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Circular Economy Concepts: A Smart Solution for Communities in European Towns

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1 ABSTRACT

The paper debates the concept of circular economy in cities through introduction of circular communities composed by materials providers, developers, producers, services, distributors and consumers which all must adopt a holistic and collaborative approach. Therefore, circular development necessitates the socio-ecological transformation of our urban systems. It requires that wasted resources are looped, the ecological regenerative capacity and adaptive capacity of urban systems developed. Therefore, spatial planning potentially has a crucial role to play in the delivery of circular development. The challenge is to integrate a circularity-based approaches into spatial planning practice, and vice versa, and to go beyond the search for temporary solutions, which in spatial terms means temporary spaces for circular experimentation, and to lay the foundations for circular spatial planning thinking and action.

Keywords: spatial planning, circular communities, circular thinking, circular development, circular economy

2 INTRODUCTION

This paper is a discussion based on theoretical knowledge and experiences obtained in many years in spatial and urban planning, built environment development, industrial product design, management and enterpreneurship, and observation of social dynamics. It is encouraging that these observations seem to be finally inline with at least some directions of environmental and socio-economic thinking and recomendations of internationally acnowledged bodies (e.g. UNEP, 2024) and such reasonings are slowly, but not surely, penetrating even into the various EU documents (e.g. EC, 2020; IEB, 2020; Directive (EU) 2024/1799). Discouraging, however, is the fact that a transformation towards global sustainable resource consumption and production is urgently necessary, however, society does still not seem to feel it.

The history of civilisation follows the logic of goods exploitation. People are used to use/exploit resources and when they are exhausted, move on to new teritories to explot and exhaust again. Thus this history shows, that the collapse of settlements and cities coincides with the depletion of resources. These are usually exhausted with the help of a current technology – usually developed at the time and recognized as modern. The current civilisation is also facing the problems of resources exploitation (reflecting the way of the exploitation) as well as with the polution that goes hand in hand with it. Therefore, the UNEP (2024) calls for not merrely a transformation towards global sustainable resource consumption and production as being necessary, but for how to urgently make it happen. Further, the UNEP (2024) document points to insatiable use of resources, which has tripled over the last fifty years, and worrns if we do not change, we could see resource use up by 60% from 2020 levels by 2060.

The pursuit of individual and material profit, which has been extrapolated over the last century, has marginalised the general well-being of our society over the profit-oriented economic activities. It is seen as one of the key elements that has caused the disintegration of local communities. The benefits and well-being of the community were not looked at, but the material gain (profit) of the individual. This paper explores the establishment and strengthening of the circular economy in local communities, as a means of transition towards resource-efficient and sustainable consumption and production, as one of the leverages that may help to revers the process of wellbeing decoupling. Hence, the key to success is a system that links the consumer and the producer – a responsible consumer (user) and a responsible producer (provider). Therefore, both need to be caught in the loop of being mutually dependent and therefore responsible.

The aim of the paper is to pave the way to the cicular community through its logical structure. The logic of the community is presented, based on the logic of economics that takes into account all stakeholders in a balanced way and does not favor or neglect the well-being of any of them, instead of being based on institutions that have become entrenched in society through the implementation of the linear economy model. We will show how certain specific directions/industries/products can be realized with such logic.

The paper firstly elucidates the circular economy concept and introduces accordingly the circular community as a solution that enables systemic socio-ecological transformation (of urban systems) with a special attention to a product as a service business model, where a responsoible consumption is motivated. True, the responsibility and motivation of the consumer (user) towards the product changes the flow of the material, and that is exactly what circular economy is all about, the economy where the value of products, materials and resources is maintained for as long as possible in the economy, and the generation of waste is minimized. The discussion is further elaborated upon DIPSTOR's definition of fully circular product (FCP) and its circular design approach Evolutionary Design (DIPSTOR, 2019), a resource efficiency approach in furniture development and design. These approaches reflect the values and principles of the New European Bauhaus Compas (NEB, 2022; EC, 2019) and are further illustrated with two circularity-based implementations, the slender revitalisation and the circular landscaping. They both are based on the cascaded use approach, such as R-ladder (e.g. Kurilova-Palisaitiene, 2023) and can in the context of urban planning and development contribute to compact, balanced and parhaps quite self-sustained neighbourhoods.

