DOI: 10.3217/978-3-85125-668-0-18

Smart Spaces | Towards a Smart-Spatial-Nexus in Urbanism The Example of Smart City Quarter Waagner Biro in Graz and Hunziker Areal Zurich

Radostina RADULOVA-STAHMER

Institute of Urbanism, TU Graz, Austria & Institute of Urban and Landscape Design, Department of Urban Neighbourhood Planning, Karlsruhe Institute of Technology, Germany

Abstract

One of the most frequently declared objectives in Smart City (SC) vision agendas across Europe is the objective of raising the quality of life for the citizens. The quality of urbanity and more precisely the quality of urban design and public space would thus appear to be crucial for pursuing and achieving the goal of the Smart City urban visions. The aim of this paper is therefore to investigate the spatial particularities of SC projects in order to find out how architecture and urban design can contribute to the quality of Smart City developments by proposing spatial principles for design. In this context, there is a lack of spatial engagement with the process of urban digitalisation and the need for a connection between spaces and technologies has become evident. The hypothesis is pursued that Smart City neighbourhoods differ spatially from conventional developments of urban quarters. This article explores a pair of urban quarters – one SC and one conventional – through which Smart City spatial particularities are rendered visible. One Austrian city that is a prominent site for smart urban development, Waagner Biro in Graz, is analysed and compared with a similar development Hunziker Areal in Switzerland. The results contribute to the establishment of spatial smartness as an additional dimension of the Smart City concept in order to enable spatial design strategies to contribute to the physical materialisation and implementation of Information and Communication Technologies (ICTs) in urban space.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

1 Introduction

ICTs are used in cities around the world to meet current urban challenges such as global warming, environmental pollution or scarcity of resources. Concurrently the demand for new, modern, urban quarters is growing. They are intended to do many things: conserve resources, be energy-efficient, socially accessible, cost-efficient, resilient and generally improve the quality of life for citizens.

The technological advances of the past two decades have brought about spatial modifications at the neighbourhood level. Smart City concepts are increasingly impacting urban space. But first global Smart City pilot projects like Songdo or Masdar City show that the one-sided orientation towards technological solutions can improve the efficiency of the city, but does not increase the spatial qualities of the city and thus the quality of life of its citizens. The opposite is frequently the case. The spatial interaction between physical urban space and digital technologies thus needs to be examined in order to prevent a purely efficiency centred use of urban technologies. The aim is thus to investigate the spatial particularities of urban technologies in SC projects with a focus on mobility and environment at the neighbourhood level in order to find out how spatial design can contribute to the SC concept and its declared aim to improve the quality of life for citizens.

This is why SC neighbourhoods are only smart if they can achieve the declared goal of not only improving the systemic efficiency in the district but also and primarily that of improving the quality of life of citizens if the technology applied in the urban context is spatially integrated and spatially designed with the urban surrounding and not only attached to it as an additional layer.

1.1 Literature overview and understanding

The term Smart City (SC) together with related concepts such as Digital City or Creative City, (See Fig. 48) have been appearing with increasing regularity in scientific articles and reports for the past two decades. Municipalities, politicians and service providers use these terms to convey an idea of a city in which technologies help in meeting the wishes and needs of city dwellers (Hollands 2008). But in addition the challenges of increasing urbanization, such as traffic load, energy consumption, pollution, or waste management, also point to the need to find possible solutions for dealing with these urban problems (Caragliu, Del Bo, and Nijkamp 2011).

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

Two major school of thoughts dominate the literature: the technology-led (Batty et al. 2012, C. Harrison 2010) and the socially-led (Hollands 2008, Caragliu and Del Bo 2018, Caragliu, Del Bo, and Nijkamp 2011, Giffinger 2007b) approach to Smart City, leaving a gap in the discussion on space and the spatially-driven approach to the topic.

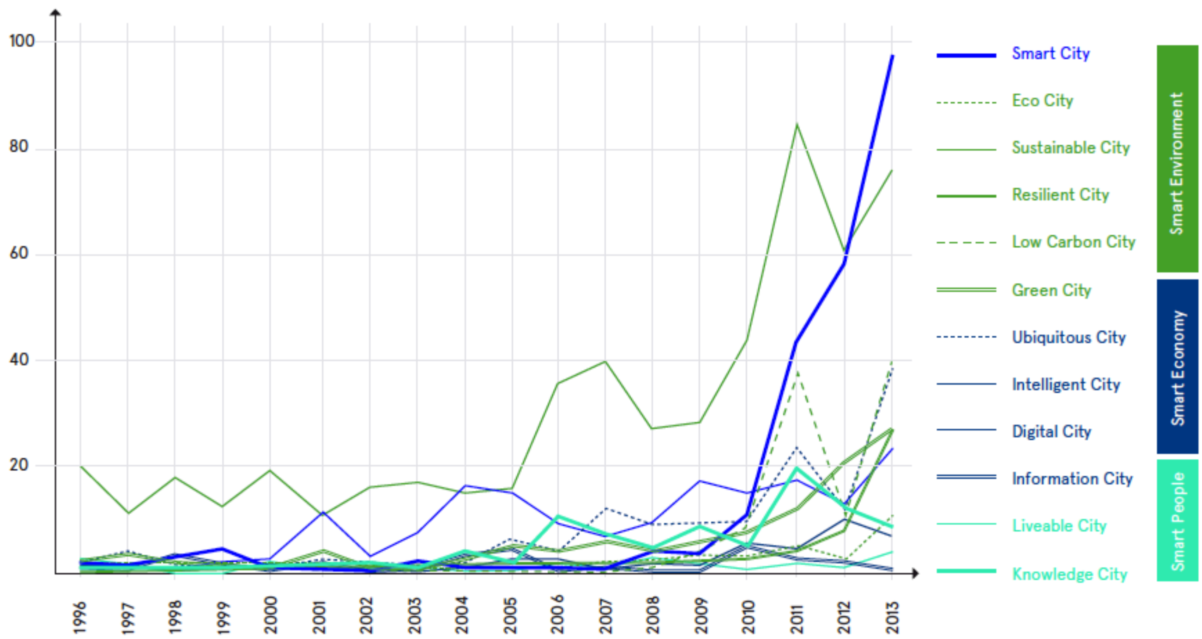


Illustration by Author: Development of the related concepts and replacement by the Smart City concept (based on SCOPUS article de Jong et al. 2015, (scientific publications in scopus 1996-2013)

Fig. 48: *Development of terms related to Smart City*

While part of the literature focuses on new technologies, such as ICTs, and perceives the city as a functional system that optimizes operational processes with the help of large amounts of data, another part of the literature focuses on soft factors, such as quality of life, human capital, or a city's ability to innovate.

Looking at the technology-oriented understanding of SC, which is characterized by different digital data collectors, the increase of productivity and smooth functionality of urban systems turns out to be a main goal of the advocates. Large volumes of real-time information are collected, transmitted, interpreted and processed in order to optimize processes and inform the relevant administrative bodies in the event of problems or dangers (Hall 2000, Marsa-Maestre, Lopez-Carmona, and Velasco 2008, Jaekel 2015, Greenfield 2006). By this means the processed data can help ensure that traffic runs smoothly, despite rush hours, or that energy consumption is distributed more evenly, thus

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

reducing energy costs. But the use of ICTs alone cannot lead to a move towards a SC that improves urban living conditions. This includes soft factors such as human experience, knowledge, skills and innovation.

