Smart Occupancy – How to Avoid City Expansion by High-Density Use of Existing Buildings

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1 ABSTRACT

Any hope of reducing CO_2 to 26 percent below 1990 levels by 2020 [in Britain] has to focus on 'green occupancy', argues Andrew Mawson, Managing Director of Advanced Workplace Associates in London, in 'Premises & Facilities Management Magazin' in September 2010. Further her explains: "The greenest building you have could be the one that you do not need to occupy".

Surveys carried out 2011 in Austria, Germany and Switzerland demonstreted, that class rooms stand empty for an average of 90 percent of the time of potential use, lecture rooms and office space for up to 95 percent. Still, they have to be financed, built, heated, cooled, maintained, refurbished and connected by roads, pipes and cables [Wiegand 2011].

Green Occupancy is defined ‚as an intensive use of space over time combined with a user behavior taking into account all approptiate possibilities to reduce climate relevant emissions of the building'. This idea is complimentary to the concept of Green Building. Buildings that do not incorporate intensity of use and user behavior are contradictionary to the overall target of Green Building: the mitigation of climate change by avoidance of climate relevant emissions!

- If companies, public authorities and individuals strive to improve ecological impact of human activities, it is most effective to think beyond the completion of construction and include the time of use by calculating the occupancy cost and climate relevant emission per user unit, e.g. one hour of education of one class or one hour of work of one employee.
- If companies, public authorities and individuals are in need of more space and consider spatial expansion, they should first analyse the space they already occupy and the degree of use. Optimisation of efficieny then can focus on improvements of the ecological footprint and of saving money. Both can be achieved by just changing the approach to workplace allocation over time. Very likely it is possible to meet demand completetly or at least in parts without additional office space.

„Intelligent" management of space and its use over time has more than just ecological benefits. For example, it is social, because it makes education cheaper and affordable for low income households; it is economical, because it saves money; and it can promote casual meeting of people – a major source for innovation. Due to these facts the authors intend to widen the approch towards Smart Occupancy.The conference contribution provides the results of a research study finished in 2017 by the Division Real Estate Development and Management at Vienna University of Technology (TU Wien) and Unternehmensberatung Wirth. In this study, a structured list of topics was discussed with real estate managers in Austria and Germany from companies with a staff of more than 500. The intention was to understand if these companies apply, or are able to implement, priciples of smart occupancy beyond mere cost reduction.

The results show that Corporate Real Estate Management at the time being mostly does not consider ecological aspects of intensive use of space over time nor targetted adaption of user behavior. This also applies to Facility Management, and even for employee representatives and the management of big companies. ‚Intesifying of use' and ‚avoiding new building' do not have lobbies yet.

The survey also reveals the necessities for implementation of an integral strategy for optimised use of built environment:

- Buildings readily to be used by different user groups with various demand – easy to realize with new objects, challenging in building stock
- Organisational framework of company structures and procedures including technical feasability by housing technology and booking system
- Company culture enabling shared space and shared responsibility

Keywords: green occupancy, high density, expansion, smart city, real estate management

2 INTRODUCTION

2.1 Problem statement

Intensity of the use of buildings and open space over time is societal highly relevant for cities and metropolitan regions with rapidly growing numbers of inhabitants. Limited space, growing demand and attractivity for investment in periods of low interest make up for a price rally in real estate. Smart occupancy is aimed to make available more space without more buildings, traffic areas and other infrastructure while reducing sealing of soils and urban sprawl.

While there are some theoretical works and research projects on Green Building there is an open field for further effort to make it happen. The term Green Occupancy has been coined to describe measures that enhance the concept of green building into the life span of buildings. We suggest the use of Smart Occupancy with respect to the role and function of housing technology and building services using IT as well as new approaches to the organisation of work including options made available by IT. This should help to make the next big step in creating awareness for the significance of intensified use of buildings.

The first mentioning of Green Occupancy might have been in 2009 in an article by Jerry JACKSON [2009], then an energy economist with over 35 years experience, in The Journal of Sustainable Real Estate. Dealing with expectations of higher return because of ‚green' qualities, this is a valuable approach but not what we understand by the term today: „Findings reveal a mean internal rate of return for Leadership in Energy and Environmental Design (LEED) buildings of 126% with a 10% probability of achieving an IRR of 50% or less. [The internal rate of return (IRR) is a widely used investment performance measure in commercial real estate.] Buildings with an ENERGY STAR certification achieve a mean IRR of 140% with virtually no probability (1.6%) of achieving an IRR less than 50%." The essence is, that green buildings yield higher with less risk.