3 CIRCULAR ECONOMY CONCEPT AND CIRCULAR COMMUNITY

Historically speaking, circular economy is a traditional economy of cities and communities. Today, the circular economy is recognised as an innovative model designed to eliminate waste and avoid the contstant use and exploatation resources. Unlike the currently prevailing linear economy, which follows a 'take, make, dispose' approach, the circular economy strives to create a closed-loop system where products and materials are reused, repaired, refurbished, and recycled (even upcycled) for as long as possible. At the heart of the circular economy lie three fundamental principles, designing out waste and pollution, keeping products and materials in use, and regenerating natural systems, being also a fundamental tenant to sustainable urban planning and development. Therefore, this shift not only reduces waste and conserves resources but also fosters sustainable economic growth and resilient communities with quality living environments, and responds by this to United Nations Sustainable Development Goals SDG11 – Sustainable cities and communities and SDG12 – responsible consumption and production, simultanoeusly (UN SDGs, 2017)

3.1 City as a community

"What is the city but the people? True, the people are the city." (Shakespeare, Coriolanus, act 3, scene 1). However, people always act in an environment, therefore the environment matters, and the relation between people and the environment is in reciprocal continuity (Goličnik Marušić and Marušić, 2024). Cities are places of many activities and are their representation, from economic, cultural to criminal, etc., but above all, they are society (Šimunović, 2007). These references call for a reasoning, that people in cities is about communities and networking. However, a community is successful when it works together and complements each other, and so the goods and knowledge start to circulate.

This paper is based on the premise that environments with strong communities having clearly identified and connected activities, adequate capacity and networking, have a better chance of being sustained and having potential for further sustainable development. Historically, in general there are two approaches of city emergence: bottom up and top down. Bottom-up approach reflects evolutionary process of networking of people with complementary interests, including exchange of goods and knowledge; manifested with marketplace and its further organic growth towards towns and cities. Top-down approach usually reflects the intention of the authorities to protect or expand their territories. The key to keeping such territories alive and well is to introduce, build and maintain communities that are socially and economically interconnected. However, the breakdown of socio-economic ties leads to the collapse of communities and, consequently, to the collapse of towns or cities. This was recorded many times in the history of civilisation already, from the very past until today.

Today, with unbridled and extraordinary technological development and society's often uncritical dependence on this technology and its development, we are faced with the breakdown of mutual social and economic ties between the inhabitants of local communities and the consequent disintegration of traditional ways of living and living environments. The concerns already identified decades ago became reality (Mumford, 1961). The narrow specialisation of particular urban areas for certain activities and the loss of the diversity of activities in them has also contributed to this, which is particularly evident in the historical centres of the cities.

Some parts of cities are losing, or have lost, the ability to offer a suitable living environment or a setting for the service and production activities that have traditionally inhabited such environments. These environments are losing their local population and are either emptying and decaying or are being gentrified. This interrupts continuity for many activities and, with it, the flow and transfer of knowledge. The strong point here is that the inhabitants of the city are not socio-economically connected to the city. To illustrate, the people who would traditionally represent the actors in the economic cycles of such a community have largely turned into intermediaries between globally available goods and services and domestic consumers. Some, however, have become merely intermediaries between external goods and services and even external consumers. Production/consumption cycles in the local community thus begin and progress to the break-up of the self-sustaining community. Re-establishing production cycles, especially in the absence of knowledge (crafts, local trade) is usually difficult.

Over the past century, and especially in recent decades, the linear economic model based on resource exploitation and depletion on the one hand, and profit and waste accumulation on the other, has been more intensively transferred from the elites to the general population through globalisation. In doing so, local economy systems that were often based on circular concepts died down. Local cycles also died out as local rural settlements began to empty (after World War II). This process has led to a point where material, energy and cheap labour resources are exhausted, and we are faced with a surplus of waste and a high concentration of wealth among a narrow elite, an unbalanced distribution of goods.

The migration that escalated after the Second World War, which in the rural-urban context meant a shift of the population to the cities for the jobs that were available there, and thus also for the new forms of living in the newly built residential neighbourhoods. Working and living on a farm was considered regressive, while working in industry and in administration was considered better and desirable. On the other hand, as society and technology developed, the educational level of the population rose and the mentality that people with higher education were not destined to live in the countryside, but to work in the cities, in administrative work, took hold. The educated were not returning to rural areas, which, again contributed to the impoverishment of the local community from which they came. Industrialisation has also had an impact on the agrarian community, so that production has increased without maintaining the workforce, even by reducing the workforce.

The process of globalisation that followed seemingly reduced the need for self-sufficiency by offering cheaper products from the global market. All these processes have also had an impact on the demographic picture. Globalisation has led to the drying up of the production that used to attract people to cities. The urban population, however, is at a very low level of self-sufficiency and even faces the problem of securing financial resources. Individuals or some parts of the population (including the highly educated) are emerging to reverse this process. They are returning to the countryside, also moving towards self-sufficiency, and trying to establish different models that have the characteristics of circularity. They are able to do this because today's technology allows them to develop, act and network in their areas of expertise wherever they live. This trend points to the potential for the concept of circularity to become more generally applicable and to become part of the planning and development of cities and their linkages with their rural and peri-urban hinterlands.

