questioned the interest in politics. The answers showed that political interest is depending on the living environment, municipality size and age. In rural regions the interest is higher than in urban regions. It further decreases with the growing size of municipalities. The bigger a municipality is, the lower is the citizen´s interest in politics. From an age perspective we can observe that political interest starts with 31 years. Citizens younger than this age do not show political interest, however they give qualitative answers why they do not.

From a qualitative analysis side we can see that the main reason people are not interested in politics is missing implication. Citizens seem to be frustrated that political decisions often take a lot of time. On municipality level another problem is that they often do not follow a communication strategy. Municipalities should concentrate on communicating their implications to their citizens. With this stronger communication they can show their voters the implications and success stories.

Another question we asked was about political engagement. 85% mentioned that they do not engage in politics. Citizens mentioned that they do not have time or interest in engaging in politics. Another factor brought up by citizens was the lack of identification with a political party. To put it in a nutshell: A fitting solution for citizens’ participation is missing.

In a final question we asked if citizens would be interested in participating if fitting online based solutions were provided. On a Likert scale ranging from 1 to 5 an average value of 4,45 showed high interest of citizens in engaging.

5 VOCITA – SHAPING OUR FUTURE TOGETHER

Vocita’s purpose is to bring citizen participation into the digital age by enabling the democratization of the decision making process in closed communities with the aim to improve the decisions taken.

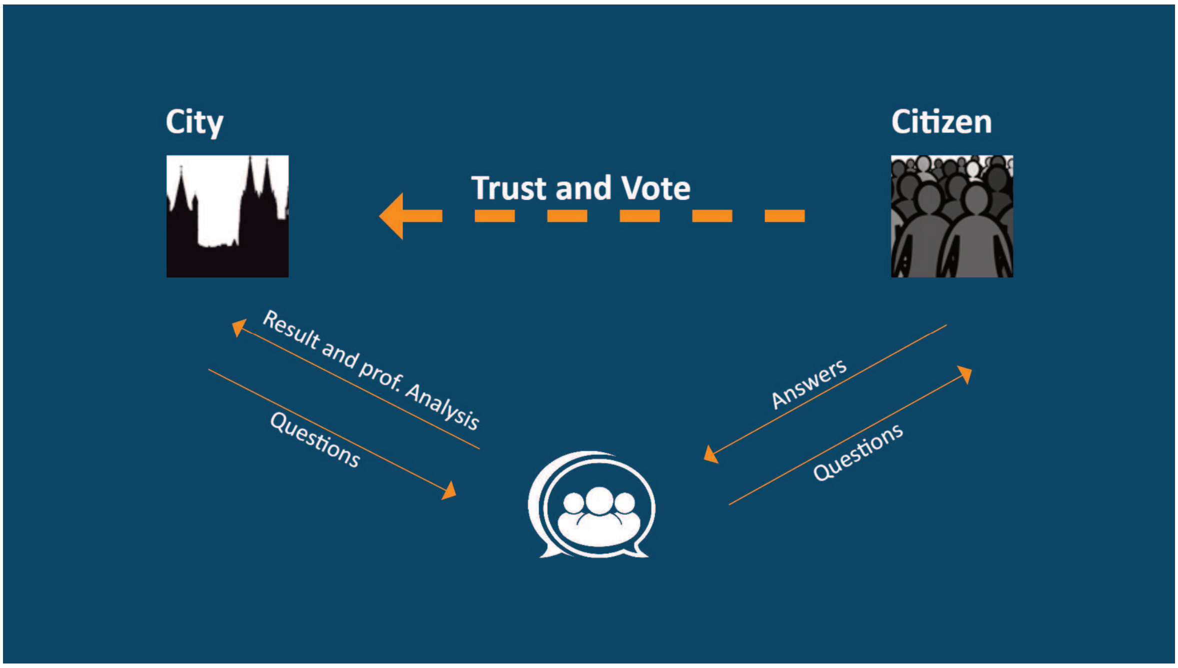

Figure 2: The Vocita Platform Solution

Vocita (fig. 2) pushes political participation into the digital age, by creating an online community, identically to the citizens living in a municipality. Thereby the citizens can participate in the decision making process of their municipality. Furthermore because of the low cost solution the mayor can ask more frequent questions, resulting in an even better integration of the people. Based on the raw data of the answers collected and a detailed statistical report the mayor can take the best decisions and secure the trust of his citizens.

In this process Vocita offers the following advantages:

- Vocita ensures citizens can participate in the decision making process by an up-to-date method, saving them a lot of time in comparison to existing possibilities.
- Vocita ensures that know-how of citizens is transferred directly to the decision takers.
- Vocita ensures that citizens can participate anonymously.
- Vocita ensures a high level of user identification, so that the mayor can be sure that people, who take part in the survey are really citizens of his community.
- Vocita allows to ask selected groups within a municipality.
- Vocita ensures increased interest politics, as people are integrated stronger
- Vocita ensures a higher acceptance of decisions, as they are made by citizens themselves and compromises are based on well-grounded analysis.
- Vocita aims to increase trust and faith into the political system, resulting in a higher probability of reelection.

Community

To use Vocita (fig. 3) the mayor creates one or more communities. The overall community shall include all citizens. The different sub-communities can be separated without limitations. After setting up the communities they can be handled by the municipality. The municipality can check who is in the community and they can delete people of the community if they move.

Figure 3: Instance on how Communities could be Structured

Verification

Generally we are going to support different stages of security. For municipalities we are first integrating the safest stage. This one can be compared to the online application for a voting card in Austria. The safety stage is described in the following.

The user verification is an important factor for Vocita's business model. We have to make sure, that only people allowed can use the Vocita service and attend at a questionnaire of a municipality.

For that reason the municipality verification process is divided into two separate parts:

- In part one Vocita makes sure that only people living in the municipality are able to get into it´s community. To do so the municipality is able to download codes, which they can send to their citizens. These downloads are immediately integrated into a mass sending, that can get printed afterwards. The code is integrated both in form of QR code and in numbers to ensure a high safety level.
- In part two of the verification process, Vocita makes sure, that people can only get into one and the same community once. So they have to scan their passport to get into the new group. After an internal verification, we can ensure that the personal data and the person that applied for the community are identical. With this security standards we can make sure that no bots are on the service.

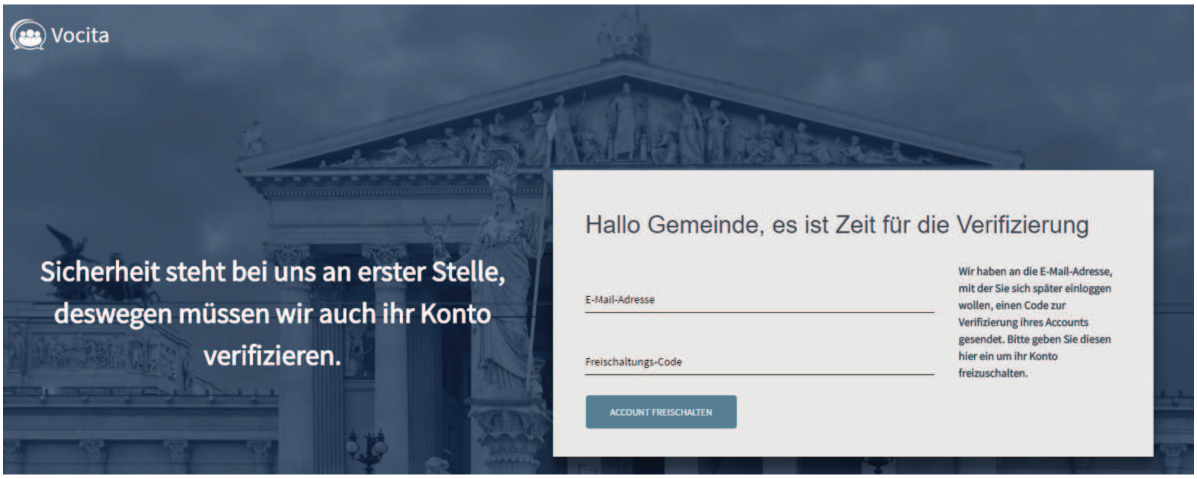

Figure 4: Screenshot from Product, Verification Process

For the second verification there are several potential third party services that could be integrated. Vocita already started negotiations with some of them. The most important factors for the negotiations are data security, customer experience and price.

Questionnaires

For our questioning tool we analyzed several existing tools. Starting with easy question types in the minimum viable product (first version people are willing to pay for) we are aiming to provide a wide range of potential question types in later versions. At the beginning we will start with easy yes/no questions multiple choice and single choice. In the next version we will add open questions with a special process to identify high value answers and low value answers.

If open questions are asked the questionnaire starts a two step principle. The first step is the answer of the question. After a specific range of time the municipality determines, we are starting the second step. With the second step the community can see all answers in a random way. Then they have the possibility to up- and downvote good and bad answers. With this second step we can identify highly valuable answers and answers without value.

As time is an important factor for the citizens we are limiting the maximum amount of questions, that mayors are allowed to ask in one contact. To do so we follow a point system. Every type of question counts for an amount of points. Adding up the questions they are not allowed to reach a limit. With this functionality we want to make sure that questions are short and easy to be answered. People should be able to answer the questionnaire within 30 seconds.

Analysis

After closing the questionnaire the municipality can download the answers in excel or csv data files. However at this point Vocita also offers professional analysis. We invite the users to share specific individual data with us. Resulting in a voluntary profile to improve analysis. With regression and correlation analysis we are going to do multi level testing to show the best decision for municipalities. These reports are customized and directly created through our program and add an extra value to the municipality, as most of them do not have the know how for statistical analysis in their city.

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Gamification

We are integrating a gamification on both the user and the customer side. For the customer we are expecting a high response rate because of their intrinsic motivation to change their near environment, however we are also integrating a gamification part. The user gets 'experience points' for his actions (answering questions, evaluating answers, completing the profile, ...). With these experience points we allow him to compare himself with others of the community, the municipality, the district, the land or the world.

For the customer we are creating a gamification part that should increase their interest for asking more questions. We are rewarding them with points for asking questions, giving feedback to the community and implementing ideas. The citizens can compare their own municipality with their neighborhood.

6 VOCITA – SHAPING OUR FUTURE TOGETHER

Our survey showed that there is a huge potential for online tools in the field of citizen engagement. To the current day an overall suitable tool is still missing. This gap should be filled with Vocita.

Based on the literature reviewed and the survey conducted we see a huge potential for municipalities and their mayors in engaging citizens deeper into the decision making process. The Spiegel (2012) could already show, that the engagement of citizens has a very positive effect on the reelection of a mayor.

7 LITERATURE

Bertelsmann Stiftung (2011). Meinungsbild zur Bereitschaft der Bürger zu politischer Beteiligung. Statista, Bertelsmann Stiftung, Zugriff: 25.04.2017.

Initiative D21 (2016). Welche Bedenken haben Sie im Bereich Datenschutz/Datensicherheit, die Sie von einer (intensiveren) Nutzung von online Behördendiensten abhalten? Statista, Initiative D21, Zugriff: 25.04.2017.

Initiative D21 (2016). Haben Sie in den letzten 12 Monaten E-Government-Angebote genutzt? Statista, Initiative D21, Zugriff: 25.04.2017.

TNS Emnid (2011). Welche Formen von politischer Beteiligung praktizieren Sie/kämen für Sie in Frage und welche kommen nicht in Frage? Statista, Bertelsmann Stiftung, Zugriff: 25.04.2017.

Spiegel (2012). Kann Ihrer Meinung nach durch mehr direkte Beteiligung an politischen Entscheidungen das Interesse der Menschen an Politik und Demokratie gefördert werden? Statista, Spiegel, Zugriff: 25.04.2017.

Statistik Austria (2016). E-Government Nutzung in Österreich nach Zweck und Alter im Jahr 2016. Statista, Statistik Austria, Zugriff: 25.04.2017.

Statistisches Bundesamt (2016). Anteil der Internetnutzer in Deutschland, die in den letzten zwölf Monaten Kontakt mit Behörden oder öffentlichen Einrichtungen über das Internet hatten in den Jahren 2008 bis 2016. Statista, Statistisches Bundesamt, Zugriff: 25.04.2017.

United Nations (2010). E-Government Survey 2010. Leveraging e-government at a time of financial and economic crisis. UN Publishing Section, New York, 2010.

United Nations (2012). E-Government Survey 2012. E-Government for the People. UN Publishing Section, New York, 2012.

United Nations (2014). E-Government Survey 2014. E-Government for the Future we Want. UN Publishing Section, New York, 2014.

United Nations (2014). Ausgewählte Instrumente für E-Consultation-Dienste nach der Anzahl der anbietenden Länder weltweit im Jahr 2014. Statista, United Nations, Zugriff: 25.04.2017.

United Nations (2016). E-Government Survey 2016. E-Government in Support of Sustainable Development. UN Publishing Section, New York, 2016.

Energetische Potenziale und klimatische Grenzen der Nachverdichtung städtischer Quartiere am Beispiel der Region FrankfurtRheinMain

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1 ABSTRACT

Aufgrund steigender Immobilienwerte verändern sich städtische Quartiere in guter Lage in den Wachstumsregionen durch Nachverdichtungsmaßnahmen. In Einfamilienhausgebieten werden benachbarte Grundstücke zusammen gelegt und mit Mehrfamilienhäusern bebaut. Geschossbauten in Nachkriegssiedlungen werden aufgestockt und um Neubauten ergänzt. So steigt die städtebauliche Dichte und die Quartiere verändern ihren städtebaulichen, energetischen und stadtklimatischen Charakter.

In einer Studie ließ der Regionalverband FrankfurtRheinMain die Potenziale der Nachverdichtung sowie die energetischen und klimatischen Auswirkungen beispielhafter Entwurfslösungen in Testquartieren untersuchen: in Zeilenbauten der 50er und 60er Jahre, in Großwohnsiedlungen und in älteren extensiven Einfamilienhausgebieten.

Die von der Hochschule Nordhausen erabeiteten Ergebnisse der energetischen und klimatischen Bewertung in der Studie von 2016: „Potenziale für zusätzlichen Wohnraum im Siedlungsbestand der 50er- bis 70er-Jahre - Ergebnisse eines Modellprojektes für ein klimagerechtes Flächenmanagement“ sollen vorgestellt werden.

Keywords: Stadtklima, Energie, Nachverdichtung, Frnktfurtrheinmain, Wohnraum

2 ENERGETISCHE POTENZIALE UND KLIMATISCHE GRENZEN DER NACHVERDICHTUNG STÄDTISCHER QUARTIERE AM BEISPIEL DER REGION FRANKFURTRHEINMAIN

2.1 Einleitung

Aufgrund steigender Immobilienwerte verändern sich städtische Quartiere in guter Lage in den Wachstumsregionen durch Nachverdichtungsmaßnahmen. In Einfamilienhausgebieten werden benachbarte Grundstücke zusammengelegt und mit Mehrfamilienhäusern bebaut. Geschossbauten in Nachkriegssiedlungen werden aufgestockt und um Neubauten ergänzt. So steigt die städtebauliche Dichte und die Quartiere verändern ihren städtebaulichen, energetischen und stadtklimatischen Charakter.

Wenn Städte mit zunehmenden Wohnungsbedarf Baurecht für neue Wohnungen schaffen wollen, sind sie gemäß Baugesetzbuch verpflichtet, zunächst die Möglichkeiten einer Innenentwicklung zu eruieren. Diesem Zweck dienen Baulücken- und Brachflächenkataster. Nachverdichtungspotenziale werden in diesen Katastern in der Regel nicht erfasst, da die Nachverdichtung auf Grundstücken stattfindet, die bereits einer Bebauung zugeführt sind. Auf solchen Arealen können zusätzliche Wohnungen realisiert werden, weil moderne Bauweisen eine höhere Dichte verträglich machen, z. B. großzügig geschnittene und gut belichtete Wohnungen.

In der Studie von 2016: „Potenziale für zusätzlichen Wohnraum im Siedlungsbestand der 50er- bis 70er-Jahre - Ergebnisse eines Modellprojektes für ein klimagerechtes Flächenmanagement“ ließ der Regionalverband FrankfurtRheinMain die Potenziale der Nachverdichtung sowie die energetischen und klimatischen Auswirkungen beispielhafter Entwurfslösungen in Testquartieren untersuchen: in Zeilenbauten der 50er und 60er Jahre, in Großwohnsiedlungen und in älteren extensiven Einfamilienhausgebieten.

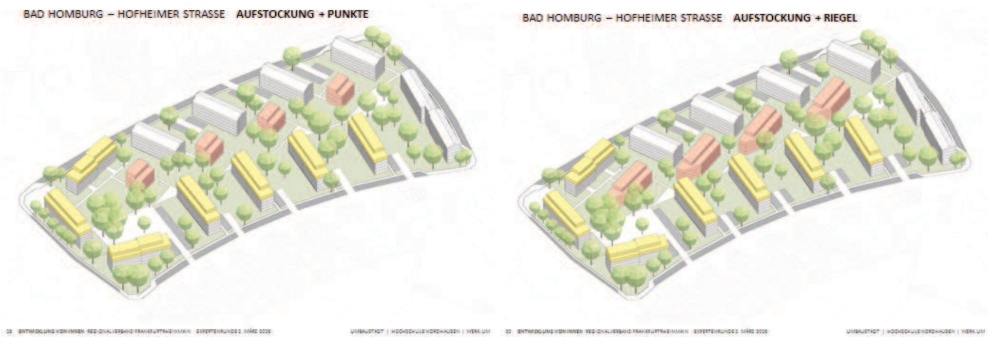
Die Hochschule Nordhausen trug zu dieser Studie die energetische und klimatische Bewertung bei. Die modellhaften Nachverdichtungslösungen entwarfen UmbauStadt (Berlin) und WerkUm (Darmstadt). Sie nahmen hierbei auch eine qualitative städtebauliche Bewertung vor.

2.2 Modellhafte Lösungen der Nachverdichtung in Testquartieren in Bad Homburg und Frankfurt

Zur Vorbereitung der Studie wählte der Regionalverband gemeinsam mit den mitwirkenden Städten Bad Homburg und Frankfurt am Main fünf Stadtquartiere als Testquartiere aus, die wegen ihrer verhältnismäßig lockeren Bebauung (niedrige GFZ) und gleichzeitig guten städtebaulichen Lage für eine Nachverdichtung geeignet schienen. Die Entwürfe für eine Nachverdichtung beinhalteten eine geringe Intensität der

Nachverdichtung (Entwurf 1) sowie eine intensivere Nachverdichtung (Entwurf 2). Jeder Entwurf verfolgt das Anliegen, eine neue stadträumliche Qualität zu bieten und die verbleibenden Freiräume – trotz steigender Stellplatzzahlen - aufzuwerten. Aufgrund dieser Zielsetzung blieb die Nachdichtung maßvoll, d. h. sie bewegte sich innerhalb der Dichtevorgaben der Baunutzungsverordnung (GFZ = max. 1,2).

Im Folgenden werden die Entwürfe für drei Testquartiere gezeigt, die in vielen Städten ein interessantes Potenzial der Nachverdichtung darstellen.



Testquartier Hofheimer Str. in Bad Homburg (Entwürfe 1 und 2)

Testquartier Gießener Str. in Frankfurt am Main (Entwürfe 1 und 2)

Testquartier Massbornstr. In Frankfurt am Main (Entwürfe 1 und 2)

3 ENERGETISCHE UND KLIMATISCHE BEWERTUNG

Die energetische und klimatische Bewertung von Nachverdichtungsentwürfen für Testquartiere im Gebäudebestand von Bad Homburg und Frankfurt sollte die Frage beantworten, ob die höhere städtebauliche Dichte an den ausgewählten Standorten und die neu entstehenden Baustrukturen das Ziel der Städte unterstützen, die Kohlendioxid-Emissionen bis zum Jahr 2050 erheblich zu reduzieren.

In ihren energetischen Auswirkungen verglichen wurden die unterschiedlichen Entwürfe der Nachverdichtung in ausgewählten Testquartieren. Ein weiterer Vergleich fand mit jeweils einem Neubaugebiet (Referenzquartier) in Bad Homburg (Neubaugebiet Am Hühnerstein) und in Frankfurt (Neubaugebiet Riedberg-Ginsterhöhe) statt.

Die klimatische Bewertung untersuchte die Nachverdichtungsentwürfe auf ihre städtebauliche Verträglichkeit, da davon auszugehen ist, dass eine höhere städtebauliche Dichte die Hitzebelastung von Quartieren erhöhen und die Durchlüftung erschweren könnte.

Der energetische Vergleich zwischen Innen- und Außenentwicklung sollte nicht zu Entweder-Oder-Entscheidungen bei der Wohnbauflächenentwicklung führen, sondern prüfen, ob der planerisch aufwendigere und konfliktreichere Weg der Erschließung von Nachverdichtungspotenzialen lohnenswerte energetische Effekte hervorbringt.

3.1 Vergleich der CO_2-Bilanzen „Wärme, Strom und Mobilität“

Nach der Studie des Bundesumweltamtes „Die CO_2-Bilanz des Bürgers (2007)“ beträgt die durchschnittliche CO_2-Bilanz pro Kopf und pro Jahr in Deutschland rund 10 Tonnen, davon fallen in den für diese Studie relevanten Sektoren an: Wärme: 1,5 t, Strom: 0,8 t, Mobilität: 1,2 t. Die CO_2-Bilanzen beziehen sich auf die Betriebsenergie (einschließlich Vorketten). Relevant ist insbesondere im Gebäudesektor auch die Herstellungsenergie (Graue Energie).

Wärme

Bei der Wärmeversorgung der Wohngebäude der untersuchten Testquartiere steht die Raumwärme im Vordergrund, ergänzt um die Wärme, die für die Warmwasserbereitung benötigt wird. Durch die Nachverdichtung der Quartiere steigt grundsätzlich der Wärmebedarf, weil zusätzliche Wohnfläche geschaffen wird, die zu beheizen ist, und weil mehr Menschen mit Warmwasser versorgt werden müssen.

Dieser Anstieg des Wärmebedarfs lässt sich in dem Teil der Testquartiere (Zeilenbauten, Großwohnsiedlung) durch Effizienzverbesserungen „ausgleichen“, in denen aufgrund der hohen Wärmebedarfsdichte auf wirtschaftliche Weise eine Nahwärmeversorgung installiert werden kann (Dämmung der Gebäudehülle im Bestand nach EnEV, Installation eines Erdgas-BHKWs). In einem anderen Teil der Testquartiere (Ein- und Zweifamilienhäuser) wäre eine Nahwärmeversorgung nicht realistisch (auch wegen der Hemmnisse aufgrund der Eigentümerstruktur). In diesen Quartieren lässt sich durch hoch energiesparend gebaute Neubauten und einer ergänzenden solarthermischen Warmwasserbereitung der durchschnittliche Wärmebedarf im Quartier senken.

Von der Nachverdichtung in einem Quartier gehen Impulse auf die Sanierungsbereitschaft der Bestandseigentümer aus, deren zeitliche Umsetzung jedoch nicht vorhergesehen werden kann. Eine Ausnahme bildet die Nachverdichtung durch Aufstockung, die aus bautechnischen Gründen grundsätzlich zeitgleich mit einer umfassenden Gebäudesanierung verbunden ist.

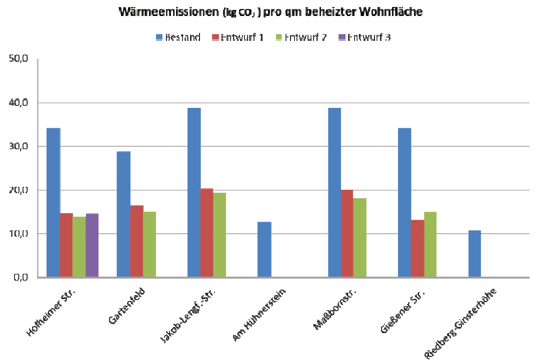


Abbildung: Vergleich der CO_2-Emissionen durch Wärme in den Testquartieren und in den Referenz-Neubaugebieten

Wird die wirtschaftliche energetische Effizienzsteigerung umgesetzt, führen die beiden in ihrer Intensität abgestuften Entwürfe der Nachverdichtung in allen Testquartieren zu einer erheblichen CO_2-Minderung, in der Regel um 50 Prozent und darüber hinaus. Als besonders einsparend erweisen sich die beiden Quartiere in Zeilenbauweise: Hofheimer Straße und Gießener Straße, so dass sie sich fast den sehr niedrigen CO_2-Werten der Neubaugebiete mit überwiegender Einfamilienhaus-Bauweise annähern. Würde allerdings in den Neubaugebieten eine kompaktere Geschossbauweise festgesetzt, läge der CO_2-Wert für die Wärme hier nochmals niedriger, also unter 10 kg CO_2 pro qm beheizter Wohnfläche.

Strom

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Der Stromverbrauch der Haushalte wird bisher nur in geringem Maß vom Wohnstandort und von der Bauweise an diesem geprägt. Eine Ausnahme bildet die Versorgung der Wohnungen mit Tageslicht. Für die Zukunft zeichnen sich durch die zunehmende Elektromobilität (Bikes und PKWs) Veränderungen ab, d. h. es ist eine große Zunahme des Stromverbrauchs zu erwarten.

Die Testquartiere verfügen über unterschiedliche Potenziale einer klimafreundlichen Eigenstromerzeugung. In nachverdichteten Testquartieren, in denen eine Nahwärmeversorgung wirtschaftlich ist, lässt sich mittels Kraftwärmekopplung Strom zum Eigenverbrauch produzieren. Letzteres gilt insbesondere für das Winterhalbjahr, während im Sommerhalbjahr die Photovoltaik ihre Beiträge leistet. Die Anteile der Eigenstromerzeugung lassen sich in Zukunft durch den Einsatz von Batteriespeichern weiter steigern.

In den Einfamilienhaus-Testquartieren, in denen sich auch durch Nachverdichtung keine Nahwärmeversorgung anbietet, lässt sich mit derzeitigen Technologien Eigenstrom nur durch individuelle Photovoltaik-Anlagen erzeugen. In allen Testquartieren führt die Nachverdichtung zu einer Erhöhung des Flächenpotenzials für die Nutzung der Solarenergie. Dies ist am Anstieg der solaren Gütezahlen gut ablesbar.

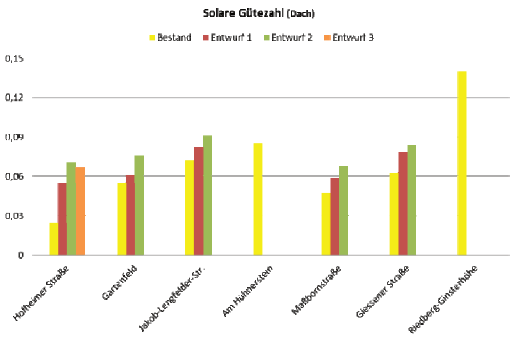

Abbildung: Vergleich der Solaren Gütezahlen Dach in den Testquartieren und in den Referenz-Neubaugebieten

Da mit der Umstellung des deutschen Energiesystems auf dezentrale erneuerbare Energie die Eigenstromerzeugung auch im Wohngebäudesektor eine wachsende Bedeutung erfährt, werden ausreichend große Stromgewinnungsflächen benötigt, die sich vorrangig auf den Dächern anbieten.

Mobilität

Die energetische Betrachtung des Mobilitätsverhaltens in den Testquartieren stellt die mögliche Reduktion von Autofahrten der Bewohner in den Vordergrund, weil hier das höchste CO-2-Einsparpotenzial liegt. Ein vielfältiges Angebot an sozialer und kultureller Infrastruktur sowie Einkaufsmöglichkeiten findet sich in innenstadtnahen, dicht bebauten und gemischt genutzten Quartieren. Wer hier wohnt, profitiert in seinem Alltag von kurzen Wegen. Allerdings geht aus verschiedenen Studien zum Verhältnis von Siedlungsstruktur und Verkehr geht hervor, dass entscheidend für die Verkehrsmittelwahl eines Haushalts der Besitz eines Autos ist, d. h. auch in dem Fall, dass ein Wohnstandort über Versorgungsangebote verfügt, die gut zu Fuß oder mit dem ÖPNV erreicht werden können, nutzen manche Bewohner für diese Wege das Auto, weil sie es „sowieso“ finanzieren, so die Ergebnisse von zwei Forschungsvorhaben in den Regionen Dresden und Köln (C. Holz-Rau, J. Scheiner: Siedlungsstrukturen und Verkehr: Was ist Ursache, was ist Wirkung? In RaumPlanung 119). Nur mit Einschränkungen läßt sich die tatsächliche Reduktion von Autofahrten und die hieraus abzuleitende CO_2-Minderung berechnen. Soweit aktuelle energetische Bilanzierungsmodelle auf Quartiersebene auch den Energieaufwand für Mobilität ermitteln, geschieht dies unter Nutzung diverser Annahmen. Insofern stellt das Vorhandensein von Daten über den aktuellen PKW-Besatz in den ausgewählten Testquartieren einen informativen Vorteil dar, der genutzt werden sollte.

Wenn in einem Quartier mit nahen Versorgungsangeboten und guter ÖPNV-Anbindung eine große Zahl von Haushalten ohne eigenes Auto lebt, spricht dies für einen Standort mit niedriger „Autoabhängigkeit“. Ein solcher Standort eignet sich für den Zuzug von Menschen, die ohne eigenes Auto leben möchten oder müssen. Bei einer höheren städtebaulichen Dichte im Quartier und in seiner Umgebung infolge von Nachverdichtung dürfte der Standort auch für die Platzierung von Car-Sharing-Kraftfahrzeugen lukrativ sein. Das Angebot von Stellplätzen je Wohnung kann reduziert werden.

Aus Sicht des Klimaschutzes entfaltet eine Nachverdichtung von Wohnquartieren mit geringer „Autoabhängigkeit“ eine hohe Wirkung, weil einer größeren Zahl von Menschen ein Leben ohne eigenes Auto ermöglicht wird.