JACKSON further states: „Financial benefits of a sustainable building option can be calculated with data on conventional building rent (R, $/square foot), the green rent premium (RP, $/square foot), conventional building occupancy (O, %), the green occupancy premium (OP, %, difference between conventional and sustainable occupancy rates), the mean incremental cost of sustainable construction (CP, $/square foot) from Exhibit 2, and the discount rate, r, with the following equation: …" [‚premium' standing for higher rental yield].

According to our research, the term Smart Occupancy was first used by Nilesh Y. NADHAV [2016] in his book ‚Green and Smart Buildings - Advanced Technology Options': „The building sector is the largest contributor to global greenhouse gas (GHG) emissions. Buildings use about 40 % of global energy, 25 % of global water, 40 % of global resources, and they emit approximately 30 % of GHG [Green House Gas] emissions. These emissions are set to double by 2050 if we carry on business as usual. Buildings present the most impactful and also economical mitigation potential for GHG emissions globally. In this book, we look at several green building design technologies, including the design methodology itself (i.e. integrated design). A green and smart building is an interplay of various integrated design strategy such as passive and active design features, as well as water and waste reduction techniques, renewable energy integration, building management systems and controls, efficient operations and rating systems that allow effective benchmarking and performance analysis and guidelines for various stakeholders involved in the building industry".

While NADHAV's approach mostly concentrates on technical aspects, others [like McNESTRIE 2013] deal with the changes of work itself: "…the old conception of the office is dead. Globalisation, the telecoms revolution and the inflation of consumer demands have ganged up to do away with it. A wasted hour commuting each way everyday, one-person-one-desk, telephones tethered to desks, a heavy reliance on face-to-face meetings, territoriality, status hierarchies and an obsession with presenteeism: all have been jettisoned. The sacred cows of 150 years of management practice have been unsentimentally culled."

An approach for practical use was developed by WIEGAND at ETH Zurich in 2005 and later on at Vienna University of Technology (TU Wien) since 2009. Creating new, improved management processes was a central aim of the cooperative project integrating Facility Management and the Institute for Analysis und Scientific Computing at TU Wien.

To make optimisation of buildingspace applicable WIEGAND et al. developed a discrete events simulation (DEVS) based software tool named MoreSpace. The representation / the dynamic simulation of the dynamic behavior of employees over time when using different workplaces, visiting customers etc. enables the estimation of workplaces needed and enables the optimization of office space and management related to its occupancy. It was uccessfully tested and applied e.g. at DATEV in Nurnberg [Schöner et al 2014].

The current situation concerning the application of Smart Occupancy concepts and tools in Austrian coporate Real Estate Management could be summarized as follwos: ´There is some interest, but the majority has not yet realised the readily available resource.´This has been confirmed by ‚Expertenbefragung Zukunft Bauen' several times. The series of annual online survey with representatives from building and real estate sectors was started in 2011. On average, it yielded over 200 questionaries filled in by qualified experts, peaking at 228 in 2017. The question concerning ‚Challenges for the construction sector' started with 16 items, with more added in following years, and was repeated in every run: „Construction sector is facing many challenges: How important will these topics be for you / your company within the next 5 years? Please assign [to the following items, 25 in 2017] marks from 1 to 5 standing for 1 = very important, 2 = important, 3 = indifferent, 4 = less important, 5 = unimportant." In 2014, the item ‚MoreSpace' was added, and, to broaden the topic, two more in 2016, without stating ‚Green Occupancy': ‚Increasing density …', and ‚Making use of vacancy …'. Both diagrams following show the same selection of items:

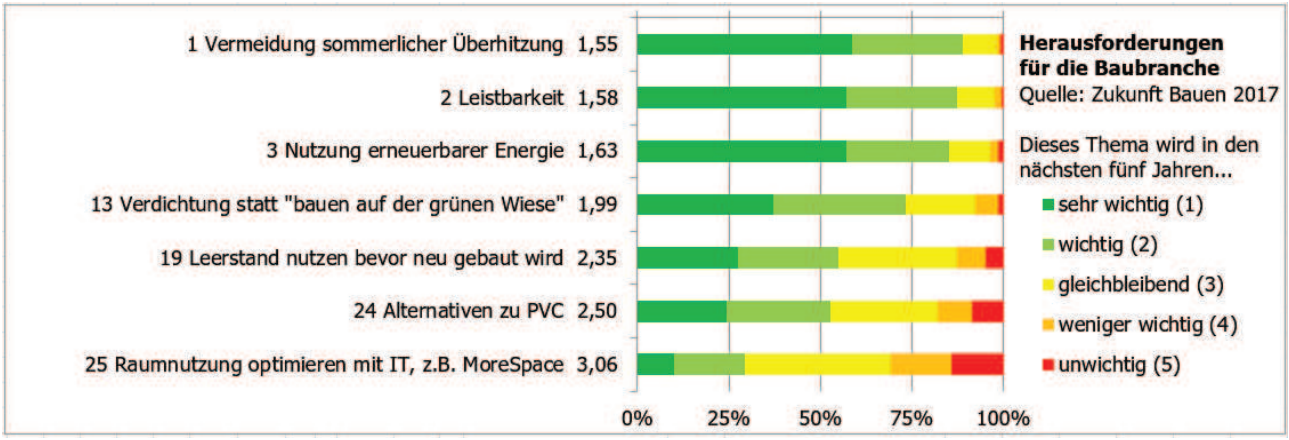

Fig. 1: Challenges for the construction sector within the next five years, as inquired 2017

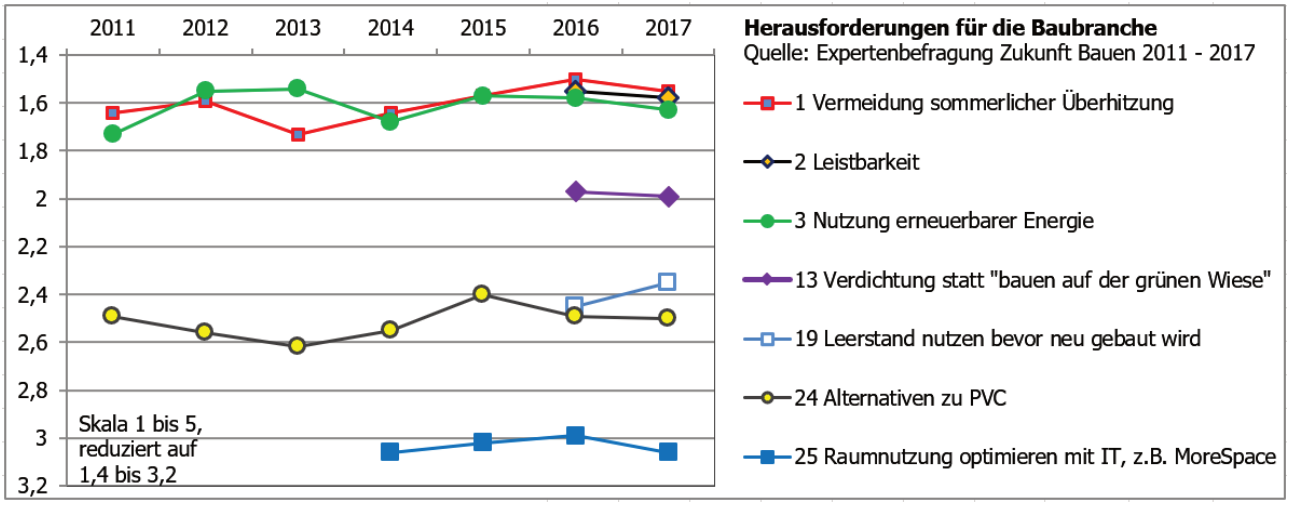

Fig. 2: Challenges for the construction sector within the next five years, as inquired 2011 to 2017

1 Avoiding overheating in summer

2 Affordability

3 Using renewable energies

13 Increasing density [of use] instead of building in open countryside

19 Making use of vacancy [upgrading existing infrastructure] before building new

Note: Top three items receive similar mark in 2017

Items 1 to 24 cluster within the range of 1.5 to 2.5

Item 25 lags far behind at 3.06

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24 [Using] alternatives for PVC

25 Optimising use of existing space supported by IT e.g. by MoreSpace

Time series show the average mark for item 25 like fixed around 3.0. This, at first glance, seems to indicate indifferency. In fact, this mark hides strong polarisation between two blocks, with 64 respondants voting ‚important', and 67 ‚unimportant'. Suprisingly, this makes for a hopeful outlook: Indeed, two thirds do not see the necessity of using IT-based support for optimising occupancy of space. The remaining third, in effect, stands for a considerable potential of persons and companies willing to pay more attention to it.

Of the new items from 2016 ‚Increasing density …', gets rank 13, well ahead of ‚Making use of vacancy …' at 24. Obviously, ‚Increasing density …' implies building activity, like rooftop extension, while ‚Making use of vacancy …' would not generate much new business for the building industry. This obviously results from architects and building companies prevailing in the sample.