However, the process of globalisation has physically emptied villages and impoverished cities in terms of diversity of contents and activities taking place there, and these call for the creation of a model that can improve that situation. Setting up of circular economy models in such environments create the need for different professional profiles, and thus the possibility of introducing a balanced distribution and diversification of the population there. This enables the development of healthy communities and increases their capacity for self-sustainability.

3.2 Circular community model

Although several circular economy business models and related value add via production of goods and services as well as value chain which addresses the activities that provide or receive a value from the activity in a cycle (e.g. developing, producing, distributing, consuming), the current discussion is mostly limited to the physical processes and business models including the way products are developed, promoted or offered to consumers, and there is basically no talk about a community that runs or enables these cycles. This section focusses on setting up of a circular community and showing step by step its possible shaping and

development through its key development phases. A sequence of diagrammatic schemata helps to represent and discuss the circular community model composed by materials providers, developers, producers, services, distributors and consumers; and elucidats the basic relations among them.

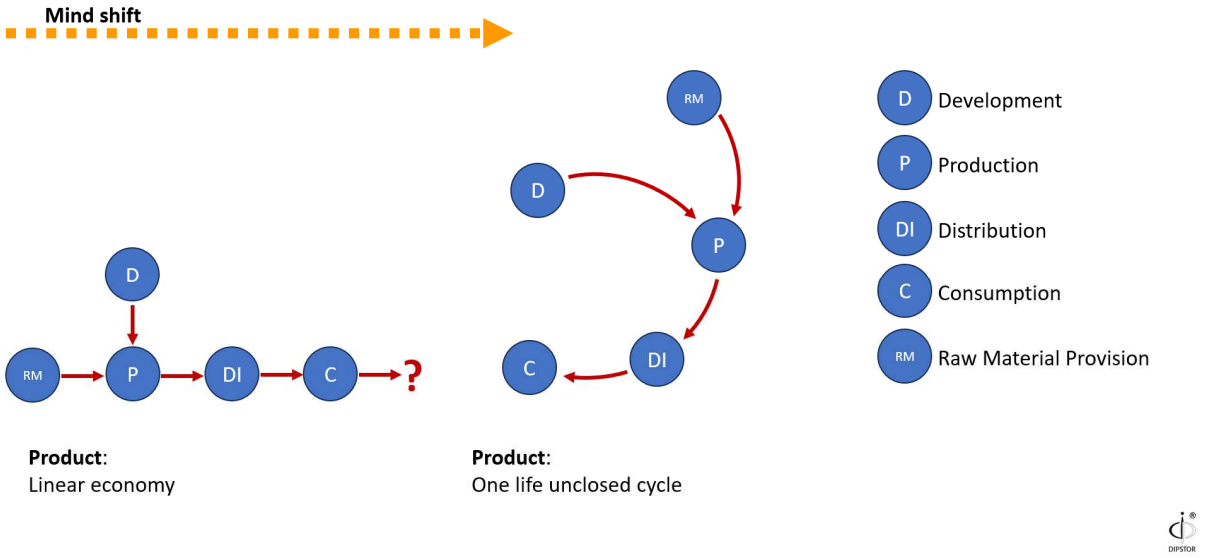

Fig. 1: From linear to basic circular economy model (illustration: authors).

Linear model in general paves the path of raw material through product production, distribution, and consumption toward waste. Development is predominantly in the function of production to serve a consumer's demand for new products. All mentioned cells have no particular need to be physically/territorially close or connected and socially or otherwise interconnected. Basically, the only goal is a profit. The consequences are dislocated production, excessive waste deposition and logistics requirements, only profit-oriented marketing and development and estranged consumption-oriented user having no real influence on quality or affordability of the product or service. The result is excessive need for transportation and waste deposition infrastructure, unbalanced jobs distribution with gravitation towards the lower-cost environments not close or even within the local environment of consumption of products or services. Spatial manifestation is either development of excessive transportation and waste deposition infrastructure requiring large amounts of valuable space or overloaded existing infrastructure or both with constantly growing spatial demand. Since available space is limited, the mind shift that could turn around such trend is essential and inevitable. Figure 1 shows the importance of readiness for as shift away from linear economy concept.