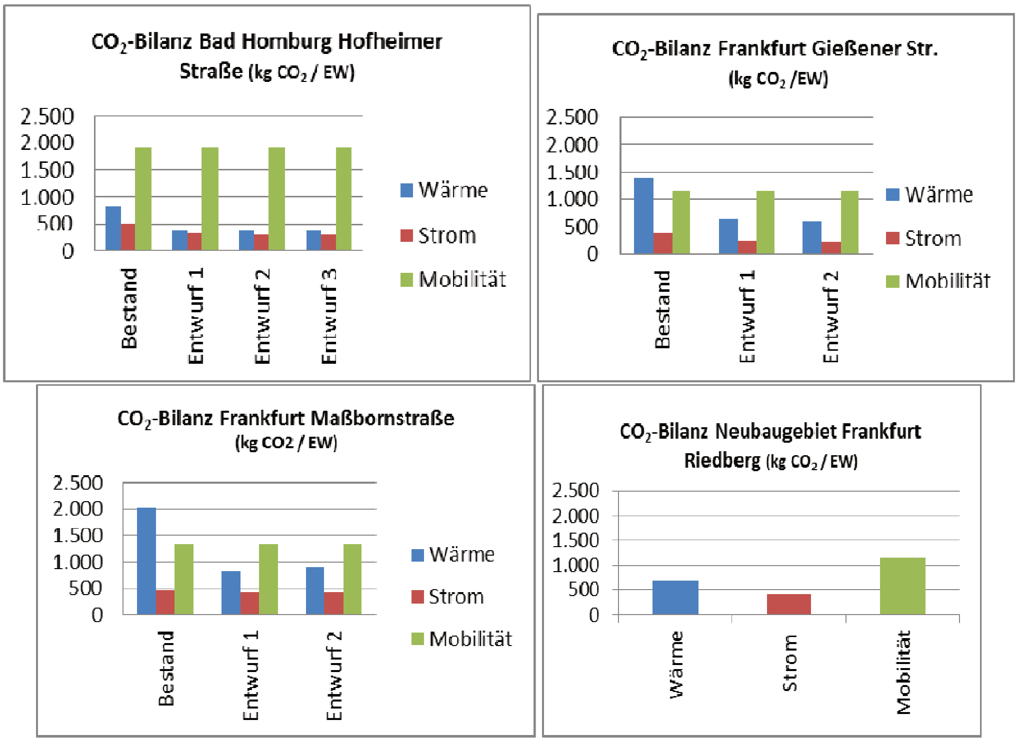

Abbildung: CO_2-Bilanzen Wärme, Strom und Mobilität in den Testquartieren und in den Referenz-Neubaugebieten

Die für die Testquartiere ermittelten Verkehrswege und Verkehrsträger sowie ihre CO-2-Bilanze lassen einen grundsätzlichen Unterschied zwischen den Quartieren in Bad Homburg und in Frankfurt erkennen. Das Neubaugebiet „Am Hühnerstein“ in Bad Homburg weist einen bedeutend höheren Energieaufwand für Mobilität auf als die Entwürfe der nachverdichteten Testquartiere in dieser Stadt. Anders zeigt sich das Neubaugebiet Riedberg-Ginsterhöhe in Frankfurt, vor allem aufgrund seiner Stadtbahnanbindung und des nahe gelegenen Stadtteilzentrums. Auch generell liegen die CO-2-Emissionen der Mobilität in den Bad Homburger Quartieren höher als in den Frankfurter Untersuchungsgebieten. Dies leitet sich aus der Zugehörigkeit der beiden Städte zu unterschiedlichen Kreistypen ab: Bad Homburg gehört zur verdichteten Agglomeration, Frankfurt zur Agglomeration-Kernstädte.

3.2 Vergleich der CO_2-Bilanz „Herstellungsenergie“

Im Jahr 1970 war der Energieverbrauch im Betrieb von Gebäuden (Beheizung, Warmwasser und Strom) so hoch, dass die Graue Energie zur Herstellung, Instandhaltung und Entsorgung mit 7 bis 19 % des Gesamtenergiebedarfs vergleichsweise niedrig war. Dagegen betrug der Anteil an Grauer Energie im Jahr 2010 bereits zwischen rund 24 und 36 % des Gesamtenergiebedarfs, so das Ergebnis des österreichischen Projekts ZERsiedelt von 2011: Bilanzierung der Grauen Energie in Wohnbau und zugehöriger Infrastruktur-Erschließung. Je energieeffizienter gebaut wird, desto weniger Betriebsenergie benötigen Gebäude. Die Bedeutung der Grauen Energie innerhalb des gesamten Energieverbrauchs steigt.

Die Graue Energie zur Herstellung und Instandhaltung von Wohngebäuden einschließlich ihrer städtebaulichen Erschließung setzt sich über einen Lebenszyklus von 100 Jahren aus vier Hauptkomponenten zusammen:

- Transport und Bau,
- Straße und Leitungen,
- Außenanlagen und Garage,
- Wohngebäude.

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Der Vergleich der Grauen Energie für neue Wohneinheiten durch Nachverdichtung in den Testquartieren und im Neubau-Referenzgebiet kann in dem Projekt nur pauschaliert auf siedlungstypologischer Basis erfolgen. Genutzt werden die Ergebnisse der o. g. österreichischen Studie ZERsiedelt.

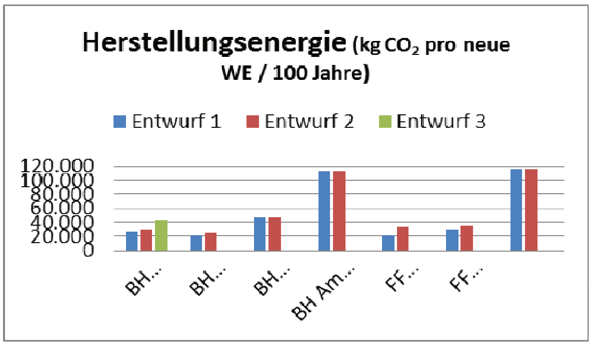

Abbildung: Herstellungsenergie neuer Wohneinheiten in den Testquartieren und in den Referenz-Neubaugebieten

Bei der Betrachtung der Vergleichsgrafik ist zu berücksichtigen, dass Nachverdichtungsentwürfe mit größeren Wohnungen eine höhere Herstellungsenergie aufweisen, als Entwürfe mit kleineren Wohnungen.

Generell lässt sich sagen: Der große energetische Vorteil der Nachverdichtung bestehender Stadtquartiere liegt vor allem in der enormen Einsparung von Grauer Energie. Dies gilt sowohl für die ergänzend neu errichteten Wohneinheiten als auch – in einem besonderen Maß – für die Aufstockung von Gebäuden Die Einsparungsraten bewegen sich zwischen 60.000 und 80.000 kg CO-2 pro neu errichteter Wohneinheit.

3.3 Berücksichtigung klimatischer Belange

Eine – wie in dieser Untersuchung – gewählte maßvolle Nachverdichtung von Quartieren mit Zeilenbauten der 50er und 60er Jahre wirkt als Beschleuniger des energetischen Stadtumbaus und ermöglicht energieeffiziente Wärmeversorgungslösungen mit niedrigen Energiekosten für die Bewohner. Auch in Einfamilienhausgebieten können zur Nachverdichtung errichtete Energiespar- und Sonnenhäuser Impulse zur energetischen Sanierung der benachbarten Bestandsgebäude geben.

Dieser im Ergebnis positiv bewerteten energetischen Wirkung wird die klimatische Bewertung der Nachverdichtungslösungen gegenüber gestellt. Um das Ergebnis vorwegzunehmen: die vorgenommene Bewertung zeigt keine gravierenden Verschlechterungen des lokalen Klimas in den Quartieren auf. Offensichtlich ist es möglich, Bestandsquartiere im Stadtgebiet zu finden, die aufgrund ihrer offenen Bauweise und der Abstände zwischen den Gebäuden ein Nachverdichtungspotenzial aufweisen, das klimaverträglich erschlossen werden kann. Auch stehen bei den Strategien zur Anpassung der Städte an den Klimawandel Kompensationsmöglichkeiten zur Verfügung, welche bei maßvollen Nachverdichtungen in ausgewählten Stadtraumtypen einsetzbar sind. So bleiben bei den gewählten Aufstockungen und ergänzenden Neubauten in der Regel Abstände für eine ausreichende Belichtung und Besonnung erhalten. Eine Ausnahme bildet die Großwohnsiedlung Gartenfeldstraße in Bad Homburg.

Bei der Entwicklung der Wärmebelastung profitieren die untersuchten Testquartiere von ihrer guten Ausgangssituation. Zwei Quartiere sind dem bioklimatisch besonders günstigen Klimatop „Vorstadtklima“ zuzuordnen, zwei weitere dem ebenfalls günstigen Stadtrandklima. Einzig das Quartier an der Gießener Straße in Frankfurt weist Ansätze einer Überwärmung auf, die sich durch eine Nachverdichtung verstärken kann.

	Hofheimer Str. (Zeilenbau)	Gartenfeld-siedlung (GMFH, EFH)	Jakob-Lengfeld-Str. (EFH)	Maßbornstr. (EFH)	Gießener Str. (Zeilenbau)
Klimatop	Stadtrandklima	Stadtrandklima	Vorstadtklima	Vorstadtklima	Stadtrandklima

Tabelle: Zuordnung der Testquartiere zu den Klimatopen (nach VDI 3787)

Das Quartier an der Gießener Straße wird von einer Hauptverkehrsstraße mit Lärmemissionen durchschnitten. Die vorgeschlagene Nachverdichtung sieht eine neu zu errichtende Riegelbebauung vor, welche die östlich gelegenen Zeilenbauten gegen den Straßenlärm abschirmt. Da ein solcher Riegel die Belüftung des Gebietes verschlechtert, hält das Umweltamt der Stadt Frankfurt folgende kompensatorischen Maßnahmen für erforderlich, um die Klimaverträglichkeit sicher zu stellen:

- Durchbrechung des Nord-Süd-verlaufenden Gebäuderiegels durch partielle Öffnungen,
- Frühzeitige Berücksichtigung der neuen (und auch der bestehenden) Baumstandorte,
- Vermeidung von Strömungswiderständen in den Gebäudelücken,
- Punktuelle Gebäudeerhöhungen zur Kompensation der Wohnbauflächenverluste sind vorstellbar.

In den übrigen Quartieren wird auch im Rahmen der Nachverdichtung eine der Belüftung zuträgliche Bauweise beibehalten.

Die Quartiere mit Mehrfamilienhäusern der 50er und 60er Jahre sind durch einen umfangreichen Baumbestand, insbesondere mit großkronigen Laubbäumen geprägt. Bei dem nicht zu vermeidenden Verlust einiger solcher Bäume durch ergänzende Neubauten greifen die Baumschutzsatzungen der Städte Bad Homburg und Frankfurt, die bei Laubbäumen ab einem Stammumfang von 90 cm (Bad Homburg) und von 60 cm (Frankfurt) Ersatzpflanzungen vorschreiben.

Wesentlichen Einfluss auf die stadtklimatische Situation hat der Versiegelungsgrad von Baugebieten. Durch die Nachverdichtung mit ergänzenden Neubauten wird der Versiegelungsgrad grundsätzlich erhöht. Um einer Verschlechterung entgegenzuwirken, sollen zusätzliche Überbauungen, z. B. durch Tiefgaragen, vermieden werden. Als weitere Maßnahmen enthält die Stellungnahme der Stadt Frankfurt (Umweltamt und Stadtplanungsamt):

- Fassaden- und Dachbegrünung (möglichst intensive) zur Kompensation der versiegelungsbedingten Beeinträchtigung des örtlichen Wasserkreislaufs und zur Steigerung der bioklimatisch günstigen Transpirationsleistung von Pflanzen und Oberflächen,
- Möglichst frühzeitige Anpflanzung vieler neuer standortgerechter Laubbäume im Quartier, Entwicklung eines großwüchsigen Baumbestands,
- Albedo-Erhöhung durch helle Gebäudefassaden und sonstige Oberflächenbeläge.

4 PLANUNGSEMPFEHLUNGEN

Aus den durchgeführten energetischen und klimatischen Bewertungen und Vergleichen lassen sich einige Planungsempfehlungen ableiten:

In den Testquartieren mit einer geringen Zahl von Eigentümern (Wohnungsbaugesellschaften oder Wohnungseigentümergemeinschaften) sollte die Kommune ihre Einflussmöglichkeiten nutzen, um die Nachverdichtung an eine möglichst zeitgleiche energetische Sanierung und an die Errichtung eines Wärmenetzes mit Nutzung der Kraft-Wärme-Kopplung zu binden.

Bei den im Rahmen der Nachverdichtung neu entstehenden Dächern (Aufstockung und ergänzende Neubauten) ist auf die Bereitstellung größerer zusammenhängender solartechnisch geeigneter Flächen zu achten.

Quartiere, in denen aufgrund ihrer guten Erreichbarkeiten ein autofreies oder autoreduziertes Leben möglich ist, sollten vorrangig einer Nachverdichtung zugeführt werden.

In Verbindung mit der Nachverdichtung sollte mit den Bewohnern über ein lokales Car-Sharing-Angebot und über Modelle zur Verringerung der vorzuhaltenden Stellplätze diskutiert werden.

Aufwendige Erschließungsbauten mit der Nutzung von Beton wie Tiefgaragen sollten bei der Nachverdichtung zur Einsparung Grauer Energie vermieden werden.

Fit für den Klimawandel: Wie passt sich Wien an?

Marianne Steiner

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1 ABSTRACT

For the past 16 years, Vienna has had a broad climate protection programme known as KliP Vienna. The current program is valid until 2020 and includes 385 individual measures in the fields of energy production and use of energy, mobility and city structure, procurement, waste management, agriculture and forestry, nature conservation and public relations. In addition KliP contains some considerations about Viennese climate adaption measures to elaborate more concretely in coming years.

Therefore 2011 the City of Vienna was starting a concrete adaption strategy based on KliP managed by the Executive Office for the Co-ordination of Climate Protection Measures.

There are a lot of adaption-measures which have been implemented independently. Especially concerning flood control Vienna has a long tradition, for instance on the Danube. Important steps were also done to improve fresh water supply and buildings.

Now we have to define what additional measures are necessary. These tasks will be done within the scope of working groups. They have to collect the existing adapting measures in Vienna and work out proposals for suitable measures. Then the measures will be submitted to stakeholders and politicians for decision. The main topics are health, energy and water supply, urban planning, traffic, city vegetation, agriculture and forestry.

An important measure of the City of Vienna relating to urban planning is the construction and promotion of green roofs and green facades. This measure includes amongst others a special support programme since many years.

Vienna takes part in “Urban Heat Islands” (UHI), which is an EU-wide project. An UHI is a microclimatic phenomenon in the metropolitan or city areas. In these areas there are significantly higher temperatures than in the surrounding peri-urban and rural areas. The Viennese UHI-Strategy-Plan includes several measures how to cool down urban heat islands and offers indicators about the efficiency of these measures.

In the health sector, a heat guide for the Viennese population was published. A heat action plan is in process.

Within the scope of energy supply and consumption an Energy Security Plan and a Renewable Action Plan has been developed but have still to be agreed upon by the Viennese city council.

Due to the increasing summer temperatures in Vienna a special focus has been placed on the promotion of passive cooling.

2 ANPASSUNG AN DEN KLIMAWANDEL IN WIEN

2.1 Die Rahmenbedingungen

2.1.1 Erfolgreicher Klimaschutz in Wien

Klimaschutz hat in Wien schon lange Tradition. Durch die Umsetzung des Klimaschutzprogramms der Stadt Wien (KliP Wien), das 1999 beschlossen und 2009 erstmals fortgeschrieben wurde (Klimaschutzprogramm der Stadt Wien, Fortschreibung 2010-2020, „KliP II“), konnten die Pro-Kopf-Treibhausgasemissionen im Zeitraum 1990 – 2015 bereits um 34,8% verringert werden.

2.1.2 Klimaschutz und Klimawandel als gleichrangige Säulen

Trotz der Erfolge im Klimaschutz schreitet der globale Klimawandel weiter voran und ist mittlerweile auch in Wien erlebbare Realität. Beispielsweise ist in den letzten Jahrzehnten die Zunahme von Hitzewellen oder Starkregenereignissen auch für Wienerinnen und Wiener eindeutig spürbar geworden.

Wien muss daher Antworten zu den zwei brennenden Herausforderungen Klimaschutz und Klimawandel liefern. Während beim Klimaschutz erklärtes strategisches Ziel die Dekarbonisierung in der 2. Hälfte dieses Jahrhunderts ist (als Ergebnis aus dem Paris-Abkommen 2015), geht es bei der Anpassung an den

Klimawandel vorrangig darum, negative Auswirkungen zu vermeiden und positive Effekte bestmöglich zu nutzen. Klimaschutz und Anpassung stellen dabei gleichrangige Säulen der Klimapolitik sowohl national und international als auch in Wien dar.

2.1.3 Was konnte bisher in Wien bereits beobachtet werden?

In den letzten Jahrzehnten nahm in Wien die jährliche Anzahl an heißen Tagen um rund 15 Tage zu. Das heutige hohe Niveau liegt um 8 Tage höher als zu Beginn der Zeitreihe im Jahr 1872.

In der Periode von 1961 bis 1990 gab es durchschnittlich 5,1 Hitzewelle-Tage pro Jahr. In der Periode 1976 bis 2005 wurden bereits 9,1 solcher Tage pro Jahr beobachtet. Ingesamt zeigt die Anzahl der Hitzewelle-Tage einen exponentiellen Anstieg. (Hitzewelle = Abfolge von 3 Tagen, an denen die Maximaltemperatur über 30°C liegt)

2.1.4 Wie wird es beim Klimawandel in Wien wahrscheinlich weiter gehen?

Es wird in Wien weiterhin wärmer. In den 40er Jahren dieses Jahrhunderts wird es im Osten Österreichs voraussichtlich im Winter um bis zu 1,8°C, im Frühjahr und Sommer um bis zu 2,5°C und im Herbst sogar um bis zu 3,0°C wärmer sein als in den 80er Jahren des 20. Jahrhunderts. Damit steigt die Gefahr für das Auftreten von bis dato in unseren Breiten nicht vorkommenden Krankheitserregern. Auch muss mit dem Auftauchen von bisher unbekannten Schädlingen gerechnet werden, welche in Zukunft auch infolge der wärmeren Winter bei uns überleben können.

Besonders relevant für das Leben in der Stadt ist das vermehrte Auftreten von Hitzewellen. Dabei sind die inneren Bezirke Wiens aufgrund des städtischen Wärmeinseleffektes von der Hitzebelastung stärker betroffen als die Stadtrandgebiete. Die Hitzewellen haben massive negative Auswirkungen auf den gesundheitlichen Bereich.

Erste Grobabschätzungen ergeben, dass bis zum Jahr 2050 insgesamt der Kühlbedarf im Sommer stärker zunehmen wird als der Heizbedarf im Winter abnimmt.

Auch hinsichtlich der Niederschläge sind Änderungen zu erwarten. Mit einer Zunahme der Niederschlagsintensität ist zu rechnen. Hinzu kommt, dass durch eine Zunahme der Trockenperioden in Kombination mit dem Anstieg der Verdunstung die Böden immer weniger Wasser speichern können. Insgesamt sind deutlich häufiger Wetterextreme zu erwarten.

Positive Effekte können vor allem durch längere Vegetationsperioden eintreten oder auch durch eine geringere Anzahl von Heizgradtagen. Eventuell könnten auch im Städtetourismus positive Effekte bemerkbar werden.

Die Szenarien der Klimaforscherinnen und Klimaforscher legen nahe, dass sich diese beobachtete Entwicklung fortsetzt und beschleunigt.

2.2 Der bisherige Prozess zur Anpassung

Wien realisiert Projekte zur Anpassung an den Klimawandel bereits seit vielen Jahren.

Nach ersten Vorarbeiten ab 2007 erging im Jahr 2009 erstmals mit dem KliP II der Auftrag, das Thema Anpassung an den Klimawandel zu bearbeiten.

In der Folge wurden im Rahmen eines Startworkshops im Jahr 2011 unter der Leitung der Magistratsdirektion-Klimaschutzkoordination (MD-KLI) interdisziplinäre und ressortübergreifende Arbeitsgruppen zu folgenden Handlungsfeldern gebildet:

- Stadtplanung & Infrastruktur
- Energie
- Gesundheit
- Wasserhaushalt & Wasserwirtschaft
- Grün (Land- und Forstwirtschaft, Naturschutz)

Diese Arbeitsgruppen treffen sich 3 – 5 Mal im Jahr zu informellen Arbeitssitzungen, bei denen im Wesentlichen anpassungsrelevante Projekte bzw. Initiativen gesammelt und auch neue Projekte entwickelt werden. Die Arbeiten erfolgten bislang auf informeller Ebene.

2.3 Schnittstellen zu relevanten Programmen in der Stadt Wien

Anpassung an den Klimawandel ist – wie der Klimaschutz - ein Querschnittsthema, das eine große Bandbreite an Handlungsfeldern betrifft: vom Hochwasserschutz über die Sicherung der landwirtschaftlichen Produktion bis zur Gesundheitsvorsorge.

Durch den Querschnittscharakter der Anpassung bestehen zahlreiche Schnittstellen zu anderen relevanten Strategien, Prozessen und Programmen, wie in folgender Grafik exemplarisch dargestellt:

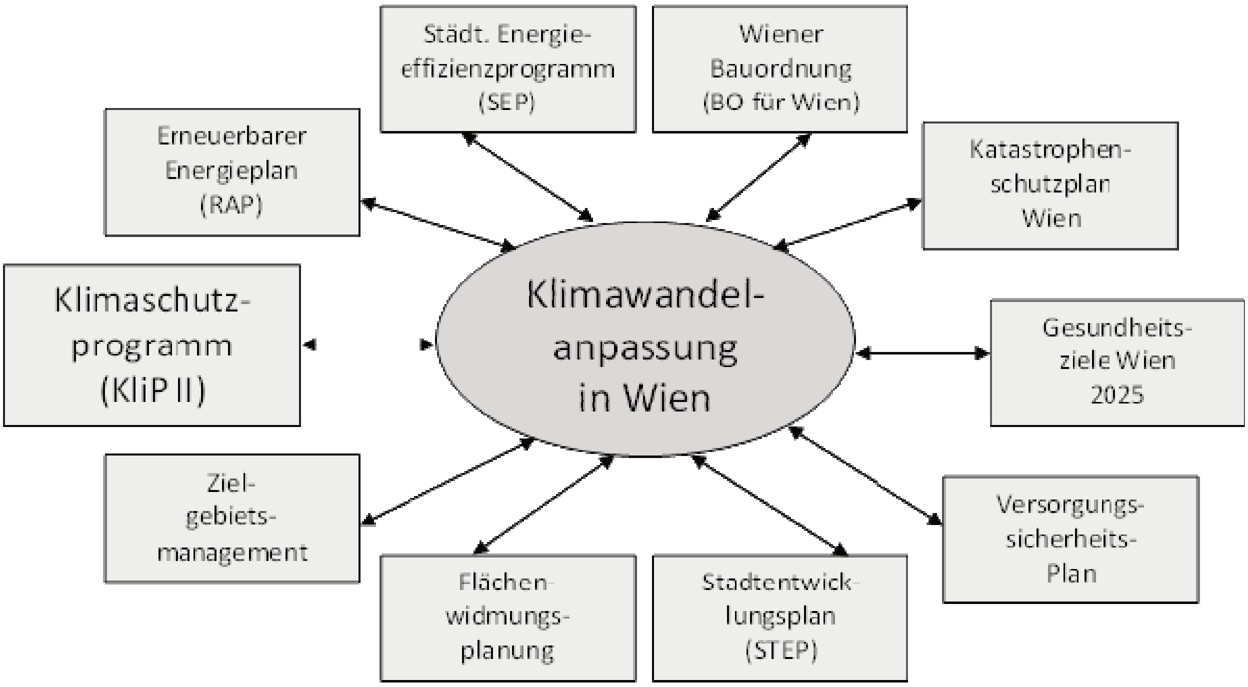

Fig. 1: Schnittstellen der Anpassung zu relevanten Programmen in der Stadt Wien (exemplarisch).

Beispielsweise ist im Stadtentwicklungsplan (STEP 2025) die positive Beeinflussung des Stadtklimas durch mehr Grün als zentrale Strategie verankert, was u.a. in der Initiative „Stadtgrün statt Klimaanlage" verdeutlicht wird. Das Ziel ist, die Aspekte Klimaschutz und Anpassung an den Klimawandel zu einem integralen Bestandteil bei der Planung, Umsetzung und Weiterentwicklung von Stadtquartieren und Freiräumen zu machen.

Darüber hinaus existieren in einzelnen verschiedenen Fachbereichen der Stadtverwaltung schon weiterführende Strategien, die wichtige Anknüpfungspunkte zur Anpassung darstellen und wo eine enge Kooperation und Abstimmung zur Nutzung von Synergien für die Umsetzung der Anpassungsstrategie zweckmäßig ist.

2.4 Welche Aktivitäten gibt es bereits? - Best Practices der Anpassung in Wien

Mittlerweile wurden 91 Projekte zur Anpassung an den Klimawandel in Wien identifiziert. Sie reichen von der Erstellung von Klimaszenarien, über den Umgang mit Städtischen Hitzeinseln bis hin zur Durchführung von Initiativen zur Bewusstseinsbildung in der Bevölkerung.

Anzumerken ist in diesem Zusammenhang, dass ein erheblicher Teil der Projekte bzw. Maßnahmen – wie beispielsweise im Bereich Forschung (z.B. CC-WaterS) bis hin zu konkreten Maßnahmen – wie beispielsweise in den Bereichen Hochwasserschutz (Donauhochwasserschutz), Energieversorgung (Versorgungssicherheitsplan), Trinkwasserversorgung (Karstwasserforschungsprogramme) oder im Gebäudebereich (Vorkehrungen gegen sommerliche Überhitzung, Fernkühlung) – von den einzelnen Abteilungen individuell bzw. im Rahmen des Klimaschutzprogramms und nicht im Kontext Anpassung an den Klimawandel gesetzt wurden.

2.4.1 Das Handlungsfeld Stadtplanung & Infrastruktur

Das Handlungsfeld Stadtplanung & Infrastruktur umfasst die Themenbereiche Stadtklima, Bauen und Wohnen, Grün- und Freiräume, Verkehrsinfrastruktur, Tourismus sowie Denkmalschutz.

Eine Reihe von Projekten wie beispielsweise das Projekt „Nachhaltiger urbaner Platz“, die laufende Klimatisierung von Fahrzeugen bei den Wiener Linien oder das Parkleitbild der Wiener Stadtgärten konnten bereits abgeschlossen werden. Die Stadt Wien forciert auch seit Jahren Dach- und Fassadenbegrünungen und fördert die Begrünung von Dächern im verbauten Gebiet. Dach- und Vertikalbegrünungen leisten durch ihre positiven Wirkungen einen wesentlichen Beitrag zur Verbesserung der Lebensqualität für die Bewohnerinnen und Bewohner einer Stadt. Die Begrünung verringert im Sommer die Aufheizung des Gebäudes und reduziert bei einer Bepflanzung mit dauergrünen Pflanzen auch den Wärmeverlust im Winter. Im Zuge der Förderung werden die Kosten für die Begrünung bis zu einer Höhe von maximal 2.200 Euro übernommen.

Andere zentrale Projekte wie der Urban Heat Islands Strategieplan Wien (UHI) laufen derzeit. Durch das für die Stadtplanung bedeutende UHI-Projekt soll die Wirkung von Planungsmaßnahmen (wie z.B. Gründächer, Fassadenbegrünung, Alleebäume, Bebauungsstrukturen, Materialien, etc.) wissenschaftlich nachgewiesen werden, um darauf aufbauend Planungsempfehlungen auszusprechen.

Erwähnenswert ist weiters die Forcierung von Regenwassermanagement. Im Rahmen des Projekts SAVE (Straßen-Abwasserlösungen für Vegetation und Entwässerungssysteme) werden in Kooperation der betroffenen Dienststellen mit Wissenschaftlerinnen und Wissenschaftlern der Universität für Bodenkultur Wien (BOKU) Entwässerungslösungen für Straßen, Wege, etc. erarbeitet. Diese sollen im Rahmen eines Monitorings evaluiert werden. Berücksichtigung finden soll insbesondere die Problematik des Salzeinsatzes im Winterdienst sowie die Pflanzen- und Baumverträglichkeit.

Der nächste Schritt ist die Bewertung und Analyse der Maßnahmen im Hinblick auf ihre Umsetzungsmöglichkeiten mit den Instrumenten der Stadt Wien.

2.4.2 Das Handlungsfeld Energie

Das Handlungsfeld der Arbeitsgruppe Energie umfasst alle anpassungsrelevanten Aktivitäten, welche die Erzeugung und Verteilung von Energie (Strom, Erdgas, Fernwärme, Fernkälte) gewährleisten sowie die Energieverwendung, wobei ein besonderer Schwerpunkt auf gebäudebezogenen Aspekten liegen wird.

Im Bereich Energieversorgung arbeitet man intensiv an der Erstellung eines Versorgungssicherheitsplans.

Derzeit in Umsetzung befinden sich u.a. der Versorgungssicherheitsplan sowie der Erneuerbare Energieplan (RAP_Vie) sowie Projekte zur Kühlung mit Nah- und Fernkälte und zur Betonkernaktivierung.

Die nächsten Schritte sind die Identifikation und Formulierung von anpassungsrelevanten Maßnahmen und deren Bewertung im Hinblick auf Umsetzungschancen, Kosten, Zeithorizonte, etc.

