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Smart City Developments in Graz: Coming up against the Limits of Planning

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1 ABSTRACT

To deal with a significant increase in population in the last decade, the City of Graz has decided to activate its former industrial areas and develop new city quarters under a "smart city" paradigm, focusing on resource efficiency and quality of life.

There has been a wide array of critical issues identified in smart city developments around the world, amongst them the tendency to interpret urban issues and problems as technical problems, to frame them in technical terms and to offer technical solutions (Bauriedl and Strüver, 2019; McFarlane and Söderström, 2017; Söderström et al., 2014). In this paper, we acknowledge and seek to build upon this critical literature but want to expand on it by focusing on the challenges of dealing with smartness in planning policies, instruments and frameworks. Using qualitative content analysis, the research presented in this paper looks back at 10 years of project development and accompanying research, through which the city's planning department has tried to reduce resource consumption and develop smart neighbourhoods with a high quality of life. While a narrowing scope of research can be observed, centering on the built object and the efficiency of its heating/cooling system, it becomes increasingly clear that the full potential of smartness comes up against limits that are to be found in the regulatory and planning system; thus, hindering increased resource efficiency on a structural level.

Through our analysis of local smart city research projects, five topics emerged that are considered relevant for a successful further development and practical implementation of the smart city concept, highlighting system boundaries as a central challenge. The integrative character of the smart city necessitates a changed spatial focus within the planning system (and its existing instruments) - entailing a needed shift from traditional decision making at the scale of the block to the entire neighborhoods and even city districts and their connection to resource circles of wider regions. This upends established legal procedures and responsibilities, established planning instruments and timeframes, as well as established protocols of data management among different disciplines. These issues have shown particularly influential for the successful organizational, structural and economic implementation of more resource efficient urban quarters in Graz.

Drawing on the concrete case of Graz, this paper highlights the challenges of planning for smartness and resource efficiency and discusses possibilities for improvement.

Keywords: Planning Instruments, System Thinking, Smart City, Smartness, Graz

2 GRAZ IN THE CONTEXT OF SMART CITIES

Graz is Austria's second largest city with a population of roughly 300.000 inhabitants; growing rapidly with approximately 3000 inhabitants per year (Land Steiermark, 2020; Stadt Graz, 2019). Besides population growth and demographic changes manifesting in growing demands of resource consumption (energy, soil, material, infrastructure), and often leading to urban sprawl in the peripheries, Graz is facing pressing issues with regards to the climate emergency. Changing microclimates through urban heating, heat island effects, an increase in CO2 emissions and ground sealing of areas due to demographic pressure, as well as its topographical location in a basin has led and will continue to lead to drastic temperature and wind speed increases over the course of the next decades (Lange, B., et al. 2010; Lazar and Sulzer, 2020; Stadt Graz, 2019; ZAMG, 2021)

Aiming for an integrative approach to tackle these concerns in its urban development strategies, the city of Graz has decided to activate its former industrial areas and develop new city quarters under a "smart city" paradigm, by focusing on resource efficiency and quality of life.

Since the start of Graz' smart city initiative in 2010, the planning departments of the city of Graz have carried out numerous research projects. Addressing topics such as spatial-energy planning, smart building

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and climate technologies as well as material cycle concepts, led to a centering on the built object and the efficiency of its heating/cooling system, neglecting the necessity of the urban scale.

The research project presented in this paper (ECR 2020, funded by the Province of Styria and the planning departments of the City of Graz, and carried out by the Institute of Urbanism in cooperation with the Institute of Thermal Technology at Graz University of Technology) can be seen as a critical reflection of existing planning and regulation devices implemented within the development of the "Smart City Graz" with the aim of developing further integral measures for the implementation of sustainable urban development in the entire city of Graz.

3 GRAZ GOES SMART

As a rapidly growing city with limited building areas, Graz aims at densifying inner-city locations, and at the transformation of urban brownfields and former industrial areas.