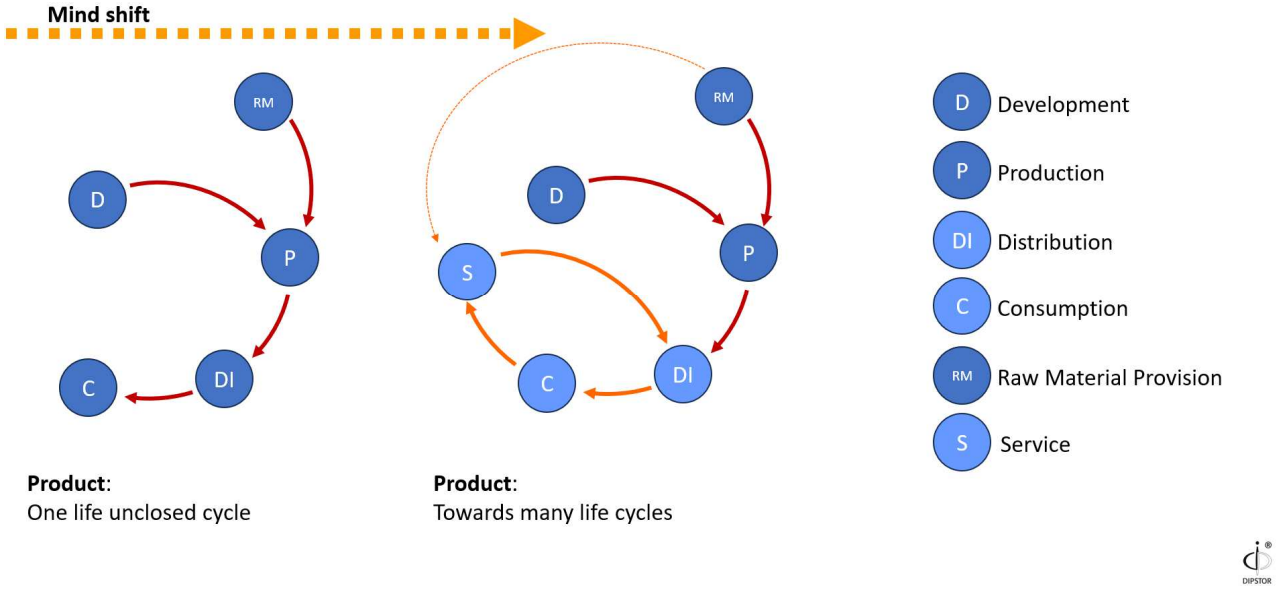

Fig. 2: From linear to basic circular economy model – stakeholders' relations (illustration: authors).

There is a challenge how to "bend the linear process" and which unit of the community could play the crucial role in that. Figure 2 shows that when adding the service in the function of repair, refurbish, or redistribute the used items to be reused, the life of products is prolonged, the need for disposal reduced as well as demand for the raw materials. Service close to consumption reduces logistics demand and provides professional employment in the local environment. Such service in general and certainly in long-term requires less space as it does not accumulate disposed products but circulate them. It also improves professional level and job-diversity in the local environment.

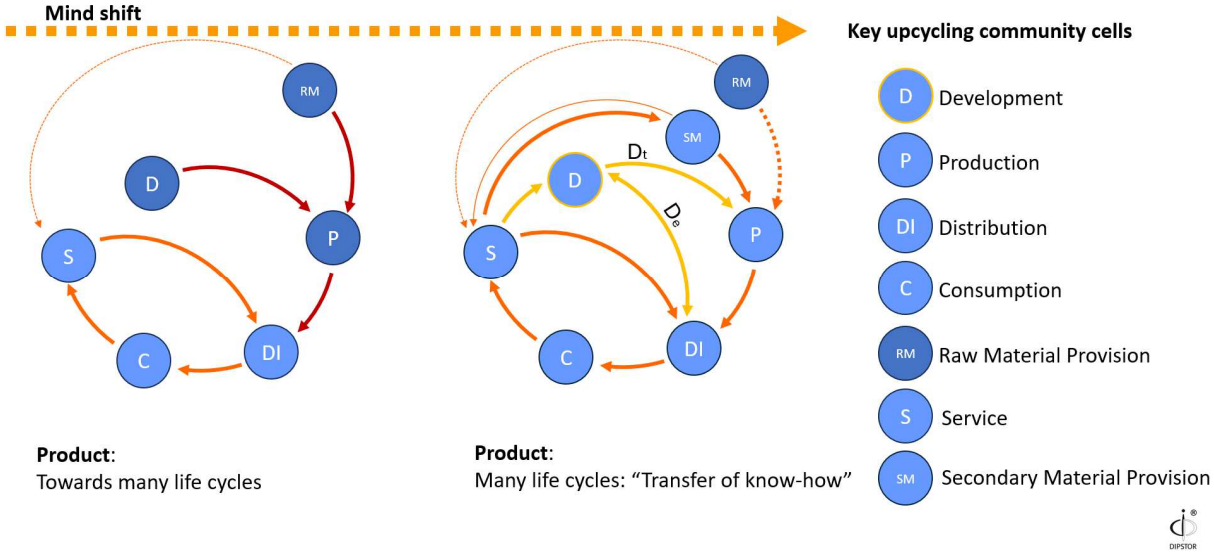

Fig. 3: From basic to advanced circular economy model – development & knowledge transfer as driving forces (illustration: authors).