2.4.3 Der Gesundheitsbereich

Der Gesundheitsbereich umfasst Maßnahmen zur Bewältigung der direkten Gesundheitseffekte (z.B. durch Hitzewellen, Hochwässer, etc.) sowie zur Vermeidung indirekter nachteiliger Gesundheitseffekte (z.B. durch die Verbreitung von Krankheitsträgern, -erregern und allergener Pollen).

Ein wichtiges zentrales und bereits umgesetztes Projekt ist der Wiener Hitzeratgeber. Dieser informiert umfassend über alle Themen rund um „Hitze in der Stadt“. Er liefert allgemeine praktische Tipps zu Vorsorge und Verhalten bei Hitze und richtet sich insbesondere an besonders betroffene Bevölkerungsgruppen wie z.B. chronisch kranke und ältere Personen, Schwangere, Betreuungspersonen von Säuglingen und Kleinkindern. Auch wird über Anlaufstellen und Links der Stadt Wien informiert. Ein wesentlicher Schwerpunkt des Hitzeratgebers liegt auch in der Prävention, d.h. welche Maßnahmen müssen bereits frühzeitig getroffen werden, um der Hitze erfolgreich zu begegnen, wie z.B. die Umrüstung der Wohnung. Der Hitzeratgeber ist auch eine wichtige Maßnahme im Rahmen der „Wiener Gesundheitsziele 2025“.

Nächstens erfolgt die Abgrenzung des Themenbereiches (z.B. Soziale Aspekte, Migration, etc.) sowie die Definition von prioritären Maßnahmen im Handlungsfeld Gesundheit.

2.4.4 Der Katastrophenschutz

Im Bereich Katastrophenschutz wurde in Wien bereits eine Vielzahl von Aktivitäten im Bereich Hochwasserschutz gesetzt. Prominente Beispiele sind der Donauhochwasserschutz mit dem

Entlastungsgerinne Neue Donau und dem Kraftwerk Freudenau, der Liesingbach-Hochwasserschutz sowie der Wienfluss-Hochwasserschutz. Für die Wienerwaldbäche wurden Gefahrenzonenpläne erstellt.

Der Katastrophenschutzplan der Stadt Wien wird laufend auf Basis der vorhandenen Grundlagendaten aktualisiert. Die gemäß Katastrophenschutzplan bestehenden Einsatzpläne – für Naturkatastrophen, Umweltkatastrophen, Verkehrskatastrophen, etc. – werden auf Krisenmanagementebene ebenfalls laufend eingearbeitet und aktualisiert.

Das Hauptaugenmerk in der Arbeitsgruppe Katastrophenschutz liegt darauf, die bereits existierenden Katastrophen- und Einsatzpläne dahingehend zu überprüfen, inwieweit sie für die Anforderungen der aufgrund des Klimawandels eintretenden Klimaänderungen gerüstet sind.

2.4.5 Das Handlungsfeld Grün

Das Handlungsfeld Grün umfasst die Schwerpunkte Landwirtschaft, Forstwirtschaft und Naturschutz (Ökosysteme / Biodiversität).

Neben der Unterschutzstellung des Wienerwalds als Biosphärenpark sowie des 1000-Hektar-Programms zur Gewährleistung der Erweiterung und Schließung des Wald- und Wiesengürtels in Wien, ist vor allem die Bewirtschaftung der Wiener Ackerflächen nach den Richtlinien des biologischen Landbaus als Umsetzungsbeispiel zu nennen.

So war beispielsweise erklärtes Ziel des ETZ Projekts „Naturschutz durch Ökologisierung im Weinbau“ zu zeigen, dass es durch gezielte Maßnahmen möglich ist, Weinbau umweltfreundlich und nachhaltig zu gestalten. Die Begrünung verbessert mit arten- und blütenreichen Begrünungsmischungen den Boden und ermöglicht die Wiedereinbürgerung gefährdeter Pflanzenarten. Nützlinge sollen für die natürliche Schädlingsbekämpfung angesiedelt und biologische Verfahren als Alternative zu herkömmlichen Insektiziden und Herbiziden entwickelt werden. Wie das Konzept umgesetzt werden kann, erfahren interessierte Weinbäuerinnen und Weinbauern bei praxisnahen Feldtagen und Seminaren.

Weiters wurde z.B. mit Baumexpertinnen und Baumexperten und wissenschaftlichen Institutionen im Projekt „Klimawandelangepasstes Alleebaumsortiment“ ein Alleebaumsortiment erarbeitet, welches seit 2006 im Straßenraum verwendet wird. Dieses enthält ausschließlich Bäume, die die extremen Wachstumsbedingungen am Standort Straße gut bewältigen können. Darüberhinaus wurde ein spezielles Alleebaumsubstrat entwickelt, welches bei Neupflanzungen Verwendung findet und ebenfalls auf den Klimawandel Bedacht nimmt.

Die Arbeitsgruppe beschäftigt sich vorrangig mit den Themen Arten- und Lebensraumschutz, Umgang mit Neobiota sowie den Erhalt und die Förderung der Stadtvegetation.

2.4.6 Das Handlungsfeld Wasserhaushalt und Wasserwirtschaft

Im Handlungsfeld Wasserhaushalt und Wasserwirtschaft werden jene Bereiche behandelt, die sich mit der Sicherstellung der qualitativen und quantitativen Wasserversorgung – Trinkwasser und Nutzwasser – und anderen Aspekten der Wassernutzung - dem Schutz des Wassers sowie der Abwasserentsorgung befassen. Die Schutzwasserwirtschaft wird im Handlungsfeld Katastrophenschutz behandelt.

Im Bereich Hochwasserschutz sind beispielsweise die Gefahrenzonenplanung Wienerwaldbäche sowie der verbesserte Donauhochwasserschutz mit dem Ziel der Verbesserung des Hochwasserschutzes innerhalb des bestehenden Überschwemmungsgebiet zu nennen.

Neben anderen Projekten, die eine Sicherstellung der Trinkwasserversorgung gewährleisten, sei insbesondere das Forschungsprogramm KATER in den niederösterreichisch-steirischen Kalkhochalpen zu erwähnen. Dieses hat das Ziel, die hohen Standards der Gewinnung des Wiener Wassers zu halten und eine genauere Kenntnis der das Karstgrundwasser beeinflussenden Faktoren zu gewinnen.

Essentielle Erkenntnisse im Bereich der Trinkwasserversorgung brachten die Forschungsprogramme KATER und KATER II sowie CC-WaterS. Durch die Wiener Wassercharta hat die Stadt Wien als einzige Stadt der Welt das Trinkwasser verfassungsrechtlich geschützt. Der Schutz des Wassers wird durch laufende Gewässervernetzungen (z.B. Dotation der Lobaugewässer mit Wasser aus der Alten Donau und Neuen Donau) sowie Gewässerrenaturierung (z.B. Alserbach, Lainzerbach). Im Bereich Abwasserentsorgung wird der Kanalbetrieb mit dem Wiener Kanal-Informations-System (KANIS) laufend optimiert.

Die Öffentlichkeitsarbeit ist als begleitender Prozess in den jeweiligen Handlungsfeldern ausgerichtet. Vorschläge für bewusstseinsbildende Maßnahmen werden in den einzelnen Arbeitsgruppen erarbeitet.

3 RESÜMEE

Wien macht sich fit für den Klimawandel. Um vor dem Hintergrund des globalen Klimawandels weiterhin eine hohe Lebensqualität in Wien sicherstellen zu können, soll die Entwicklung des Prozesses zur Anpassung an den Klimawandel in Wien weitergeführt und forciert sowie insgesamt auf eine offiziellere und systematischere Ebene gestellt werden.

4 REFERENZEN

Magistrat der Stadt Wien, Magistratsdirektion Klimaschutzkoordionation: Klimaschutzprogramm der Stadt Wien, Fortschreibung 2010 – 2020. Wien 2009.

Magistrat der Stadt Wien, Wiener Umweltschutzabteilung – Magistratsabteilung 22: Urban Heat Islands, Strategieplan Wien. Wien 2015

IPCC, 2013/2014: Klimaänderung 2013/2014: Zusammenfassung für politische Entscheidungsträger. Beiträge der drei Arbeitsgruppen zum Fünften Sachstandsbericht des Zwischenstaatlichen Ausschusses für Klimaaänderungen (IPCC). Deutsche Übersetzung durch Deutsche IPCC-Koordinierungsstelle, Österreichisches Umweltbundesamt, ProClim, Bonn/Wien/Bern, 2016.

Kromp-Kolb, Formayer, Clementschitsch: Auswirkungen des Klimawandels auf Wien unter besonderer Berücksichtigung von Klimaszenarien. Wien, Dezember 2007

Is Bike Sharing Competitor, Relief or Supplement to Public Transport?

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1 ABSTRACT

In many cities the growing popularity of bicycle-sharing schemes has added additional options to the transport regime. A significant amount of research has been stipulated by data recorded from lending and returning bicycles at geographically diverse stations. In this contribution, focus will be laid on the relationship that the bike-sharing system of the City of Vienna (CityBike Wien – CBW) has with its well developed public transport system. Does bike-sharing serve as competitor, relief or supplement? By surveying the total CBW trip data of 2015 – about 1 million records – we approach to answer this question. We cleanse and route all bicycle trips and compare them with routed alternative public transport trips in terms of travel time ratios. In interviews of 1,389 CBW users conducted in July and September/October of 2016, we ask about the purpose of their trip, the position of the CBW as part of their door-to-door trip, the role of CBW as substitute for other means of transport and the reasons for this substitution. The age group that has the highest number of users among CBW and the shares of tourists/visitors and locals using CBW is identified. Identifying the top 10 of trips from the cleansed dataset and mapping them emphasizes the role that we identify for Vienna's bike-sharing system in the inner city: A supplement to public transport.

Keywords: bike sharing; public transport; relationship; GIS-analysis; questionnaire

2 INTRODUCTION

On one hand Vienna is known for its long and consistent public transport tradition. On the other hand Vienna started in 2003 its new bicycle sharing system (BSS) CityBike Wien, which now holds 121 stations with 3,097 boxes and a fleet of 1,500 bicycles and its know-how was exported throughout the world to other BSS that started later on.

As sharing booms, the existence of these new elements, recently added to our urban transport systems, leads to the question of the role they play. Is bike-sharing a competitor, relief or supplement to other modes of transport that already existed?

For the analysis of the question we used a full-year dataset of the BSS City-Bike Wien and the routing engines of Bike City Guide Apps and Wiener Linien public transport operator.

The characteristics of BSS have in many aspects already been covered by various studies; e.g. ranging from urban form's impact on bicycle flows (Faghih-Imani, Eluru, El-Geneidy, Rabbat, & Haq, 2014) via typologies of users (M. Vogel et al., 2014) to the impacts of BSS on health (Woodcock, Tainio, Cheshire, O'Brien, & Goodman, 2014).

In an example for previous research Beecham and Wood conducted analysis of spatial data compared to BSS usage data for London. Their findings concentrated on different usage patterns in comparison of female to male users. Furthermore even detailed analysis of characterizations for groups such as postwork or lunchtime trips is possible. (R. Beecham & J. D. Wood, 2014)

Another issue is the future development outlook of CBW. Possible answers are extending or concentrating the CBW system in Vienna.

3 METHODS

3.1 Survey

To get to know how the people use CBW and for which kinds of purposes, we conducted a survey in July and September/October 2016 by interviewing CBW users, while they were borrowing out or bringing back

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their CBW bikes at one of the viennese stations. 820 users were interviewed in July and in September/October 569, altogether 1389 interviews were carried out.

The questions concentrated on the topics:

- Position of the CBW as part of door-to-door trip.
- Purpose of trip.
- Role of CBW as substitution of other means of travel and if so for which reason.

To get a better knowledge about the participants of the survey, we asked them if they are tourists / visitors or locals, if they are in posession of a seasonal ticket, a driving licence and / or have access to a car. Also the gender was noted and age in 10-years-steps between 20 and 70.

With an exception of just three stations the return rate of adressed users was over 50% in the remaining 117 stations.

3.2 Data analysis

To identificate the interdependency between PT and CBW we determined the journey times of all cycling and PT trips for all 14,520 relations, from every CBW-station to all other CBW stations. (121 CBW stations, 121*120 relations, only direct trips)

To consider different intensitys in PT intervals and CBW lending processes at different day times and weekdays several time periods were defined:

- section 1: weekday Peak, 05am-09pm
- section 2: weekday night, 01am-05am
- section 3: weekend Peak, 09am-09pm
- section 4: weekend night, 01am-05am

Not considered into comparison were trips that suggest the use of Nightline busses (these are running at night-time before workdays).

In comparison the full set of 2015 CBW trip data was analysed. All round or indirect trips were removed. Further all bikes reported stolen were deleted from the dataset as well as all trips to or from a temporary station.

4 RESULTS

4.1 Survey

Out of 1,389 users we interviewed, 57.7 % were male and 42.3 % female. The dominant age group was 20-29 with almost 50 % share. 35 % were tourists/ visitors, 65 % were locals. 48 % were in possession of a seasonal ticket for Wiener Linien (public transport operator). While 78.9 % were in possession of a driving licence only 26.9 % had the possibility to use a car instead of CBW. 78.3 % used CBW as their main means of transportation, 20.9 % used it as a connection to public transport, only 0.8 % used it as a connection between two different public transport modes.

The table 1 shows that in an overwhelming number of cases CBW replaces at least one other means of transportation.

Does CBW substitute other modes of transportation?	Absolute	share [%]
Yes	1,284	92.4
No	105	7.6

Table 1: Share of responses, where CBW substituted another mode of transportation

As shown in figure 1 the purpose of a trip with CBW is leisure with a share of 65 %. The way to or from work counts with a share of 15 %.

CBW substitutes with a share of 71.4 % trips otherwise made by PT followed by ways made by walking with 15.9 % (Figure 2). Figure 3 shows that out of the role CBW has as part of a door-to-door trip it dominantly substitutes PT trips with a share of 60 % as main means of transport and 64% as connector to other modes of transportation.

Reasons for substitution are exercise, cheaper and faster compared to PT, faster compared to walking and more eco friendly compared to car use (figure 4).

Is the argument of more environmental friendliness of CBW compared to cars related to collegiate users? The results indicate that it probably is.

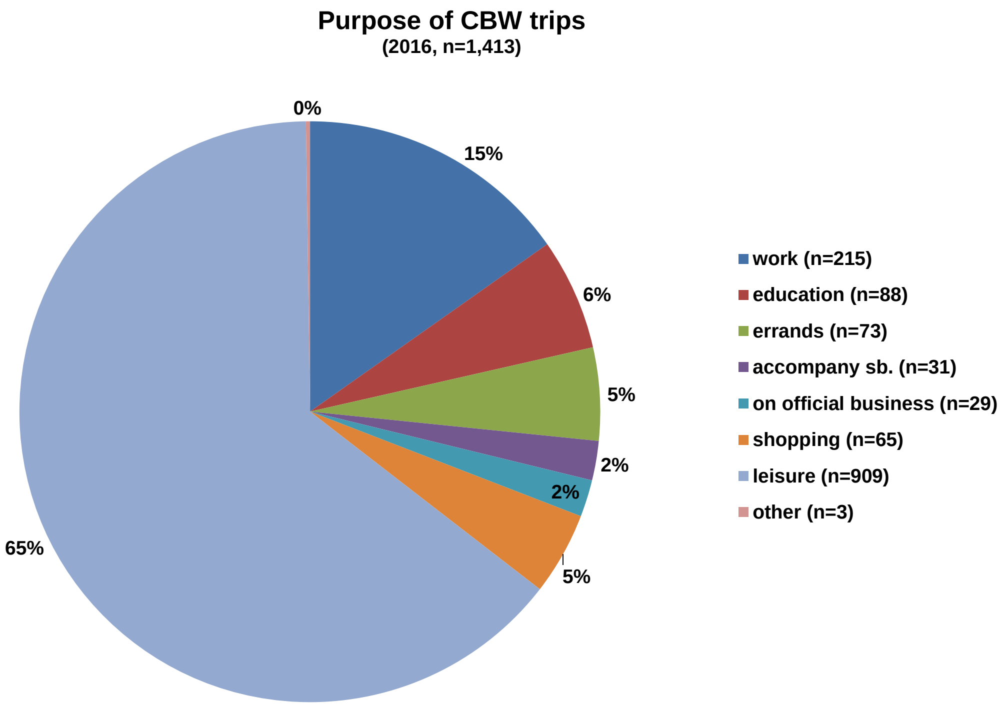

Fig.1. Purpose of CBW trips

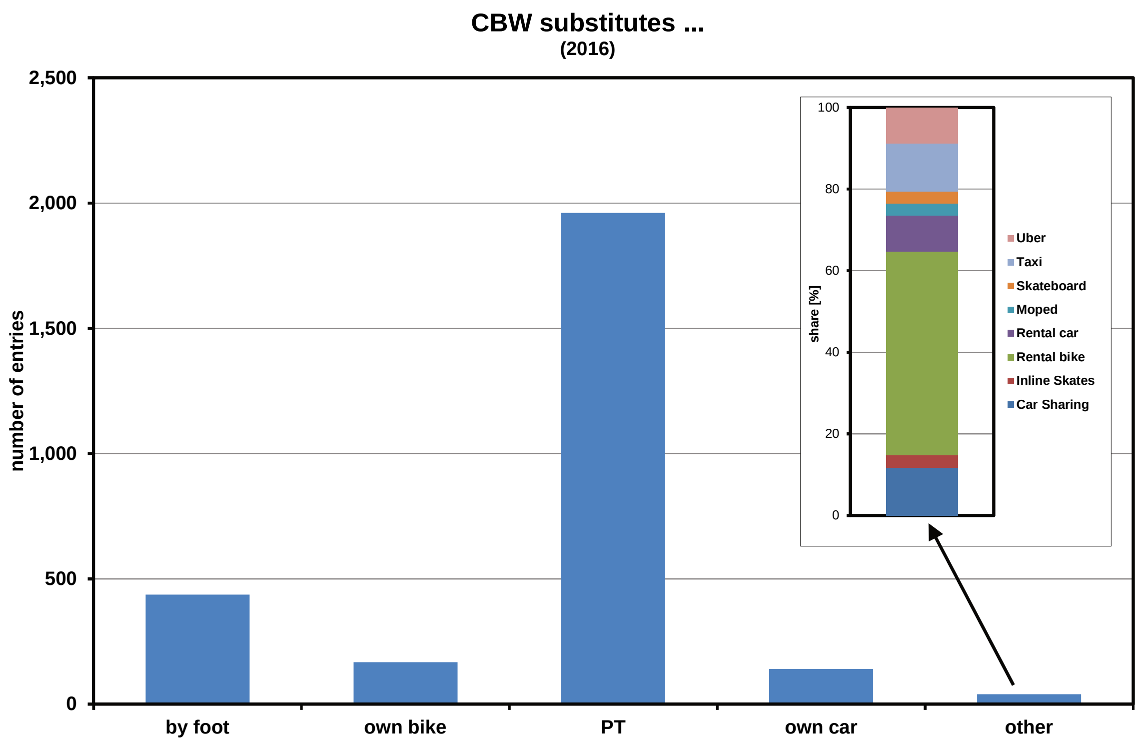

Fig.2. Substitution of trips by CBW

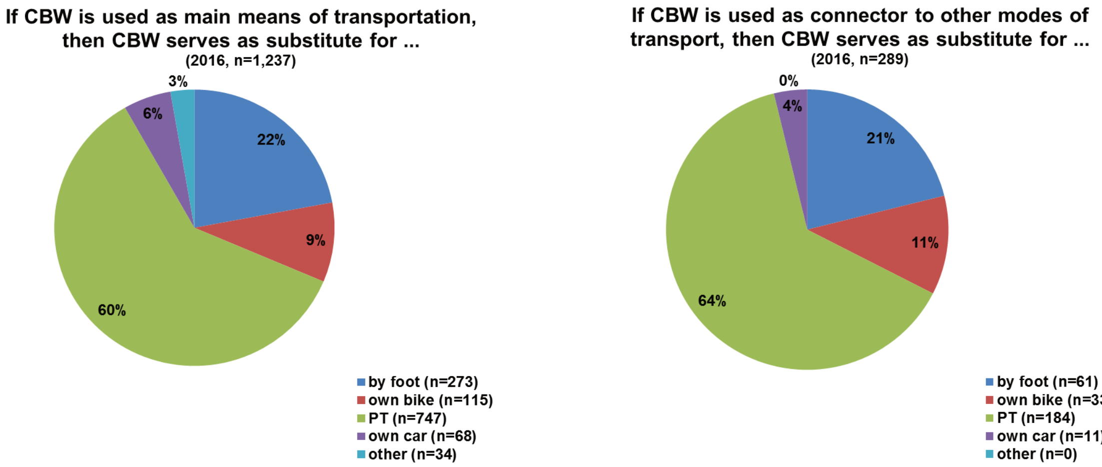

Fig.3. Role of CBW as part of door-to-door trips and substitution of other modes of transport

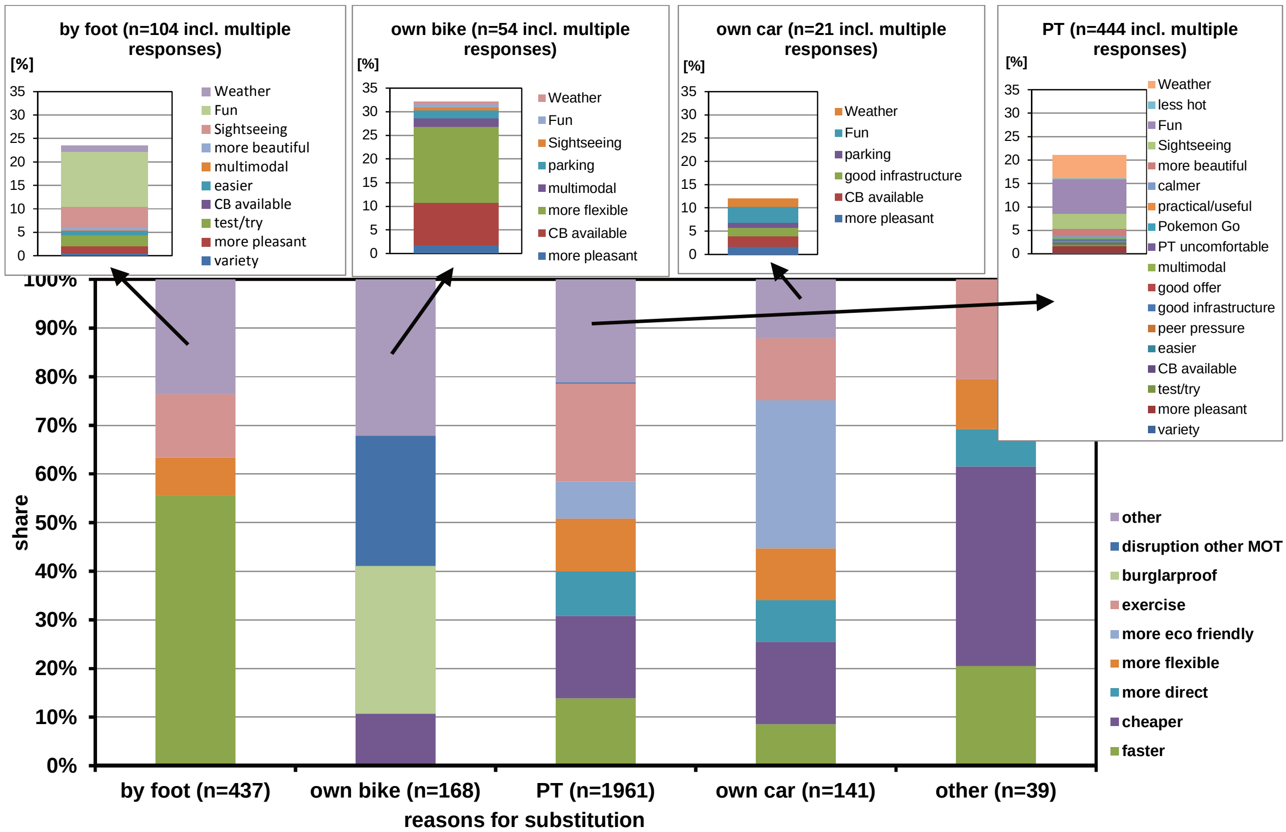

Fig.4. Reasons for substitution

4.2 Data analysis

One result of the data analysis shows that only 10 % of trips take place on 50 % of connections and 45 % of trips take place on 10 % of connections (for 402 connections no direct CBW trips at all were detected in 2015). Only a few connections hold an important role as high frequency trip generators.

To measure the effect of whether CBW is a competition or supplement for PT, we assigned the direct trips onto PT and CityBike routes (Figure 5). The left map shows the PT routes which are potentially replaced by switching to the bike routes shown in the right map. The maps confirm previously identified usage patterns (student trips, feeder trips to PT hub, pedestrian/shared space zone).

As part of the data analysis a detour factor for CBW was calculated by comparing the direct distance of CBW trips to the routing distance. The result shows a detour factor of 1.29 which means that a CBW user will probably cycle a roughly 30 % longer distance than the beeline would be from station to station.

Fig.5. Potential decrease of trips on PT network (left), increase of bicycle trips (right) (Leth, U., & Brezina, T., 2017)

5 DISCUSSION

The next step in improving our work lies in connecting adjoining urban densities (e.g. residents, jobs) and trip generators (e.g. transport hubs) with CBW trip and station data. As trip generation is closely related to attractors and generators in the area around stations, this improvement could increase the explanatory value.

Including fine grained weather data (intense rain, heavy snowfall, harsh temperatures) and topography would as well improve the understanding of the CityBike's role as a supplement to public transport. Further effort could be put in the consideration of other factors influencing mode and route choice such as the ratio of travel times and distances by bike vs. car. An effort could be put into the question how longterm PT operating limitations affect CBW use on a overall system level.

Some limitations due to availability of data have been located as socio-economic data isn't available on a level of detail that would have been useful for correlation to stations.

Further comparison with results of surveys in other cities would increase the importance of the results of this study.

A possible derived deduction out of the Survey data of lenghts of access and departure paths and a connected diagram as cumulative frequency allocation wasn't possible due to resource constraints.

6 CONCLUSION

The data analysis shows that roughly half of the direct CityBike trips occur on only 10 % of the connections. But as our work also proves that short trips are the main target of CBW users it is a coherent conclusion.

Comparing 939 million annual trips with PT in Vienna to currently 1 million CBW trips shows that CBW is not big enough to actually appreciably rival the PT in Vienna.

About the research question of PT network densification vs. grid-expansion: during this study the role of CBW for dispersion was proven. So the assumation is that a network densification would be followed by an increase of usage.

On the other hand extension along PT axes in the outskirts could also be wise.

We therefore conclude that CBW works today as a supplement and addition to the PT network in Vienna.

7 REFERENCES

Beecham, R., & Wood, J. (2014). Exploring gendered cycling behaviours within a large-scale behavioural data-set. Transportation Planning and Technology, 37(1), 83-97.

Faghih-Imani, A., Eluru, N., El-Geneidy, A. M., Rabbat, M., & Haq, U. (2014). How land-use and urban form impact bicycle flows: evidence from the bicycle-sharing system (BIXI) in Montreal. Journal of Transport Geography, 41, 306-314.

Leth, U., & Brezina, T. (2017). Final Presentation ABS study, Vienna

Woodcock, J., Tainio, M., Cheshire, J., O'Brien, O., & Goodman, A. (2014). Health effects of the London bicycle sharing system: health impact modelling study. British Medical Journal, 348, g425.

Vogel, M., Hamon, R., Lozenguez, G., Merchez, L., Abry, P., Barnier, J., et al. (2014). From bicycle sharing system movements to users: a typology of Velo'v cyclists in Lyon based on large-scale behavioural dataset. Journal of Transport Geography, 41, 280-291.

Mobilität und U-Bahn-Umsteigeknoten der Stadt: Transferzentrum Yenikapı in Istanbul

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1 ZUSAMMENFASSUNG

DieMobilität in der Stadt, die durch öffentliche Verkehrsmittel bereitgestellt wird, ist mit der Entwicklung der Technologi eund den Umsteigeknoten in den Kreuzungen der Verkehrsnetze entstanden. Die U-Bahn-Umsteigeknotenpunkte treten aufgrund der Erweiterung des Netzes in größerem Maßstab auf und Transferzentren gehörenzu den Hauptattraktionen der Innenstadt.

DieVerkehrsknotenpunkte zu Schnellverkehr und zur Erreichbarkeit sind ein wichtiges Thema heutzutage. Die Integration des urbanen physischen Raumes hat dieseTransferzentren als einen Ort mit starker Auswirkung auf das 21. Jahrhundert geschaffen.

Transferzentren sind nicht nur als Transit wahrzunehmen, sondern gelten als Sammelbereiche von Service sowie städtischen Funktionen. Diese Zentren werden als Schnittstelle zwischen der Stadtund dem U-Bahn-Netz gesehen. Sie werden nach der Verkehrsart differenziert, welche viele verschiedene Arten von Transport verbinden kann.

Auch in ihrer Größe lassen sie sich unterscheiden. Durch die Verbindungen der verschiedenen Verkehrsarten, die in den großflächigen Transferzentren entstehen, existieren in diesen Bereichen verschiedene Gebäudenutzungen zusammen, zum Beispiel Büros, Geschäftszentren, Einkaufszentren, Wohnungen usw.

Das Ziel dieser Studie ist, Informationen über die Entwicklung der U-Bahn-Umsteigeknoten im theoretischen Fall zuzeigen, die zuständigen, geplantenTransferzentren im Verkehrsplanungsprozess Istanbuls zu untersuchen sowie die Lösung des Problems im Rahmen der Erreichbarkeit im UmsteigeknotenpunktYenikapi in der historischeHalbinselIstanbulszudiskutieren.