The "Smart City Graz" - as referred to from the planning departments of the city of Graz - describes a former industrial and commercial area, situated at the western part of the city in close proximity to the main train station and to the city's centre. It is an area which has been in a state of upheaval for about 30 years and has been connotated and referred to as an industrial district with little quality of urban life.

The city of Graz is convinced that the transformation of those brownfields and former industrial areas into energy and resource-optimised urban developments - in the means of "smart city criterias" - offer solutions to the upcoming challenges faced by the city.

The planning departments of Graz and in particular the city planning directorate and its unit dedicated to smart city development, has established not only a definition of what the smart city development shall embody, but also a catalogue of criterias and objectives. Measures and indicators for the Smart City Graz have been defined for several fields of action, such as economy, society, ecology, mobility, energy as well as supply and disposal chains of the neighbourhoods in order to initiate the transformation of Graz to a climate neutral city (Stadtbaudirektion Graz b and Hoffer, 2018; Stadtbaudirektion Graz and Hoffer, 2012).

Lively urban neighbourhoods with a high quality of living space, attractive public spaces which offer diversity in programmes and uses, a neighbourhood of proximities and short distances, an increase in active mobility, efficient public transport systems, eco-efficient and recyclable materials, as well as an energy efficiency within the building are just few criteria to name (Stadtbaudirektion Graz a, 2018). Through their implementation a pioneering role in the field of integrated spatial, urban, transport and energy planning is envisioned, and the creation of synergies in the fields of energy, ecology, infrastructure, mobility, urban planning, and economy is desired (ibid.)

The implementation of these goals, however, is met with an (institutional) reality that separates different uses and levels, thus making the desirable diversity of these qualities impossible, mainly due to an aim of avoiding conflicts between economic profits and urban quality (Fellner et al., 2020).

Consequently, the laid out criterias and objectives for the development of a smart city do face a different reality, countering inhabitants' needs and advising actions with economic and technological as well as political interests (McFarlane and Söderström, 2017).

Additionally, the set-out criteria within the smart city framework catalogue (Stadtbaudirektion Graz and Hoffer, 2012), often imply the need for actions across a meta level, operating on the scale of the neighbourhood or a city's district. Actual measures, however, are often set on the level of a building plot and being hindered through limitations of planning and its existing instruments.

So instead of offering innovative approaches through technological innovations to implement the above mentioned, smart technologies seem to come to their limits if confronted with issues of planning and governance.

4 COMING UP AGAINST LIMITS OF SMARTNESS

Cities have to cope with complex and interdependent challenges such as the climate emergency, population growth, environmental problems, increasing resource consumption and processes of social change. Within the last decade the approach of facing these issues through the planning concept of a smart city has become a popular strategy and tool. Since the vision of a smart city kept promising sustainable economic growth, high

quality of life and environment, and sustainable management of resources through investments in information and communication technologies, human and social capital, new demographic decision-making mechanisms, and future-oriented urban management, many cities started to implement its development (Sassen, 2014; Sennett, 2012).

For some, the smart city seems to be the realisation of a long-held desire for a fully integrated, efficient planning of urban spaces and supply systems based on digitalisation that permeates all structures and usage practices (Chambers and Elfrink, 2014). For others, it visualizes the nightmare of transparent citizens and digitalised surveillance in favour of neo-liberal control fantasies (Kropp, 2018).

In both cases, the concept of a "master plan" in order to control urban decision making through an engineering-technological rationality (Kropp, 2018; Sassen, 2011), which was thought to have been overcome, returns: It is imagined that technological data and its comprehensive collection and evaluation will now bring about the control on a meta level, that urban planning had failed to achieve so far and that had therefore been abandoned in theory and practice in favour of pragmatic decision-making (Sassen, 2014; Sennett, 2012). As Zhou et al. argue, in fact, however, the future of high-quality urban spaces will depend much more on strategic planning and governance as on technology (Zhou et al., 2018).

