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SSSEIC – StreetScapes for a Social-Ecological Inclusive City: A Model for the Interdisciplinary Consideration of Streetscapes and Public Spaces

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DOI: 10.48494/REALCORP2025.6090

1 ABSTRACT

The multiple crisis that today's metropolises and cities are facing, present an additional challenge when it comes to maintaining and improving the quality of urban public space in order to subsequently ensure living standards and quality of life. The conditions determining the state of public space represent an interwoven network of mutually dependent factors. Due to this complexity they cannot be treated by one discipline alone, rather, they require a strong inter- and transdisciplinary approach in order to ultimately produce future-fit urban spaces – ones that are ecological, social and inclusive (for human and not-human city-users).

In contrast to work on the building scale – where collaboration between architects and specialist planners (with or without BIM tools) is common practice – interdisciplinary exchange and coproduction at the urban and regional planning scale are not yet standard. Although, planning teams with experts from the fields of traffic or landscape design are also common there, and cooperative processes or participatory workshops are sometimes carried out, shifting the focus to the crucial street/block/neighbourhood scale brings new complexities and challenges, as well as a multitude of different actors and stakeholders. What is missing here are co-operative instruments and methods that, on the one hand, enable inter- and transdisciplinary urban planning and, on the other hand, bundle all the spatial qualities of public space in a holistic and systemic way. The disciplines relevant to such co-operation are many and varied, ranging from practitioners such as urban planners, architects, landscape architects, traffic planners, road engineers, etc., to researchers in the same disciplines, also including sociologists, material sciences, etc. Finally, the executive and administrative units must also be taken into account: the people responsible for the furnishing, cleaning, maintaining and preserving public spaces have extensive knowledge in their field, which is of fundamental relevance for any future-oriented planning.

This paper describes the design and development of the SSSEIC tool; a tool that encompasses two models in different spheres: on the one hand, aiming at a theoretical concept for capturing relevant qualities and, on the other hand, meaning a computer-based 3D model. The theoretical concept seeks to capture all the parameters that determine the quality of streetscapes, including, obviously, the parameters of the street space itself, but also those of the ground below and the adjacent buildings. To this end, interviews were conducted with experts from the fields of practice, research and administration, and a cooperative workshop was also held. The resulting concept represents a new type of holistic and systemic recording of qualities in the street space, including their interrelations and connections – and consequently it provides the basis for creating a 3D model that visualizes those qualities and parameters in an actual street space. The model should ultimately show/visualise/illustrate the impact and correlations of parameters and thus provide a possible planning basis for future inter- and transdisciplinary co-operation in the sense of a city information model (CIM).

Keywords: Streetscape, Public Space, CIM, Inter- and transdisciplinary, 3D Model

2 INTRODUCTION

Science and everyday life equally show and confirm the overall importance of urban streets. This tightly woven network spans the entire city and represents the largest share of unbuilt urban space; its surface area exceeds that of other public spaces such as parks or squares. While – over the last century – legislative and urban planning did consider streets purely as traffic spaces, it can no longer be denied that they indeed do represent much more than that: (not only) through their sidewalks they provide public space that can be easily accessed by anyone directly from their front door, the most immediate public space and the most important area for urban interaction, "a place where people can meet and move among, or simply observe, each other relatively freely […] the site of interactive integration between minorities and majorities in a diversified society." (Psenner 2015, 583-584). They are also essential for a wide range of logistical infrastructures and processes. While waste collection, emergency services, and deliveries are in the direct field of vision, another supply network runs hidden below the street level and supplies the city with drinking water, sewage, electricity, gas and internet.