Die Transfer-Funktionen und Design-Merkmale werden untersucht und Probleme identifiziert. Die Auswirkungen auf die Mobilität werden nach der Forschungsfragen der Passagiere im ausgewähltenBereich (Yenikapi) ausgewertet.

Keywords: Transferzentren, U-Bahn, Umsteigeknoten, Yenikapi, Mobilität

2 TRANSFERZENTREN

Transfer in der Verkehrsliteratur kann als die Transfermechanismus in zwei oder mehrere Verkehrsmitteln definiert werden. In Fällen, wo die Zufahrt an die gewünschte Stelle durch ein Verkehrsmittel nicht möglich ist, die Transfersysteme werden verwendet.

Brunet (1997) " definiert das Wort „intermodal“ als einen Übertritt von einem Transportform zu einem Anderen. Wobei das Wort "Multimodal" (mehrfach-) ist ausführlicher. Da dieses Wort umfasst oder schließt mehrere Transportformen ein. In dieser Definition, Brunet bezeichnet die Transferzentren, die er als einzelne oder mehrere feststellt, als ein Verbindungspunkt von verschiedener Transportmöglichkeiten. Diese Punkte sind zugleich Wechselzentren und werden betrachtet als die Grundlage des Systems für von Platz in der Stadt zu einem anderen zu gehen.

Die Transferzentren sind nicht nur Transitbereiche. Diese Punkte werden von vielen Leuten als Felder, wo die Transportfunktion angenommen, die städtischen Funktionen und Dienstfunktionen eingesammelt sind, angenommen. In dieser Zentren, wo auch Bereiche wie die Information, Ticket-Verkaufsstellen liegen, können auch Bereiche für Fast-Food Plätze, Beratungszentren usw. stattfinden. Diese Zentren sind für die Erleichterung der Wartezeiten von Passagiere und die und um Reise von einem Ort zu anderen schöner zu machen geplant. Dieser Zentren, die als eine Zwischenfläche zwischen der Stadt und das Verkehrsnetz gelten, setzen sich gemäß der auf dem gleichen Bereich gesammelten Transporttypen auseinander und können viele verschiedene Transportarten wie Busse, Straßenbahn, U-Bahn, Züge, Flugzeuge, Fähre zu einander verbinden. In der groß angelegten Transferzentren, die auch nach ihrer Größe differenziert werden, neben eine Vielzahl der Verbindungen von vielfältigen Verkehrs-Typen, auch kombinierte Funktionen wie Büros, Business-Center, Handelszentrum, Gehäuse können stattfinden.

Transferzentren dienen zur drei grundlegenden Ziele. Diese sind:

- Für die Verbindungen, die die Hauptaufgabe der Knotenpunkte sind, zu dienen,
- Die Zugangsoptionen für ein bequemer Zugang von den Benutzern an die Verkehrsknotenpunkte zu vermehren,
- Zugang zur Stadt und die polare Punkte darstellende Bereiche räumlich zu integrieren.(Sacr. Interm. Transp. F. 2004)

Die Design-Prinzipien der Transferzentren für die Integration zwischen der öffentlicher Nahverkehr und der verschiedenen Verkehrsarten während der Mobilität sind wie folgt:

- Transferzentren müssen einfach und klar sein, und ein ganzheitliche Plan haben (eine einzige Sprache im Design),
- Die Gestaltung soll unter Berücksichtigung der Intensität während der Hauptgeschäftszeiten gemacht werden,
- Sie müssen gemütlich, bequem und kompatibel mit Behinderungen (nicht verhindernde) Stellen sein,
- Der Abstand zwischen der Umsteigfahrzeugen muss minimal sein. Für schnelle Zugang und Erleichterung der Leuten mit einem Last und um behinderten Menschen zu helfen, Fuß Bänder helfen müssen verwendet werden,
- Falls eine Höhenunterschied mehr als 4 m. zwischen der Umsteigstellen vorhanden ist, Aufzüge und Fahrtreppen unbedingt da sein
- Die Einrichtungen in Wartestellen, nämlich Sitze, Papierkörbe, Beleuchtung, Kartenschalter und manchmal auch kleine Handelsfunktionen müssen vorhanden sein,
- Es muss eine gute Leitung und Einweisung anbieten. Für diesen Zweck, Informationstafeln und -schilder, Sprachführung und Bodenunterschiede und müssen in erforderliche Stellen verwendet werden. (İnanlı 2013, s.30)

3 VERKEHR UND TRANSFER-ZENTREN IN ISTANBUL

Das Hauptprinzip in dem das Jahr 2023 zielende „Integrierte Stadtmasterplan des Metropolitanbereich von İstanbul“ ist als die Erhöhung der zunehmenden städtischen Zugänglichkeit und die Integration zwischen Transporttypen zu gewährleisten. In diesem Zusammenhang wurden in Istanbul viele Transferzentren geplant um vor allem die Straßenverkehr und Schienenverkehr Systeme zu integrieren.

In dem Bericht des Plans; auf die Transport-Systemintegration wo die Passagiere in dem Großraum öffentlichen Verkehrssystem zu ihrer Zielorte schneller und einfacher erreichen, und problemlos zu anderer Transportmitteln umsteigen können, wurden verwiesen.

Zu berücksichtigende grundlegenden Elemente bei der Planung dieser Bereiche im Bericht sind;

- „muss genügend Fläche für die Wartezeiten der Passagiere anbieten,
- Die Meldesysteme müssen effizient, der Übergangabstand und Umsteigzeit muss kurz sein um die Passagier Mobilität oder Übergänge von einem Verkehrsmittel zu einem anderen nahtlos, bequem und sicher zu machen,
- Wegen höheren Bedarf der Passagiere an der Haltestellen, diese Stellen sind für die kommerzielle Entwicklung geeignet und kommerzielle Dienste in einer Haupthaltestelle wie Einkaufsmöglichkeiten, Cafés, Restaurants und so weiter schaffen Mittelpunkte für Passagiere,
- Umsteigen zu anderen Arten von Transporttypen: bedeutet Umsteigen der Passagiere zwischen Zug und Bus, Zug und Taxi, Zug und privaten Fahrzeugen usw.“

In dieser Hinsicht, in dem Großraum von İstanbul, die Stationen von Bakırköy, Yenikapı, Kadıköy, Üsküdar wurden als die wichtigste Bereiche, wo verschiedene Verkehrssysteme wie Seetransport, Bahn, U-Bahn, Bus aufeinander treffen, vorgesehen.

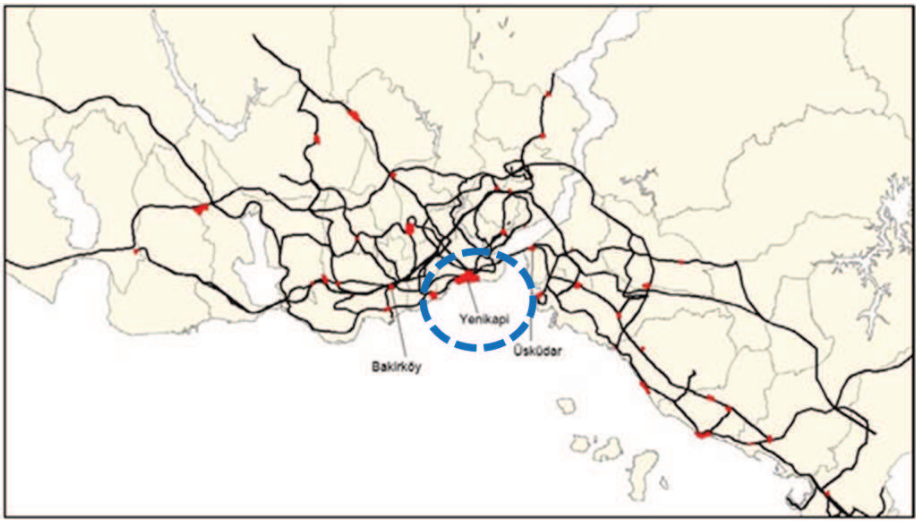

Abbildung 2:Transferpunktezwischen den Schnienstreckenfür das Jahr 2023 (İUAP, 2010)

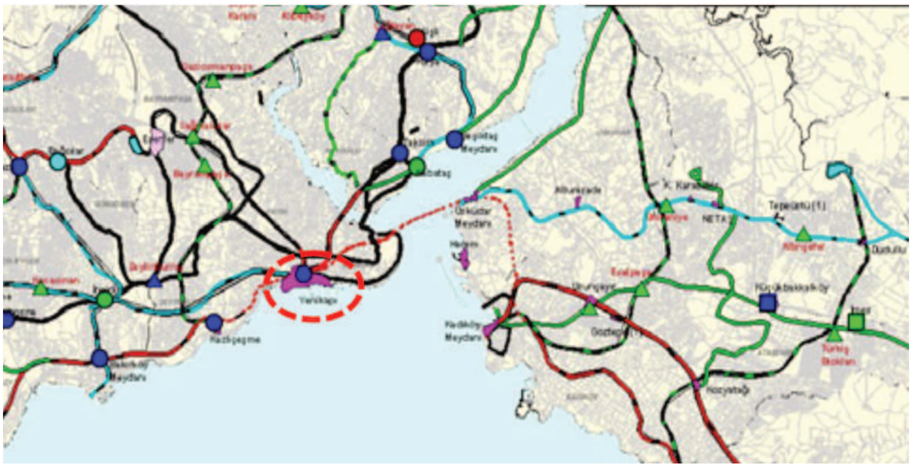

Abbildung 1: Transferzentren in der europaischenSeitein Istanbul und Yenikapı (İUAP, 2010)

3.1 Yenikapı-Transferzentrum

Das Yenikapı-Transferzentrum befindet sich in der Marmara-Küste, innerhalb der Grenzen der historischen Halbinsel Fatih in der Nähe von Handelszentrum, Wohngebieten, touristischen Funktionen und dem Demonstrationsbereich. Yenikapi-Transferzentrum ist die Kreuzung von vielen Transportwegen von İstanbul. Die Verbindungen von schnellen Seefahrtanlegern nach Bursa, Yalova und Bandırma macht das Zentrum zu einem wichtigen Schwerpunkt der Marmararegion. Die Verteilung in der Stadt wird durch U-Bahn- und Buslinien vorgenommen.

Abbildung 3:Yenikapı Transferzentrum und dessen Umgebung

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Die Integration an diesem Knotenpunkt, wo eine Kombination der verschiedenen Verkehrsformen zusammen vorhanden sind, ist nur in Bezug auf Schienensysteme, die U-Bahn-Linien unter der Erde zur Verfügung gestellt. Jedoch sind Unzulänglichkeiten und Schwierigkeiten hinsichtlich des Zugangs auf der Erde wie die Fußgängerzone zwischen Yenikapı und Aksaray Straßenbahnhaltestelle, archäologische Zone, neuen Demonstrationsbereich vorhanden. Diese Unzulänglichkeiten sind die Unterbrechungen gegen die Gestaltung der Zugangsabstände, um den minimalen Zugang zum Yenikapi Transferzentrum zu leisten.

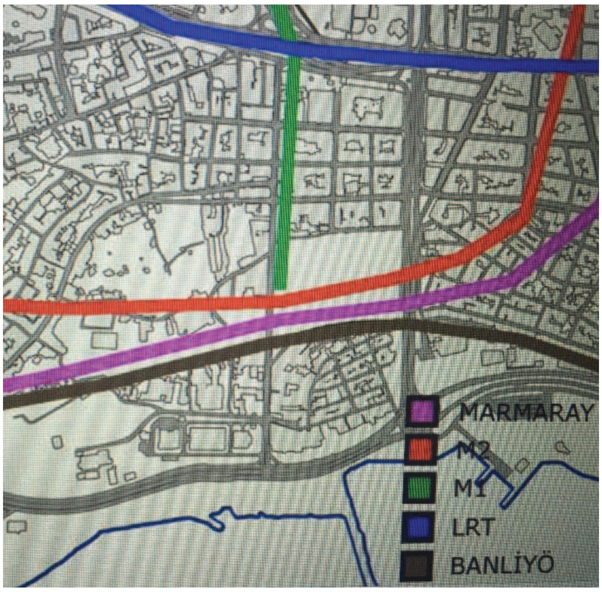

Abbildung 4:Kombination der verschiedenen Verkehrsformen in Yenikapı

Auf der anderen Seite istder Abstand vom Yenikapı-Transferzentrum zu den schnellen Seefahrtanlegern über 500 m Fußweg. Aber Sicherheitsprobleme wegen Oberflächen-Beschichtung und Kreuzungen mit der Fahrzeugverkehr sind erfahren. Die kostenlosen Minibus-Services zwischen der Landungsstelle und U-Bahn station sind ungenügend nach der Anzahl der Passagiere.

Die oberirdische Fußgängerzone an Marmaray und U-Bahn-Eingang ist ein leerer, undefinierter, unausgerüsteter Übergangsbereich. Yenikapi-Transferzentrum hat mit heutigem Stand keine Anziehungspunkte wie Einkaufsmöglichkeiten, Cafés, Restaurants etc. und leistet nur anstrengenden Transit-Transfer-Dienst und die horizontale/vertikale Verbindung konnte nicht ausreichend hergestellt werden. Die für die Behinderten vorgenommenen Einrichtungen sind unzureichend und nicht dauerhaft.

3.2 Forschungsfragen und Bewertung in Yenikapı-Transferzentrum

Eine Umfrage wurde mit insgesamt 60 Benutzern wurde in Yenikapi Transferzentrum an Wochentagen von morgens 08:00 bis abends 18:00 und am Wochenende von morgens 10:00 bis abends 18:00 durchgeführt. Die Fragen und Antworten der Umfrage und die Ergebnisse sind wie folgt:

1. Wie oft nutzen Sie das Transferzentrum Yenikapı?

Die Passagiere nutzen Yenikapi Transferzentrum am meisten 4-5 Tage pro Woche.

2. Mit welchen Verkehrsmittel kommen Sie zum Yenikapı-Transferzentrum?

Am meisten mit Marmaray und als zweite mit U-Bahn.

3.Mit welchen Verkehrsmittel reisen Sie von Yenikapı-Transferzentrum zu ihrem Zielort weiter?

Das meist umgestiegene Verkehrsmittel ist U-Bahn und das zweite ist Marmaray. Die andere Umsteig-Transportmittel gemäß der Nutzungsintensität sind Wasser-Bus, Straßenbahn und Bus.

4. Welche Mängel sehen Sie im Yenikapi-Transferzentrum?

Die in der Umfrage teilnehmende Benutzer finden die folgende Mängel;

- Das primäre Thema ist Design und die anderen Mängel des Yenikapı-Transferzentrums sind hinsichtlich der allgemeinen Architektur, Leitungsschilder, Kartenschalter, Wartebereiche, Beleuchtungskörper, Verfügbarkeit der Zugangsplattformen, P+R-Umsetzungen.

- Zweitens die kommerziellen Funktionen wie Buffet, Verkaufseinheiten und Pausenbereiche. Ein weiteres Problem ist der Mangel an Verbindungen, nämlich die Abwesenheit einer direkten Verbindung von dem Zentrum zum Seebus und Straßenbahn spielt eine effiziente Rolle für die Nutzungspräferenzen.
- Darüber hinaus wird der Abstand zwischen U-Bahn und Marmaray als zu lang und der Zugang als unbequem bezeichnet.

5. Denken Sie dass die Verkehrszentren helfen zur Lösung des Verkehrsproblems von Istanbul?

Die überwiegende Mehrheit von 72 % der Passagiere denkt, dass die Transferzentren eine Lösung Verkehrsproblems von Istanbul sind. Es ist vorgesehen dass durch die Verkürzung der Reisezeit und Erhöhung des Reisekomforts die Menschen von Einsatz von privaten Fahrzeugen an die Nutzung der öffentlichen Verkehrsmittel geführt werden. Es gibt 25 % ,die nicht sicher in diesem Sicht waren, und 3 % denken nicht, dass es nicht möglich ist, die Verkehrsprobleme zu lösen.

4 AUSBLICK

Die Transferzentren sind wichtige Schwerpunkte für die Transportintegration in der Regionen mit intensiven Verkehrs- und Menschenbelastung. Diese Mobilitätzonen müssen in Bezug auf die horizontale und vertikale Verbindungen richtig gestaltet werden. Bei der Gestaltung dieser Zentren, die als eine wichtige Ausrüstung für die Verbindung mit der der Stadt mit der nahen Umgebung und deren Leistungen gelten, müssen Kriterien berücksichtigt werden wie die verbundenen Transporttypen, Zugänglichkeit, horizontale/vertikale Verknüpfung, Integration. Die Transferzentren müssen auch die Verkehrsanbindungen, die in Zukunft zunehmen werden, verschiedene Formen von Mobilität und erhöhte Anforderungen der Benutzer bewältigen können.

Das Yenikapi-Transferzentrum mit seiner heutigen Lage im historischen Kern von Istanbul ist nur ein Mobilitätsbereich für Passanten, die öffentliche Verkehrsmittel in der historischen Stadt benutzen.

5 QUELLE

Aktan, E. Ö. A., UlaşımdaYeniTeknolojilerveUygulamaların Kent Biçimine (Olası) Yansıması. TMMOB İnşaatMühendisleriOdası İstanbul Şubesi 6. UlaştırmaKongresi, İstanbul, 2005

Brunet R. “Lesfiguresducarrefour”, Mappemonde Sayı 97/2, 1997, s.1-8.

Candan, S. Kent içi Ulaşım Sistemlerinde Bütünleştirme Çözümleri. IV. Ulaşım ve Trafik Kongresi Sergisi Bildiriler Kitabı. TMMOB Makine Mühendisleri Odası, Ankara, 2003

İnanlı, F. Kentsel Dönüşüm-Transfer Merkezi İlişkisinin Yenikapı Örneğinde İncelenmesi. Yüksek Lisans Tezi. İstanbul Teknik Üniversitesi. Fen Bilimleri Enstitüsü, İstanbul, 2013

İstanbul Büyükşehir Belediyesi, Ulaşım Daire Başkanlığı, Ulaşım Planlama Müdürlüğü, İstanbul Metropoliten Alanı Kentsel Ulaşım Ana Planı (İUAP), İstanbul, 2011,

Sacramento IntermodalTransportationFacility, 2004, s.11-12.

URL-7, http://www.marmaray.gov.tr/ Yenikapı Transfer Merkezi. 25.04.2017.

URL-8 http://www.ido.com.tr İDO Yenikapı İskelesi. 10.05.2017.

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Praxis der Datenerfassung mit Drohnen für GIS und Vermessung

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1 ABSTRACT

In der Vorbereitung zur Bauphase von Projekten ist die Visualisierung sowie die Erfassung tagesaktueller Naturstandsdaten ein gewichtiger Aspekt. Bilder von Online-Karten, die via Satellit oder Flugzeug erstellt wurden, können bis zu mehreren Jahren alt sein. Drohnen mit Kameras bestückt können Gebiete gezielt befliegen und nach anschließender Auswertung werden die Daten zur Vermessung und Visualisierung herangezogen. Mit Hilfe der drohnengestützten Photogrammmetrie werden so digitale Karten, Geländemodelle, 3D Modelle rasch und tagesaktuell generiert.

Ein wesentlicher Faktor stellt die weitere Integration der Daten in Verwaltungssysteme dar. Die generierten Pläne können in einer Verwaltungssoftware und/oder einer GIS Software direkt verarbeitet werden. Der administrative Aufwand, bei der Verortung von Sachdaten, wird dabei nicht nur durch die Visualisierung erheblich verringert. Beispielsweise soll hier die Digitalisierung von Friedhöfen genannt werden, die durch diese Technologie kostengünstig und rasch realisiert werden kann.

Die durch Drohnenbefliegung generierten 3D Volumenmodelle von Steinbrüchen sind nicht nur für Visualisierungen interessant, sondern die daraus gewonnenen Höhenschichtmodelle, digitalen Gelände- oder Oberflächenmodelle dienen auch Vermessungen und sind Behördenkonform. Die Befliegung mit Flugrobotern, mit anschließender photogrammetrischer Auswertung, bietet mit Orthofotos, 3D Modellen und Luftbildern meist eine kostengünstig Alternative gegenüber der terrestrischen Vermessung.

Das verwendete uLFZ (unbemannte Luftfahrzeug) muss von der Flugsicherungsbehörde (ACG = Austro Control) für den Betrieb zugelassenen werden, sowie der Pilot die entsprechende Befähigung nachweisen.

2 DIGITALISIERUNG IN STÄDTEN UND GEMEINDEN

2.1 Friedhofsdigitalisierung

In Städten und Gemeinden geht man in Sachen Digitalisierung mittlerweile oft neue Wege und lässt die bestehenden Friedhofspläne mittels Drohnen-Geodatenerfassung digitalisieren. In der Verwaltung kommt es durch die hohe Genauigkeit der Daten zu einer exakten Verortung der Sachdaten. Die Effizienz der Luftaufnahmen führen in der Umsetzung zu einer Zeitersparnis. Abbildung 1 zeigt einen Auszug aus einem Friedhofsplan.

Fig. 1: Beispiel eines digitalen Friedhofsplanes

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„Im Sinne einer effizienten und serviceorientierten Verwaltung haben wir uns dazu entschieden, die Friedhofsdaten mittels Geodatenerfassung durch Drohnen umzusetzen. Das bringt den Vorteil eines genauen digitalen Friedhofskatasters und erleichtert die Verwaltung der städtischen Friedhöfe“, erklärt der Bürgermeister aus Eisenstadt Hr. Mag. Thomas Steiner .

Friedhofsverwaltungen nutzen heute moderne Friedhofssoftware, um den Anforderungen hinsichtlich Grabgebühren, Gräbersuche und auch der Realisierung virtueller Friedhöfe gerecht zu werden. Die Grundlage für eine solche Friedhofsdatenbank bildet die detailgenaue Friedhofsdigitalisierung.

Um Gräber, Sektoren und Grabreihen genau zuordnen zu können, verschiedene Arten und Größen von Gräbern genau unterscheiden zu können und danach rasch Informationen abzufragen, bedarf es genauer Datensätze zum Friedhofsplan. Vor allem die Ersterfassung des Friedhofskatasters kann Stadt- und Gemeindeverwaltungen jedoch vor große Herausforderungen stellen.

Die Vermessung von Friedhöfen und die Erfassung von Grabstellen manuell vom Boden aus bergen Fehlerquellen und Ungenauigkeiten in sich. Insbesondere bei großflächigen Friedhofsanlagen ist sie außerdem mit einem hohen Zeit- und Kostenaufwand verbunden. Eine Alternative dazu bietet die Digitalisierung des Friedhofs aus der Luft. Mittels Drohne mit hochauflösender Kamera gelingt es Friedhöfe mit all ihren Details aus großer Höhe zu erfassen. Dank mitgespeicherten, punktgenauen Geo-Daten zu jedem Bild lässt sich anschließend ein digitaler Friedhofskataster erstellen.

Die so in vergleichsweise kurzer Zeit erfassten, jedoch sehr genauen Daten lassen sich in die Friedhofsverwaltungssoftware einspielen, zur Verwaltung der Gräber nutzen und aus der Datenbank jederzeit abrufen. Von Vorteil ist der Zugriff auf digital verfügbare Daten außerdem dann, wenn es bei der Friedhofsplanung darum geht, einen Friedhof neu zu zeichnen. Auch bei Erweiterungen oder Umbauten können die mit der Drohne erstellten Datensätze genutzt werden, um Anpassungen im digitalen Plan rasch und korrekt vorzunehmen.

Stehen die mittels Befliegung durch die Drohne erfassten Friedhofsdaten erst einmal zur Verfügung und wurden ins System eingespielt, bieten sich vielfältige Nutzungsmöglichkeiten. Die somit vereinfachte Verwaltung von Grabstellengebühren steht dabei in der Regel an oberster Stelle. Ein immer wichtiger werdender Aspekt besteht jedoch auch darin, die Suche der Grabstellen für Besucher sowie auch Totengräber zu erleichtern.

Zum einen wegen immer größer werdenden Friedhofsanlagen, zum anderen aufgrund der aus Zeitmangel selteneren Besuche. Vor allem für Menschen, welche sich die genaue Stelle eines Grabes nur schwer merken, bedarf es neue Werkzeuge die das Auffinden der Gräber ihrer verstorbenen Familienmitglieder unterstützen. Abbildung 2 gibt einen Einblick in eine Friedhofsverwaltungssoftware. Die Grundlage bildet der Friedhofsplan.

Fig. 2: Beispiel einer Friedhofsdatenbank

2.2 Digitalisierung von Mobilheimplätzen / Campingplätzen

Für Mobilheimanlagen bzw. Campingplätze liegen teilweise nur lückenhafte bzw. mangelhafte Pläne vor. Zur Digitalisierung kann die Drohnentechnologie herangezogen werden. Lediglich sehr schwer einsehbare Bereiche müssen nach wie vor händisch durch eine terrestrische Vermessung eingemessen werden. Erfasst werden u. a. Hauptgebäude, Nebengebäude, Dachflächen, Grundstücksgrenzen (Zäune, Mauern), Kanaldeckel, Schieber, Leuchtmittel, Straßen, Wege, etc. …

Die Drohnenbefliegung (Photogrammetrische Auswertung) in Kombination mit einer terrestrischen Vermessung stellt hier eine effiziente Digitalisierungsmethode dar. Maßstabsgetreue und hochaufgelöste Orthofotos, zusätzlich berechnete 3D Modelle, sowie die direkt am Gelände eingemessenen Fixpunkte dienen als Grundlage und bieten den Gemeinden bzw. Betreibern zusätzlich die Möglichkeit den aktuellen Zustand der Anlagen zu bewerten.

Das Gebiet wird mit einer Drohne, an der eine hochauflösende Kamera befestigt ist, beflogen und die gewonnenen Daten anschließend mit einer Spezialsoftware zu einem digitalen georeferenzierten Plan zusammengefügt. Die Vektorisierung erfolgt in Kombination mit der terrestrischen Vermessung. Bei dieser Methode wird eine Bodenauflösung des Orthofotos von < 1 cm erreicht und eine 3D Punktwolke von bis zu 200 Millionen Punkten generiert.

Abbildung 3 zeigt einen Ausschnitt eines digitalisierten Mobilheimplatzes inkl. Orthofoto und den vektorisierten Layern.

Fig. 3: Beispiel eines Mobilheimplatzes Orthofoto inkl. Vektorisierung

3 DSM (DIGITAL SURFACE MODEL), DTM (DIGITAL TERRAIN MODEL)

3.1 DSM-Projektplanung, -entwicklung

Die Planung von Umbauten, vor allem im unwegsamen Gelände, wirft oft Fragezeichen auf und lässt sich zum Teil nur situativ bewerkstelligen. Die Erstellung von digitalen Oberflächen-Modellen (DOM) bzw. digitalen Gelände-Modellen (DGM) in Kombination mit hochaufgelösten Orthofotos (siehe Abbildung 4) erleichtert diese Planung enorm. Ein konkretes Beispiel stellt ein Re-Powering Projekt in einem Windpark auf einem Bergkamm in etwa 2000 m Seehöhe dar. Im angesprochenen Projekt wurden 13 Windkraftanlagen

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samt Fundamenten abgebaut und durch neue, effizientere Anlagen ersetzt. Enge und lange Zufahrtsstraßen und die große Entfernung zu Baustofflagern erforderte eine möglichst effiziente Planung von Logistikwegen und Erdbewegungen. Durch schwierige Witterungsverhältnisse in Bergregionen war das Zeitfenster für den Umbau sehr schmal und der Auf- und Abbau verlief teilweise parallel.

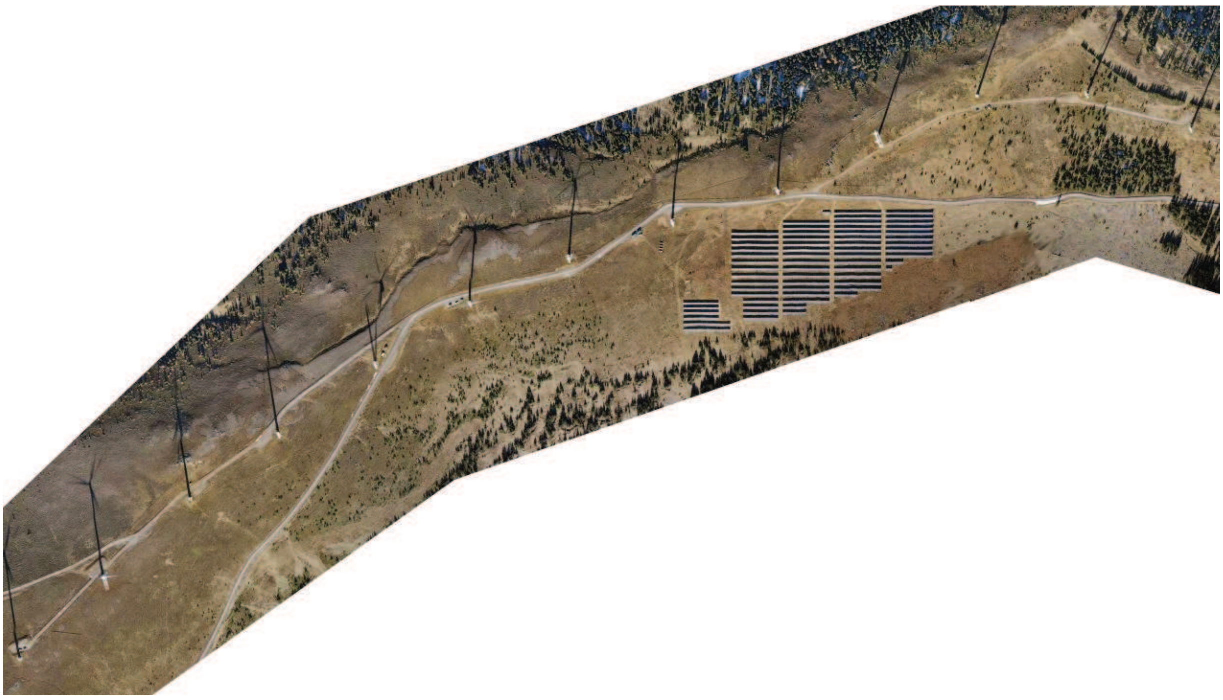

Fig. 4: Orthofoto Windpark GSD 1,5cm

Die Forderung der Projektplanung war ein Geländemodell mit einem 5x5 m Raster über eine Gesamtfläche von etwa 60 ha. Diese Fläche und das unwegsame Gelände lassen hier keine effiziente terrestrische Vermessung zu. Die mit Drohnen gesammelten Daten lieferten hier exakte Daten für die Berechnung erforderlicher Kubaturen der Erdbewegungen. Die Maschenweite des erstellten DGM / DSM lag bei etwa 10 cm. Weiters konnten Logistikwege / temporäre Zufahrtsstraßen und Zwischenlagerplätze per tagesaktuellem Orthofoto geplant und weitergegeben werden. Abbildung 5 zeigt einen Auszug aus der generierten georeferenzierten 3D Point-Cloud.