A problematic key feature of smart city developments is the tendency to interpret urban issues and problems as technical problems, to frame them in technical terms and to offer technical solutions (Bauriedl and Strüver, 2019; McFarlane and Söderström, 2017; Söderström et al., 2014). In this form of smart urbanism, social characteristics of urbanity and urban socialisation, as well as forthcoming and state of the art approaches to urban planning, which inspire to analyse planning assemblages beyond the scale of the local and the agency beyond the role of human actors and their interactions are lost from view (Bauriedl and Strüver, 2018; Latour, 2009). The need of understanding the social crisis occurring in our cities inherently connected to the climate crisis and the challenges the cities are facing seems to have taken on a secondary role, leaving technical solutions for one specific issue at the forefront (Latour, 2018; McFarlane and Söderström, 2017).

Even if projects are successful at the pilot stage, it can often be witnessed that once rolled out across the broader city, challenges - mainly with regards to adapting the organizational structure and requirements to the new system - occur (Fellner et al., 2020).

This proofes once more that technology can’t be an immediate fix. Instead, an understanding on how technology can address social and ecological needs is of essential means (Latour, 2018, 2009). That is to say, an inclusive approach to urban planning is essential - one that integrates notions of technology to enable wider system thinking.

5 POLITICAL INTERFERENCES WITHIN PLANNING

Smart City concepts - depending upon the basis of a wider system thinking - see their limits in planning not only as in the above-mentioned paragraph within technological constraints, but merely also within planning instruments and their level of intervenency. Thus, it is essential to understand the political implications of planning instruments and processes and their spatial, social, and ecological effectuality (Fainstein & Fainstein, 1971). Political interferences in planning processes, structural differences within the organization of a city’s apparatus, as well as the level where planning instruments can intervene, are decisive for wider system thinking and inherently for smart city concept implementations (Fellner et al., 2020). Understanding these relationships reveals the range of political influence upon the role of planning and its objectives and ultimately at which level of the political-administrative system the responsibility for an area of action is located and the consequences for spatial development (Schindegger, 1999).

In the case of Austria this is visible within spatial policies and their implication levels. As in the sense of a federal state structure, the Austrian counties possess a high degree of autonomy and are responsible for spatial planning. However, the planning competence is not matched by much enforcement power, as actual zoning is carried out by the municipalities (ibid.). Contrary to Switzerland and Germany who have spatial - and often also building policies regulated on a national, supra-regional and regional scale; Austria and in particular Styria leaves zoning and primarily building policy implementations at the municipal level – leading often to politically biased and short-visioned decisions (see Fig.1) (Lang, 2003; Stadt Wien, 2018; ARE, 2021; Stadt Graz, 2020). However, the city of Graz seems to take on a particular role within this

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paradoxon. While urban planning policies – compared to Switzerland (ARE, 2021) or Germany (BBSR, 2021) - are often regulated within zoning plans or regional policies, Graz seems to lack certain planning devices within this meta-level.