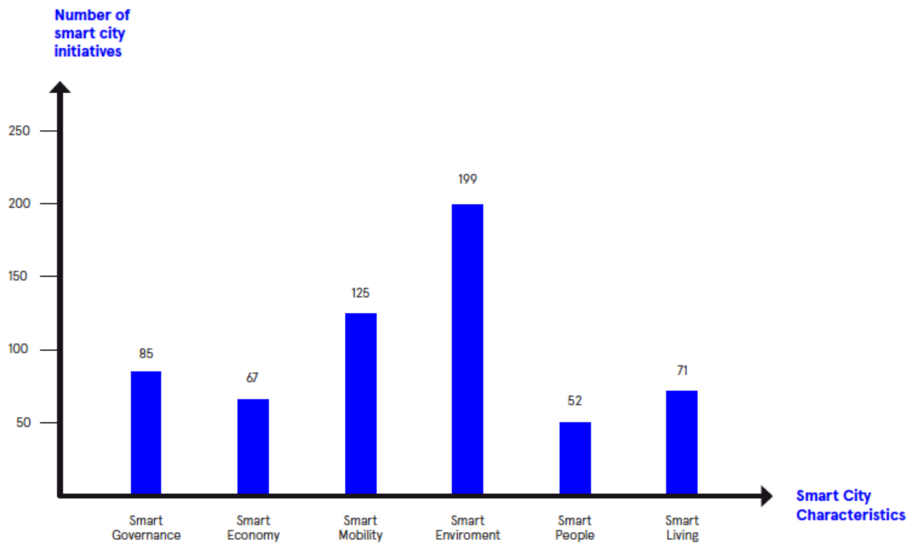
The other essential part of the literature deals with quality of life, educational opportunities, or employment opportunities in cities. Here, the self-determination and skills of urban dwellers come to the fore in order to improve the quality of the city or to establish forward-looking business models (Caragliu, Del Bo, and Nijkamp 2011, Giffinger 2010, Hollands 2008, Giffinger 2007a, Townsend 2013).

In between this spectrum, other areas of SC understanding are appearing, such as the "smartness" of the municipality or the administration. Their ability to make services, information or communication available to the local population in an innovative way is an important pillar of the SC model under the term e-Governance (Sangeetha G 2016, Luciano 2014, Hollands 2015).

The SC model developed by the research group at Vienna University of Technology (Giffinger 2015), is based on a total of six core areas: Smart Mobility, Smart Environment, Smart People, Smart Living, Smart Governance and Smart Economy. Twenty-seven fields of application were defined and 90 indicators were determined in order to quantitatively evaluate the degree of efficiency of a city and thus enable a Europe-wide ranking. According to Giffinger, a city is smart if it offers good performance in the combination of these six areas. The core areas include detailed application areas such as Smart Mobility: local transport systems, international accessibility/networking, ICT infrastructure and sustainability of means of transport.

The EU report “Mapping Smart Cities” shows the highest numbers of initiatives in the smart mobility and smart environment characteristics. (See also Fig. 49) This is why I chose those two characteristics as the focus for the article.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18



Source: European Commission, Report „Mapping Smart Cities in the EU" 2014, p. 38

Fig. 49: *Relevance of Smart City characteristics*

The spatial dimension aspect of SC, however, remains disregarded. Adam Greenfield offers a critical view of the SC model. In his book "Against the Smart City" (Greenfield 2006), he discusses the concept, which is predominantly recruited by technology providers and service providers, and formulates critical questions in with the context of the purpose, benefits and need for such a concept. To this end, he examines prototypes of SC - Songdo City in South Korea, Masdar in Abu Dhabi and PlanIT Valley in Portugal - and filters options for defining the term SC from the perspective of globally leading ICT companies. His investigations do not, however, address aspects of SC's spatial design and perception. Furthermore the spatial dimension was not considered at the conference Digital Clouds - Urban Spaces - City as Information System, organized by the magazine Dérive and the World-Information Institute in Vienna (2014).

Some scholars are describing how urban technologies and ICTs are affecting urban planning and space even when this is not in the SC context (Mandeville 1983, Nijkamp and Salomon 1989, Grentzer 1999, Ogawa 2000, Sohn, Kim, and Hewings 2002, Talvitie 2002, Sassen 2011, Comin, Dmitriev, and Rossi-Hansberg 2012, Zawil 2017), but none of the literature engages with technologies from an urban design perspective. Thus in order to be specific a narrow spatial definition of the term Smart City is useful for understanding the scope of the paper.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

1.2 Operational definition

Although there is still no global definition of the term Smart City many scholars try to locate the meaning at least from an academic perspective and discuss it from different angles and viewpoints (Caragliu, Del Bo, and Nijkamp 2011, Anthopoulos 2017, Albino, Berardi, and Dangelico 2015, Mosannenzadeh and Vettorato 2014, Lazaroiu and Roscia 2012, Hollands 2008).

What all definitions have in common is the ICT-driven development. These new technologies promise to change the cities both as systems and as society. Some scholars describe the SC concept as an multilevel system consisting of multiple categories such as natural environments, hard infrastructures both ICT-based and non ICT-based, soft infrastructures and smart services for example (Anthopoulos 2017). Despite all the significant amount of research that has been conducted in the last two decades on SC it is lacking in a significant spatial understanding of the concept (Hall 2000, Marsal-Llacuna and López-Ibáñez 2014, Picon 2015, Roche 2016).

In order to be able to discuss the concept from an urban design perspective we need to focus the understanding it brings on space. In my understanding, an SC is a territory with system boundaries of any size, in which ICTs are not only implemented in urban space but are physically thought-through and designed together with the urban space, hence ICTs are design embodied in space. This SC process is integrated in urban design and follows specific key objectives in order to improve people’s lives by presenting spatial-technological solutions to current social, ecological and economic challenges. I suggest referring to the resulting physical reciprocity between technologies and space as a “smart-spatial-nexus”.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

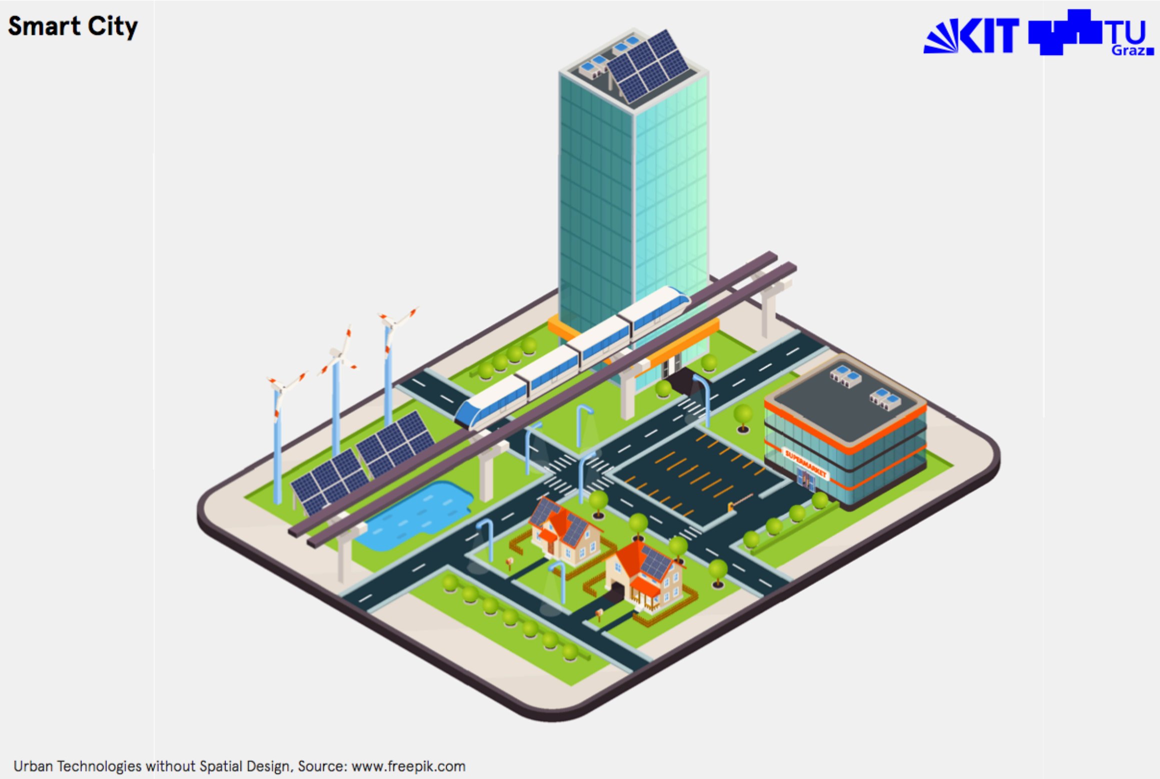


Fig. 50: *Spatial Production of Smart City Approach*

Fig. 51: *Smart Spatial Design, Approach ICTs Design Embodied in Space (Smart Spatial-Nexus)*