Fig. 5: Auszug aus der 3D-Punktwolke

3.2 Tagebau

Die behördenkonforme Vermessung von Rohstofflagerstätten zählt zu den Hauptaufgaben im Markscheidewesen. Die Ergebnisse in Form von Karten und Plänen zeichnerisch darzustellen und diese hinreichend zu dokumentieren stellt die Markscheider vor eine Herausforderung. Immer öfters werden dazu Orthofotos und 3D Modelle herangezogen. Dahingehend entwickelt sich der Flugroboter zu einem nicht wegzudenkenden Werkzeug im Tagebau. Stichtagsbezogen kann so der Bestand gefahrlos und rasch erfasst werden. Vor allem kommt es während der Erfassung zu keiner Unterbrechung des Betriebes und das Vermessungspersonal muss sich keiner Gefährdung aussetzen.

Im Post-Prozessing können dann alle erforderlichen Größen gefahrlos am Bildschirm herausgearbeitet und zu Papier gebracht werden (siehe Abbildung 6). Zusätzlich bietet das Orthofoto durch die photogrammetrische Erfassung eine Dokumentationsgrundlage mit der sich Veränderungen in der Lagerstätte sehr gut darstellen lassen. Über die 3D Punktwolke können zusätzlich automatisch Höhenschichtlinien ausgegeben und Volumen von Schüttungen berechnet werden. So können über den Zeitverlauf Veränderungen im Tagebau sichtbar gemacht und das abgebaute Volumen sehr genau bestimmt werden.

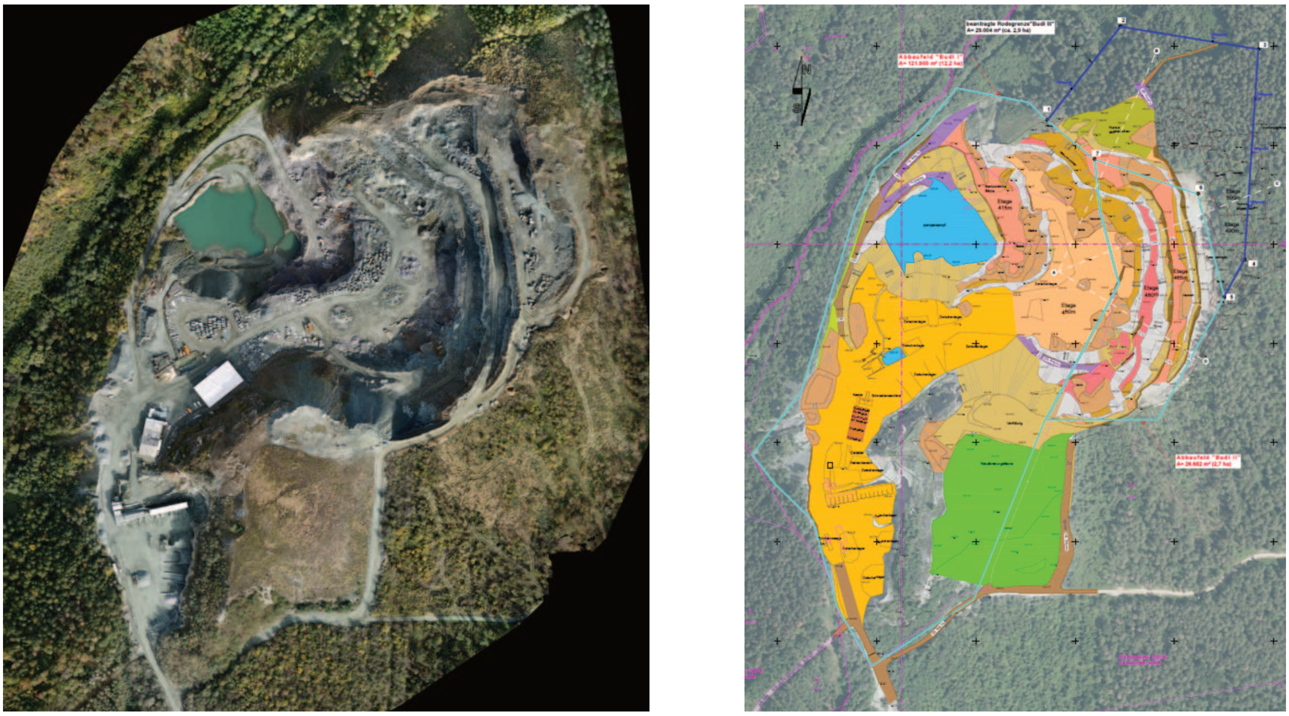

Fig. 6: Orthofoto (links) und Plan (rechts) eines Steinbruchs

3.3 DSM Skigebiete

Die Betreiber von Schigebieten sind gefordert ihr Angebot bestmöglich an die immer höheren Bedürfnisse der Gäste anzupassen. Deshalb ist es notwendig jedes Jahr aufs Neue in Erweiterungen der Pisten und in den Ausbau von Seilbahnen zu investieren. Die Klimaerwärmung und die damit zunehmende Schneeunsicherheit führen dazu, dass in immer neuere Technologien im Schneemanagement Einzug halten.

Viele Neuerungen können nur auf Basis von 3D Modellen des alpinen Geländes geplant bzw. umgesetzt werden. Der Einsatz von Flugrobotern schließt hier aufgrund der hohen terminlichen Flexibilität und der preislichen Attraktivität eine Lücke zur bemannten Befliegung bzw. terrestrischen Bestandserfassung. Die Möglichkeit Teilgebiete zu verschiedenen Zeitpunkten zu erfassen, ohne mit erheblichen Mehrkosten zu rechnen, lässt Flugroboter noch attraktiver werden. So kann ein Großteil des Geländes zum günstigsten Zeitpunkt, der kurz nach dem „Mulchen“ vorliegt, erfasst werden und weitere Teilgebiete, nach Vollendung von Bauarbeiten, nachgezogen werden.

Skyability hat zu diesem Zweck die Flugplanung sohin entwickelt, dass der Flugroboter das Gelände in konstanter voreingestellter Flughöhe abrastert. Das heißt die Drohne folgt dem Gelände eigenständig und liefert so Daten mit konstanter Bodenauflösung. Hochalpines Gelände, die Drohne kann dabei mehrere hunderte Höhenmeter zurücklegen, kann so hochaufgelöst in einem 3D Modell abgebildet werden.

Größere Gebiete können durch geeignete Wahl der Start- und Landeplätze so sinnvoll umgesetzt werden, ohne dass nur schwer oder gar nicht zugängliche Gelände betreten werden müssen.

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Die Daten werden sodann aufbereitet und dienen als Grundlage für Bauprojekte oder der Bestimmung der Schneehöhe in Echtzeit über Differenzmessung am Pistengerät. Die optimale Verteilung des Schneevorrates sichert so eine lange Saison in einem hochinnovativen Schigebiet. Abbildung 7 zeigt Beispielausschnitte aus dem mittels drohnengestützter Photogrammmetrie erstellten 3D Modell eines Schigebietes.

Fig. 7: Beispielausschnitte aus dem texturierten 3D-Modell eines Schigebietes

3.4 Kubaturermittlungen (für Inventuren)

Die Ermittlung des aktuellen Lagerstands in Sand- Kieswerken, bei bolzverarbeitenden Betrieben, die Massenermittlung vor oder nach Erdbewegungen oder auch die Abtragsberechnungen in Schottergruben bzw. Steinbrüchen sind nur Beispiele bei denen es notwendig ist das Volumen der jeweiligen Kubatur zu ermitteln. So sind händische Vermessungen neben einem hohen Zeitaufwand auch mit gewissen Sicherheitsrisiken für die Mitarbeiter behaftet. Gewisse Kubaturen können bzw. dürfen aus Sicherheitsgründen nicht betreten werden.

Aus dem durch die Drohnenbefliegung generierten georeferenzierten 3D Modell werden Kubaturen berechnet. Im Zeitraum der Befliegung muss der laufende Betrieb nicht (bzw. in Einzelfällen nur kurz) unterbrochen werden.

Ein Beispiel der Kubaturberechnung bei holzverarbeitenden Betrieben stellt Abbildung 4 dar.

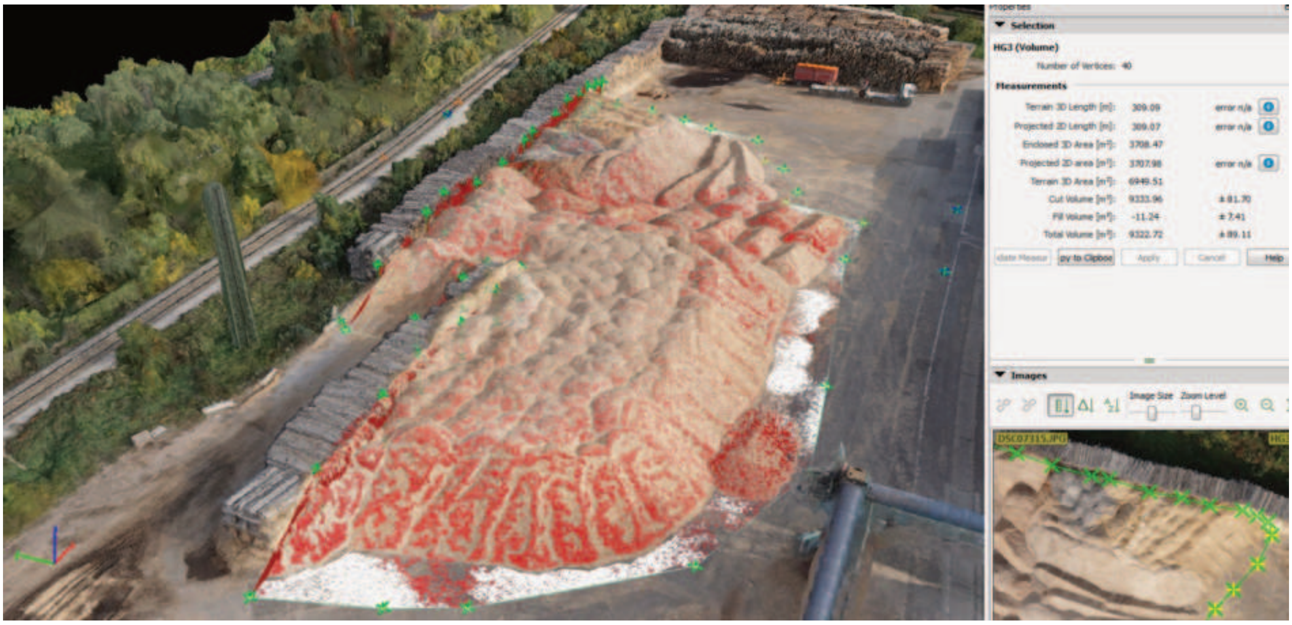

Fig. 4: 3D-Punktwolke zur Kubaturberechnung einer Hackgutschüttung (Volumen 9300 m³)

Private or Public Transport? The Determinants of Travel Behaviour in Post-industrial City – the Case of Łódź

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1 ABSTRACT

Travel mode choices and the frequency of the usage of different modes of transport are subject to numerous studies nowadays. The importance of this research is especially visible when we consider the level of pollution, noise and congestion in big cities. These phenomena became more problematic as the agglomeration develops. Therefore careful analysis of the factors determining travel mode choices in daily travel activity of citizens should be conducted. Especially when the share of private car usage overwhelms other transport modes.

This situation is particularly visible in developing economies as the possession of car can be used as a proxy for the economic status. The case of Łódź - the post-industrial city located in the centre of Poland seem to be a very interesting case study in terms of the problems described above. According to the report of TomTom Traffic Index 2016, Łódź was the fifth most congested city in the world. On the other hand, the city of Łódź faces the problem of rapid ageing of its inhabitants and very low birth rate. This motives summed up give us a justification to use Łódź as a scientifically interesting subject of the analysis.

The data used in the empirical exercise are taken from the study Quality of life of the citizens of Łódź and its spatial diversification. Such choice of the dataset allows us to include a broader range of explanatory variables than in regular travel mode choice studies. As a tool of econometric analysis, we employed multinomial logistic regression model.

The results are in line with the findings of similar studies in the field of travel behaviour analysis. We observe the high impact of socio-demographic factors on the frequency of the usage of a particular mode of transport. Also, the state of city's infrastructure and effectiveness of functioning of the public transport turned out to be the meaningful factors determining travel behaviour of the citizens of Łódź in their daily travel activity. The set of determinants differs between the modes of transport. Especially interesting results were obtained for age groups, where we observed an intensive increase in private car usage for mid-aged people, and afterwards gradual decline in favour of public transport. The statistically significant impact of financial situation assessment and the student/employee status were also confirmed in this study.

Keywords: travel frequency, travel mode choice, multinomial logit, travel behaviour, microdata

2 INTRODUCTION

The purpose of this study is to investigate the factors which determine travel behaviour of the citizens of Łódź. According to Eurostat and Polish Local Data Bank, there were 502 registered cars per 1000 inhabitants in Łódź in 2016. This number should be considered as high, especially when we compare it to 396 cars per 1000 citizens registered in Berlin. It's worth mentioning that Poland has the oldest passenger car fleet in the EU (33% of cars older than 20 years in 2015). Considering a high number of private cars, which results in high level of pollution and noise in the city, we claim that careful study of the travel behaviour and its reasons can be helpful in shaping urban policy dedicated to public transport development and infrastructural investments. Also, knowing the determinants of the choices regarding transport mode in daily travel activity, we can formulate some recommendations for local policymakers in terms of addressing the transport needs of particular groups of inhabitants.

The goal of this study is achieved with the usage of microeconometric models, namely multinomial logistic regression model. This approach is widely used in the literature and will be discussed in following sections.

3 MOTIVATION

The city of Łódź is located in the nearly exact centre of Poland next to the intersection of the two main motorways namely: A1 (E75) and A2 (E30). As Łódź is the third largest city in Poland, this location provides a convenient way to travel for nearly 700 thousands of its inhabitants. Moreover, this high accessibility to motorways asserts suitable environment for the development of the transport companies and logistics centres. Dynamic evolution of the transport sector carries on many positive effects, however, it also causes some problems which decrease the quality of life of the inhabitants. To this, we can add serious delays in the development of transport infrastructure in the city and in a whole agglomeration. This obstruction can be explained by the financial problems caused by the transition from planned economy to market economy in the early nineties. As the city of Łódź was primarily built on the textile manufacturing, the economic system change caused a strong downturn in the city, by opening the polish economy for cheap goods from abroad – in this case especially inexpensive textiles from China. Eventually, the unemployment rate in Łódź rose rapidly which caused many social problems. These issues were to be solved in the first place leaving infrastructural investments for the future.

Nowadays the city of Łódź starts to regain its position on the economic map of Poland. The development of highways and express roads followed by investments in tram lines and railroad infrastructure stimulates the economic growth of the whole agglomeration. On the one hand, these dynamic changes improve the state of the transport system in the city by enhancing the offer and shaping up the quality of services. On the other hand, the level of congestion and complementary side effects (noise, pollution, etc) started to rise which situated Łódź in the fifth place in the TomTom Traffic Index 2016 among the most congested cities in the world.

Therefore in our opinion, the case of Łódź can be the scientifically interesting subject of travel behaviour analysis. The results of this study can be helpful for local urban planners as a source of knowledge of the determinants of mode choices made by the citizens of Łódź. This information will be especially useful in case of the need to address social campaigns aimed at the particular groups of the society to persuade them to use public transport instead of private cars.

4 LITERATURE BACKGROUND

The literature concerning travel behaviour research is rather broad. To the seminal papers, we can include the work of McFadden (1974, 1977) who employed microeconometric methods (conditional logit model) in the modelling of the demand on San Francisco Bay Area Rapid Transit (BART). The models introduced by McFadden proved the relevance of microeconometric methods in travel behaviour research. These models are still widely used and developed.

For example, we can point to the research conducted by De Witte and Macharis (2010), where binary logistic regression was employed to research the propensity of the citizens of Brussels to use free of charge public transport. Their results suggested that sociodemographic characteristics of the respondents and their habits have a significant impact on the travel mode decisions. Cervero (2006) also used binary logistic regression in studying travel behaviour of white-collar workers in California.

In this paper, we used multinomial logistic regression (MNL) in order to find the determinants of the frequency of using the particular modes of transport (public or private). Multinomial logistic regression was used in similar context for example to study travel mode choices of the students in six Asian countries (Van et al., 2014). Schwanen and Mokhtarian (2005) also applied MNL model to research the relationship between travel behaviour and residential location of the citizens of San Francisco. The authors also tested the nested logit model, but multinomial logistic regression was better in terms of economic correctness. MNL model was also employed by Mahmud and Rabbani (2012) in order to study the travel behaviour of the white-collar workers in Dhaka. The authors compared MNL results with the outcomes of random parameters logit model. The outcomes turned out to be very similar, but for the multinomial model, a better goodness-of-fit was achieved.

For Poland, there were just a few papers regarding travel behaviour analysis. To the most important we can add Strawinski (2003), who used multinomial logistic regression in order to analyse the determinants of the travel behaviour of the citizens of Gdynia (northern Poland).

From the short review of the literature, we can infer that multinomial logistic regression is especially useful in the travel behaviour research. The validity of this method and its popularity in the literature let us justify the usage of MNL model in the empirical part of the study.

5 DATA AND METHOD

In the empirical part of this study, the multinomial logistic regression model was applied. This method is based on the concept of Additive Random Utility Modelling and can be considered as natural extension of standard binomial logistic regression model, where dependent variable has more than two categories, which are not ordered (see: Verbeek, 2000, p. 194-197; Cameron, Trivedi, 2009, p. 479). This model was primarily introduced by Luce (1959). In MNL model we assume that probability of the choice of j-th alternative by i-th respondent is defined as:

$$P(y_i = j|x_i) = \mathrm{p}_{ij},$$

where $x_i = (x_{i0}, x_{i1}, \dots, x_{ik})'$ is the vector of explanatory variables. Each respondent chooses one of the J alternatives. Deterministic part of respondent's utility coming from the choice of j-th alternative, V_{ij}, can be written as the combination of explanatory variables and model parameters:

$$V_{ij} = x_i'\beta_j,$$

where β_j is the vector of parameters for j-th alternative. In this method, we assume that stochastic part of the utility has the Gumbel distribution, which allows us to define the probability of the choice of j-th alternative as:

$$p_{ij} = \frac{\exp(x_i'\beta_j)}{\sum_{r=1}^{J}\exp(x_i'\beta_r)}$$

It should be noted that MNL model requires the normalisation of one of the deterministic utility levels to zero in order to identify the parameters. The model is estimated by maximum likelihood, where the above probabilities enter the likelihood function. It's worth mentioning that MNL model must meet the assumption of the independence of irrelevant alternatives (IIA).

The data used in this research come from the study *Quality of life of the citizens of Łódź and its spatial diversification* (Rokicka, 2013; Rokicka and Petelewicz, 2014). The representative sample of the 1000 citizens of Łódź was surveyed in 2012. The questionnaire included 104 questions related to various aspects of social life and was supported by 16 demographic questions. Such choice of the dataset allowed us to employ more explanatory variables than in standard travel behaviour studies. The dependent variable was constructed on the basis of question: "How often during last 12 months were you using: a) private car as a driver or passenger, b) public transport modes (bus or tram)". The scale of answers was as follows: "Never, once a year or couple times a year", "At least once a week/once a month", "Every day or almost every day". Knowing the structure of the dependent variables we estimated two models. One for the frequency of the usage of private transport modes, and the second for public transport modes. The set of the explanatory variables was primarily based on the work of Curtis and Perkins (2006) who surveyed the literature on the determinants of travel behaviour. Additionally, some variables which were unique for this dataset were tested.

6 RESULTS

The empirical exercise was conducted with the usage of the multinomial logistic regression model (MNL) described above. In Table 1 we present the average marginal effects dedicated to the particular variables. The reason we do so is that parameters of MNL model do not have a straightforward interpretation. Due to the nonlinearity of the model, we can only assess the correctness of the sign of the parameters. Contrary, average marginal effects (AME) give us a possibility to interpret their values as the probabilities which are very convenient and much more informative from the scientific perspective.

The results presented in Table 1 are the best estimates obtained after the stepwise regression. It's worth noting that presented outcomes are related to the answer: "Every day or almost every day" while the base outcome was "Never, once a year or couple times a year". This was done to maintain the clarity of the presentation of the results. The goodness-of-fit of the models was scrutinised with the Pseudo-R2 measures. Model of private transport received a better explanation than the model of public transport, however, as for the microeconometric studies both levels of explanation can be assessed as satisfactory. The assumption of independence of irrelevant alternatives was tested with the Small-Hsiao test. The result of the test proved that assumption was met.

	Private transport		Public transport	
	AME	p-value	AME	p-value
Public_transport_too_rare	-.031	0.006	.034	0.000
Too_long_to_city_center	.037	0.000	-.032	0.019
Poor_offer_at_night	-.025	0.027	-	-
25-34 years	.079	0.803	-.03	0.869
35-44 years	.155	0.197	-.11	0.167
45-54 years	.053	0.670	-.03	0.954
55-64 years	.001	0.497	-.123	0.026
65-74 years	-.041	0.084	-.208	0.049
>74 years	-.226	0.004	-.28	0.000
Woman	-.18	0.000	.083	0.000
Worker	.069	0.002	.154	0.258
Student/pupil	-	-	.24	0.005
Own_car	.328	0.000	-.29	0.000
Moderate_finantial_sit	-.068	0.033	.112	0.000
Poor_finantial_sit	-.103	0.000	.096	0.010
Debts	-	-	.062	0.098
Pseudo-R^2	0.31		0.19	
N	1000		955	
LR chi^2	557.36		339.48	
p-value (LR)	0.000		0.000	

Table 1 – Average marginal effects calculated on the basis of the results of MNL estimates. Note that the base category for age groups is 18-24 years, and for the financial situation assessment the base outcome is "Good_financial_situation".

From the analysis of Table 1 we can draw following conclusions:[1]

- Opinions and attitudes toward the state of public transport and infrastructure in the city have statistically significant influence on the travel behaviour of the citizens of Łódź.
  - Respondent's opinion that "Public transport operates too rare" negatively stimulates everyday choice of the private transport and positively the public one. This effect seems to be ambiguous. It can be partially explained by the low overall assessment of public transport offer in Łódź which, however, isn't connected with resigning from using the public transport modes.
  - People declaring that "The journey to the city centre from the place they live in is too long" have a greater probability of choosing private transport in their daily activity than public modes.
  - Negative assessment of the offer of the night public transport lines ("It's hard to reach my home destination using night public transport lines") is linked to the lower probability of the choice of the private transport. This phenomenon does not meet our expectations, but it can be explained by the fact, that many people use taxis to go back home at night. In the model of public transport, this variable was not statistically significant.
- The next group of variables is related to socio-demographic characteristics of the respondents.

[1] The readers should remember that all the interpretations are related to the baseline category "Never, once a year or couple times a year". To preserve the clarity of the paper we do not repeat this statement for each interpreted marginal effect. Of course this also applies to the ceteris paribus rule.

  - The significance of the variables related to age groups was checked with the joint F-test, which confirmed the statistically significant influence of the whole set for both models. In the model for private transport, we observe that people of age 35-44 years have the highest probability of choosing private transport in their daily travelling activity, and it decreases gradually afterwards (negative values for age 65 and more). In the case of public transport, we observe the highest probability in the baseline group (18-24 years). Then the downward trend can be observed.
  - Women are less likely to choose private transport in their daily activity (the probability nearly 20 percentage points lower than men). On the other hand, women have a slightly higher probability of choosing public transport than men.
  - People who work are more likely to choose public transport modes than private cars than the people who are not employed. This effect is not statistically significant for public transport.
  - The status of student/pupil is not statistically significant for private transport model (possibly by driving licence obstacles and car affordability). It's worth noting that this variable is the highest positive factor for choosing public transport (24 percentage points gain).
- The last group of the variables is related to the financial status of the respondents.
  - People who own at least one car in their household are very likely to use private transport in their daily journeys. This variable is also the strongest negative factor in the model of public transport choice.
  - If the assessment of the financial situation of the household decreases the probability of using private transport modes is negatively influenced, whereas the probability of choosing public transport modes rises.
  - If there are any debt/mortgages in the household its members are more likely to choose public transport (at the 10% level of significance).

7 CONCLUSIONS

The purpose of this study was to investigate the determinants of travel behaviour of the citizens of Łódź – the post industrial city located in central Poland. In order to achieve the scientific goal of this research, the multinomial logistic regression model was applied. The database used in this paper was taken from the quality of life studies which allowed us to enhance the set of explanatory variables in the manner rarely available in standard travel behaviour analyses.

The results of empirical exercise are in line with the findings of similar studies in the field. This means that for the city which suffered seriously from the economic decline caused by the industrial recession, we can find similar determinants of the travel behaviour as in well-developed cities from other countries around the world. We observe the strong impact of socio-demographic factors on the frequency of the usage of given modes of transport. Also, the state of city's infrastructure and effectiveness of functioning of the public transport turned out to be the meaningful factors determining travel behaviour of the citizens of Łódź in their daily travel activity. The set of determinants differs between the modes of transport. Especially interesting results were obtained for age groups, where we observed an intensive increase in private car usage for mid-aged people, and afterwards gradual decline in favour of public transport. The statistically significant impact of financial situation assessment and the student/employee status was also confirmed in this study.

Future research will concern identifying the spatial differences between the districts of Łódź. Also, the international comparisons with other post-industrial cities are considered. The realisation of this study depends on the availability of the data.

8 ACKNOWLEDGEMENTS

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9 REFERENCES

Cervero R., Office Development, Rail Transit, and Commuting Choices, "Journal of Public Transportation", Vol. 9, No. 5, 2006.

Curtis C., Perkins T., Travel Behaviour: A review of recent literature, Working Paper No. 3: Travel Behaviour, 2006.

De Witte A., Macharis C., Commuting to Brussels: how attractive is 'free' public transport?, Brussel Studies, Issue 37, 2010.

Luce R. D., Individual choice behaviour: A theoretical analysis, Wiley, New York, 1959.

Mahmud M., Rabbani A., Travel Mode Choice Preferences of Urban Commuters in Dhaka: A Pilot Study, IGC Working Paper, 2012.

McFadden D., The Measurement of Urban Travel Demand, "Journal of Public Economics", No. 3, 1974.

McFadden D., Talvitie A., Cosslett S., Hasan I., Johnson M, Reid F., Train K., Demand Model Estimation and Validation [in:] Urban Travel Demand Forecasting Project, Final Report, Vol. V, Institute of Transportation Studies, University of California, Berkeley, 1977.

Rokicka E. (red.), Quality of life of the citizens of Łódź and its spatial diversification (Jakość życia mieszkańców Łodzi i jej przestrzenne zróżnicowanie), Univeristy of Łódź Editing (Wydawnictwo Uniwersytetu Łódzkiego), Łódź, 2013.

Rokicka, E., Petelewicz, M. Subjective Quality of Life and Socio-economic Status. The Case of Lodz Inhabitants (Subiektywna jakosc zycia a status spoleczno-ekonomiczny. Na przykladzie mieszkanców Łodzi), „Przegląd Socjologiczny", 63(2), 143, 2014.

Schwanen T., Mokhtarian P. L., What affects commute mode choice: neighbourhood physical structure or preferences toward neighbourhoods?, "Journal of Transport Geography", No. 13, 2005.

Strawiński P., The Inner-City Travel Demand in Poland. A Discrete Choice Analysis of the Preferences for Different Modes, Master Thesis, 2003.

Van H. T., Choocharukul K., Fujii S., The effect of attitudes toward cars and public transportation on behavioural intention in commuting mode choice — A comparison across six Asian countries, "Transportation Research Part A", No. 69, 2014.

Internet sources:

http://ec.europa.eu/eurostat/statistics-explained/index.php/Passenger_cars_in_the_EU

Public Spaces Planning Policies and the Effects on Pedestrian Mobility in a Metropolis City; the Case Study of Tehran

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1 ABSTRACT

Referring to the relationship of urban planning and health issues, pedestrian mobility has been introduced as a key concept in contemporary literature and experiences of public spaces planning and design. Pedestrian friendly urban spaces with good qualities like safety, vitality, diversity, cleanness, etc. have tremendous effects on phisycal and mental health. Especially thoes sort of spaces are essential in metropolis cities with car dominant urban spaces to change quality of life.

Looking to metropolis cities in developing countries has revealed that Tehran as the capital of Iran has started a great change in public spaces planning policies which directly effects on pedestrian mobility. That's why based on new international statistics the quality of life growth rate in Tehran has been increased in recent five years, although there is a long way ahead. This reasearch is seeking to evaluate public spaces planning policies in Tehran during the recent decade.