However, without appropriate development that would follow and fit the contemporary economical and technological needs of consumers the products in the loop after some time (i.e. several loops) exhaust their potential and find the end in disposal. Avoiding such situation and prolongation the life of useful material as long as possible demands further development of this circular community model. As illustrated in Figure 3, Development (D) has to further develop, and interconnect with service (S) and distribution (DI) to offer along with technological development (Dt) also economical development (De) with financial products (e.g. renting, leasing, loans etc.) for both, consumer (C) as well as supplier (e.g. distributer (DI), producer (P)). Such development opens the door to wide spectra of specialisation and jobs within a local community. The products of such model are not any more merely repaired or refurbished old products, but also completely new products, which were developed from the materials of old products entering the cycle as worn-out products from various levels of the value hill R-ladder. Such an approach enables substantial metamorphoses or remanufacture of mass of worn-out products avoiding their substantial degradation (i.e. downcycling) but rather upcycling them into new potentially serial products. Methodology of development and design of industrial products that are able of metamorphosis into new generation of products in the next cycle opens new aspects in development of industrial production with fully circular products (see Section 3.3.1). A vast majority of raw material demand is replaced by secondary material. The space required for disposal of waste material is further diminished. Service (S) takes over another important task such as sorting of collected products or materials according to the value hill and their distribution to relevant units of the model.

This model also addresses the responsibility of final user. Consumer (C) which is involved in such circular process is motivated to act as responsible user as the product he/she is using is perceived as his/her currency, the value he/she will exchange in the next cycle for at least partly covering the costs of the new goods and services, respectively. This whole process suggests the introduction of evidencing and tracking of products and their parts, which can be introduced via digital passport using blockchain technology, especially in larger systems. Such approach not only improves the consumption (C) and distribution (DI) aspects, but also contributes to environmental considerations, such as carbon footprint tracking.

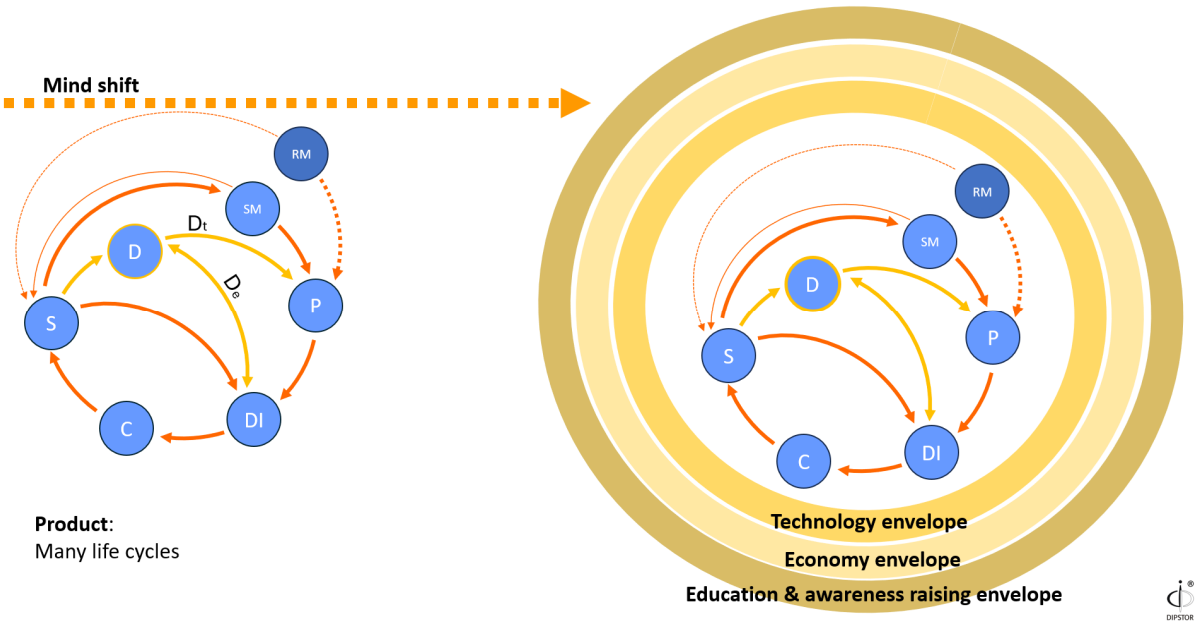

Fig. 4: Circular community model (illustration: authors).

Besides technological knowledge and technical support that every production process needs, a smart circular community to function, must be also supported by adequate economic knowledge and environment. That includes for example, appropriate financial services, presence of adequate individual and collective consumers. However, for community to sustain, it is essential to develop knowledge environment with continuous systematic education and awareness rising programmes for both community members and general public (see Figure 4). Such community is rational and people- and environment-friendly and therefore can be considered a smart community, where high technology is used only to support implementation of these values.