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

Against this background, it remains unclear whether and, if so, how the concept of a SC is spatially represented. Finally, if the city is the research object, then the concept of the SC needs to have a three-dimensional, spatial, or even atmospheric consequence. In order to be able to assess the development of the SC holistically, an intensive examination of the spaces created within this concept is necessary.

1.3 Research approach

As mentioned in the abstract one of the most frequently declared objectives in Smart City vision agendas throughout Europe is the objective of raising the quality of life for the citizens (Albino, Berardi, and Dangelico 2015, Ballas 2013). The quality of urbanity and more precisely, the quality of urban design and public space would appear to be crucial for pursuing and achieving this goal. The integrated and extended design approach presented in this paper enables the qualifying of the city and its urban space instead of only improving the technological efficiency of cities as systems. But first we need to study the spatial particularities of SC projects and differences between those and conventional quarter project in order to tackle the question of the spatial consequences of ICTs.

To do so an analysis matrix of SC and conventional city districts in the German-speaking area is elaborated with 24 quarters in the German speaking area along seven mobility criteria. These criteria have been chosen to narrow down the possibilities and choose the most adequate case studies in order to indicate the characteristic of smart mobility, as it is one focus area of the research. (See Fig. 53) A good accessibility on foot influences the mobility behaviour of the inhabitants in the neighbourhood.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

Thus, the investigation is carried out on the basis of isochronous maps with 10 minute walking distances. The polygon deflections are set concave[1] in order to map the traffic space and accessibility as accurately as possible. The uses are shown only within the isochronous map and are recorded independently of the quarter boundaries.[2] (See Fig. 52)

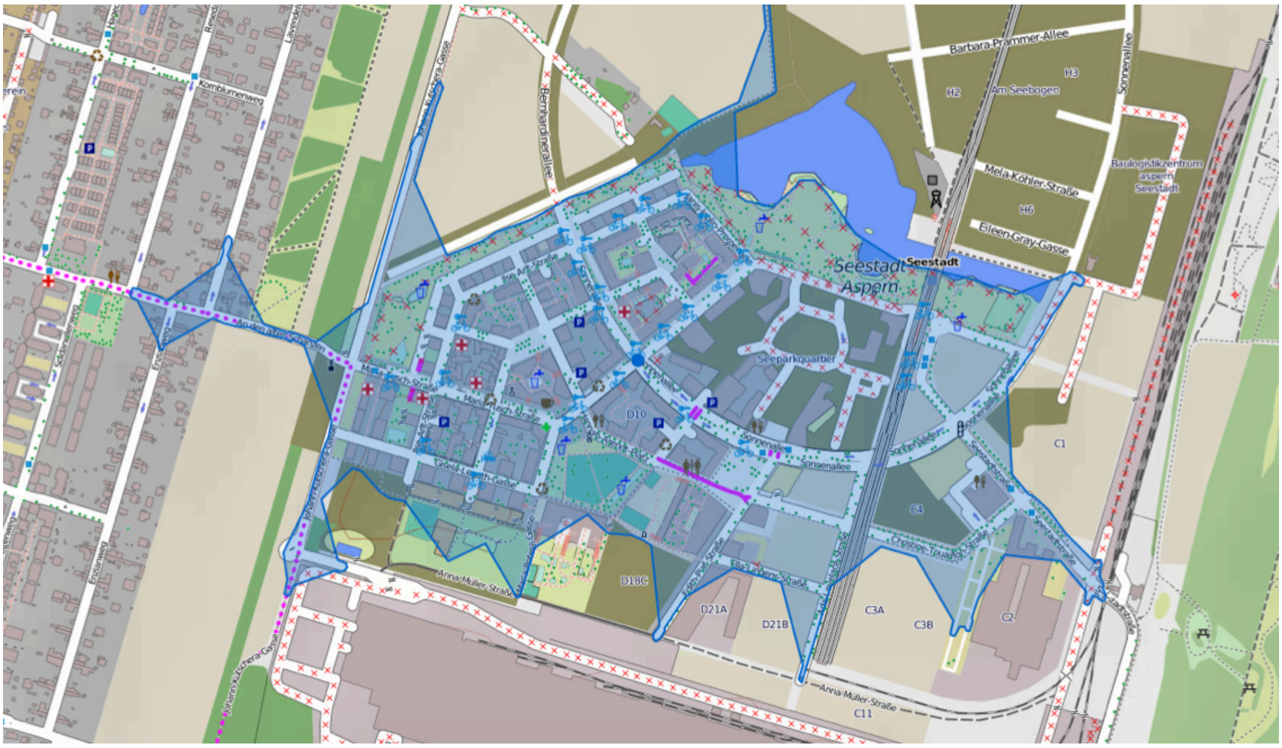


Fig. 52: *Example of GIS Isochone Map of Parking Garages in Seestadt Aspern Vienna*

1. at level 8 (at 0 convex, at 8 concave)

2. All data are based on Open Street Maps (OSM). In the case of districts that have not yet been completed, some building structures and uses have not yet been entered in OSM, so that the representations do not correspond to the current state of construction. These data are used for the first phase of the evaluation and assessment in the criteria matrix. In the event that a neighbourhood does not yet have any data on OSM, the respective project website is used to collect information.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

	Accessibility	Public Trans-port Links	Multimodal Hubs	Cycling In-frastructure	Mix of uses	Collective Parking	e-Mobility	Location in the City	Location Favor	Development Process	Size of Area	Type of De-velopment	Possible Case Studies
Waagner Biro Str./ Alte Poststr. (Graz)	1	3	1	3	3	0	0	zentrumsnah	Bahnhof	Im Entstehen	Quartier	Konversion	
ANNA – Eggenbergergürtel/Niesenbergergass	0	3	3	3	3	1	1	zentral	Hbf	fertig	Objekt	Neubau	
Brauquartier (Graz)	1	3	3	3	3	3	1	peripher	Autobahn	Im Entstehen	Quartier	Konversion	■
Green City (Graz)	2	3	0	2	2	0	1	peripher	Autobahn	Im Entstehen	Baufeld	Neubau	
Aspern Seestadt (Wien)	3	3	3	3	3	3	3	peripher	Bahnhof	Im Entstehen	Quartier	Konversion	■
Perfektastraße (Wien)	3	3	3	3	2	0	3	peripher	Autobahn	fertig	Baufeld	?	
Stadtwerk Lehen (Salzburg)	3	3	3	3	3	3	0	zentral	Wasser	fertig	Baufeld	Koversion	■
Hamburg Barmbek Nord Q21	3	3	3	3	3	1	3	zentral	Bahnhof, Wasser, Autobahn	fertig	Quartier	Nachverdichtung	■
Rieselfeld (Freiburg)	3	3	2	3	3	1	2	peripher	Autobahn	fertig	Quartier/Stadtteil	Neubau	
Hunziker Areal (Zürich)	3	3	3	3	3	2	0	innerstädtisch	Autobahn	fertig	Quartier	?	
Erlenmatt Ost (Basel)	0	3	2	3	3	1	0	zentral	Bahnhof, Autobahn	?	Quartier	Konversion?	
Lincoln-Siedlung (Darmstadt)	2	2	1	3	2	0	0	peripher	Autobahn	?	Quartier	Konversion	
Benjamin Franklin Village (Mannheim)	3	3	3	3	3	1	2	peripher	Autobahn	in Planung	Quartier/Stadtteil	Konversion	■
Bahnstadt (Heidelberg)	3	3	3	3	3	2	2	peripher	Bahnhof	fertig	Quartier	Konversion	■
Stadtteil Hubland (Würzburg)	2	3	1	3	2	1	3	peripher	-	in Planung	Quartier/Stadtteil	Konversion	
Domagk Park (München)	2	3	3	3	3	0	0	innerstädtisch	Autobahn	fertig	Quartier	?	
Freiham Nord (München)	3	3	0	2	2	1	0	peripher	Autobahn	in Planung	Quartier/Stadtteil	Koversion	