As methodolgy, in the first stage three largest pedestrian zones with different functions have been choosed to study. In the second stage two main streets of Tehran have been chosen to evaluate pedestrian mobility policies according to sidewalk qualities. Deep observations, questionnairs and behavioral analysis are key methods in these two stages. In the third stage, pedetrian spaces planning policies have been compared with highways design in a quantative approach to demonstrate how much attention has been paid to pedestrian mobility in Tehran Municipality policies in recent decade.

Some results show overall satisfaction of citizens in new pedestrian zones. Those pedestrian zones which have a better connection to public transport have been more successful. As a critical view pedestrian moblity planning policies of Tehran have concentrated in segregated zones which needs improving an integrated urban spaces network. The analysis of sidewlaks reveals that in spite of new paving projects the sensetive groups needs have been neglected. Also, intersections design, paving quality, distiribution of activities and connectivity in sidewalks need major modification. In comparison to highway development policies, based on economical point of view Tehran Municipality needs more to spend on pedestrian mobility policies.

Keywords: planning policies, public spaces, mobility, pedestrian zone, Tehran

2 INTRODUCTION

The 21th century is a different era in history of urbasim. Based on UN data in 2014, 54 percent of the world's population lives in urban areas, a proportion that is expected to increase to 66 percent by 2050.[1] In this situation quality of life in cities is a key concept for urban experts, because each planning policy effects on quality of life. Global challenges like urban heat islands, urban pollution and new issues like urban health have lead to change urban policies. In this way public space planning policeis are more important because of the nature and benefits of public spaces as palces for social life. Looking more to the literature demonstrates more attention to public spaces analysis and design whereas the planning policies to distribute, manage and control of public spaces through the city are more important. Public space planning policies can connct strategical level and design level of public spaces coherently. In this area pf public spaces studies the lack of researches is clear. According to contemporary key concepts like urban health and quality of life a number of cities in developed countries have changed their public spaces planning policis through creating pedestrian zones, health districts and introducing new documents like pedestrian mobility and safety guide and pedestrian master plan in which walkability is a main cocept with different benefits.(fig1.)

Affected from this new trend, in car dominant countries like Iran in which easy access to gas encourages car usage, in recent decade acdemic associatins have started a quasi movement to pedesrianize urban spaces. This effort has affected on Tehran as the capital of Iran and one of metroploises in the world. Tehran is a pattern city for other cities of Iran from urban planning and design actions so smart public spaces planning

[1] http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html

policies in Tehran can influnce on the nature of public spaces in other cities of Iran. As a main goal this articles concentrates on Tehran Municpality plans for improving public spaces from pedesrian point of view in the recent decade. In this period the mayor of Tehran has been fixed, so there is a good context for analyzing urban policies.

3 CHANGING CONCEPT OF MOBILITY

Mobility can be asumed as a universal drivng force that changed urban form since ancient time. An overview to the history urban form and mobility interaction put modern era in front as a negetavi dimension of mobility while highways captured cities and declined quality of public spaces. For many years mobility had a close meaning to transportation. Because of humanistic approach to cities the meaning chaneged and new dimensions of mobility have bean emerged. Urban mobility is continuously changing. As a result of advances in transportation and communication systems, people frequently live in one place, work in a second and recreate in yet a third. The situation of metroploises in current century has lead to creation of different types public spaces beyond classic ones. These new types like consuming spaces, lost spaces, etc.(Carmona,2008) have created new hidden network of public spaces which criticize traditional mobility in classic public spaces like streets and squares. Considering sensetive groups needs like women, children and older people increase complexity of mobility concept. Planning must be adapted to this shifting reality through the redefinition of new concepts and tools. Reffering to the revealing powers of walkability, communications nodes seem to be key elements in understanding flows and destinations. In this context, walking areas continue being fundamentally places which foster a distinctive quality in cities. Walking has positive effects on the quality of air, economy or public health e.g. promoting commercial developments or interconnecting communications nodes. (Soria&Talavera, 2013)

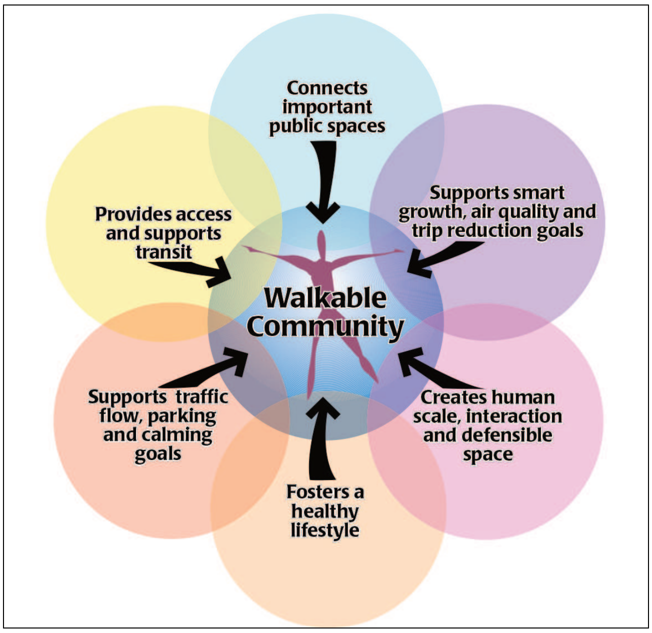

Fig. 1: walkable community benefits. (City of San Diego pedestrian master plan)

Emerging, evolution and concenrating on pedestrian mobility concept through different researches and practices in thses two decades have led to emergence of new dimensions of mobility and different tools for measuring. An overview to evolution of Space Syntax thechnique and more usage of it in urban projects can be assumed as a result of this change.

Inspired initially by Bertolini and Dijst (2003) respect of the concept of Mobility Environment as well as by Zacharias (2001) respect of the concept of Walking Environments, Soria&Talavera (2013) have expanded the concept of Pedestrian Mobility Environment. In an integral view they have analysed Evolution and relationships between urban mobility, pedestrian projects, planning concepts and evaluation. (fig2.)

With this background, public awarness about pedestrian spaces benefits, growing researches that show effects of walking on physical and mental health, fast changing of city centers to pedestrian zones and great efforts to enhance public transport especially in European cities, it seems that 21th century is more inspiring in mobility concept comparing to modern era. So referring to benefits of pedestrian mobility, quality and quantity of walkable spaces in a network is a key index to evaluate quality of life which is measurable through qualitative and quantitive assessment.

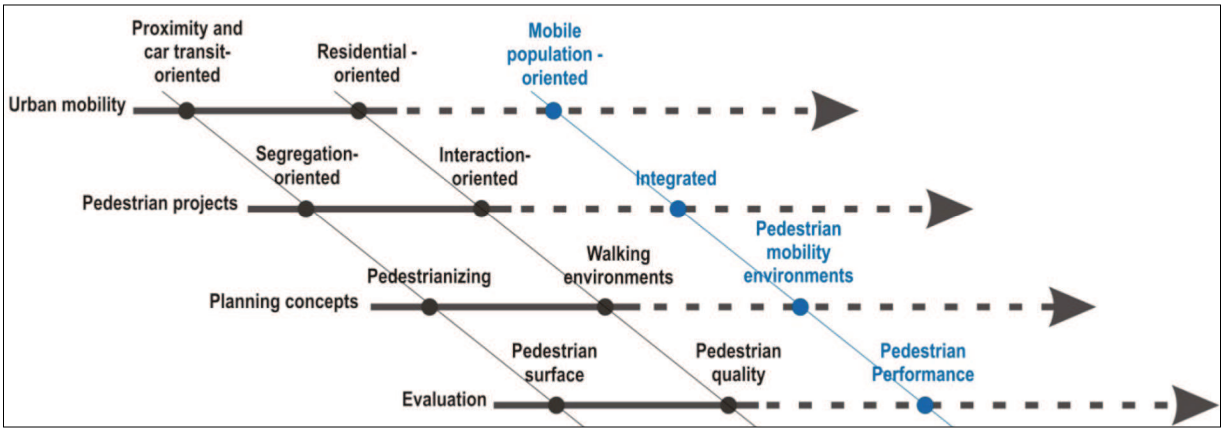

Fig. 2: Evolution and relationships between urban mobility, pedestrian projects, planning concepts and evaluation. (Soria&Talavera, 2013)

4 METHODOLOGY

In the research public spaces planning policies of Tehran Municipality have been considred since 2005 till now. The analysis of policies has been done through selected public spaces as case studies. The mayor of Tehran in this period, has been nomitaed as top 11 mayors of World in 2008.[2] A period of relative stability has put the Iranian capital No1 on the list of world cities that have achieved biggest improvements in liveability over the past five years, as calculated by the Economist Intelligence Unit.[3] From mobility point of view, this perid is a unique period of Tehran while both pedestrian and car mobility have experienced tremendous changes. In the first stage three largest pedestrian zones with different functions have been choosed to study The first case study is a pedestrian zone in historic part which includes the most vibrant urban street of Tehran because of huge amount of people coming for old Bazar as the greatest economic structure of Iran and visiting touristic places like UNESCO world heritage of Golestan palace. Changing car dominant streets to pedestrian streets in this part of Tehran has started from 2005 and now it is the biggest pedestrian zone in Iranian cities. The second case study is a new waterfront around Chitgar artificial lake in the west of Tehran that has opened in last three years. The area is an urban change in history of Tehran. The area is a mixed use arae based on recreational activities. The third case study is Abbasabad area which is a big cultural area with different function in the middle and north of Tehran. Including Tabiat Pedestrian Bridge (winner of Aga Khan award for architecture 2016), the area has been defined as a contemporary touristic destination of Tehran. In the second stage two main streets of Tehran have been chosen to evaluate pedestrian mobility policies according to sidewalk qualities; Valiasr streets which is the longest street of Middle East and Enghelab street which is the most cultural street of Tehran including bookstores, universities, city theater, cafes, etc. Redesign and renovating of thses street sildwalks started in 2006. As a project in Urban Design Methods and Techniques Course at Tarbiat Modares University leading by Ehsan Ranjbar, different groups of students have been used deep observations, questionnairs and behavioral analysis as key methods to analyze these five case studies. In the third stage of the reasearch, pedetrian spaces planning policies have been compared with highways design in a quantative approach to demonstrate how much attention has been paid to pedestrian mobility in Tehran Municipality policies in recent decade. Especially Sadr Expressway, the highway in two level, is the main concentration point to analyze.

5 DISCUSSION

5.1 Pedestrian zone of central Tehran

According to touristic dimension of historic part of Tehran with a number of touristic places and beyond it, locating old bazar of Tehran in the area, developing pedestrian zone has caused to creat vibrant and livable spaces in which around 1000 people per hour are using Panzdah-e-Khordad the most crowd pedestrian street

[2] http://www.iclei.org/fr/details/article/mayor-of-cape-town-wins-the-2008-world-mayor-award.html
[3] https://www.theguardian.com/cities/gallery/2016/aug/18/tehran-economist-intelligence-unit-global-liveability-ranking

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of the area. Accessibility to two metro station has effected on the richness of pedestrian mobility. Also providing public transport in the area has been helped to those who are not able to walk a lot. According to Samavati & Ranjbar (2017) reaserch “The Effect of Physical Stimuli on Citizens' Happiness in Urban Environments: The Case of the Pedestrian Area of the Historical Part of Tehran“, pedestrianization of the area has been effective in overall happiness. Results of quesstionnair show overall satisfaction of people of changing mobility in the area. Also shopkeepers are more satisfied from economic point of view after changin streets from car dominant to pedestrian friendly situation. The main quality of the area which is more notable for people is safety especially for women (in day time not night time). Also decreasing the level of noise pollution is a key characteristic of the area which is rare in Tehran public spaces.

Fig. 3: Panzdah-e-Khordad pedestrian street

5.2 Chitgar Lake waterfront

Based on deep observations, locating close to mountain in connection to forest, the artificial lale of Chitgar has provided unique waterfront for Tehran citizens, which is quite new change in history of 230 years old capital of Tehran. In spite of opening different restaurants in various styles some people use the area as a picnic place because of natural elements. This is a type Iranian usage of public spaces which gather people around a tablecloth. Around 9 kilometer continuous pedestrian including a ring of bicycle track bring pedestrians at the heart of public spaces. Although inner spaces are well equipped for pedestrian but accessibility to the waterfront from other part of the city is not so easy because of lack public transport. Planning different shopping malls like Iran Mall (one of the largest business centers in the Middle East with 1,200,000 m2 constructed area) has affected on the mobility of the area. So a paradoxical planning of mobility can be felt in the area.

Fig. 4: Chitgar Lake

5.3 Abbasabad cultural area

Verity of cultural and recreational functions, innovative design of elements, pedestrian bridges, cycle tracks, differen theme parks in 68 hectar with connection to a forest park and a vast view to the mountains of north of Tehran, have lead to introduce Abbasabad area as a tourisitic destination for pedestrians. Good connection to Metro and public transport by a network of walkable spaces and sidewalks at the heart of Tehran, introduce an excellent public spaces planning policy of Tehran Municipality. Connectivity is a key quality in the area. This is the main factor of Tabiat Bridge success as a new type of public spaces in Tehran which also has captured virtual spaces because of selfie photos on the bridge by young groups.

Fig. 5: Tabiat Pedestrian Bridge

5.4 Sidewalks

Analysis of sidewalks in two main streets of Tehran, shows improving overall quality of walking. The challenges reveals when we concentrate on the details of paving, urban furnitures, the interaction of paving to old trees and facilities for disabled people. Because of paying less attention to protection and irrigation of trees which are a part of identity of these streets, we can see a failure in this way because of renovating sildwalks projects. The big challenge relates to mobility of disabled people in the project which is quite hard for them to use these sidewalks especially at intersection. Two years ago the intersection of these two streets has been a critical project in Tehran in which the pedestrian mobilaity has transferred underground. The dominancy has been gained by cars. In spite of developing sildewalks in these two streets, the intersection project is a sign to show urban manager main toughts.

Fig. 6: Valiasr Street

5.5 Highways

Looking at to the data of Tehran Municipality tell us that during the recent 12 years, highways has been developed from 304 Km to 548 Km with 80 percent growth. In comparison to pedestrian public spaces area, the data about highways show a parallel planning policy that is not consistent to pedestrian mobility. Critics

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are raise up when we look at Sadr's Elevated highway. A lot of money has been spent on project[4] that it was better to use such resource for developing public transport. Ranjbar & Mashhadi Moghadam (2017) research "Upgrading urban highways: issues and negative impacts based on a case study of Sadr's Elevated highway" results showe the highway has significant negative impacts in ecological dimension, including air and noise pollution and energy-consuming parameters.

Fig. 7: Sadr Elevated Highway

6 CONCLUSION

Results show overall satisfaction of citizens in new pedestrian zones when we analyze these spaces from public spaces quality point of view. When we analyse them as spots in the city challenges are raising up. In this way the connection of pedestrian zones to other mobility patterns like public transport has a key role. Those pedestrian zones which have a better connection to public transport have been more successful. As a critical view pedestrian moblity planning policies of Tehran have concentrated in segregated zones which needs to plan an integrated urban spaces network. Also other mobility patterns like public transport should be planned to connect them together. The analysis of sidewlaks reveals the emergence need for modification of intersections design, paving quality and connectivity based on sensetive groups needs. In comparison to highway development policies, Tehran Municipality planning policies in recent decades are paradoxical. This can ve related to lack of inegrated mobility plan which cover pedestrian spaces network, cycle network, public transport network and car dominant spaces together. Without this plan Tehran has a long way to overcom the challenges of the city. Looking to Chigar Lake area where a new highway designed at the south part of waterfront and countinuing under the forest park (with destroying some part of forest park because of intersections and U-turns) announce us the uncertainty in planning policies of mobility in Tehran.

7 REFERENCES

Bertolini, L. and Dijst, M: Mobility Environments and Network Cities. Journal of Urban Design. Vol 8, no1, pp 27-43, 2003

Carmona, Matthew: Public Space: The Management Dimension, Routledge, 2008

Ranjbar, Ehsan & Mashhadi Moghadam, Navid: Upgrading urban highways: issues and negative impacts based on a case study of Sadr's Elevated highway, PLEA conference, Edinburg, 2017

Samavati & Ranjbar: The Effect of Physical Stimuli on Citizens' Happiness in Urban Environments: The Case of the Pedestrian Area of the Historical Part of Tehran. Journal of Urban Design and Mental Health 2017; 2:2

Soria, Julio & Talavera, Ruben: Pedestrian Mobility Environments: Defenitions, Evaluation and Prospects. AESOP-ACSP Joint Congress. Dublin, 2013

Zacharias, J: Pedestrian Behaviour and Perception in Urban Walking Environments. Journal of Planning Literature, vol 16, no 1, pp 3-18, 2001

City of San Diego pedestrian master plan, 2006.

http://www.akdn.org/architecture/project/tabiat-pedestrian-bridge

https://www.theguardian.com/cities/gallery/2016/aug/18/tehran-economist-intelligence-unit-global-liveability-ranking

http://www.iclei.org/fr/details/article/mayor-of-cape-town-wins-the-2008-world-mayor-award.html

http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html

[4] There is no clear data but some news based on interview with Tehran Minicipality managers presents 325 million Euro as final expenditure. http://donya-e-eqtesad.com/news/1064089

Re-thinking Housing and Mobility – A European Living Lab for Sustainable Mobility in Munich

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1 ABSTRACT

This paper aims to describe the vision and implementation approach of a sustainable and innovative mobility and housing concept of a city district at the pericentral edge of Munich. Within the European CIVITAS initiative, the ECCENTRIC project demonstrates an innovative approach to mobilize residents by offering intermodal mobility and mobility on demand. With around 8000 new inhabitants and 12,000 new employees within the next years, the transport system in the Munich living lab Domagkpark and Parkstadt Schwabing needs an integrative and innovative approach to ensure a functioning, ecologically compatible and socially acceptable mobility supply. Central objective is to increase quality of life in the district through a substantial roll-out of innovative mobility solutions, that reduce the use (and number) of private cars.With the implementation of various project measures in the field of sustainable and shared mobility, mobility management, city logistics and road security, a new model quarter for sustainable urban development and compatible mobility will be development. Successful research findings aim to be implemented in future newly-built quarters of Munich and replicated in other European cities.

Keywords: Civitas Eccentric, European Living Lab, Mobility on Demand, Shared Mobility, Munich

2 CIVITAS ECCENTRIC – SUSTAINABLE MOBILITY IN SUBURBAN CITY DISTRICTS

In the CIVITAS ECCENTRIC project, Munich aims to demonstrate innovative solutions that show potential for upscaling and embrace multimodal and demand-oriented mobility. Positive impacts on the utilization of public space, housing and urban mobility are expected to be multiplied beyond the borders of the living lab. Just as various other major cities in Europe, Munich is facing serious challenges in terms of population growth, transport demand and lack of space. Various transport modes compete for the limited urban space available – cyclists ride their bikes on sidewalks, cars park on cycle paths, delivery vehicles block roads and parking space etc. The dominance of motorized individual traffic is particularly emphasized in conflicts for the use of street and public space. Purely additively, high-quality and functional solutions for the public space can hardly be realized against this background. The gain of one type of use means loss for another. At the same time, the freedom of mobility and movement in public space is a basic requirement of civil society. More courage is needed to test and roll-out alternative models that help improving urban mobility and reducing car ownership. The establishment of alternative mobility solutions is faced with the challenge to reduce the existing motorized individual traffic in order to gain space for better solutions and – one of the most important points - to win back space for its people. Therefore, Munich creates its new ECCENTRIC living lab in the North of Munich that is foreseen to fulfill all the different mobility needs without having a car that occupies unused space. A range of demonstration measures in the field of sustainable and shared mobility, mobility management, city logistics and road security are developed and tested.

3 DEMONSTRATION MEASURES IN THE LIVING LAB

All demonstration activities within ECCENTRIC are organized into four common phases in order to ensure (i) process comparability, (ii) a common evaluation base and (iii) consistent transferability for the foreseen uptake and measure replication in other cities. The project implementation scheme is shown in Figure 1.

In the following, all ECCENTRIC demonstration measurers taking place in the Munich project area (‘living lab’) are shortly presented within the respective topic frames. Above mentioned activity phases are only considered summarized or strongly reduced due to the frame of this paper.

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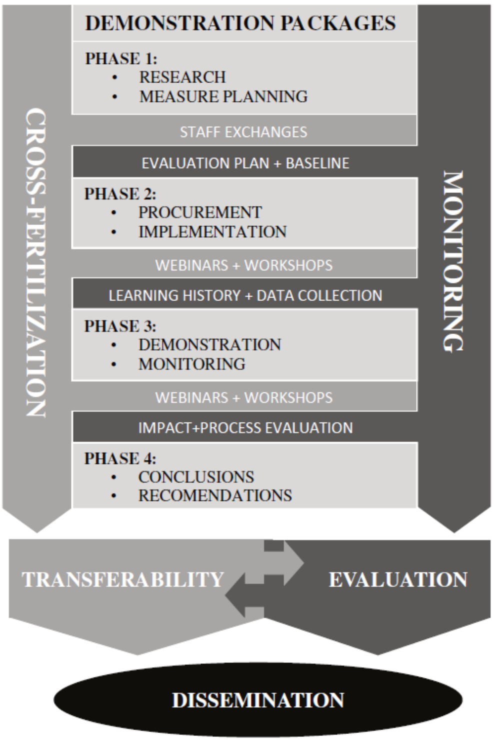

Fig. 1: CIVITAS ECCENTRIC measure implementation scheme

3.1 Sustainable and shared mobility

An integral part of sustainable mobility concepts intended to reduce parking pressure and high traffic volume in suburban city districts is the extensive roll-out of shared mobility services. Only easily accessible and user-friendly offers for any purpose at any time are a real alternative to individual car ownership. Nobody is forced to give up the private car if it is not desired - but everybody should have the opportunity to do it. The goal is to enable higher living quality and entired mobility, without the basic necessity to own a private car.

3.1.1 Intermodal E-Mobility stations

Important backbone of the new mobility concept in the living lab is the development of four intermodal E-mobility stations, providing a combination of different types of (shared) mobility services, ensuring that suitable means of transport are available for any purpose at any time. The mobility stations will be integrated in public space and accessible to all residents of the living lab and beyond to everyone who is registered customer of the service providers integrated within the mobility station. The new and innovative aspect is to combine several sharing mobility technologies (car-sharing (stationary, free floating, electric), (e-) scooters, cargo- and normal bikes) in connection and complementation with the use of public transport like trams and buses. A great challenge but also essential part of the mobility stations, is the provision of one common booking service where all sharing services are available. Consequently, the aim is to bundle all relevant stakeholders within an interactive service pillar at the station. Further on, the existing mobility app of MVG (Munich Transport Corporation) will integrate all mobility services provided at the station and guarantee an easy mode of booking from anywhere online.

Furthermore, the selection of services provided at the different mobility stations is foreseen to be completed in the future by two newly developed (prototypic) vehicles: an E-Trike for physically impaired people and an Electric light-weight vehicle, as presented in the following.

3.1.2 E-Trike-Sharing

This demonstration measure consists of developing a prototype of an E-trike and analysing barriers and drivers for its later integration into the existing bike sharing system in Munich (MVG Rad). The ultimate goal of this measure is to provide a concept of an alternative prototypic mobility service for elderly people and/or those who are physically impaired.

The development concept is based on a multi-level approach: a questioning of potential users is the basis for a needs assessment and tailored construction plan. In parallel, several master thesis with topics related to power units, frame constructions and user apps will define further details of the concept. The construction of the prototype in the innovation and founder centre of the Technical University of Munich (TUM) will enable comprehensive user tests and evaluation processes.

3.1.3 Electric light-weight vehicle

Until now, the field of electric mobility has to deal with several severe problems: the need for several hours of battery charging time, higher investment costs for the vehicle purchase and the costs and needed space for the installation of an area-wide battery charging system. In fact, a rentable business model especially for the use of electric vehicles in services and logistic usages has not been developed yet. In addition, new solutions are mostly limited to vehicle construction concepts – the integration within a future orientated mobility system is not taken into account as well as the problem of inefficient utilization and space consumption of cars that are only in use for 10-20 % of their time.

The Adaptive City Mobility (ACM) vehicles provide a new solution within the field of e-mobility and fit directly into the idea of the evolving "sharing economy" and provide a new form of "urban commons". ACM offers a new designed E-light-weight vehicle that only weights 450kg (batteries excluded). In addition, the vehicle is based on an innovative manual battery change system that reduces the standing times of the vehicles. It is a completely new designed vehicle concept in a newly developing market niche. The multimode software makes multipurpose usages possible: "One for all" - for passenger transport, delivery services / logistic and freight, as tourist car and for car sharing as well. By that, it helps reducing car ownership and car density within cities which means in turn more space for a liveable city. In addition, through the battery swapping system, long charging times can be avoided and the cost efficiency of electric mobility is increased.

This measure consists of organizing test trials and demonstration events in which people from different target groups can try the vehicle for multiple uses. Based on the feedback from the users, a business model for its wide uptake will be developed.

3.2 Mobility management

Mobility management is a comprehensive measure that embraces all mobility services and offers in the neighbourhood, promotes these to the target groups, and encourages an intensive and enduring, demand – oriented use. Within ECCENTRIC, a comprehensive mix of mobility counselling initiatives, supporting tools and training offers for various target groups are foreseen to be implemented in the living lab.

3.2.1 Mobility counselling

The most extensive demonstration measure comprises information, communication, marketing and mobility counselling about all sustainable mobility options and multimodal mobility services available in the Domagkpark and Parkstadt Schwabing living lab. Pilot actions will focus on the target groups living, working and moving in the living lab area, i.e. private households, local childcare facilities and schools, and local companies.

In order to ensure familiarization with and acceptance of the new offerings, a marketing campaign is required which is customized to the target groups and related to specific occasions. In this context, the measures of the successful and award-winning ('URBACT 2017') Munich action program for mobility management "München - Gscheid Mobil" for local issues of concern (target groups, offers and occasions) will undergo continuing evolution and implementation as community-related mobility management:

- The core is formed by extensive direct and dialog marketing which addresses individual households in a personal and individualized manner. It provides information, consultation and services about the mobility offer in the area in a multi-level dialog.
- Based on the Munich approach of mobility biography, a concept for mobility training and management will be developed for the school that is located in the community as well as for daycare facilities. This concept is intended to, on the one hand, reduce delivery and pick-up service by car, both for improving traffic safety and for ecological and social reasons. On the other hand, this approach will help parents, teachers and children to also design their everyday mobility in a sustainable manner. The focus will be aimed at increasing traffic safety on the way to school.

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- In order to optimize and use the full capacity of the mobility offerings provided by the residential community of Domagkpark and the commercial area of the adjoining southern Parkstadt Schwabing, all companies will be provided with an opportunity for mobility consultation. Interested companies can receive expert advice on mobility management with the objective of reducing commuter traffic of staff members and customers and shifting such traffic to sustainable means of transport as well as dedicating parking space to other usage.

3.2.2 Interactive mobility training

Exchanging communication and information technology for everyday mobility between generations is the content of a measure, where teenagers aged between fourteen and eighteen years old will teach senior citizens how to use internet, smartphones and applications for organising their daily mobility.

In a first phase, students will be trained by mobility experts about technologies and devices for mobility planning and their use. This will contain using applications on smartphones and tablets, using the internet in general and mobility services in particular. In addition, pedagogical training sessions will be conducted where students will be teached in the interaction with elderly people and knowledge transfer.

A second phase will comprise the knowledge transfer to senior citizens who will join the project at this point. The students will now be in the role of a teacher, supervised by mobility experts of ECCENTRIC project partners.

This approach is intended to facilitate daily mobility of senior citizens (e.g. by travel planning using mobility-apps) and to motivate them to intensify walking, cycling, using public transport and car sharing models instead of using own cars or taxi services. At the same time, the students will improve their soft skills and abilities in communicating complex technical issues to an older generation.

3.2.3 Mobility-App for the Living Lab

This measure consists of implementing a mobility-app with real time information (e.g. availabilities, schedules) on offered mobility services in the Munich living lab in combination with real time measurements of local air pollution. The app will provide an opportunity to create a personal ‘green’ profile, e.g. by using tracking functions for the estimation of individual carbon footprints. Additionally, a network of automated, easy-to-use air quality measurement nodes will be implemented in the city lab. Automatically generated air pollution heat maps will be available in order to promote sustainable travel behaviour and to increase the quarter identity.

3.2.4 Mobility-App for deaf and blind people

In order to achieve a mobility system that is truly inclusive and attractive to all users, the adaptation to the increasing and at the same time changing demand for seamless door to door mobility should reach not only the “ordinary” people, but also people with special needs. New mobility offers should not limit their scope to be simple, fast and flexible to use. They should also be adapted to specific target groups. In this demonstration measure, the focus is on special needs of deaf and blind persons.

The goal is to implement a routing application for deaf and blind persons, based on existing services of the Munich Transport Corporation (MVG). This will be managed due to the implementation of beacons, which will give needed information to facilitate the mobility of this target group. Currently it is only possible to navigate and route outside through the public transport, but it is not possible to navigate passengers indoor in order to switch mobility services, route to the next connection or find the exit. During the development phase the beacons will be temporarily installed in a public testing-place close to the Munich living lab in order to test the application in cooperation with the local association of deaf and blind persons. As a result of this measure, the opportunities of beacons for indoor routing in public transport station in Munich will be evaluated.

3.3 City logistics

In the last years, the volume of traffic caused by delivery services has increased rapidly with the success and rapid growth of e-commerce. Main effect, especially in inner city areas, is a tremendous increase of delivery trucks often combined with dangerous situations and conflicts between the trucks, pedestrians, cyclists, cars and other road users. Effects on air pollution and living quality don’t need to be mentioned separately at this point. Within ECCENTRIC, two measures will be implemented in order to substantially reduce the delivery traffic in the living lab but also in the Munich city center.