The main focus of public attention and research efforts is usually on main streets. Since they are part of important traffic routes or central shopping streets, overarching interests are proclaimed, which are also vehemently advocated by the respective stakeholders. By comparison, less attention is paid to secondary streets. However, this is a fundamental deficiency, since they make up the majority of urban street space. (Psenner/Tobisch 2023) This means that they are also essential to the city's ability to adapt to challenges such as climate change. By being prepared for rising overall temperatures and an increase in weather extremes like heat, draught and heavy rain, they can not only help to mitigate the impact on the immediate residents and street users, but also contribute to overarching issues such as reducing the urban heat island effect. (Hagen et al. 2014; Loibl et al. 202; Bügelmayer-Blaschek/Züger/Tötzer 2025) Purely on the basis of the number of secondary streets, it is clear, these streets are also where the majority of people live and therefore, where actual urban life takes place. (Tobisch/Psenner 2021) The way they are designed determines form, extend and intensity of urban life: are they purely a traffic area, or do they offer people the opportunity for a pleasant stay? Do they support socialising and participation? These usage options are enabled and promoted by certain qualities in the streetscape. The quality of life in cities is therefore directly affected by the quality of secondary streets.

2.1 SSSEIC – Developing a conceptual Framework for streets

A large number of regulations and associated processes that shape our cities to this day were mostly developed at the end of the 19th and beginning of the 20th century. The panacea of that time was to expand the city and functionally separate it. Today, however, there is a general consensus, that a city must be both mixed and compact in order to be sustainable and liveable. (Psenner 2012, Loeschenbrand/Tobisch/Psenner 2022, Peer/Psenner 2024)

The urban parterre (Stadtparterre) which consists of the streets, the ground floor zone of the adjacent buildings and the courtyards is the most relevant zone in the city to ensure an appropriate lifestyle for all its inhabitants and visitors. (Psenner 2023) The approach of this study is based on the Urban Parterre modelling (UPM) method, that provides a 3D modelled approach to viewing and evaluating the ground floor zone. (Psenner 2019 & 2020) Naturally, street space itself plays a unique role within the urban parterre, since, in addition to the overall plot arrangement, it demonstrates structural permanence – the framework of a city that endures for centuries – and serves as a location where public authorities and city administration can take immediate influence. (Kretz/Kueng 2016; Krusche/Roost 2010) Keeping the consideration of the neighbouring spaces and of course the interfaces between them (Zoller 2014), this study puts a special focus on street spaces themselves and examines them in detail.

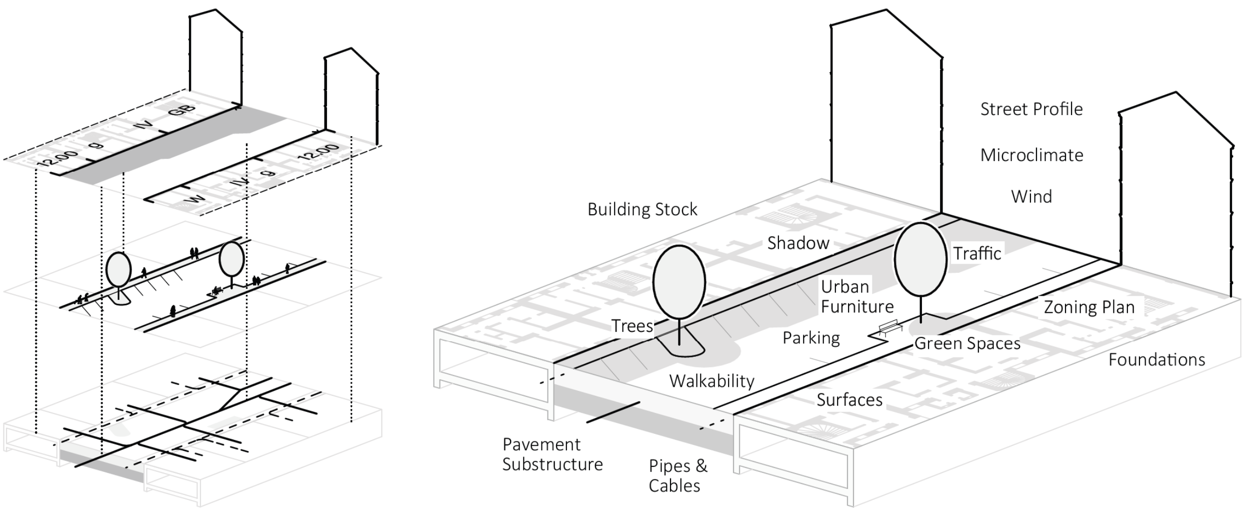

Fig. 1: The superimposition of layers with a variety of topics enables the holistic capturing and representation of street space. (Loeschenbrand, Tobisch, Psenner 2024)