Fig. 53: *Analysis matrix for the selection of case study districts*

In order to ensure the comparability of the different neighbourhoods, further plausibility criteria are included, such as (1) the location in the city (inner-city, close to the centre, peripheral), (2) the location (motorway, long-distance railway station, airport, port, lake, river, etc.), and (3) the type of development (existing, new, conversion), as well as (4) the progress of development. (See Fig. 53) All selected cases have curtain up measures to promote mobility and the environment, the project type is new district and not an existing one, and finally the good data availability is provided for all six selected districts. Despite of the systemic approach this analysis is an exemplary concept to select suitable case studies but does not extensively cover all spatial dimensions of SC projects. In the second step the two selected quarters are spatially examined on the neighbourhood scale and brought into a direct spatial comparison.

All of the following factors included in the assessment are factors that can and should be influenced and strategically decided by the developers of the neighbourhoods. This assessment shows the spatial qualities in a certain context of a SC and of a conventional quarter. Although the mapping in the context of the two projects indicates conditions which depend on environmental factors, the specific conditions of the project site itself reveal the strategic design decisions. By means of this spatial comparison the ways in which the SC project differs in these six criteria from the conventional project is displayed:

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

• encouragement and encounter (usage mix)

• interface and Infrastructure (collective parking)

• system and synergy (open space system)

• appropriation and atmosphere (pedestrian areas and multi-coding)

• mobility and modality (street connections)

• distance and dimension (path network, grain size).

Finally after the spatial comparison the potential for urban space is described and conceptualized into three spatial principles for urban design.

2 Introduction case studies

The Waagner Biro site is in Graz, the second largest city in Austria and the capital of the province of Styria. Graz currently has about 325.418 inhabitants and the core zone covers an area of 286,88 km². The population density in this core zone is 1,134 E/km^2. Some 87% (2018) of households in Styria have broadband access and 90% of Styrian households have Internet access. By comparison, 89% of households in Austria have Internet access. The motorisation rate in Styria was 593 cars/1000E (2016) and 867,7 cars/1000E (2018). The trend continues to rise. The boiler location of Graz also contributes to the poor air quality. Whereas Zurich has 402.762 (2017) inhabitants living on an area of 153,06 km². The population density is slightly lower comped to Graz with 905 E/km2 (2017). And the motorization rate is with 492 cars/1000E (2016) also slightly lower compared to Graz.

In Austria the Federal Ministry of Transport, Innovation and Technology (Bmvit) established a funding channel, the Climate and Energy Fund[1], which supports the implementation of sustainable energy supply in Austria, to help reduce greenhouse gas emissions and contribute to climate adaptation. SC demonstration projects such as Waagner Biro have been funded by the Fit4set call funding. The project decisions were started in an interdisciplinary consortium shortly before the funding was received. In Graz the SC vision is aimed at two strategic key objectives: (1) to reduce the environmental impact such as energy consumption, waste production or dust emissions in the city and (2) to increase the well-being and quality of life for the citizens. (Stadt Graz 2012, Rainer, Grabner, and

1. Klima- und Energiefonds

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

Konrad 2016) This is why the project suites well for examination of urban qualities such as functional mix, mobility infrastructure, or accessibility to name only a few.

In the former industrial area near Graz Central Station, a new self-sufficient energy district is being created with an integrative planning process. Waagner Biro is located in the vicinity of the Helmut List Cultural Hall and about 2 km northwest of Graz city centre. The main Graz railway station is approx. 800 m distant to the south. The railway line and Graz Central Station are located to the east of the area. The planning area of the urban development master plan covers an area of approx. 127.000 m², or 12,7 ha. Energy technologies for the intelligent "Zero Emissions" city are tested here. The project size is not yet fully developed.

Fig. 54: *Urban context and location of the Waagner Biro Smart City District in Graz*

While the Hunziker Areal is located 5km from the city centre. The site in Zurich-Leutschenbach is the first project of the building cooperative Mehr als Wohnen. The 4ha site is on the former Hunziker concrete factory territory in the centre of an industrial zone. Similar to the Waagner Biro project the site is bordered by the railway track to the south. The project was stared in 2010 and finished five years later. It now provides offices for 150 citizens and homes for 1.200 people. The vision of the 2000-watt society has been realised here. Energy-efficient buildings, new technologies and few cars support an

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

environmentally friendly lifestyle and save resources. Great importance has also been given to high-quality architecture, quality in construction and sustainability in building maintenance.

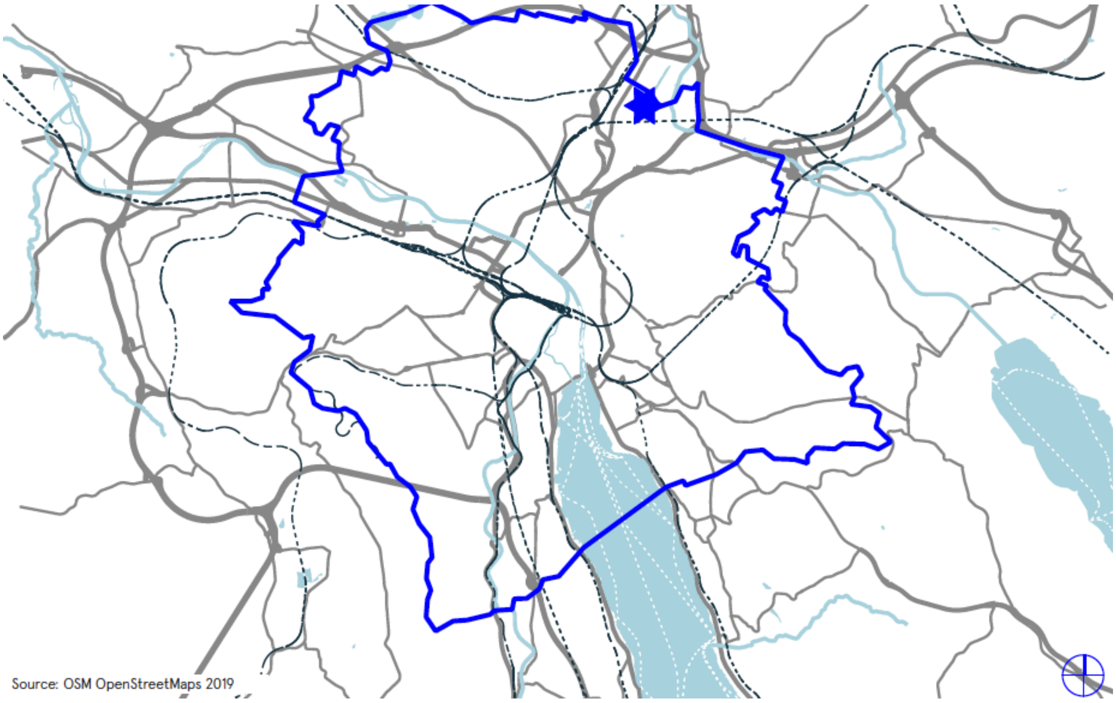


Fig. 55: *Urban context and location of Hunziker Areal in Zurich 2.1 Encouragement and encounter*