3.3.1 Neighbourhood-oriented Concierge System

The residents of the Munich living lab Domagkpark are suffering from a large number of delivery tours by the various delivery services (usually including a first delivery attempt and if unsuccessful, a second and sometimes even a third attempt). The provision of a concierge service, managing packages sent to and from residents of the Domagkpark, will contribute to reduce vehicle kilometres travelled by the delivery trucks in the covered area. Residents will be able to walk to the concierge service, send goods or pick up delivered goods or even get their goods delivered by the local concierge on the 'last mile' with an eco-friendly electric cargo bike (100% carbon free energy). To increase the attractiveness of the concierge business concept and to support the mobility concept of the neighbourhood, further manual services (e.g. electricion and painter services) are foreseen to be imparted by the concierge service.

3.3.2 Eco-friendly logistics

The use of electric cargo bikes for delivery services was also a key aspect for the design of a city-wide demonstration measure aiming to reduce and partly replace motorized courier services in the city centre. The delivery of goods by (cargo) bikes has a great potential to keep the city accessible for freight transport and to improve road safety. Compared to ordinary bicycles, cargo bikes have a higher load capacity and facilitate the bundling of deliveries. To extend the use of cargo bikes, a flexible storage system will serve as an interface where cargo can be handed over from cars to cargo bikes and vice versa. Due to limited space in the inner city, a system of flexible boxes will be used to help delivery services to continuously optimize their disposition.This measure will test several boxes and logistic systems in co-operation with delivery companies. The boxes will be located at the boundaries of the city center. Deliveries combining the use of cars and cargo bikes will furthermore improve the cost effectiveness of all actors in the logistic chain. Cargo bikes will be able to bundle deliveries and thereby fully use their higher load capacity. Car messengers will save time, because flexible cargo bikes will take care of deliveries on the last mile.

3.4 Road security

Often overseen is the fact that sustainable mobility basically starts with the guarantee of the physical integrity especially of the road users, who chose sustainable modes of transport, like pedestrians, cyclists and public transport users. Cities, which want to promote cycling, walking, the use of public transport and sharing mobility services have to improve the safety and the reputation of safety of this modes and their use. For some time, Munich and a lot of prosperous European cities are faced with a strong growth of cycling traffic, demographic change, general increasing road traffic and increasing complexity of traffic light programs at crossings. This requires new road safety strategies, concepts and innovative measures, especially considering safety needs of the most exposed road users, like cyclists, pedestrians, handicapped people, senior citizens and kids.

With the help of a new software tool, geo-referenced accident data of the past five years (approximately 200.000 accidents in Munich) collected by the police are linked to data of traffic models and other sources, e.g. infrastructure data. Based on this information, potential accident situations can be forecasted and the municipal urban and traffic planning can cooperate with the police in order to take preventive measures which significantly reduce the likelihood of accidents on the living lab's road network. A safety audit of roads in the living lab based on new IT preconditions will be further tested in Munich for the first time.

4 MONITORING AND EVALUATION

The multiple measures of the CIVITAS ECCENTRIC project in different local contexts explore answers to the shared challenges of sustainable urban mobility. Only a thorough evaluation on the level of the individual measures as well as across the living laboratory sites in the ECCENTRIC partner cities will enable common learning. The evaluation process is based on common objectives, comparable criteria across work packages and cities, and a robust set of common indicators. The Technical University of Munich (TUM) is responsible for a consistent process and impact evaluation of all conducted measures in order to provide sound information about all relevant project outcomes.

4.1 Impact evaluation

Several methods are used for the individual measure evaluation, comprising literature research, interviews and surveys. In order to define a baseline for the measures to be implemented in the Munich living lab, an ex-ante household survey will be carried out at the beginning of the project and will gather data on e.g. modal split, vehicle kilometres travelled and vehicle ownership as well as awareness and attitudes regarding mobility measures implemented in the framework of ECCENTRIC. Consequently, an ex-post household survey will be carried out in order to contrast the results of the first survey and determine the impact of measures in the living lab. For measures with no direct influence in the living lab, individual surveys and data collection methods will be carried out.

4.2 Process evaluation

The process evaluation aims to identify barriers and drivers for the successful implementation of the ECCENTRIC measures. It focuses on the means and procedures by which a measure is implemented throughout all phases of the project, from research and planning, procurement and implementation and demonstration or operation. For the basic evaluation level, a review of the Measure Progress Reports and the use of standardized forms will be used. For the detailed evaluation level, interviews and workshops are planned.

5 CONCLUSION

Within ECCENTRIC, a model quarter for sustainable and city-compatible mobility will be developed and is supposed to be an ideal for further development areas in Munich. Therefore, a wide range of demonstration measures in the field of sustainable and shared mobility, mobility management, city logistics and road security will be implemented in the Munich living lab within the project duration. All measures are based on a consistent implementation scheme and will be scientifically attended and evaluated, in order to provide sound recommenations for the intended uptake and measure replication in upcoming development areas of Munich and also in other German and European cities.

6 REFERENCES

ADAPTIVE CITY MOBILITY (ACM): http://www.adaptive-city-mobility.de/en/
CIVITAS ECCENTRIC project: http://civitas.eu/eccentric
CIVITAS ECCENTRIC Munich: http://civitas.eu/eccentric/munich
CYCLING CITY MUNICH: http://www.abcmultimodal.eu/cycling-city-munich.html
MUNICH FUTURE PERSPECTIVES: http://civitas.eu/sites/default/files/munich_future_perspective_en_web.pdf
MUNICH TRANSPORT COOPERATION (MVG): https://www.mvg.de/en.html
URBACT Good Practice City 2017 ‘Munich’: http://urbact.eu/bright-mobility-management

The Need of the Establishment of a Federal German Sacral Building Authority for Islamic Faith Affairs – Roadmap and Capacity Building of an Institutional Framework for Religious Communities, State Bodies and Citizens in Europe

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7 ABSTRACT

Rising trends of migration to Europe and the combined efforts of the integration process by the German Government and a great variety of stake holders highlights new aspects of developments of the civil society within Germany. By the end of 2015 an estimated 4.5 million Muslims (5.8%) were living in Germany. The majority of German Muslims are of Turkish origin (63% / 2008) and migrant labourer who came as "Gastarbeiter" during the 1960 and 1970s. There are no exact studies of the numbers of strong religious practitioner in Islam in Germany. In the past decades Muslims who attends religious services had little options in worship in appropriate sacral facilities. Most religious services are held in so called backyard house of prayers. Those sacral infrastructures are allocated in the industrial centres in Germany. The numbers of suitable mosques and house of prayers is slightly rising. The aging population of migrant workers of the first generation, the renaissance of religions within a globalizing world and the influx of refugees from the Middle East is enhancing the demand of applicable places for religious worshipping and parochial orientated social services. The further expansion of parochial facilities is limited by the carefully tread of the current Muslim communities, the missing adequate dialogue within the council administrations and planning boards. Germany is a country of a rich European heritage of sacral building culture and tradition. By a century long tradition a fundament were led by the churches, religious foundations and rulers in construction of sacral buildings and social infrastructures. Today there is a well functional system of church owned building departments within the country. The two established German Church institutions are currently facing a declining number of worshippers, caused by ageing population and the ongoing trends of secessions from the churches. This paper is focused on the current request for sacral buildings and site religious social infrastructure for the Muslim minority within the framework of freedom of worship granted by the German constitutional law. In addition perspectives are given for a potential need of adequate properties and land resources for the next twenty years. It discuss the demand of an institutional body as an acting contact point for setting the standards of religious aspects within the framework of German and European building codes and planning basic principles. Further on alternative options were disputed for the common or separated use of social facilities of different religious faith in order to sustain the necessary precaution for the local population.

Keywords: European islam, religious heritage, sacral building, migration, institutional building

8 INTRODUCTION

8.1 Overview

The Federal Republic of Germany as the economic power house of Europe underwent different phases of immigration of sections of the population and ethnic groups into the country the last sixty three years. It is a story of success starting from the integration of a vast number of German refugees fleeing from the Eastern parts of the former German Reich after WWII, through the integration of migrant workers within the 1960/70s. Further on into the assimilation of millions of migrants of German origin from the former Soviet Union, the unification of Germany and the admittance of the civil-war refugees from the Balkans during the 1990s. Since the 1960s when Muslims or migrants coming from Islam dominated countries to Germany or Europe, they are often subject of demagogue and populist campaigns. Representing just 5 % of Germany's total population, they are the current target group for populist parties.

8.2 Muslim communities in Germany in the framework of globalisation

Within the context of Muslim community life in the Federal Republic of Germany the country can look back to the early phase of foreign workforce migration to the country during the 1960/70s. Founded by the enormous influx of refugees from Islam dominated countries in 2015/16 a base of Anti-Muslim hysteria were set-up. The wrong communication policy by the German government to the German people and the misunderstanding of the decreasing level of tolerance by the German society in relation to the rising numbers of displaced persons arriving to the country had an negative impact to the ongoing process of integration of minorities. As a result most of the progress of the former dialogues were minimized.

8.2.1 Status and situation of Muslims in Germany

The history of early Islam in Europe is connected with a long standing attempt to conquest the Continent. It starts in the 8th century by the Umayad conquest of Hispania and the establishment of the Kingdom of Al-Andalus. Through the Otoman Empire and the conquest of land in todays Russia and Ukraine it finds its ways to the edge of Europe mainly during the 14th 15th century. The most long standing Muslim communities in Central Southeast Europe are the Muslims in parts of the Balkan like Bosnia and Albania. As a result the Islam never had the chance to conquest Europe. By surveying the statistical data base by 2010 an estimated 44 million Muslims were living in Europe (6%), including an estimated 19 million in the EU (3.8%) . They are projected to comprise 8% of the total poulation by 2030. In December 2016 an official extrapolation by the Research Centre of the Federal Office for Migration and Refugees on behalf of the German Islam Conference gave new numbers of Muslims living in Germany. The result is that between 4.4 and 4.7 million Muslim men and women were living in Germany on 31 December 2015. Accordingly, out of a total of 82.2 million inhabitants, between 5.4 and 5.7 percent belong to the Muslim faith. . The majority of German Muslims are of Turkish origin (63% / 2008) and migrant labourer who came as “Gastarbeiter” during the 1960 and 1970s. They came to Germany to fill the gap of sufficient numbers of workforce for the economic development. Most of them were deployed in unattractive job positions. Having planned to stay a few years the Turkish workers in comparison to other work migrants of other nations did not move back to their homeland. After having live for more than fifty years, married and raised their children in Germany, the majority of the migrants decided to stay in the country. Till the German reunification in 1990 most Muslims in Germany were located in the industrial belts and centres of the Western part of Germany. As a fact of being a quite small minority within the German civil-society, the integration process of Muslim living in Germany is a relation to be shy with strangers. Both parties involved, the German politics and administration on one hand and the Muslim communities on the other side are lacking on sufficient efforts in managing a qualified integration process. German politics and the main parts of German society did not accept the fact, that most migrants of Turkish or Islam dominated origin within the Country are a real part of the German civil-society after being stayed more than fifty years. At the second half of the 1980s sociologist scientists and politicians starting a debate to do more efforts for the better integration especially of migrants with an Muslim background. They are still a subject of discrimination. That was accompanied with discussions to reform the residence permit regulation for foreigners. This discussion was halted by the German reunification in 1990 and the economic and social integration process within the unified Germany. The population development – the so called demographic change – after the turn of the millennium regain one´s momentum to reform the integration process in the country.

8.2.2 Islam in Germany influenced by developments in the International context

A renaissance of Islam can be observed since the 1970s in the global context. Accompanied by the strengenthsing of the Islamic brotherhood movement in Egypt, which spread all over the Middle East, the Islamic Revolution of 1979 in Iran and the theological and financial support of conservative Wahhabi faiths all over the world by Saudi-Arabia. Germany and the German society was nearly not affected by this. The first changes came up during the break-down of the former Yugoslavia in the 1990s and the civil-war in the following states of Bosnia, Macedonia and Serbia. This caused a wave of refugees from the Balkans. Later on the political, economic and cultural achievements of the Turkish-Islamic movement of Erdogans AKP party during the End of 1990s to the 2016 influenced the Turkish community living in Germany. Accompanied by the events of 9/11 in the USA and conflicts in the Middle East an instauration of Islamophobia arise in the mass media of Germany. Islamophobia is defined as fear of Islam, esp. as a political force or hostility towards Muslims. The cultural and social exchange between the Turkish community and their homeland were always very strong. Inner Turkish politics are currently misused by all sides to disqualified the harmonic Turkish-German relationship.

8.2.3 Sacral infrastructure and parochial orientated social facilities for Muslim practioners in Germany

Muslim community life is still a young and hided and unknown part in our society. The developments to establish praying rooms started mostly during the 1970s. In the past decades Muslims who like to attend religious services had little options in worship in appropriate sacral facilities. Most religious services are held in so called backyard house of prayers. Those sacral infrastructures were often founded in abandoned industrial buildings within industrial zones in Germany. After more than forty years the number of suitable mosques and house of prayers is slightly rising. The reasons are the state of being more emancipated Muslim communities and the better financial situation. The aging population of migrant workers of the first generation, the renaissance of religions within a globalizing world and the influx of refugees from the Middle East is enhancing the demand of applicable places for religious worshipping and parochial orientated social services. The further expansion of parochial facilities is limited by the carefully tread of the current Muslim communities. There is a missing of an adequate dialogue within the council administrations and planning boards. These lack of communication can be identified as the central iussue in start. In analogy to the real estate task of Muslim communities there are needed structures to be adopted in boths of the great churches. As Germany is a country of a rich European heritage of sacral building culture and tradition, lessons can be learnt. By a century long tradition a fundament were led by the churches, religious foundations and rulers in construction of sacral buildings and social infrastructures. Today there is a well functional system of church owned building departments within the country. The state and the two major churches have set up a system of finance, construct and maintain sacral buildings and social facilities. Since more than twenty years the two established German Church institutions are facing a declining number of worshippers, caused by ageing population and the ongoing trends of secessions from the churches. As an alternative the current request for sacral buildings and site religious social infrastructure for the Muslim minority could be met by the re-use of the church properties. In addition perspectives are given for a potential need of adequate properties and land resources for the next twenty years. Due to the strong demand to serve the needs of practising Muslims and provide the infrastructural facilities and installations within a proper environment to practise their worship guaranteed by the constitution. which is avoiding possible reactions of majority. Missing expertize show the need for an institutional body as an acting contact point for setting the standards of religious aspects within the framework of German and European building codes and planning basic principles. The establishing of an Federal Sacral Building Authority for Islamic sacral infrastructure is one of the different steps to create a technical and institutional framework for serving consulting and accompanying all citizens especially the Muslim communities, the state administrations and the society. There are further alternative options were disputed for a common or separated use of social facilities of different religious faith in order to sustain the necessary precaution for the local population.

8.3 Analysis of current state of research

By doing research in the subject area of “sacral buildings and social infrastructure for Muslim communities in Germany” the outcome is quite sobered. This area of expertise needs a wider support by the scientific institutions, the public administration and politicians. A lot of theoretical and basic research, discussions and strategies to implement the need for solving that iussue has to be done. Even the Muslim communities had to put their focus to this technical and organisational field of work to formulate the duties and responsibilities for their executive boeards and the governmental administration to meet the demands for having a society tolerated and integrated spiritual life within their religious faith. This young field of research has lots of potentials to exame.

9 THE ENLIGHTENMENT, STATE BUILDING AND SECULARIZATION IN GERMANY

For establishing a structural base for sacral infrastructure for Muslim communities, the status and history of the relationship between the state and Christian communities have to be observed. The relations of the German state to its major religious institutions is a history of a century long power struggle between the mundane aristocrats of Europe to the Roman Catholic Church in Rome and the local branches of the Catholic Church represented by their bishops within the regions. Initially a war between various Protestant and Catholic states in the fragmented Holy Roman Empire,. The early stages were meld by the Protestant Reformation during the 16 th Century, which resulted in the Thirty years war. Ended with the Peace of Westphalia. It was one of the most destructive conflicts in Europe where major parts of German territory and settlements were completely destroyed. Up to now the country is still traumatized by this deadliest religious

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war resulting more than eight million casualties. The Protestant Reformation came in effect in diverting the country in two Christian faiths each identified by the believe of the local or regional ruler. The power struggle continous the next centuries frequently.

9.1 Secularization

The church as a refuge of social institutions and education during the middle age, lost this status by two major developments. The most important refers to the historical process of Secularization during the French Revolution and later on the Concordat of 1801 in which Christian religion lost social and cultural significance in Central Europe. In parallel to the Catholic Church in the reformation phase, both churches lost lands and properties by seizure acts and confiscation by the state. The Concordat was an agreement between Pope Pius VII and Napoleon of France. It solidified the Roman Catholic Church as the majority church of France, with most of its civil status restored. But it did not restore the vast church lands and endowments confiscation during the French Revolution. Those events had similar effects on the balance of church-state relations in Germany, too. In 1803 during French occupation of the German Rhine provinces, German aristocrats lost lands in Western Rhine area. The French Empire using confiscated assets and property of the church to reimburse the princedoms in financial means. Most of the church estates as like as monasteries and residences of bishops accumulate to the German royal families. Those ruled by royal families like four kingdoms, six grand duchies and six duchies. The “Reichsdeputationshauptschluss” (German mediatisation) of 1803 , ratified by the Imperial German assembly same year, used as road map organizational chart plan how to prepare the reparation of the German royal families. A detailed compensation plan proceeded to occupy the prince-bishoprics, imperial abbeys, and free Imperial cities that had been allotted to them. By this annexation organizational and social aspects arise. So there was the question how to handle and finance the duties and the payments of staff, maintain the buildings, facilities etc. of the former ecclesiastical principalities and bishoprics estates. By social means many of the staff lost their jobs and poverty. Huge gueter and were switched to foundations status. The proprietary outcome had special effects on the relation between the state and the church. As a result of the secularization and the compensation plan a major territorial restructuring of German regions took place. Large numbers of wealth, property, Imperial Estates, ecclesiastical principalities and other bodies lost their independent status and were transferred and integrated into remaining duchies or kingdoms within Germany. Germany shifted from an Roman Catholic church dominated Country to a much more protestant lutherian church orientated state. Especially the King of Prussia, who was in majority protestant lutheran benefitted strongly from the clash between the state and the Roman Catholic Church. Even after the German mediation Prussia continued its campaigns against the Roman Catholic Church. This phase was named “Kulturkampf” culture struggle is a German term referring to a set of policies enacted from 1871 to 1878 by the Prime Minister of Prussia, Otto von Bismarck, in relation to secularity and the role of the Roman Catholic Church in the Kingdom of Prussia. Jesuits, Franciscans, Dominicans and other orders were expelled in the culmination of twenty years of anti-Jesuit and antimonastic hysteria. The other effect were the German/French war 1870/71 and the unification of Germany enabling of the German Reich dominated by the protestant Prussia. The Kulturkampf ended about 1880 with a new pope willing to negotiate with Bismarck. Till 1887 several new laws were decreed to regulate the proportion between the church and the state. The aftermaths of proprietary transferring of assets to the state and the mischief to the church were never reversed by the state. But during the early days of the mediation the state started to reduce the hardship of a few victims like staff and monks in the beginning or to take on responsibilities for buildings, social foundations and properties. Although it takes nearly two hundred years accompanied by many negotiations and agreements to find solutions to create a normal understanding between both main churches and the state.

9.2 Setting-up the constitutional base of the relationship between the state and the religious bodies and churches within Germany

The most important agreement was the Weimar compromise after the WWI. Since the “Weimarer compromise” of 1919 the churches and all other religious institutions gain the special status to act as non-state bodies / corporations under public law. Set in the third section of the “Weimar Verfassung” (constitution) freedom of faith is ensured. Article §137. disclaim the existence of an state church. Granted by the so-called “Kirchenfreiheit” ranked as an constitutional level all religious bodies are guaranteed to have a self-governing structure. The Art. §§ 136, 137, 138, 139, 141 of the Weimarer constition regulate all. The

Weimar compromise is by separate interstate treaties between the Federal and the Laender governments to the churches and enlarged to other religious confessions. In comparison no one of the different Islamic religions applied for the status to be a body of law in Germany.

10 CONCLUSION

Muslims living in Germany have an perfect environment to practise their individual worship to their faith. To do the worship in greater groups or well equipped mosques, it depends on the region and the status and abilities of the local religious communities. Because of secularization of Germany the religious communities are independent and have to act by ones own initiative to create an sufficient religious infrastructure for their religious needs. In comparison to other European countries (Britain and France) the situation of Muslims living in Germany to have a comfortable standard to practise their religious is disappointing. Since 2006 the Federal Government represented by the Minister of Interior set up the German Islam Conference as a platform for dialogue between the different Muslim communities with represantatives of the political class, the administration and German society there is a slight move for discussing options and strategies for a better integration of Muslims. In 2017 the results of the ongoing process of the joint German Islam Conference showing some slight developments, but the overall situation is still unsatisfactory. Caused by the emergence of demographic change of population, the availibility of church property and the influx of more Muslim people it is necessary to create efficient structures. As an important milestone a work group of experts should be set-up. The members should be a selection of the experts from the targeting fields. These are architecture, construction, the cultural and heritage sector. The work group could give the right stimulus for the establishment of an Islamic building Authority for Germany.

11 REFERENCES

Forschungszentrum des Bundesamtes für Migration und Flüchtlinge: Wie viele Muslime leben in Deutschland?; Working paper; Nuerernberg; 2016.

Deutscher Bundestag. Integration von Flüchtlingen mit Hilfe von Islamverbänden, Drucksache 18/7123; March 2016; Berlin 2016.

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Transformation of Public Spaces and Changing Pattern of Mobility in a Historic City, Case Study: Isfahan, Iran

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1 ABSTRACT

Esfahan is one of the central and historic cities of Iran, which dates back to 2000 years ago. The city is enriched with crafts and folk art, which has lead to it being registered as part of the Creative Cities Network of UNESCO. The centerpiece of the city, NaghsheJahan Square, was inscribed as a UNESCO World Heritage Site in 1979, and it well represents the brand of the city Esfahan; its intricate mixture of historic architecture, viable urban space for work and recreation for its citizens, and a welcoming landmark on tourists' maps.

The variety of typologies used to build the urban spaces has lead to strong pedestrian patterns throughout a coherence network. Hence, these areas have a powerful potential to change structure, mobility patterns and people's perception.

In spite of this, in recent decades, new developments and urban changes such as mega malls and recreational sites have resulted in new poles in design and architecture in the outside areas of the urban city. This phenomenon is leading to movement of people, energy and resources as well as changes in life styles, the image of the city and its mobility patterns.

The objective of this article is to further analyze and discuss how urban transformation and urban changes in a micro and macro scale affect the mobility pattern and pedestrian flow. In order to this, methodology used is based on analysis of literature and environment in two levels; first, urban transformation analysis based on public urban space's typology and urban space analysis; and second, mobility patterns based on space character and pedestrian flows.

The results show that emergence of structures such as megamalls City Center or Dreamland Project create daily driving flows, which decrease urban space's perception.

In conclusion, in historic cities, such as Esfahan, urban changes should be planned and centered around its historic fabric, and public urban spaces should be designed and controlled with mobility's patterns in mind.

Keywords: Esfahan, historic city, mobility, transformation, urban space

2 INTRODUCTION

Isfahan is one of the central cities of Iran. It has a long history of various civilizations. One of the most important period, in which fundamental changes made in the city, began about 400 years ago when it was re-established as the capital. During this period, the city consisted of large buildings along with useful, huge urban spaces and infrastructures. In that time the government acted powerfully that it brought about structural transformation, and so far its importance has not been diminished.

The transformation process in the entire Isfahan City has created a variety of new urban spaces.Different types of squares, recreational-commercial spaces and local urban spaces have been created from the standpoint of spatial typology. The contrast between the nature of traditional textures and the policies of decentralization of the city center has created forces that have led to exogenous development and the duality of use of spaces has practically emerged. The main structure of this city, which is located on two natural axis of Zayandehrood River and Abbasid Charbagh Street remained from the Safavid urbanism, has aregular and organic structure. In fact, the main structure of Isfahan was created by Safavid urbanization changes. But in recent decades, new spaces have raised a new subject that different mobility has been created in the city. Pedestrian presence is one of the main mobility in a city that depends on the identity and mental health of citizens.

3 DIFFERENT PERIODS OF URBAN SPACES TRANSFORMATION PROCESS IN ISFAHAN

The evolution and development of the Isfahan City can be described in five periods in terms of physical structure as follows:

Period I: from the end of the Sassanid era to the beginning of the Islamic era (the Abbasid era)with the character of neighboring urban cores.(750-1258)

Period II: Isfahan during the Seljuq era with the character of the interconnected and enclosed city (1037-1194).

Period III: extensive development of the city in the Safavid era ; with the view of open city. (1501-1722).

Period IV: Isfahan in the Qajar era. (1789-1925).

Period V:Contemporary Isfahan in the last century.

In the Seljuk era (1037-1194), Isfahan had a coherent and central structure and texture in which the main spaces and residential and governmental textures were placed surrounding the Atigh Square and the Jame Mosque. Therefore, if one wants to talk about the urban spaces in the Seljuq era, he must consider square, street and markets as the most important spaces.

In the Safavid period (1501-1722), which is the brightest period of urbanism in Iran, Isfahan was the capital of Iran and the center of civilization and urbanism has culminated with the new concepts such as ChaharBagh, square and royal gardens. Walls have been built on the four sides of ChaharBagh. The royal gardens were located in it and it is interesting that people can go there freely, and in fact they could be considered as semi-public spaces. The combination of plant and water and built environment in this street and the gardens surrounding it created a unique space. Public spaces, in addition to ChaharBagh and Abbasis street and other main streets and covered streets, have been formed by several squares and the most important squares are the NaghsheJahan Square (Shah Square) and the Kohneh Square(Atigh square). The first urban planning was planned in Isfahan and performed during twenty-five years and then. It became a model for many other cities. The re-capitalization of Isfahan led to the flow of wealth from other parts of Iran to the city and culminated in economics and mobility. This culmination was beyond the Seljuq era and all subsequent periods until contemporary reforms in the third and fourth decades of the twentieth century.

During this period, Shah Abbas directed the main development of the city outside the limits of Seljuq Isfahan and towards Zayandehrood and then, its south. The neighborhoods of Jolfa, Gabrha and Tabriziha, which were disconnected from the main city, gradually connected to it.The Naghshe Jahan Square was built and the main building, such as the royal palace, mosque and Bazar were placed around it; Keisaria gate opens into the Isfahan Grand Bazaar.

Designing a new and vast urban street called ChaharBagh, and creating a broad square with a clear definition of spatial arrangement as the new center of the city and not as a new city, makes it possible to use the concept of urban zoning in organizing the Iranian city for the first time; (Fig 2)

Fig. 1: Different periods of Isfahan

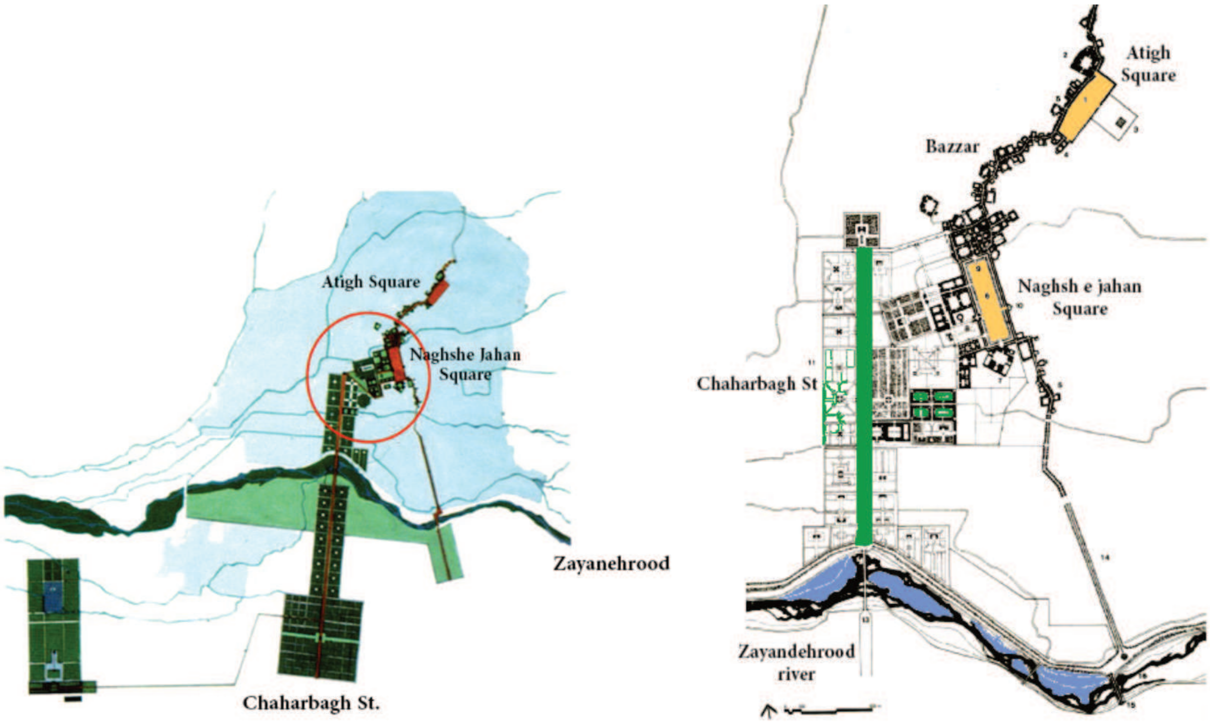

Fig. 2: Safavid City Structure, Ttwo Axies, Zayandehrood and Chaharbagh, Pedestrain And Coach Mobility.

Fig. 3: Chaharbagh, now and safavid period.