While everything seeems clear in theory, adequate practice is missing. To make the challenge visible, WIRTH conceived a diagram showing one year with the shares of typical activities for an employed person in Austria. This diagram shows a year consisting of 8640 hours resulting from 360 days at 24 hours. This assumption allows simple calculation of shares and their presentation in a data matrix, with a deviation of less than 1.4 percent from the true figure, 8760 hours for a year of 365 days.

Every year consists of three parts – night time (shown in dark blue), leisure time (in yellow) and work time. Talking about paid working time, two thirds of every day are not at disposal. From the remainig third of 2880 hours we have to deduct time for different reasons. Please keep in mind that a day in the following calculation consists of only 8 hours.

(1) Weekends and holidays (in yellow, separated from leisure by a fat dashed line.), meaning 104 plus up to 13 days a year in Austria, rounded down to 108 days, or 864 hours. Remainig are 2016 hours of ‚Potential working time' (framed by a fat line).

(2) Vacation days (in green) – at least five weeks in Austria, totalling 25 days as weekends have been deducted before – and days resulting from other time-off entitlements like Sick leave, Family reasons like children's weddings or care for relatives, and Residential change, adding up to 60 days, or 480 hours. Remainig are 1536 hours of ‚Effective working time'.

(3) Trainings and business Events (in light green), and Work dates (in pale green) out of offce and in office but not at the desk, estimated to be 3 days per month, in total 288 hours. Remainig is the white block of 1248 hours of ‚Effective working time at desk'.

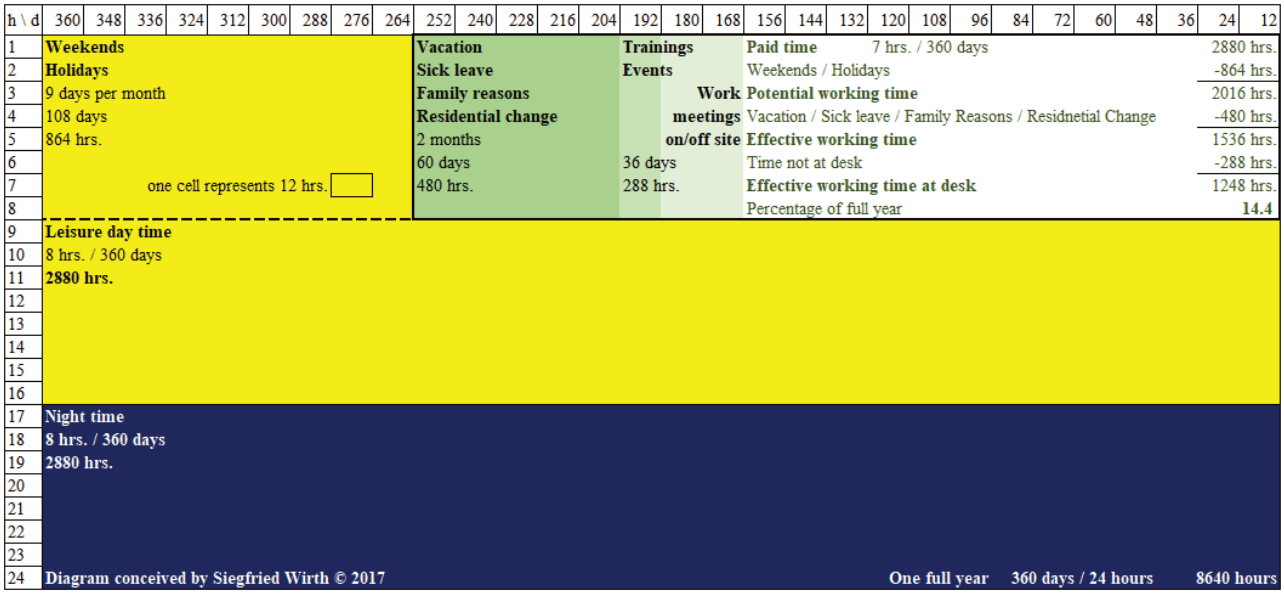

Fig. 3: Annual working time - Cautious assumption for the proportion of effective work time at desk during one full year

According to this calculation the average employee spends on the job at desk only 14.4 percent of the total annual time, or 61.9 percent of the ‚Potential working time' and 81,25 percent of the ‚Effective working time'. This gives a scope of action of at least 18,75 percent at the time beeing. This percentage is likely to

expand, possibly very soon and fast, with further developement towards more flexible and even agile working, which after McNestrie [2013] “is flexible working that is extremely flexible”.

2.2 Defining the research question and methods

Green Occupancy is defined as an intensive use of space over time combined with a user behavior taking into account all approptiate possibilities to reduce climate relevant emissions of the building. This idea is complimentary to the concept of Green Building. Buildings that do not incorporate intensity of use and user behavior are contradictionary to the overall target of Green Building: the mitigation of climate change by avoidance of climate relevant emissions!