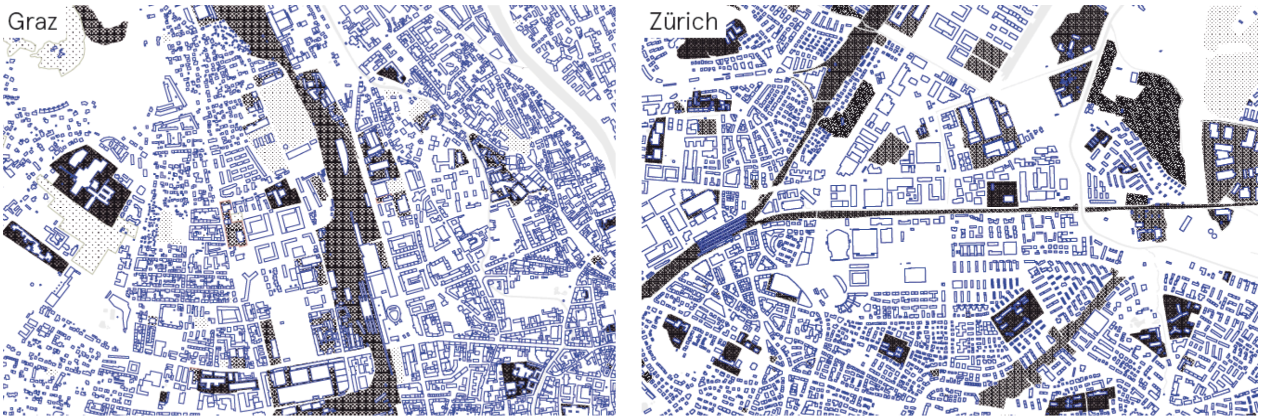


Fig. 56: *Encouragement and encounter – mix of functions*

Accessibility on foot to local suppliers, educational or health facilities for example, promotes active mobility. In the spirit of the city of short distances, the mixed use in the neighbourhood creates pedestrian accessibility for everyday needs. The functional mix of a neighbourhood thus provides information about the walkability value of the development. The Waagner Biro area is one of the last conversion areas along the railway in the

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

Eggenberg district. The surrounding area is largely mono-functionally designated as a residential area. Few educational institutions are located in the immediate vicinity and a school is also planned on the Smart City site to cater for this need. The buildings on the Waagner Biro site are to be large-format and will partly have mixed-uses on their ground floor.

The situation around the Hunziker area is somewhat different. Here, too, educational institutions can be found both in the surrounding and on the site. Many different commercial, service uses and offices are scattered around the area. Object-specific mixed use presents itself as a very small-scale mixed ground floor zone.

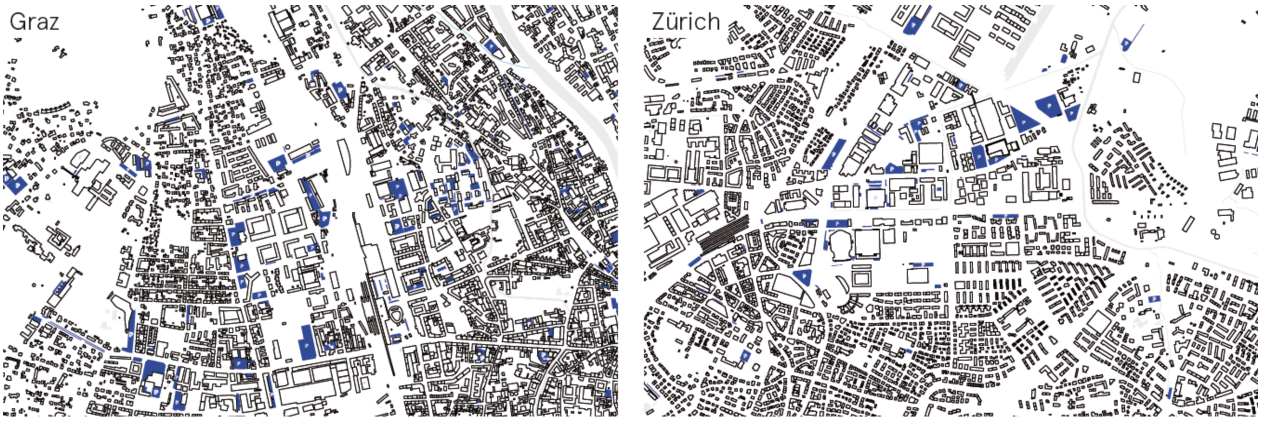


Fig. 57: *Interface and infrastructure – collective parking*

2.2 Interface and infrastructure

The availability of parking spaces is an important key for the choice of mobility. Above ground parking is associated with the sealing of surfaces and reduces the quality of the public space. In Waagner Biro, a rail-bound structure with an above ground collective garage is planned. However, surface parking still exists around the all-purpose events hall Helmut-List-Halle. The aim here is to adapt a car park to different parking requirements over the course of the day and thus use the parking areas as permanently as possible. In the Eggenberg district there are numerous large sealed parking areas. In the Hunziker area, the entire area is free of stationary traffic. A generous underground car park offers parking space for the cars of the residents and visitors. Loading zones for deliveries are provided in the district. These are not, however, for permanent parking use. Only the communal e-car-sharing vehicles park is permanently aboveground, on the road bordering the area.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

2.3 System and synergy

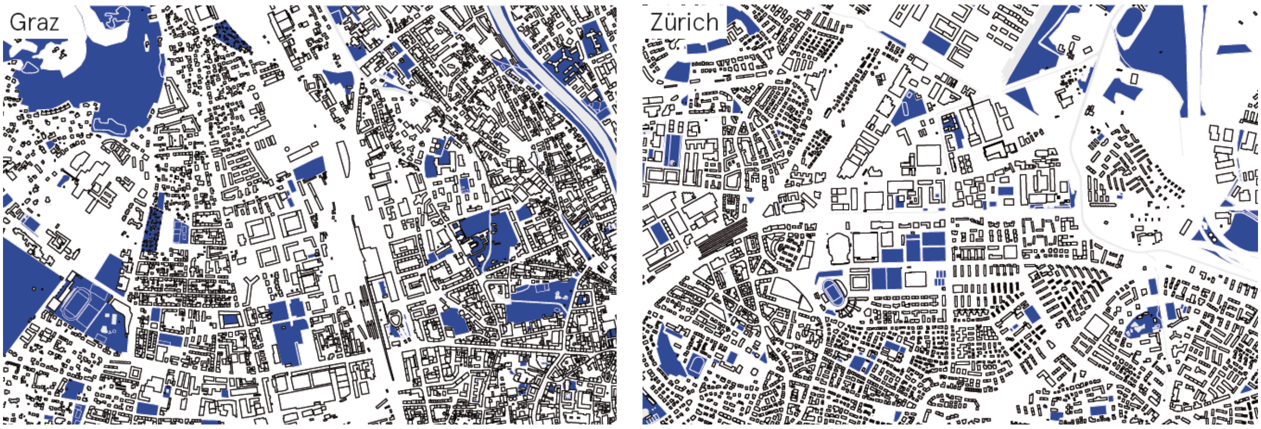


Fig. 58: *System and synergy - open space system*

Green spaces and other public spaces with a high quality of life strengthen social exchange, the sense of belonging to the neighbourhood and thus create identity. In the Waagner Biro area, a spacious public park in an east-west direction is planned, which will also be accessible to the residents of the surrounding area. Greenery along the roads will create green space connections to the north and south.