Each such local niche community may consist of several production (P), development (D), distribution (DI), or any other identified units as long as they are supporting each other and looking for synergies in common and shared activities. This means that a local circular community consists of a conglomerate or network of local niche circular communities specialised e.g. for furniture, tourism, gastronomy, fashion, and the like, where each entity/stakeholder can play different roles in different niches, e.g. being producer (P) in one and consumer (C) in another. Such conglomerate can support its members by sharing some common services and even more efficiently circulating the goods.

The market area that may be considered as a local often depends on product or service specifics. The circular model does not imply to extinct the interregional cooperation. On the contrary, development of knowledge network is very important for development of circular economy. Also overlapping and cooperation of neighbouring communities and their markets is important for their sustainability. Therefore, emergence of regional and even global societies and networks supporting circular economy by sharing knowledge is essential. It implies only to reduction of negative environmental impacts and developing sustainable socio-economical local environments. By reduction of transport demand the logistic infrastructure expansion may decrease and its spatial and energetic demand along as well as societal expenses for all that. That would be nice.

3.2.1 Circular product as a service

In the context of fast consumption society, the affordability of high-quality or good-quality products and services is often low. Also, in many fields, it can be observed that the quality of products and services at affordable prices is decreasing. In order to optimize the user experience and use of products, their affordability, material flows and added value in products, the model in which the consumer becomes the owner of a physical product seems not always the most successful. A product-as-a-service (PaaS) business model can offer optimal performance from multiple perspectives in many areas or for many product groups, provided that it is managed in an appropriate environment, such as a functional circular community. Such a service gives the user the opportunity and permission to use, but not the ownership of the object of use.

Responsible consumption is motivated because a responsible consumer benefits from lower service costs. Affordable and incentivized financing options can be developed, including e.g. rental, sharing, leasing, membership, etc. A wide range of products can be included in such services, especially if blockchain technology is introduced to keep records and track products. In practice, this means that one can rent a high-quality product, e.g. furniture, computer, car, etc., for an affordable initial cost and maintain the quality of service for a long time. Such a model supports local niche communities and can be well harmonised with compact neighbourhoods and a city of short distances.

3.3 The material flows

In the linear economy model the raw material extracted from a (natural) source is used in the product and after this use is exhausted, it ends as a waste expanding the infrastructural demand. Often logistic of such product life path is rather demanding as the costs of labour and input (raw) material are reduced by migration into low-cost environments. Disposing of worn-out products takes space and logistics. In somewhat improved economic models, the worn-out products are disassembled and degraded to the level that can be used in the products again. Such process is circular regarding the material flow as the primary material sources are preserved. However, it transforms the product to a very low level at the value hill (downcycling) which often requires substantial energy and the whole production process. Some materials degraded to such a low level cannot be fully recovered. As material is degraded, return to the basic production is required, often not in the local environment. Logistics for that is required, however no jobs for local community growth and reinforcement. In the case of circular models that more intensely include local community capacities and target the higher level of the value hill, efficiency of circular process may be much higher and cover multiple aspects including environmental and social ones, as they seem to be the two sides of the same coin.

Strictly speaking the story of material flows physically starts at the material origins (resources), however it arises by the consumer's need. How this need is developed and does it have a real basis is another story, however, also important in the context of sustainable circular economy. Anyhow, since we are talking about circular economy, we can basically start anywhere to get further and around in the loop. Assume a potential consumer (C) have a need for a certain product. He/she can get it (buy, rent, etc.) at the circular community distribution centre (DI). After some time, for some reason, the product is of no use any more for the given consumer (C). Perhaps it is broke, used up, do not serve the new needs, not attractive to the user anymore, etc. So, consumer (C) brings the product to the circular community service centre (S), reception of which may be at the same spot as distribution centre (DI). Regarding the condition of the used product and the needs/requirements of consumer (C), service (S) and distribution (DI) consult/offer possible solutions to consumer (C) to fulfil his/her new needs. The product brought to the service (S) is assessed and subjected to the treatment according to its condition and market requirements. It can be basically maintained and sent directly from service (S) to distribution (DI) to be reused. If necessary and possible, it can be repaired or even refurbished, if the procedures to do so are simple enough to manage them in the service workshop. Then repaired and simply refurbished products are sent from service (S) to distribution (DI). If more demanding operations are needed for refurbishment, however it is still reasonable to do so, the product is sent to one of the production centres (P). If none of above procedures are appropriate, the product is sent to the secondary material collection centre (SM) to be further treated (probably at least partly decomposed), sorted and redistributed for remanufacture, repurpose or recycle. Some products or their parts are useless for further processing in the form they are due to excessive degradation or inappropriate design, however material stored in them is useful and valuable. For material to be used again, these products have to be severely degraded first and then recycled into some kind of basic material – downcycled in the recycling plant (PRECY). To avoid such situations as much as possible, an introduction of fully circular product (FCP) development/design is needed and applied already in the production phase. Some material from old products is too decayed to be even recycled, however it might be useful for a kind of recovery production (PRECO). However, there might be some leftovers of the worn-out products that are completely useless or even toxic and have to be disposed at the appropriate waste-disposal centres (W). To avoid these situations FCP should be applied in the production of new generations of products. Some products from secondary material collection centre (SM) may be designated for repurpose (PREPU), so they may enter another circular system/loop. Circular production centres (C) get material (products or products' parts) mainly from secondary material collection centre (SM), however, also some from raw material centre (RM). They may