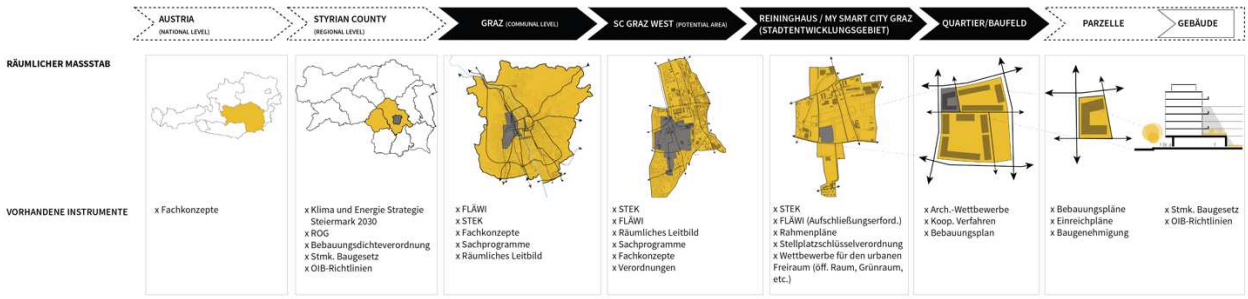

Fig. 1: Spatial matrix of planning instruments and levels in Austria

Particularly, decisions which need to be taken on the level of an urban quarter are currently either regulated within the building plan – or sheer not existent (Gruber et al., 2018). Contrary to other cities (Stadt Wien, 2018; Stadt Zürich, 2021; Freie Hansestadt Hamburg, 2020) Graz additionally finds itself in a standalone position, as all planning departements are mandated not through a city's senates member as usually systematized within cities of such size, but rather through the mayor and its deputy (see Fig.2) (Stadt Graz, 2020; Land Steiermark, 2021).

Fig. 2: Building authorities within Austria's countys and political interconnectivity of planning departements, city senates and mayors, grey colour indicating mayors' areas of responsibility (Stadt Zürich, 2021; Freie Hansestadt Hamburg, 2020; Stadt Wien, 2018; Stadt Graz, 2020).

6 PROJECT DESCRIPTION

The research project ECR Smart City 2020 (05/2018 – 12/2021) is based on the results of previous research projects in the Smart City Graz context. It is carried out by the Institute of Urbanism in cooperation with the Institute of Thermal Technology at Graz University of Technology and funded by the Province of Styria and the planning departments of the City of Graz.

Offering a critical reflection of existing planning and regulation devices at the Smart City Graz, the aim is the further development of integral measures for a sustainable future development of the City of Graz. The undertaken research of the Institute for Urbanism consists of two main parts. On the one hand the evaluation of past research in order to improve further planning measures is placed in focus and on the other hand the modelling of scenarios for a future urban transformation towards resource efficiency and climate neutrality is undertaken.

6.1 Methodological considerations

This paper presents parts of this much wider, aforementioned research project, dealing with the evaluation and contextualisation of past Smart City research in Graz. After a pre-selection, 18 local smart city projects were selected and analysed in order to derive recommendations for further actions. For that end, final reports were analysed through the means of qualitative content analysis, supported through the analysis software MaxQDA (Mayring and Brunner, 2009).

The selected projects were examined in depth with regards to topics such as structural similarities, forthcoming solutions and issues, timeframes and implementation processes, stakeholders, content correlations, main topics and primary targets of the research. Measures and recommendations for actions were established upon findings of the undertaken qualitative analysis and good practice examples.

6.2 Findings

Overall a narrowing scope of research can be observed, manifesting in a centering on the built object and the efficiency of its heating/cooling system. While this brings about technological innovation, it becomes increasingly clear that the full potential of smartness comes up against limits that are to be found in the regulatory and planning system; thus, hindering increased resource efficiency on a structural level.

This becomes imminent through the analysis of the main targets of the research projects. While most of the analysed projects deal with energy efficiency in buildings, use of waste heat and questions of energy efficiency zoning - mainly focusing on technological innovations on an object or plot scale, only three of the analysed projects touch upon social, ecological or qualitative spatial concerns. Considering that the creation of energy efficient districts - which should inherently take the design of its non-built environment into consideration - was just one of the many aims set out for the Smart City Graz, it seems that the holistic objectives of the smart city criteria are not reflected.