In the Hunziker area there are several green pocket parks, which extend into the development district in the south and east. A continuous green strip lines the River Leutschenbach a t the western edge. Many pathways with retention strips between the buildings create additional green links to the area. The large school sports facility is in the centre of the area and is freely accessible and offers the residents of the quarter and the wider neighbourhood a diverse green area and small-scale play opportunities. The area is connected to the surroundings by the green strip on the River Leuschenbach in north-south direction and in east-west direction by the green strip on the rails.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

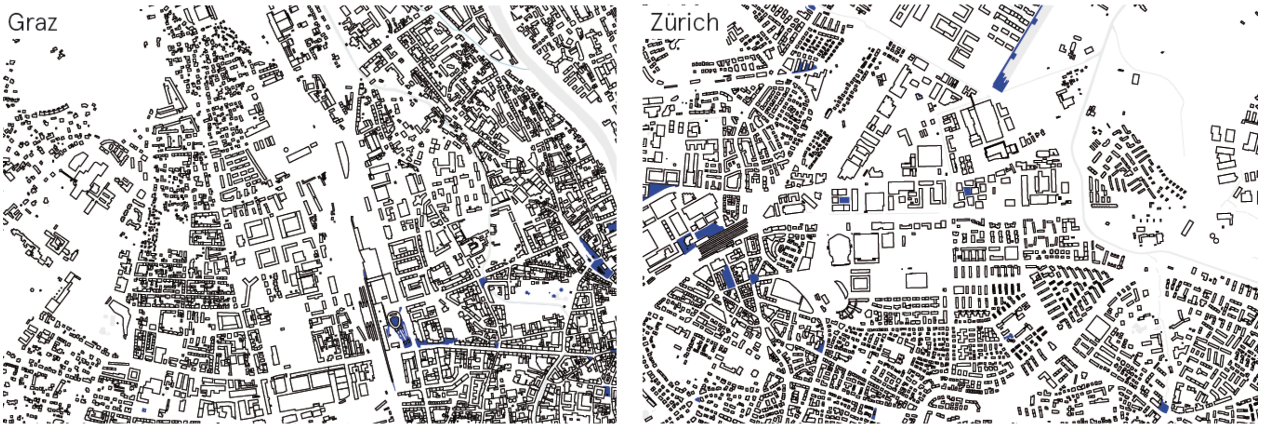


Fig. 59: *Appropriation and atmosphere – pedestrian areas and multi-coding 2.4 Appropriation and atmosphere*

Accessibility to a neighbourhood and thus its networking with the surrounding area is an essential criterion for local mobility. Close-meshed bicycle connections promote health and contribute to the reduction of emissions. Above all, explicitly designated pedestrian areas in the neighbourhoods can significantly increase the quality of life and strengthen the coexistence.

In the Waagner Biro Areal, a street divides the quarter into two. No pedestrian areas are planned, but the street design is intended to create shared space-like areas at two points, on the level of the school and that of the park, in order to reduce driving speeds. Due to the large-format buildings and the noise protection structures along the rails, most of the footpaths run along the roads. A higher-level pedestrian footpath link from west to east is planned with a footbridge crossing the railway. Furthermore, there is no east-west connection.

In the Hunziker area, the location, except for a motorised loop around the neighbourhood square, is designed as a pedestrian area. The neighbourhood square itself is also not passable and can only be used on foot. The small buildings allow a close-meshed network of paths. The cycling quick connection to the rails on Andreasstraße makes the area easily accessible for bicyclists. The areas between the buildings are very diverse and have been adopted and designed by the inhabitants.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

2.5 Mobility and modality

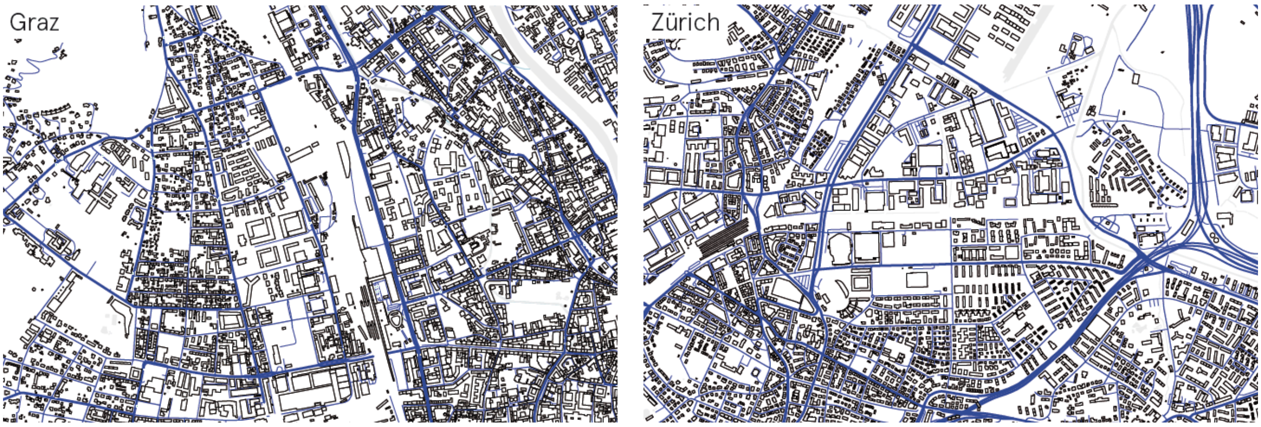


Fig. 60: *Mobility and modality – street connections*

Multimodal hubs ensure a rapid change of means of transport and facilitate the multimodality of everyday journeys. This makes a lasting contribution to the reduction of motorised individual traffic. E-mobility is also sustainable and low in local emissions. The development of a neighbourhood with e-charging stations favours the choice or the switch to electric mobility.

In the Smart City area Waagner Biro a multimodal hub is planned. Here it is possible to change from tram, to bike, to car-sharing, taxi or bus. The proximity to the railway station also means connections are readily available for long-distance travel. In addition to the cultural centre Helmut List Halle, parking spaces are planned for e-car sharing and private e-mobility.

The Hunziker area also has e-car-sharing facilities for residents and visitors. This area, however, does not have a direct connection to the tramway system, but is primarily accessible via the road and the cycle path. The multimodality takes place here between bus, bike, e-car-sharing and private e-mobility.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

2.6 Distance and dimension

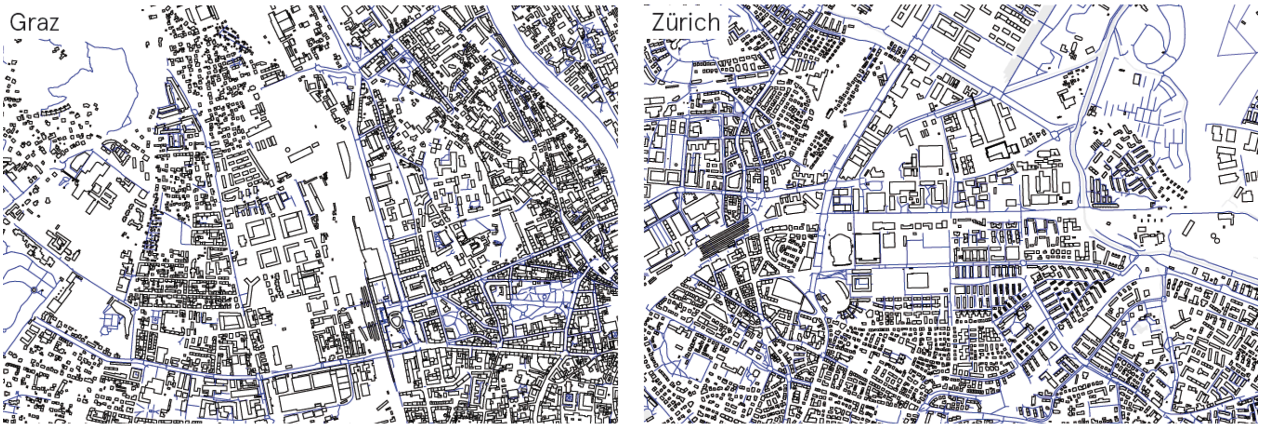


Fig. 61: *Distances and dimension – path network*

Diverse and small-scale path connections in the neighbourhood and in the surrounding neighbourhoods represent a good prerequisite for the extent of walkability. The more enjoyable and varied these connections are, the more incentive is offered to make the paths of daily needs on foot. The relationship between roads and sidewalks, or cycle paths leading into the neighbourhood, also clearly shows the prioritisation for means of transport.