In such condition which the axis has been formed during the ten centuries of Iran's urbanism history after the Islamic era and before the Safavid era, formation of straight urban axes have become important and valuable as much as the market in addition to the creation of urban open space in the role of recreational and tourism walkway. It can be said that the urbanization of Isfahan in the Safavid era presents two types of specific urban axeswith a completely different structure to the urbanism in the world. The first type is an organic and covered axis of markets which is the dominant element in providing the city's economy and since it spatially connects the squares, mosques, caravanserai, etc. to each other, it is considered as one of the most powerful public spaces.Such a structure with the scale of Isfahan market design can rarely be found as a continuous urban axis in the urbanism history of other territories. The second type is the green and straight tourism axis in a given scale. In addition to playing a role in providing urban green space, it is considered as urban public space by placing a specific architectural element around it and linking it to other important urban spaces (Ranjbar et al., 85).

Therefore, in this period, new urban spaces such as the construction of Si-o-se pol and Khajou bridges, provided a new type of water-side space. Holes, benches and platforms of the bridges provides a space for a fun gathering in addition to the service and movement space. Construction of the new square of Naghshe Jahan Square on the southern side of the Kohne Square(Atigh Squre) was performed with respect to the old center, and, in order to connect these two centers to strengthen the Bazzar.

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After that in the Qajar period (1789-1925), changes in the Safavid gardens began and this ends to the construction of massive mansions in the garden.In the Qajar period, the developments were focused on buildings with decorations and orientation. Also due to the powerful changes made during the Safavid period, the transformations were led to single building and cultural land-uses, all of which were created in imitation of Europe after kings' journeys.

In the Pahlavi era(1925-1979), due to the formation of network skeletons and the domination of the streets, the Bazzar lost its economic function as an enclosed and active environment in a specific set, and many active trading centers were built on sides of new streets to make the flows of capital and goods easier. In this period, urban life was based on two structures: old structure that was so strong that and the city would continue to live its urban life based on it and new structure which is based on traffic axes. Here, one of the most important transformations occurred in the mobility in the city. The streets where the cars moved in and walking was actually removed and the axes where the walking was prioritized. One of the most important urban transformations in Isfahan occurred during this period. In any case, urban developments in Isfahan have taken place without paying attention to its historical potentials, and the arrival of cars in the city, the formation of dense industrial and services centers, and the unidentified construction have disrupted spatial balance and urban life.

4 NEW DEVELOPMENTS AND THEIR IMPACT ON URBAN SPACES IN ISFAHAN

In the past two decades, the Isfahan city has been undergoing fundamental transformations through structural and infrastructural developments. Macro projects such as the reconstruction of the Atigh Square in the historical texture and the main core of the city have created new spaces and led to future changes in the city.

Urban spaces types in Isfahan suggest new spaces due to global and regional developments. The conversion of the permanent river to the seasonal river and the process of changing the nature and quality of the urban space surrounding it, the changes and developments in the historical texture and around the Naghshe Jahan Square and the creation of spaces with tourism axis, new redevelopment approaches in urban projects, such as recreation of the basic and event-based culture etc., all are of the driving forces of transformations of urban public spaces and creation of their new nature and types.

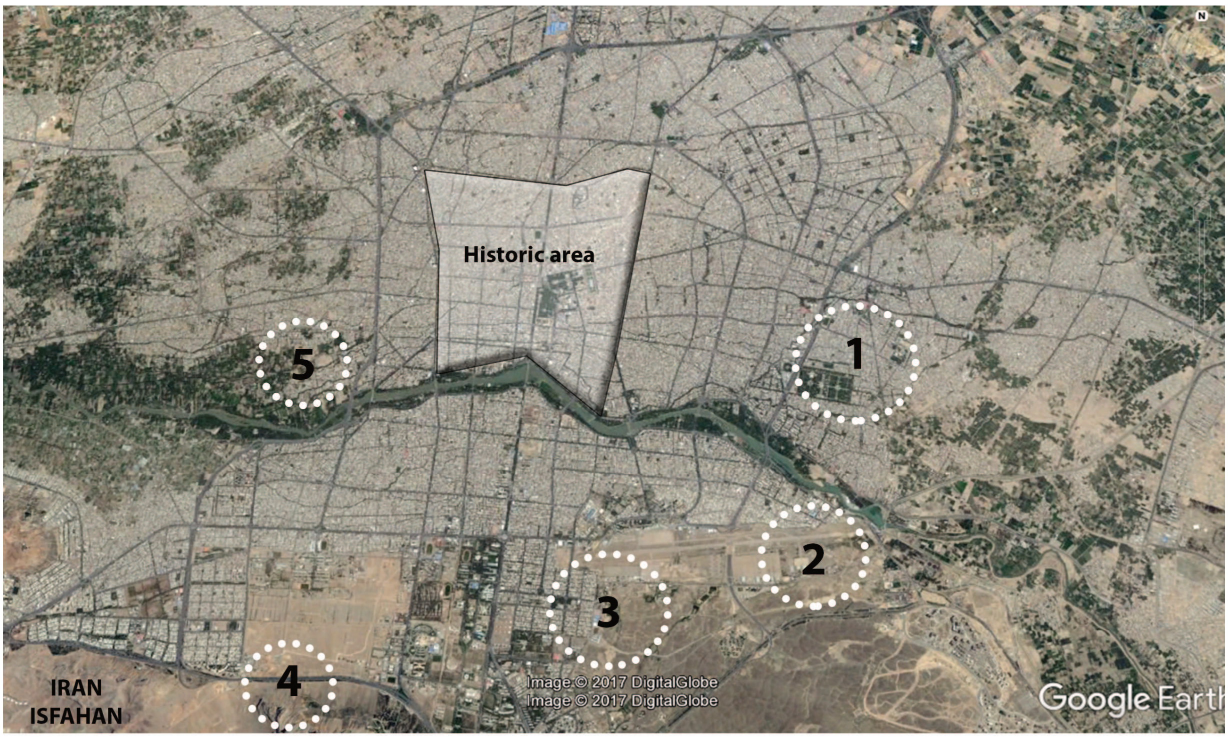

Fig. 4: New project and urban spaces (Google Earth, 2017)

So, in a summary, regarding the process of urban developments and transformations from the important periods so far, it can be claimed that, almost to the end of the Pahlavi era, the urban development has taken place within the city and no urban development was observed out of the city. Even the industrial factories were built within the urban area and emerged in the main axis of urban development; but, in the contemporary period and after the 1990s, the policies of decentralization of central textures led to the use of this American urbanization approachin the development. Therefore, the definition of projects such as City Center created a new and fast development pole along with internalslow changes.

5 EXAMINATION OF MOBILITY RESULTED FROM STRUCTURAL AND SPATIAL CHANGES IN THE CITY DURING THE LAST DECADE

There is two kinds of changes are taking place in the Isfahan City: on the one hand, creation of out of the central development and decentralization of the center, such as the City Center and Healthcare Center projects, etc. and on the other hand, the only focus is on the Safavid Historical structure not the historical textures, and also on minor and general changes. By looking at the totality of the textures of the central region and their spatial nature, it becomes evident that in the central regions, there is a need to create squares and urban green and open spaces in the future urban transformations and the potential for creating such spaces is available but urban developers and management institutions have focused the urban transformation process of the Isfahan city on the construction of infrastructures and streets.

The process of spatial changes in the central texture of the city is focused on the physical improvements of the ChaharBagh axis and its building and the creation of urban open spaces in the central texture parallel to Chaharbagh Street in order to facilitate traffic. Perhaps, reconstruction of the Atigh Square is one of the most important measures to increase and create urban open spaces because it provides a large space for pedestrians. Lack of space’s quality cause decreasing the vitality and presenting .So, this square could not worked with the structure and mobility of the city.

In this study, based on the analysis of documents and the study of the existing states at two levels of changes in the types of urban spaces and the resulting mobility, it can be concluded that some programmes as outer developements, the construction of the streets in the central areas to facilitate the traffic, the creation of closed spaces and megamals on the peripheral areas and adjacent highways and main streets other types of movement patterns have been created in a historic city such as Isfahan. These patterns come about as a result of macro structural changes. However, the central texture of the city has many pedestrian potentials, but as long as the out of central development is on the agenda, change process of movement patterns is based on the traffic and this imposes a kind of American urbanization on the city.

6 DISCUSSION AND CONCLUSION

A study of the changes in a city in different periods requires a historical interpretation. The beginning of the formation of the main urban spaces in Isfahan can be seen in the Seljuq period: establishing the main centers of settlement and building Jame mosque in the north of Isfahan which was considered as the only public space. After that, we witness the culmination of construction of urban spaces and structures in the Safavid era, where the main spaces and the urbanization art have reached their highest level and the spaces such as square, the tourism axes such as Chaharbagh, etc. were created and then in the Qajar and Pahlavi eras, no great changes were made. In the contemporary era, new urban spaces have emerged.

The development process in the historic cities of Iran is basically influenced by external driving forces such as globalization and urban competitiveness, politics, government and technology. At the level of metropolitan, these forces have caused different patterns of mobility in the city. This mobility is mainly based on high-speed movement and car driving in the main streets and has added daily journeys to the peripherial. Meanwhile, the central textures of the city with a coherent structure and high potential for pedestrian networks has lagged from the internal development and are generally degraded and transformed into an area for the automobile and a fast speed flows. The traffic constraints in the central texture affected by urban subway infrastructure development projects have inevitably led the surrounding axes to accept the vehicle. In fact, most of the spaces with the potential to become an urban space havs become the parking lot for cars. The axes such as Abbas Abad with an identity of street with many trees, have become only a passing axis.

Therefore, the nature of the transformation of urban spaces and the development of structure of a historic city should be based on the preservation of urban identity and perception. This requires attention to the mobility in the city and increasing the flow of pedestrians in the historical and central textures with focusing on

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internal development. This means that the movement infrastructure in the city should go towards general displacements such as the tram and metro and the pedestrian network is considered as the dominant axe in the central zone. Therefore, pedestrian networks with the nodes of precious urban spaces make it possible to increase the flow of pedestrians in the city and the central areas and this leads to the promotion of citizens' perception and, ultimately.

This research demonstrates the value of urban spaces transformation analysis in urban studies. Although mobiliy pattern affects on transformation of public spaces; transformation pattern creates new mobolity pattern. It depends on the power of public space which can influence the city main structure. Indices of this power are hidden and can be found in an integral analysis through social, economic, political and environmental interaction of public spaces and whole city. The scale of such analysis can be expanded to regional level.

7 REFERENCES

Azarm, Zahra ,Ranjbar, Ehsan: A New Framework for Sustainable Urban Tourism in Esfahan based on Urban Spaces Transformation. Urban Transition Global Summit Conference, Shanghai,China, 2016.

Azarm.Z ,Ranjbar. E, Marti casanovas. M: Urban Design Guideline In Middle Urban Fabric Based on Analyzing Public Space Transformation (Case study: Bid Abad District). Master Thesis, Tarbiat Modares University, Tehran, Iran, 2017.

Ghalani.Z, Ranjbar. , Izadi. M.S: Urban Design Framework Based on the Interaction of Flagship Regeneration Project and Historical Neighborhood (case study: Regeneration of Atigh Square and Haronieh Neighborhood in Isfahan city). Master Thesis, Tarbiat Modares University, Tehran, Iran, 2017.

Hoblyk, A: Transformation of urban space, tasks and methods of study. Przestrzeń i Forma, 2013.

Madanipour, A. Knierbein, S. and Degros, A: Public Space and the Challenges of Urban Transformation in Europe, Routledge, 2013.

McCormick, K., Anderberg, S., Coenen, L. and Neij, L: Advancing sustainable urban transformation. Journal of Cleaner Production, 50, pp.1-11, 2013.

Yang, Y: Sustainable urban transformation driving forces, indicators and processes, Doctoral dissertation, Bauhaus University Weimar, 2010.

Warp-Innovation Study for Justifying Boost Space Services

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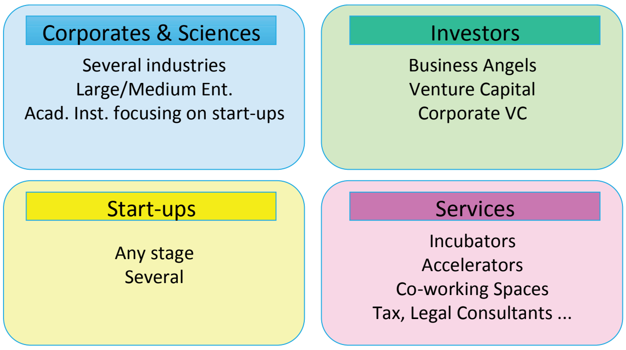
1 ABSTRACT

Warp-Innovation (WI) challenges innovation teams, academic spin-offs and start-ups on their biz ideas.

One important orientation is establishing collaboration amongst proper stakeholders of an eco-system. We therefore engage with strategic partners, following the principle of forming relationships between science, corporates, start-ups, services and investors.

Warp-Innovation therefore conducts a study - during 2017 in the German speaking countries and 2018 within Europe - adhering to this setting. Enabling mutual benefits for all parties involved is our credo.

At REAL CORP 2017 we may give some insights to this - proud to be there as the conference format addresses multi domains since its very beginning.



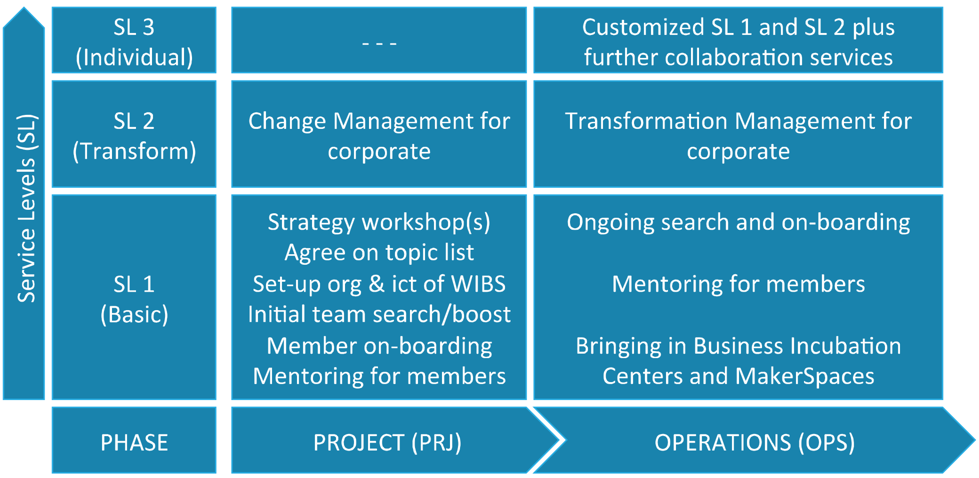
In here we focus on the study conducted together with selected study partners with the motivation to justify experiences and assumptions in designing Warp-Innovation Bosst Spaces (WIBS) for corporates - several industries, large/medium enterprises, academic institutes focusing on start-ups, the latter ones at any stage; investors - business angels, venture capital, corporate VC; services – incubators, accelerators, co-working spaces, tax, legal consultants etc.

It's vital to differentitate the following:

Incubators and Accelerators are organizations, serving start-ups temporarily in bringing up their business faster and more successfully and mostly take equity in doing so.

The Warp-Innovation Boost Space is established and operated for large/r organizations - willing to engage with small/er partners – exclusively and permanently - collaboration models to be formed during the course.

We are convinced, that enabling a successful relationship between established and emerging organizations can be achieved by involving intermediaries accompanying the process of establishing and operating corporate cooperation programs (which we call Boost Spaces) in order to achieve mutual benefits for all parties involved.



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We support building up such a corporate accelerator (project phase) - optionally followed by operating it. Several service levels as illustrated are available.

Our study results are supposed to enable continuous service improvement and innovation.

Keywords: enterprise, start-up, investor, collaboration, study

2 COLLABORATION MODELS

We use ‘E’ for established organization and ‘e’ for emerging organization.

2.1 Current overservations

Model 0: Large/medium enterprise internal program (no intensive discussion on this setting)

Model 1: Strategic partnership

Model 2: ‘E’ Start-up program

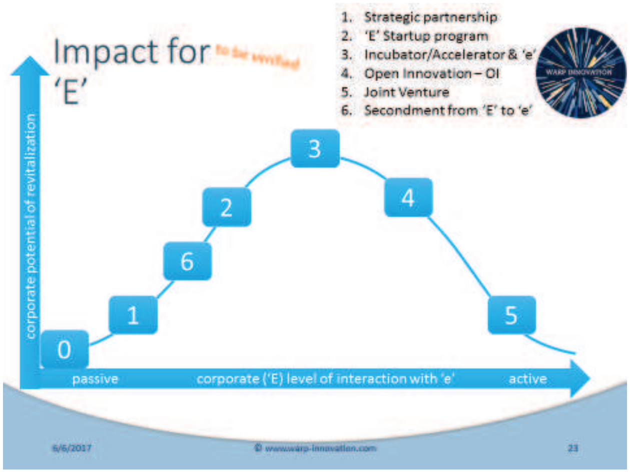
Model 3: Incubator/Accelerator & ‘e’

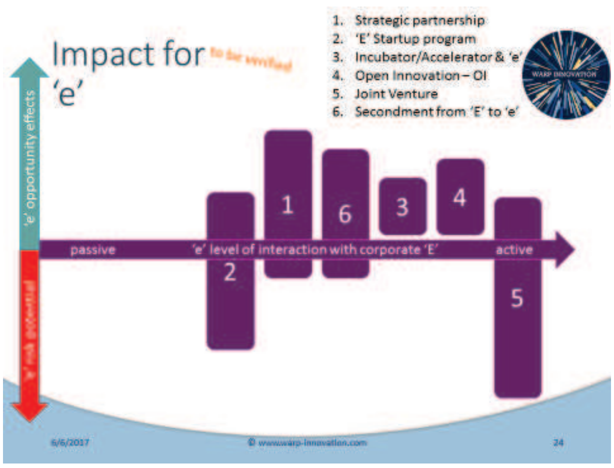
Model 4: Open Innovation – OI

Model 5: Joint venture

Model 6: Secondment from ‘E’ to ‘e’

Based on given observations and market experiences we relate those models to each other.





The study results shall confirm such relationships and/or identify new ones by discussing advantages/disadvantages for E&e in order to help in motivating start-ups as well as corporates to sustainably cooperate by leveraging their different frameworks.

3 SERVICE DESIGN

3.1 Building Blocks

In order to bringing up such programs we need WIBS sponsors (the ‘E’) and WIBS operators (Warp-Innovation incl. its associate partners) to build

- a business incubator
  - virtual network (using proper ICT to linking up all stakeholders)
  - physical center (service organizations mainly in the start-up and/or maker scene)
- with WIBS members (the ‘e’)
  - probably assigned to separate trust layers and therefore treated as
    - contract partners
    - equity partners
- in order to work on selected topics of the ‘E’ as

- ‘inner circle’ members respectively
- further members.

The study helps to arrang a common language and context for the behaviors of innovation and those around. Nevertheless the results of the study will gain a further understanding of which conditions best fit the various roles using the strengths.

3.1.1 Statement of Work

Corporates need to state their objective in engaging with selected market partners like start-ups, founders, makers, smaller enterprises and list their work topics to be covered by them.

WIBS sponsor’s offerings

Strategic Business Units … the market oriented organization structure of the ‘E’

Internal … internal topics of the ‘E’ (i.e.: corporate IT systems and services, business processes)

Collaboration layers

Protected circle - own professionals on enterprise payroll only

Inner circle **-** cooperation partners (shareholding ev. preferred)

Public circle **-** suppliers and partners, cooperation partners

Collaboration topic mapping

WIBS Sponsor Core Business – Stratecic Business Units – and stated objectives to be achieved via such collaborations (i.e.: becoming more innovative, reducing cost, increasing revenue, have payroll focusing on own core business) lead to a list of topics for which suitable partners are identified and assessed in order to become member of the Boost Space funded by the ‘E’.

3.1.2 Organization

WIBS sponsor & Warp-Innovation

The WIBS operator acts with the following responsibilities:

- managing the Boost Space and
- acting as ‚holding‘ for business incubation centers in selected cities,
- engaging with maker platforms, maker spaces, etc. and
- managing the relationships with WIBS members.

business incubators in selected countries/regions

- are the physical representation of the Boost Space

‘inner circle’ WIBS members & further WIBS members

- Included/on-boarded start-ups, makers and SMEs plus other relevant resources for expected business operations and objectives.

3.2 Business Process from virtual space up to physical/maker spaces as needed

3.2.1 Roles & Responsibilities

	Actors	
	Sponsor	Warp-Innovation
WIBS Manager	Decide on topic mapping. Define requirements.	Decide on recruiting process dependent on origin of resources.
WIBS Professionals	Focusing on core activities and collaborating with WIBS members	Support on demand (i.e. cultural/org. change).
Virtual Incubator	Making use of accepted deliverables	Manage the WIBS member portfolio
Business Incubator	Own or rent the business incubators in selected regions	Propose candidate facilities and take care of operating them
Maker Space	Rent or own the maker spaces in selected regions	Propose candidate facilities and take care of operating them

Innovative results only arise when people engage creatively within a proper environment. Collaboration requires an effective interplay of different people with different role structures and the way they gather as

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well as process information, make decisions, manage risks and manage them. The study is designed to show how to handle these roles.

3.2.2 Establishing and operating the program

The Boost Space member process has three phases:

Recruiting process

There will be a permanent collection & clarification of WIBS sponsor requirements on products

and/or services to be passed on to desired partners from business incubators, co-working spaces, maker spaces, labs, ...& chambers for hooking up with candidate members.

- Screening & selecting proper hubs … proper regions relevant for selected sites
- Performing events ... presentations, pitching sessions, challenges, hackathons, solvathlons (a new format designed by one of our associated partners) accompanied by press/social media announcing to respective opportunities
- Hooking up with candidate members … nominate contact partners on both sides, collect further info and documents on SME, start-up biz model and products agree on next steps, discuss engagement and agree on next steps
- Preassessing ... team, product, mobility, current stage, sustainability, …

Readiness process

Pre-assessing start-ups, SMEs, makers through ongoing communication

- Preparing ... get ready fort the Boost Camp
- Boosting & proposing ... focus on WIBS sponsor business/product opportunity, focus on start-up/SME entire market, agreement on road-map addressing both streams, proposing short listed teams to WIBS sponsor
- Contracting ... decision on contract- or equity partnership, establishment of related contractual relationship, first order of deliverable(s), scope and time plan plus acceptance criteria
- Including ... run in-taking of WIBS member into the Boost Space.

Collaboration process

Partnership with WIBS members (main contact point WIBS sponsor - WI)

Step 1: anouncing. Communicate to stake-holders and enrole in relevant systems and databases.

Step 2: onboarding. Become part of the virtual incubator. Optionally move into business incubator center and/or maker space.

Step 3: controlling. Monitor WIBS member performance and decide on resource allocations. Accept deliverables.

Step 4: learning. Improvement potentials also leading to further orders. Amend partnership status. (contract or equity) Decide on future collaboration scenario. (M&A, exit) through ongoing learning, improvement & innovation, strengthening partnerships (sustainability)

The study is created based on the following need. It looks at thwelve areas of the business culture: strategy and goals, communication and market, HR and knowledge management, process and organisation management, technology plus legal and financial framework. So it will be allowed to match the areas, to create more effective process formations and to develope a ‘relay race’ for highly valuable idea generation which may lead to a successful collaboration.

4 RISKS & OPPORTUNITIES

Examples as per project work in progress are illustrated below.

Risks & Opportunities WIBS Sponsor

risks	mitigation	opportunities	leverage
Internal management acceptance	Top level decision and Change Mgmt. Process	Focus on core products & services	‘inner circle’ + ‘public’ topics
Internal acceptance	Initial cases as proof-of-concept	Cost reduction and/or revenue increase	Agile, skilled members, suitable products
Proof-of-concept fails	Solid topic selection, virtual net 1st	Become (even) more innovative	Enable teams to working in ext. spaces

Risks & Opportunities WIBS Members

risks	mitigation	opportunities	leverage
Loss of agility	Stay in own or business incubator environment	Equity partnership	Demonstrate indispensability
Loss of focus on own biz direction	No exclusive work with WIBS sponsor	Strategic partnership	Strong complementary
Loss of reputation in the market	Avoid failure in delivery	Revenue, recognition & reference	Excellent performance

Risks & Opportunities Warp-Innovation (WI)

risks	mitigation	opportunities	leverage
Bad cost coverage	Agree on mutual adjustments/caps	Joint company mid-term	Ensure WIBS performance
Less emphasis on other WI biz	Add staff - ambassadors, facilitators	Faster WI dissemination	Supp. WIBS sponsor’s int. communication
Legal or ‘natural’exclusivity	Focus on lead partner per segment	Collaboration model - reference	Demonstrate WIBS performance

The study elaborates on these domains, risks and their mitigation plus opportunities and how to leverage them.

5 CONCLUSION

Building up such micro eco systems needs to adhere to a solid service design and implementation process which has to be verified by the study to be conducted with corporates, science, start-ups, services and investors.

6 REFERENCES

Lean Canvas: Osterwalder, Pigneur: "Business Model Generation"

Value Creation; Customer Value; buying motives; USP: Gassmann, O./Sutter, P.: Praxiswissen Innovationsmanagement: Von der Idee zum Markterfolg, München 2010.

Hauschildt, J./Salomo, S.: Innovationsmanagement, 4. Auflage, München 2007.

Müller-Prothmann, Tobias/Dörr, Nora: Innovationsmanagement, München 2009.

Minimum viable product: Eric Ries: Lean Startup: Schnell, risikolos und erfolgreich Unternehmen gründen; Redline Wirtschaft, 2012

Blue Ocean Strategy: Chan, Kim/Maubourgne, Renée: Blue Ocean Strategy, Boston 2005.

Open innovation, co-creation: Chesbrough, H. W.: Open innovation - The new imperative for creating and profiting from technology, Boston 2003.

Howe, Jeff: Crowdsourcing. Why the Power of the Crowd is Driving the Future of Business. New York 2008.

Surowiecki, James: Die Weisheit der Vielen. (Warum Gruppen klüger sind als Einzelne). München 2007.

Process models of Innovation: Innovation funnel, Stage-Gate-Process, Design-Thinking: Verworn B./Herstatt C.: Modelle des Innovations-Prozesses, Hamburg-Harburg 2000

Cooper, R. G.: The new product process: an empirically-based classification scheme, in: R & D Management,Jg. 13 (1), 1983-2, S. 1-13.

Cooper, R. G./Kleinschmidt, E. J.: Screening new products for potential winners, in: IEEE Engineering Management Review, Jg. 22 (4), 1994, S. 24-30.

Cooper, R. G./ Kleinschmidt, E. J.: New Products: The Key Factors in Success, Chicago 1990.

Kyffin, S./Gardien, P.: Navigation the innovation matrix: An approach to design-led innovation, in: International Journal of Design, 3 (1), 2009, S. 57-69.

Core competencies: Staudt, E.: Kompetenzentwicklung und Innovation: die Rolle der Kompetenz bei der Organisations-, Unternehmens- und Regionalentwicklung, Münster u. a. 2002.

Basics of strategy planning, especially Vision / Mission: Tidd, Joe/Bessant, John: Managing Innovation; West Sussex 2009.

Christensen Innovator's dilemma: Christensen, C. M.: The innovator’s dilemma - When new technologies cause great firms to fail, Boston 1997.

Basics of Innovation Management : Bessant, Tidd: Managing Innovation

Problem description: Ishikawa, Mind Map 4 Problem Solving; other: Johannes Kern: Ishikawa Diagramme - Ursache-Wirkungs-Diagramme, BoD – Books on Demand, 2009

Basics of Business Model Generation: Mark W. Johnson: Seizing the White Space: Business Model Innovation for Growth and Renewal, Harvard Business Press, 2013

Basics of Business Process Modeling: Marlon Dumas, Marcello La Rosa, Jan Mendling, Hajo A. Reijers: Fundamentals of Business Process Management, Springer Science & Business Media, 2013

Swim Lane concept: Rob Davis: Business Process Modelling with ARIS: A Practical Guide, Springer Science & Business Media, 2001; p 325 ff

SWOT Analysis: O. C. Ferrell, Michael Hartline: Marketing Strategy; Cengage Learning, 2012; pp 87ff

5 Forces (Porter): Michael Porter: On Competition, Harvard Business Press, 2013

Basics of Project Management; work packages; deliverables; milestone and resource planning: Boris Gloger: Wie schätzt man in agilen Projekten: - oder wieso Scrum-Projekte erfolgreicher sind, Carl Hanser Verlag GmbH Co KG, 2014

Günter Drews, Norbert Hillebrand, Martin Kärner, Sabine Peipe, Uwe Rohrschneider: Praxishandbuch Projektmanagement, Haufe-Lexware, 2014

Basics of legal forms of companies: Warp-Innovation OG, 2015

Basics of financing and (public) funding: Warp-Innovation OG, 2015

Overview on property rights: Warp-Innovation OG, 2015

Basis of Risk Management: Warp-Innovation OG, 2015

Eco-Systems: what they are and how they are constructed: Warp-Innovation OG, 2015

The invisible Element “A Practical Guide for the Human Dynamics of Innovation”: Robert B. Rosenfeld, Gary J. Wilmhelmi, Andrew Harrison, 2011

Making the Invisible Visible: “The Human Principles for Sustaining Innovation”: Robert B. Rosenfeld, John Kolstoe, 2006

7 APPENDIX

Those two just for illustration. Of course there are many formats, services and infrastructures offered to the communities both by acadeemic institutions – like i2C at TU-Wien or Entrepreneurship Avenue and Gründerzentrum at WU-Wien – and on economic side, hereunder many Co-working spaces, some maker spaces and just recently Co-living spaces in preparation – this as tribute to Vienna as CORP 2017 takes place in this city.