To date, streets have been considered on the bases of their uses – either real life predominant uses or planned uses that never came to fruition. Categories like commercial street, main road and residential street are based on land use, and therefore on urban development parameters that must be considered outdated. (Loeschenbrand/Tobisch/Psenner 2023) SSSEIC (StreetScapes for a Social-Ecological Inclusive City) introduces a framework for a comprehensive understanding of streets, that includes a compilation of relevant criteria, that are spatial, urban development, traffic, climate-relevant and sociographic in nature (see fig. 1). This allows for a detailed, qualitative analysis of streets, while keeping the larger context and overarching aspects affecting the neighbourhood or the entire city in mind.

2.2 Interdisciplinary Work & CIM

Given the complexity of the space that is the street, it is clear that it cannot be addressed and planned by a single profession. The city of Vienna's municipal department MA18 (Magistratsabteilung 18) has made an effort to compile a list of all departments, agencies and services that currently engage with the street space in some capacity. (see fig. 2) It includes a total of 23 departments of the city, as well as the municipal district offices, the district representations, various coordination units, the chambers of commerce and labour, and federal authorities such as the police. (Schlager et al. 2018)

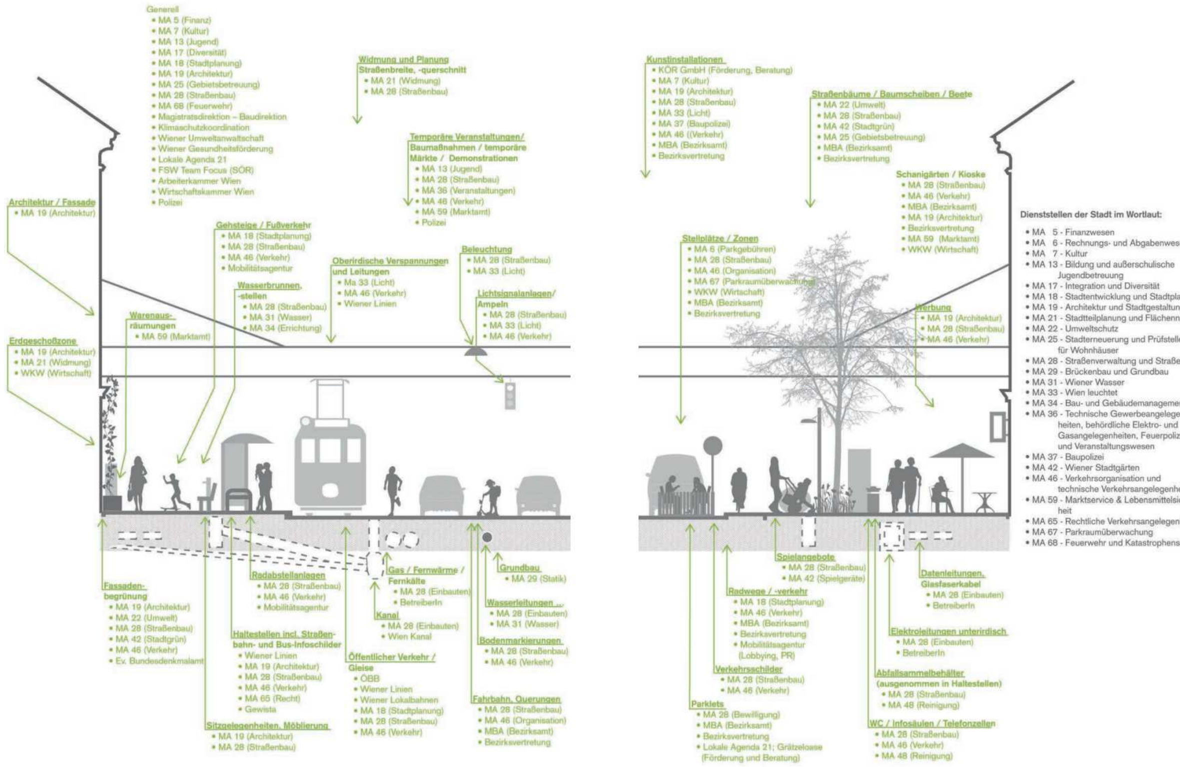

Fig. 2: "Who plans and manages public space in Vienna?" Illustration of all public authorities involved in public space, compiled by the City Administration (Schlager et al. 2018)

It is essential to recognize that these are only the involved parties from the public sector; there are many additional players, including planners from a variety of professions, and not least entrepreneurs, residents and passers-by. Considering the sheer number of the players, the question arises as to how the involvement of the individual parties in this public space is actually organised. Nowadays, there is little opportunity for multidisciplinary collaboration and co-creation since stakeholders are assigned a certain section of the street area and plan sequentially. Working groups are occasionally established to facilitate collaboration between different municipal departments, however they are usually limited to new urban development areas. Recently, participatory approaches that involve the public have also been increasingly implemented. (Brosenbauer et al. 2017) These are generally carried out by an external agency contracted by the city, inviting residents, business owners and street users to take part in the first steps of a transformation process by compiling their needs and preferences for the area in question in a guided process.[1] However, both of