In the Smart City area in Graz the Waagner-Biro-Straße is a fundamental barrier separating the area. It represents the one main connection route into the district, apart from the tram. Scarcely any path links are available here, as the structural granulation is very large and only along the park do paths from the surrounding area lead into the quarter.

In the Hunziker area it has been possible to bridge the railway and to provide an underpass to the neighbourhoods south of the rails and also to create a good pedestrian connection to the surroundings up to the Zürichberg. High-quality and diverse public spaces and paths you are an open invitation for pedestrians to freely cross the quarter. In the north and east of the area there are no road connections. Commercial and recycling companies are located in close proximity.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

2.7 Summary

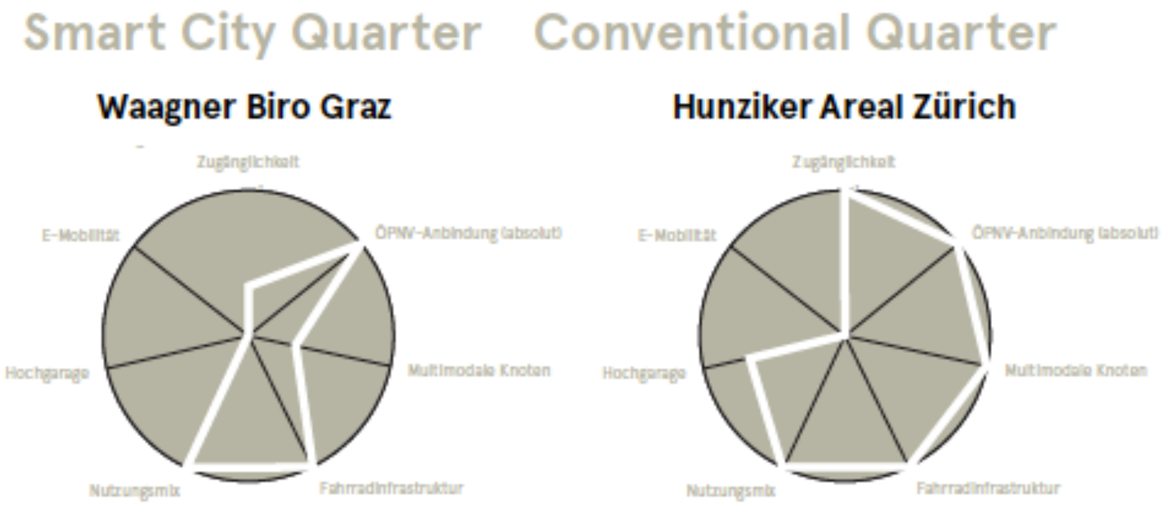


Fig. 62: *Evaluation of case studies*

In summary the comparison of both quarters according to the spatial criteria – encouragement and encounter (usage mix), interface and infrastructure (collective parking), system and synergy (open space system), appropriation and atmosphere (pedestrian areas and multi-coding), mobility and modality (street connections), distance and dimension (path network, grain size) – shows in a comparison that in many of the spatial criteria the non-SC project Hunziker Areal performs significantly better than the SC Waagner Biro neighbourhood.

We can thus conclude from this example that despite its declared goal of improving the quality of life, the production of space in SC neighbourhoods does not perform better. In the following the potentials for urban space are revealed and principles for smart spaces are proposed in order to enable spatial design strategies to contribute to the physical materialisation and implementation of ICTs in urban space.

3 Potentials and principles for urban space

From the spatial comparison three categories for Smart Spaces emerged – multiple spatial overlays and multi-coded surfaces, Time spatial densification of use and seamlessness of surface and openness of use. The three categories for Smart Spaces are described in the following.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

3.1 Time spatial densification of use

New technologies enable a time-spatial densification of use. Technologies in the form of applications enable a time-spatial densification of use. The example of couchsurfing or Airbnb summarized under the concept of collaborative consumption or sharing economy, shows the spatial potential of use that can be developed by establishing these applications. What makes these applications spatially effective is that unused and underused spaces in private homes can be put online, mapped on an online map, so they are digitally and physically made visible and accessible via the platform. This results in a spatial densification of use as spaces can be rented and a temporal densification of use as co-habiting space occurs simultaneously. The physical spatial potential is thus increased. In this category, the usage and organization of temporal programming in public space can be spatially condensed. Scarcity of space in public areas can thus be defused while space reserves in both private and public domain areas can be activated.

3.2 Multiple spatial overlays and multi-coded surfaces

Urban technologies enable flexible and multiple spatial overlays. A classic example is the invention of the elevator in 1853. With the introduction of the crash-proof elevator Otis succeeded in enabled living space to be opened up in skyscraper buildings over one hundred meters high. This technology permits a capsule to move vertically and combines the multiple stories and programmes of a building with each other.

This principle can be applied to public space when private vehicles are understood as an infrastructure element   roads, sewer pipes or electric cables, with the result that new patterns of thinking and fresh solutions emerge, enabling the creation of new urban spaces. Through this transcoding of the car into a mobility cell, the stationary traffic can be moved underground. This creates a multiple spatial overlay as soon as an area in public space is not exclusively dedicated to parking and other areas are not exclusively understood as green areas, or retention areas. They can be multi-coded with the digitally-based urban technologies of space. In the context of urban space design this could enable the vertical organisation of many multiple programmes that are currently organised horizontally.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

3.3 Seamlessness of surface and Openness of use

Urban technologies enable the seamlessness of surfaces to be achieved and for establishing a high degree of user-friendliness, bounteousness and appropriation in public spaces. Tidy public spaces increase the appropriation potential for the residents. In Noderhavn, Copenhagen, for example, garbage bins are organized underground. The waste is conveyed by a suction mechanism into the collecting container, which reports its filled level automatically for the bundling and organization of the refuse collection. This urban technology makes it possible to move waste management infrastructures underground and create surface freedom in public spaces. Transferred to urban space developments further "infrastructure cuts" and synergies would be conceivable. Decentralization plays an important role here. Underground decentralized district sewage treatment plants and waste incineration plants ensure short transport routes and create small-scale cycles. The waste heat from the combustion can thus be used directly and locally as heating without significant energy losses. Above-ground vegetation filter systems and retention areas are integrated into the design of the public space.

4 Conclusion and outlook

New technologies are developed by IT service providers and implemented by administrations and private investors. The impact and relevance of these technologies has not yet entered the discipline of urban design or urban planning.

This paper examined the correlation between urban qualities in Smart City physical space and conventional urban districts. The concept of the Smart City has been analysed on the basis of concrete quantitative analyses on the urban scale.

The question how the discipline of urban design can use technological progress to qualify the urban spaces of the future and thus create the best spatial conditions for a high quality of life for citizens is difficult to answer. New ICT developments can help to boost a rethinking of urban design approaches and instruments. The three spatial principles can be suitable for giving a direction to the process but there is no general blueprint solution for the design, which must always be contextual.