use also some material from recycling plant (PRECY) and other sources (e.g. other circular system/loop). They supply distribution centres with refurbished and remanufactured products. The new generation products may be based on secondary material, but also on new (raw) material, provided that these products are FCP. They also supply circular community service centres (S) with spare parts. The brain of the whole community is development centre or network (D) supporting two important components: technology (Dt) and economy (De). It is responsible for rethink solutions (e.g. FCP), refuse materials and processes harmful to environment and reduce consumption of natural resources within any products, processes and activities in community. Figure 5 shows the material flow in circular community and illustrates the community as a holder of activities which reflects the so-called R-ladder strategies (e.g. Kurilova-Palisaitiene et al., 2023) that can help to readdress concept of waste, and accordingly rethink the consumption patterns and redesign of products, which all finally affect the spatial logistics, uses and activities distribution, and therefore can represent a bottom up circular economy approach to cities and towns planning and development.

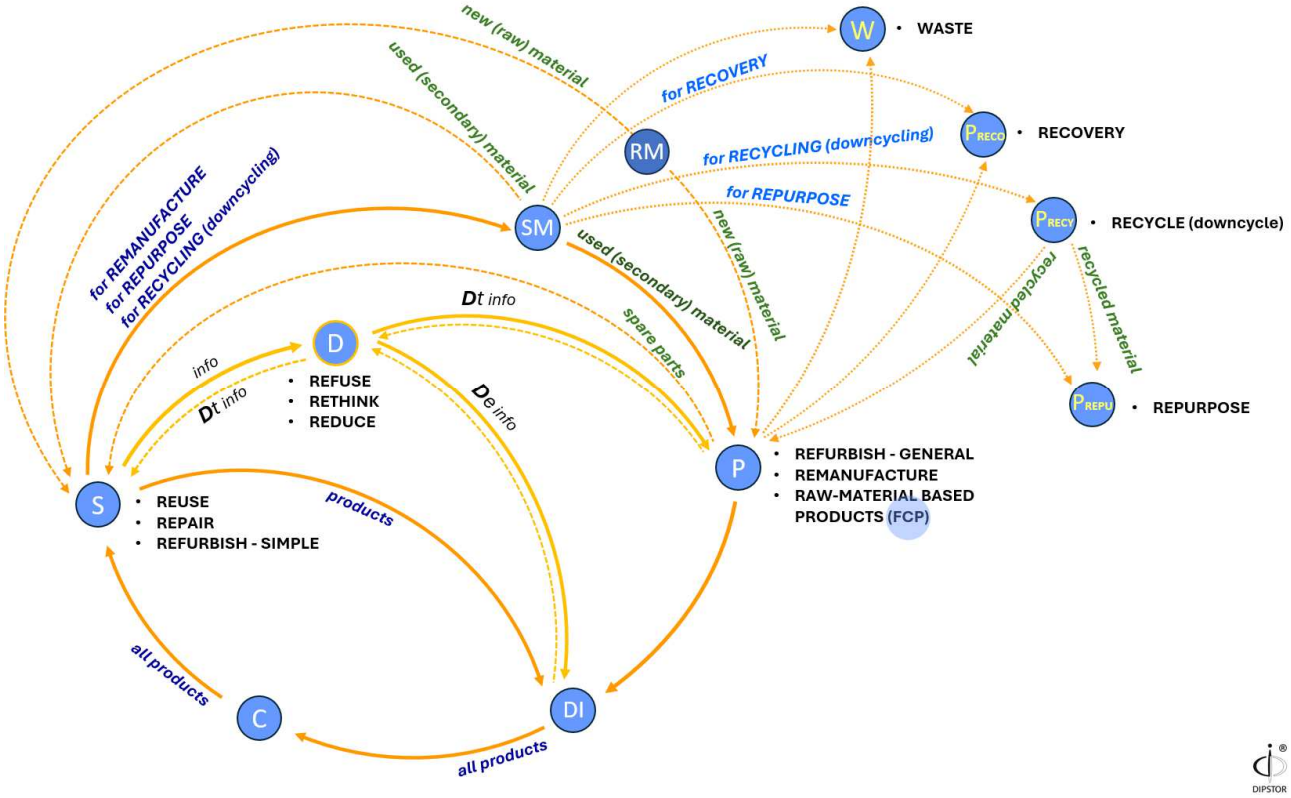

Fig. 5: Material flows in the advanced circular community model (illustration: authors).