[1] The participatory redesign process for the Gumpendorfer Strasse is a recent example in Vienna; the City of Vienna offers details on this and other public participation initiatives on its participation portal (mitgestalten.wien.gv.at).

those approaches only focus on a small group of the stakeholders that is only involved in a limited part of the entire process. The adequate tools for this kind of transdisciplinary work are also lacking: While Building Information Modelling (BIM) – that enables the direct collaboration between architects and specialist planners and even allows clients to participate in monitoring the process – is standard practise on an architectural scale, there is no shared standard at a larger scale, i.e. at the urban planning level.

Increasing transdisciplinarity and collaboration as well as an underlying database on which the 3D model is based (see 3.2) are reasons why the SSSEIC-tool is considered a City Information Model (CIM). Comparable to BIM, CIM operates on an urban scale and was introduced by Lachmi Khemlani in 2007. In recent years, the concept has become established in scientific urban discourse and has also increasingly found its way into urban design. Xu et al. describe CIM as 'a three-dimensional (3D) city model based on city information data with a multidisciplinary collaborative framework' (2021:1). Stojanovski (2013) sees CIM not only as a conceptual model, but also as an opportunity to reflect on urban theories, approaches and tools from different disciplines in an urban context.

A widely used approach, which was also central to early works, is the view of CIM as a merging and integration of BIM and GIS data. Xu et al (2014), for example, outlined early frameworks for CIM for dealing with BIM and GIS data sets. More recent CIM related papers illustrate technological developments using laser scans, point clouds, AI and VPL (La Russa et al., 2023), link CIM with smart cities, urban digital twins (Cureton/Harley, 2023), see CIM as a way to promote sustainable cities (Mohamed, 2023; Salles et al., 2023; Soltanifard et al., 2024) or identify ways to improve planning processes or to analyse environmental pollution and meteorological issues (Szeligova et al., 2024). A dynamic field of research in which different disciplines and approaches are adopting the CIM concept. Omrany et al. (2023) defined nine application areas for CIM: Natural disaster management; Urban building energy modelling (UBEM), Urban facility management, Urban infrastructure management, Land administration systems, Improvement of urban microclimates, From smart cities to digit twin of cities: the key role of CIM, Improvement of social engagement and Urban landscaping design. A clear definition of CIM did not exist a few years ago (Müller et al., 2016) and, according to the authors' current knowledge, does not exist today. Therefore, CIM can be regarded as umbrella term for intelligent city models.