Further research needs to be conducted on spatial effects that are able to indicate the potentials of urban technology for the future development of the discipline, if their well-established urban technologies are integrated already in the design process. The question then is how urban technologies can help urban design to create qualitative, robust and resilient urban spaces of the future in order to improve the quality of life for citizens.

Urban technologies could be used to benefit spatial planning and urban design and contribute to the qualification of public space. Smart Space Design can help in achieving a strengthening of urban design perception for technological potentials and a holistic understanding of the concept of the SC. However, if we want to live in Smart Cities districts, we first need to design and make them spatially smart.

References

Albino, Vito, Umberto Berardi, and Rosa Maria Dangelico. 2015. "Smart Cities: Definitions, Dimensions, Performance, and Initiatives." Journal of Urban Technology 22 (1):3-21. doi: 10.1080/10630732.2014.942092.

Anthopoulos, Leonidas G. 2017. "The Rise of the Smart City." In Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?, 5-45. Cham: Springer International Publishing.

Ballas, D. . 2013. "What Makes a Happy City." Cities 32 (1):39-50.

Batty, M., K. W. Axhausen, F. Giannotti, A. Pozdnoukhov, A. Bazzani, M. Wachowicz, G. Ouzounis, and Y. Portugali. 2012. "Smart cities of the future." European Physical Journal-Special Topics 214 (1):481-518. doi: 10.1140/epjst/e2012-01703-3.

Burdett, Ricky; Rode, Philipp. 2012. "Urban Age Conference." The Electric City, London.

C. Harrison, B. Eckman, R. Hamilton, P. Hartswick, J. Kalagnanam, J. Paraszczak, and P. Williams. 2010. "Foundations for Smarter Cities." IBM Journal of Research and Development 54 (4):1-16.

Caragliu, Andrea, and C. Del Bo. 2018. Smart cities: Is it just a fad? Vol. 17.

Caragliu, Andrea, Chiara Del Bo, and Peter Nijkamp. 2011. "Smart cities in Europe." Journal of urban technology 18 (2):65-82.

Comin, Diego A., Mikhail Dmitriev, and Esteban Rossi-Hansberg. 2012. "The Spatial Diffusion of Technology." NBER (Working Paper No. 18534).

Giffinger, Rudolf. 2007a. Smart cities. Ranking of European medium-sized cities. Vienna University of Technology, University of Ljubljana and the OTB Research, Delft University of Technology.

Giffinger, Rudolf et al. 2007b. Smart cities. Ranking of European medium-sized cities. Vienna University of Technology, University of Ljubljana and the OTB Research, Delft University of Technology.

Giffinger, Rudolf; Gudrun, Haindlmaier. 2010. "Smart cities ranking: an effective instrument for the positioning of the cities?" ACE: Architecture, City and Environment = Arquitectura, Ciudad y Entorno 2010, Año IV (núm. 12 Febrero):P. 7-25.

Giffinger, Rudolf; Kramar, Hans; Heindlmaier, Gudrun; Strohmayer, Florian. 2015. "European Smart Cities 4.0 (2015)." http://www.smart-cities.eu/.

Greenfield, Adam. 2006. Everyware : the dawning age of ubiquitous computing. Berkeley, CA: New Riders.

Grentzer, Martin. 1999. Räumlich-strukturelle Auswirkungen von IuK-Technologien in transnationalen Unternehmen. Münster: LIT Verlag.

Hall, Robert E. 2000. The Vision of a Smart City: Brookhaven National Laboratory.

Hollands, Robert G. 2008. "Will the real smart city please stand up?" City 12 (3):303-320. doi: 10.1080/13604810802479126.

Hollands, Robert G. 2015. "Critical interventions into the corporate smart city." Cambridge Journal of Regions, Economy and Society 8 (1):61-77. doi: 10.1093/cjres/rsu011.

Jaekel, Michael. 2015. Smart City wird Realität : Wegweiser für neue Urbanitäten in der Digitalmoderne. Wiesbaden: Springer Vieweg, SpringerFachmedien.

Lazaroiu, George Cristian, and Mariacristina Roscia. 2012. "Definition methodology for the smart cities model." Energy 47 (1):326-332. doi: http://dx.doi.org/10.1016/j.energy.2012.09.028.

Luciano, Edimara; Macadar, Marie Anne; Wiedenhöft, Guilherme. 2014. "IT Governance Enabling Long-Term Eletronic Governance Initiatives." In Electronic Government and Electronic Participation, edited by M. Janssen, Bannister, F., Glassey, O., Scholl, H.J., Tambouris, E., Wimmer, M., Macintosh, A. , 390 - 391. IOS Press.

Mandeville, Thomas. 1983. "The spatial effects of information technology: Some literature." Futures 15 (1):65-72. doi: https://doi.org/10.1016/0016-3287(83)90073-3.

Marsa-Maestre, Ivan, Miguel A. Lopez-Carmona, and Juan R. Velasco. 2008. "A hierarchical, agent-based service oriented architecture for smart environments." Service Oriented Computing and Applications 2 (4):167-185. doi: 10.1007/s11761-008-0030-7.

Marsal-Llacuna, Maria-Lluïsa, and Maria-Beatriz López-Ibáñez. 2014. "Smart urban planning: designing urban land use from urban time use." Journal of urban technology 21 (1):39-56.

Mosannenzadeh, Farnaz, and Daniele Vettorato. 2014. "Defining Smart City. A Conceptual Framework Based on Keyword Analysis." TeMA - Journal of Land Use, Mobility and Environment. doi: 10.6092/1970-9870/2523.

Nijkamp, Peter, and Ilan Salomon. 1989. "Future spatial impacts of telecommunications." Transportation Planning and Technology 13 (4):275-287. doi: 10.1080/03081068908717406.

Ogawa, Hikaru. 2000. "Spatial impact of information technology development." The Annals of Regional Science 34 (4):537-551. doi: 10.1007/s001680000028.

Picon, Antoine. 2015. Smart Cities: A Spatialised Intelligence: Wiley.

Rainer, Ernst, Martin Grabner, and Oliver Konrad. 2016. "Smart City Project Graz." REAL CORP 2016.

Radostina RADULOVA-STAHMER
DOI: 10.3217/978-3-85125-668-0-18

Roche, Stéphane. 2016. "Geographic information science III - Spatial thinking, interfaces and algorithmic urban places-Toward smart cities." Progress in Human Geography 0 (0):0309132516650352. doi: doi:10.1177/0309132516650352.

Sangeetha G, L. Manjunatha Rao. 2016. "Modelling of E-Governance Framework for Mining Knowledge from Massive Grievance Redressal Data." International Journal of Electrical and Computer Engineering (IJECE) Volume 6 (Nr. 1):pp. 367 - 374. doi: 10.11591/ijece.v6i1.9019.

Sassen, Saskia. 2011. "Urbanizing Technology." Urban Age, London.

Sohn, Jungyul, Tschangho John Kim, and Geoflrey J.D. Hewings. 2002. "Information Technology Impacts on Urban Spatial Structure in the Chicago Region." Geographical Analysis 34 (4).

Stadt Graz, Stadtbaudirektion. 2012. I LIVE GRAZ – smart people create their smart city. In Smart Cities, edited by Blue Globe Report.

Stalder, Konrad Becker; Felix. 2014. "Stadt als Informationsystem." Digitale Wolken und Urbane Räume, Wien, 11.06.2014.

Talvitie, Juha. 2002. "The Influence of Information Technology on Spatial Development." FIG XXII International Congress, Washington, D.C. USA, April 19-26 2002.

Townsend, Anthony M. 2013. Smart cities big data, civic hackers, and the quest for a new utopia. New York: W.W. Norton.

Zawil, Riham 2017. "How does ICT change urban planning, the city, and architecture?".