To make the challenge manageable the research question was focussed on the obviously most rewarding target group, big companies. They engage staffs of hundreds or even thousands that share space in more or less big buildings. In the average company, the traditional approch still widely in use allocates a personal workspace to every person. This may have some benefits but definitely is maluse of space.

For a preliminary research project, funded in parts by vienna business agency (Wirtschaftsagentur Wien), a guideline was conceived along which narrative interviews could be conducted to find out about the current approaches and practices. In this study, seven leading experts for real estate and facility management from companies with staffs of over 500 have been interviewed. Findings from this research are the basis for others that are intended to provide representative results as an input to a commucations process aimed to creating, in a longer term, expanding and deepening awareness for an integrated approch to occupancy, encompassing the life span from the building concept to the end of occupancy and beyond.

3 RESEARCH FINDINGS

The expert talks reveal that any occcupancy process is not just happening but every company has a clear approach of how to allocate workspace. Also, there mostly is an idea of optimised organising of occupancy. The scope of action strongly varies according to the type of building, the existing status of occupancy, and company culture.

- Older buildings with a grid resulting from technical limitations also are limited regarding flexibility of use.
- Traditional companies tend to have a strong relationship between attributes like size and/or location of offices and hierarchic values, limiting flexibility of use even more.
- With new buildings, the future use is an aspect of planning and can be optimised in interchange of shaping the grid – or mostly avoiding to create one, thanks to improved building techniques - and providing technical services to allow intelligent, intense use over time as well as parallel multiuse.
- Projects of relocation like moving whole companies, transferring departments, or merging company sites in one building, theotretically give the best opportunity for the application of smart occupancy.
- There is no automatism for the application of Green Occupancy even in cases as mentioned before: The focus is on aspects of costsaving by reduction of space, improvement of communications and cooperation, while there is hardly any awareness for the relation beteween intensity of use and ecological effects.
- Successful occupancy planning requires the inclusion of the of future users’ needs and desires from the start of building develeopment.
- Allocation of space is not only a question of building and housing technologies and efficient work but also has to include the users and their wellbeing.
- New office conceptions will reduce the demand for space in centralized offices.
- Green Occupancy is not a particular step to be achieved but an ongoing process allowing for adaption and improvement.

4 CONCLUSION AND OUTLOOK

As even the term Green Occupancy has been mostly unknown to the experts interviewed, there is strong necessity for the creation of awareness. As internal guidelines for occupancy come from the company leaders

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whose main interest rightfully is the core business, intensity of use of their offices is merely a side aspect. The challenge is to combine cost saving with maximum benefits for environment – outside of buildings and inside – and the wellbeing of employees. For future application, the term of Green Occupancy shall be changed, and the content extended, to Smart Occupancy prior to any further action, with this statement at REAL CORP 2018 as a kickoff.

Effective roll out calls for diversified action:

- Widening the knowledge about the companies methods and habits for the allocation of workspace by representative studies, the first one to be launched as soon as possible, and, if required, later ones according to progress focussing on fine tuning.
- Starting a long term process of communications on Smart Occupany.
- Identifying building and relocation projects with potential for application of Smart Occupancy. With new buildings, the future use is an aspect of planning and can be optimised in interchange of shaping the grid – or mostly avoiding to create one, thanks to improved building techniques - and providing technical services to allow intelligent, intense use over time and parallel multiuse.
- Supporting responsible experts in the process of implementing and continuosly practicing Smart Occupancy.
- Help creating a holistic mindset regarding all aspects of building and real estate over time and for the life cycle of buildings, focussing simultaniously on economical, ecological, and social factors, in paticular the wellbeing of users.

As the latter is an upcoming trend in human resource policy, we see an opportunity to accelerate the awareness rate by putting the side benefits in front. Further, this can combine with the other trend mentioned before, making cities, quarters and, of course, buildings smart.

5 AFTERTHOUGHT

Optimising space is not only an issue for big companies, according to another international trend in housing. People tend to live in ever smaller homes. In Austria, we see two reasons for this new behaviour: Rising prices for property, mostly caused by increasing prices of building plots, and stagnation of net incomes.

This trend is met by an expanding range of space-saving furniture. A very impressing and convincing example is given by Resource Furniture, a New York based international company co-founded by Ron BARTH. When talking to journalist David FRIEDLANDER he stated: “Most high end furniture doesn’t take space efficiency into account because the people who can afford it usually have huge homes. We’ve been successful because we offer something unique: quality furniture with high design that optimizes any space it’s put in.”

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