The SSSEIC tool will introduce a new form of CIM that involves linking street space qualities with a three-dimensional city model at a micro-urban level. In addition to the complex core task of visualizing all the parameters influencing the street space, the aim is to identify synergies and correlations between individual qualities. Furthermore, the interaction between the street space qualities and the built environment should also be revealed. In other words, from a superior level, an understanding should be developed of which urban patterns and building typologies determine which qualities in the public street space.

In addition to the three-dimensional modelling of factors influencing actual urban street spaces, the project's further aim at a meta-level is to generate insights for consideration at the city-wide level.

2.3 Research Question and Methods

2.3.1 Research Question

Considering the complex nature of both the subject matter of the street itself and the processes surrounding its representation and planning in a transdisciplinary setting, the research question is divided into two parts:

(1) What are the relevant qualities in the street space from the perspective of stakeholders from different professional backgrounds, and what are the synergies and correlations between them?

(2) How can the complex space of the street with all of its characteristics be represented in a comprehensive theoretical concept, and how can this be converted into a CIM (computer-based 3D model with an underlying database) that can be used in collaborative processes?

2.3.2 Methods

The methods used to approach the research questions above can also be separated into two areas: the collection of qualities of streetscapes and the development of a theoretical concept for the holistic representation of the space. This will subsequently enable the creation of a comprehensive computer-based 3D model for analyses and collaborative design processes.

Interviews

For a comprehensive collection of qualities covering a wide variety of perspectives on streets, interviews with professionals from practise, research and administration with different disciplinary backgrounds were held. The questions were open-ended and process-oriented, revolving around the topics of historical development, adaptation of the status quo and novel methods (see table 1). The aim was to gain a comprehensive understanding of the elements and aspects of street space that are relevant to the respective profession and the associated general perception of street space. Tangible qualities and their possible incorporation into a computer-based 3D model were only enquired towards the end of the conversations to not limit the interviewees in terms of their expectations with regard to the feasibility object-orientated representability of qualities.

Interview Questions		
1. What are the inherent logics of the field in regards to street space and its planning? Historical, current and future aspects.	2. How are existing structures approached? What restrictions are there in terms of adaptability?	3. What are the interrelations of the respective field with other, city-wide systems?
4. What large-scale mishaps or planning errors have there been in the past, and do they still have an impact?	5. What standards are there in terms of planning? What approximations and assumptions can be used? What are the specifications?	6. What new approaches are there, and what are the corresponding planning paradigms? Are there positive/negative experiences?
7. What prerequisites are necessary and where is potential for conflict?	8. What conflicts of use in public space are relevant, how are they currently addressed?	9. What factors should be considered in terms of implementation and costs?
10. Life cycles of infrastructure: what are the renewal cycles and do they represent an opportunity for redevelopment?	11. Maintenance of infrastructure components and other street space elements. How is it performed, are is there anything to be considered?	12. Which of the aspects from your field do you think can be implemented in a 3D model? (spatial or quantifiable)
13. Literature, sources, tools... on the topic of the research project?	14. Additional information and tipps (for interview partners)	

Table 1: Interview Questions

In addition to the qualities that were explicitly mentioned by the interviewees, the qualities that were implied in the interview but not stated outright were also identified. The recommended projects and literature were also analysed for further aspects.

Workshop

A workshop was held in which the streetscape of 2040 was envisioned in a collaborative setting. While further qualities were also collected during the workshop, the focus was on the cooperation between the participants. Participants were asked to anonymously write down qualities from their field that they considered relevant in the street space in 2024 on individual cards. These were then shuffled in the middle of the table and drawn in turns. In this way, the participants received qualities that were not related to their own field of expertise. The qualities were then drawn on a prepared poster of an empty street space with adjacent buildings indicated, creating the impression that the street was part of an existing urban context. Together, the participants then considered positive (+), potentially conflicting (-) and neutral (o) aspects of these qualities.

This setting required the participants to reflect on qualities with which they were less familiar, while also considering different aspects of qualities and interrelations with other qualities. The step-by-step addition of elements by each participant resulted in a jointly negotiated vision of the street space. Throughout the workshop, the interactions and cooperation between the participants from different fields, as well as the synergies and correlations between the qualities, were observed and recorded.