3.3.1 Fully Circular Product – Evolutionaty Design

The implementation of circular economy models requires a rethinking of the processes with which the products are managed throughout their life cycle from design to recycle. The methodological approach of evolutionary planning represents a relevant potential for its implementation. This approach is characteristic for not to focus on just one phase of the process but throughout the entire life cycle of a product in each phase of the life cycle (maintain, repair, reuse, refurbish, remanufacture, repurpose, recycle).

Evolutionary Design is an advanced product design-development approach (DIPSTOR, 2019) that continuously generates upgrades or improvements of existing designs and generates new ones, based on success and lessons learnt from parental/related designs simultaneously considering environmental, economic, user experience and societal aspects. It is a concept of development of modular systems that are easy to maintain, repair (e.g. possibility of disassembling and changing parts) and remanufacture (modularity), following the iterative choice of the best characteristics of a product to achieve the best performance, and where each product generates the next development phase and opens new questions and possibilities for further design.

The aim is to adopt a product design-development planning process resulting with Fully Circular Product (FCP), which will, following the Evolutionary Design, move the focus of design process from deterministic

product design of a single product to possibilistic development of product evolution. In such a process the usability readiness of product or its parts for further new designs is prepared. An initial product is subject to an assessment of possible metamorphoses of the initial product via cascades of a product's life cycles.

As well as perpetuum mobile, also a FCP is an ideal, not entirely realistic to achieve. Yet, the bright goal should be to make cities Fully Circular Products (FCP) or as close as possible.

3.3.2 Slender revitalization

An illustrative example of circular process in the urban an environemnt such as a historical city is revitalisation approach where the old building material is treated with care and respect. With careful decomposition and separation of old building materials and parts a substantial share of material can be reused in the new project of revitalization and introduction of some new material is reduced. Due to disposal reduced to the minimum, transportation cost is reduced as well as demand for the landfill. However, some more qualified and careful work is required for such "slender revitalization". Such approach is easier or even possible in the case of built with simple materials rather than with the composite ones, where decomposition and reuse is problematic or even impossible. The natural materials are also often easier to be reused and their decay less harmful to environment than of the synthetic ones. DIPSTOR is currently involved in such a project. Most materials (wood, bricks, roofing tiles, stones, plaster, etc.) are being reused. Some wooden parts that are unable to be used for construction anymore, are used for furniture design, which will be included in furnishing of the renovated building. Such an approach of slender revitalisation also refers to aspects of FCP.

4 CONCLUSION

The presented concept of circular community and a community as a foundation of a city reflects circular economy concept from a bottom-up perspective. It starts on the other end as infrastructural concerns and conceptualisation of industrial symbiosis, water waste or all sorts of waste management, to complement these bigger systems and solutions. The presented model addresses rather small scale and strives towards the shift from product maximisation to provision of human needs, reflecting users' dimensions of circular economy as an instrument for delivering decoupling of economic growth from resource use (waste production) and environmental impacts in practice, as well as a part of the bigger picture of economic, societal, environmental and cultural transformation needed to deliver truly liveable cities.

In the circular model understanding and considering the user needs is addressed by how the material embedded in any product circulates through the product's life cycles or generations of products and their creators. These creators of one generation do not know who and how will create the next generation of products. All they can do is to make their design as wide as possible for the next generation, thus allowing the most probable and/or possible products to be implemented. Unlike linear models, which are deterministic, as the next generation of creators responding to the needs of the community is not actually foreseen, the challenge in designing fully circular products is to cover the needs of the present while allowing for the widest possible possibilities of the future. Thus, products created with circular models are more complex compared to those of a linear model, whether it is the design of a chair or the renovation of a house.

Circular community model discussed in this paper reflects relationships among many actors in it (representative units: P, D, S, DI, C etc.) and when considering them spatially, they all express certain demands about a place but most of all they perform a sort of behaviour pattern which reflects their optimal spatial-temporal relations, and can lay crucial bottom up foundations for optimal locations, spatial dimensions needed for their successful manifestation and the like.

The reasoning in the paper paves the way towards new conceptions of spatial planning in which circularity approach could help spatial planning to move from sectors to systems to address and find solutions for urban systemic inefficiencies and imbalances.

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