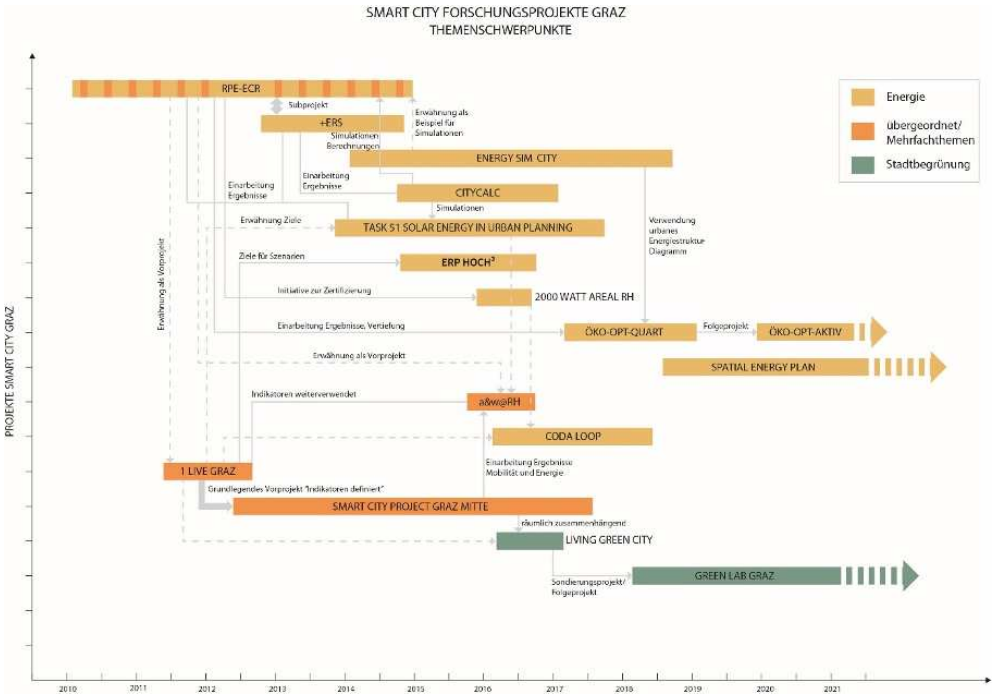

Fig. 3: Pert chart diagram depicting main focal points of analysed research project. A clear lean towards energy as a central research topic is visible.

Moreover, five overarching themes of challenges emerged. The acquisition of data, the monitoring and evaluation of those, the establishment of mobility concepts, mixed-use as well as system boundaries. It became apparent that the latter seems to be of central concern, overarching and determining the successful solutions of the other challenges.

While for example structured data management and acquisition is particularly necessary for the successful organisational, constructional as well as economic implementation of solution approaches for an energy and mobility optimisation of urban districts, limits mainly occured in connection with a lack of system thinking. The evaluation and monitoring of this hitherto (often not) acquired data represent a central way of probing

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solutions adopted so far. Not only is the discovered lack of these measures critical for the ongoing; but also for future smart city developments and strategies for the city as a whole. At the same time the need of mobility concepts and the implementation of a mix of uses within the urban districts long for concepts which consider a wider system; rather than the existing concepts which consider, if even, just the direct neighbourhoods.

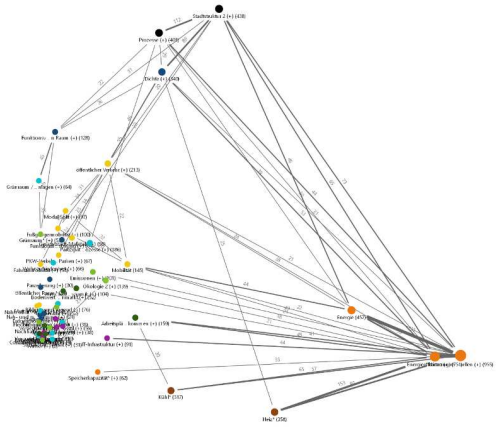

Fig. 4: Visualisation of qualitative content analysis through MaxQDA software. While topics linked to energy are considered and discussed within research projects mostly, smart city concept criterias are sparsely noted.

6.2.1 Data acquisition

Most of the analysed projects display issues with data collection especially at the scale of urban planning, needed in order to make recommendations or take actions. Predominantly these are either not recorded in a standardised way or only accessible with difficulty or for fees. Due to individual solutions and applications for single plots, data is often not compatible with one another. Additionally, databases are often not integrated into the cities geo-reference system. Consequently, the data is often useless for a distillation of measures and actions. This brings up front that systematic, standardised, interdisciplinary data collection (e.g. energy data, mobility, climate data, urban geographic data, zoning, vacancies, brownfields) and central administration are essential for real "smart" services, in order to research, monitor and later optimise methods and approaches.

6.2.2 Monitoring and evaluation

The current stage of the development of the Smart City Graz would essentially profit from feedback loops of already implemented systems. However, monitoring and especially the essential evaluation is often absent, mainly through a non-existence of data. Besides the importance of feedback loops within the Smart City Graz development, monitoring and evaluation processes seem extremely important for an international applicability for Smart City developments, considering that long-term evaluation and publications of findings are still of scarcity (Fellner et al., 2020). In general, an overall tendency of loose ends and unanswered questions was noticeable across all analysed projects. New urban development agreements and urban planning processes were implemented, but a monitoring or an evaluation if intended goals were achieved never occurred. Same holds true for the evaluation of spatial and economic qualities, as well as the monitoring of implemented projects according to mobility or energy measures. For most research projects, no statements could be made regarding the success of the desired effects due to discontinued or non-existent evaluation.

6.2.3 Mobility

While smart transport technologies would have the potential to offer solutions for old governance and planning problems, such as the avoidance of traffic jams and other infrastructure bottlenecks, the establishment of a transparent administration and, in general, a resource-efficient, fully plannable and demand-oriented management of public services and large-scale projects for a wide range of uses in urban development (Bauriedl and Strüver, 2019, 2018), the undertaken analysis clearly showed that this is not the case in the smart city development of Graz so far.

Although mobility has often been mentioned in conjunction with implementation processes of spatial-energy planning in the analysed project reports, so far, no mobility-focused research projects have been undertaken nor an evaluation of existing efforts. Whilst cooperations between urban development and transport planning is demanded in contracts and most of the measures and criterias are set up in coordination with the surroundings of the entire urban area, the implementation mostly fails due to non-existent policies and planning instruments which regulate the interests of stakeholders and the public.

6.2.4 Mixed use

One of the main aims of the city's vision for the development of the Smart City Graz is the implementation of concepts for a city of short distances (Moreno, 2020; Stadtbaudirektion Graz and Hoffer, 2012). This positions the concept of mixed use not only as a central element with regards to the aims for the development of the smart city, but also functions inherently as a dependency factor for reducing CO2 emission via primary energy-saving networks and soft mobility concepts.

However, within the built urban quarters of the smart city, it is evident that the envisioned mix of uses layed out in the development criterias and framework plan has only been implemented to a limited extent, entailing the loss of urbanity and vitality of open space (Jacobs, 2011). Corporate interests and economic profits of private developers lead to monofunctional uses on the ground floor level, as seen in several implemented developments (Dumke et al., 2017). Similarities in structural challenges can be seen with the topic of mobility and therefore necessitates concepts where the city, as well as a third party can cooperate as strategic partners in order to overcome monopolitcal interests.

6.2.5 System boundaries as overarching theme

The integrative character of the Smart City confronts us with completely new challenges. It is no longer the traditional individual building on a plot that has to be considered but rather entire neighbourhoods up to city districts. This leads to major challenges at many levels, which were previously oriented towards the scale of the parcel / property and retrospectively to their owners. The importance of a paradigm shift within the meta level is essential to overcome the predominant limits and establish a system of thinking dedicated to symbiotic connections.

Although dense urban settlements are predestined for systemic energy solutions, concepts must be thought beyond system boundaries in order to contribute to a significant increase in the efficiency of society as a whole. However, this can only succeed if smart cities also develop correspondingly smart business models (Rainer et al., 2014). Especially since balancing the interests of all actors in the energy system seems to be very complex. Central to this is the creation of a clear regulation of responsibility and risk compensation. Here, the importance of a legal basis must be emphasised once again.

Besides, it is important to note that newly interdisciplinary technical planning and simulation tools for energy, mobility, supply and data networks (Moser et al., 2020; Staller et al., 2018), often only operate at the level of implementation planning, and dismiss the importance of urban planning phases. Here, the development of new, integrative models for energy planning at neighbourhood and urban districts, but even on a regional level would also be necessary (Dumke et al., 2017), since decisions made on a building plot level are also space effective on a regional scale and vice versa. Exemplary therefore is the cross-energy hybrid grid integration, which requires diverse conversion technologies and storage solutions that need to be embedded in urban living spaces.

As seen in various smart city related projects undertaken in Graz, current legal frameworks are limiting the successful implementation of networks and alliances with regards to energy and resource consumption as well as production due to the predominant focus on an individual building plot (Stadtbaudirektion Graz b and Hoffer, 2018) This resulted for example in the discarding of a sustainable spatial energy and power supply concept developed for a neighbourhood in the Smart City Graz, which would have offered 100% locally produced energy consumption (ibd., 2018). Consequenting on this, spatial energy and resource planning across neighbourhoods require a format of inter-municipal associations and legal frameworks by addressing contracts of economically monopolistic agents such as in this case the power supplier. In general, policy needs to be a prime part at the meta level, deviating from silo thinking towards crossdisciplinary approaches.

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Only if a legal basis is developed, a "smart" integration of new economically and resource efficient smart city models is possible. Exemplary therefore are collectively operating networks or the often-proposed new economic evaluation models (Greencity Zürich, 2020).

Moreover, requirements of new systematized and holistic, as well as interdisciplinary planning processes with regards to societal, ecological, sustainable and resource related as well as spatial aims for the vision of a neighbourhood / district are needed. Not only can these planning processes be an actant for ensuring the above mentioned aimed qualities; but especially with regards to new complexities stemming from an interdisciplinary approach, the currently often enormous time resources required for decision-making processes can be eased. The oblivion of such processes in Graz can currently be observed in numerous spatial and resource related errors.

7 CONCLUSION

Through our analysis, the above discussed topics emerged and were considered essential for a successful further development and practical implementation of the smart city concept. As illustrated, the central challenge among these is that of systems thinking. Overcoming system boundaries seems to be the pivoting point for reaching set aims. The integrative character of the smart city necessitates a changed spatial focus within the planning system (and its existing instruments). Where traditionally decisions were taken at the scale of the block or the individual parcel of land, now entire neighborhoods and even city districts and their connection to resource circles have to be considered, transgressing boundaries of ownership, competencies and responsibilities. Instead of offering an immediate fix, technological innovation is often used as an evading mechanism in order to cover up structural issues of planning and governance (Marvin et al., 2016; Shelton and Lodato, 2019). This can be clearly illustrated within the development of the Smart City Graz.

Although clear legal responsibilities at the scale of urban quarters, development axes or even regions exist (spatial planning laws or building regulations at the federal state level), essential cooperation processes for developments on this scale are not standardised and even less institutionalised. Despite the establishment of binding law- agreements with landowners, the anchoring of aims according to sustainability, ecology, energy efficiency and reduction of MIV in the zoning plan in order to allow mixed uses, soft mobility, and sufficient open spaces was pushed, the actual implementation of a neighbourhood wide energy or mobility concept in the smart city development in Graz partially failed.

Meanwhile, innovative and smart use of planning processes and instruments such as an anchoring of a cooperative development and planning structure through development agreements between landowners, stakeholders and actors of the city in the zoning plan, gave way for the successful implementation of district wide implementations of energy concepts in the Green City Zurich (Greencity Zürich, 2020). A similar approach to planning instruments was applied at the Kalkbreite in Zurich. Economic networking and lifespan models for investors and property owners were established at the level of the neighbourhood, offering legal certainty and planning security, as well as insuring fulfillment of important aspects of urban planning (such as mixed use on the ground floor level, mobility concepts, qualitative open green spaces) (Genossenschaft Kalkbreite, 2019, 2014).

As most of the measures need to be implemented in coordination with the surroundings of the entire urban area - rather than an isolated consideration of a neighbourhood - cooperations between private and public actors are often concluded through the aforementioned urban development agreements. However, Germany and in particular the city of Hamburg uses urban development measures set out in zoning plans as a tool to influence and guide developments from an early competition stage onwards, up to building phases (Freie Hansestadt Hamburg, 2013). Mobility as well as energy concepts and their implementation in the resource efficient district Neue Mitte Altona profited from the set out urban development measures, as economical interests and challenges of system boundaries were evaded (Freie und Hansestadt Hamburg, 2012). Besides, it offers possibilities to rethink and implement transit-oriented development on an urban scale. The establishment of mobility funds on the level of an urban quarter through a third party, as implemented in the Seestadt Aspern[1], is an additional approach to push agreements and cooperations between individual developers (Hinterkörner et al., 2015).

[1] "The business model of the Mobility Fund is based on the use of levies in connection with revenues from motorised private transport to support sustainable mobility. In concrete terms, the fund is fed by the levying of charges on the

The analysis showed that other than system boundaries as an overarching theme, mixed use seems to be a prerequisite for fulfilling smart city aims. Furthermore, the reaching of CO2 emission goals, energy efficiency as well as urban spatial quality results from a diverse mix of functions (Dumke et al., 2017; Stadtbaudirektion Graz and Hoffer, 2012). In order to increase mixed use, to establish a certain quality to ground floor zones and consequently dismiss speculative usage through private developers, a special-purpose entity was founded throughout the development process in Seestadt Aspern (Hinterkörner et al., 2015).

Other challenges seemed to be of the acquisition of data, the monitoring and their evaluation. A central way of probing adopted solutions so far is the action of monitoring and evaluating the development in all stages. However, a successful evaluation and monitoring is dependent on the completeness and accuracy of the previously obtained data. Especially in the field of energy planning, early feedback loops could have counteracted shortcomings of implemented solutions. The need for an interdisciplinary data platform for the increasing flood of data from ever new sensors and end devices is once more highlighted within the outcomes of the analysis. The establishment of a Smart City data platform Graz at the Digital Agenda Graz[2] would be the aim - a district-specific data platform in the smart city district that can be expanded and subsequently used as a smart city platform for the whole of Graz.

In order to facilitate this, the establishment of a Smart City Graz innovation team would be fruitful, following the example of Salzburg (SIR) and Vienna (TINA Vienna) (SIR and Land Salzburg, 2021; Wien Holding, 2021). The aim would be to monitor the energy performance of urban developments, as well as the sustainable programming of the architectural competitions, the continuation of the international exchange of experience and the transfer of the findings to other Smart City developments in Graz.

Overall, a shift towards system thinking is central to the Smart City development process. This calls for targeted cooperation between the city administration, the province of Styria, research, investors and leading companies, inherently also aiming for a restructuring of current planning instruments, to bridge the gap between the individual plot and a city's wider fabric.

Long-term systemic thinking and planning are imperative in order to avoid temporary paths such as shortcuts by means of supposedly cheaper and quicker solutions.

Technological data and its comprehensive collection and evaluation will only be able to offer support on a meta level, if urban planning doesn't dismiss the importance of strategic planning and governance, through necessitating adaptations in planning instruments and processes.

Moreover, an understanding on how technology can address social and ecological needs is of essential means (Latour, 2009) implying that only if urban planning offers a comprehensive approach, the incorporated technology can facilitate broader solutions and system thinking to meet the upcoming challenges.

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construction of garages (a one-time charge of 1,000 euros per garage space) and their operation (2% of the garage rental income, after the 6th year of use)" (Hinterkörner et al., 2015).

[2] The „Digital Agenda Graz" forms a platform established through Graz Holding to implement and discuss the digital transformation of the city through evaluating, testing and monitoring of research visions and guidelines (ITG Informationstechnik Graz GmbH, 2021).

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