Translation into a theoretical concept

Once the street space qualities had been collected, they were clustered according to different perspectives, for example according to the profession they concern, whether they can be represented in a computer-based 3D model or according to their physical location in the street space. In this way, different possibilities of structuring the qualities were tested in order to subsequently develop a holistic theoretical concept that is able to represent all relevant qualities and their linkages. The aim is to enable the mapping and ultimately the collaborative planning of street space. The functionality and comprehensiveness of the concept was then evaluated in a further step by constructing a computer-based 3D model of segment of a research street.

3 RESULTS

3.1 Collection of Qualities – Interviews and Workshop

A total of 20 individual interviews were conducted with 22 individuals. They represented the fields of urban planning and urban development, zoning, architecture, landscape architecture, gender sensitive planning, sociology, traffic and mobility planning, urban climate, sustainability and environmental protection, urban soundscapes, street lighting, street construction, canalization, street cleaning and winter maintenance, waste collection, emergency services and land surveying. It is not possible to provide a precise distinction between the areas of practice, research and administration, as some interviewees work in both research and the private sector, and some departments in the public sector focus on either implementation or administration. However, it can be stated that 13 of the interviewees are employed by the municipality of Vienna in some capacity, while the remaining 9 people work in research and/or practice outside of the city administration.

The subsequent workshop was attended by a total of 11 people who worked in two groups. The groups were made up of 5 and 6 people respectively, with the aim of including as many different areas of expertise and different fields of work in each group as possible. This ensured that there were no redundancies in the professions and that the groups contained people from practice, administration and research in equal measure. Due to scheduling issues, the original plan to have the same individuals who had been interviewed collaborate during the workshops was only partially feasible. Six of the participants were present at both events, but as the five new participants were direct colleagues of the interviewees (and were sent by them as replacements) no entirely new areas of expertise were added at this stage.

In the workshop a total of 38 unique characteristics of streets were named by participants. A significant number of aspects were mentioned more than once, which demonstrates that there is considerable overlap in the professions in terms of relevant qualities. This was further confirmed in the discussions between the participants. There were significant differences in the tangibility, or immediacy with which these characteristics could be represented by physical objects. They ranged from aspects that could be represented by a single object (e.g. a bench), to those that encompass multiple objects (e.g. continuous shade), to those that could not be represented in an object-related way at all (e.g. diverse user groups). This suggests the need to define proxy parameters for certain concepts. For example, the presence of tangible aspects such as shade, planting and seating could be used as an approximation for a high quality of stay.

3.2 Development of the theoretical concept

The theoretical concept represents the translation and visualisation of the numerous individual qualities and parameters into one holistic vessel. In order to facilitate an understanding of the street, it is necessary to consider both the individual elements as well as their position within the system.

After a preliminary analysis, it was found that the parameters fell into three distinct clusters: Meta parameters that describe the context for the entire street. Modelling parameters that can be represented by objects in a computer-based 3D model and their respective attributes specified in the object properties. And evaluation parameters which have an effect on the qualities perceived but cannot be easily represented by specific objects or even be associated with a specific the street segment. In order to be able to take them into account, they are therefore represented in the underlying database of the model.

3.2.1 Meta Parameters

The first category of parameters provides the context for a finer grained analysis and can be recorded on a street segment basis. It includes aspects such as street orientation, proportions, linearity and gradient, the proximity to green spaces and the number of residents, but also legal aspects such as speed limits and access restrictions.

3.2.2 Modelling Parameters

The object-related modelling parameters can be divided into different spheres (see fig. 3): The street level, i.e. the surfaces of the street space and all its uses. The street furnishing, which includes all objects that are located in the public space above the street level. The underground, which includes all objects that are located below the street level. And the building level, which represents both the interfaces (i.e. the facades) and the spaces and uses of the buildings beyond. Ecology is treated as a separate sphere because its many interconnected aspects make it challenging to capture it within a single spatial category. Due to its relevance for the urban climate, it is also of significant importance to the future development of street space and is therefore given particular emphasis.

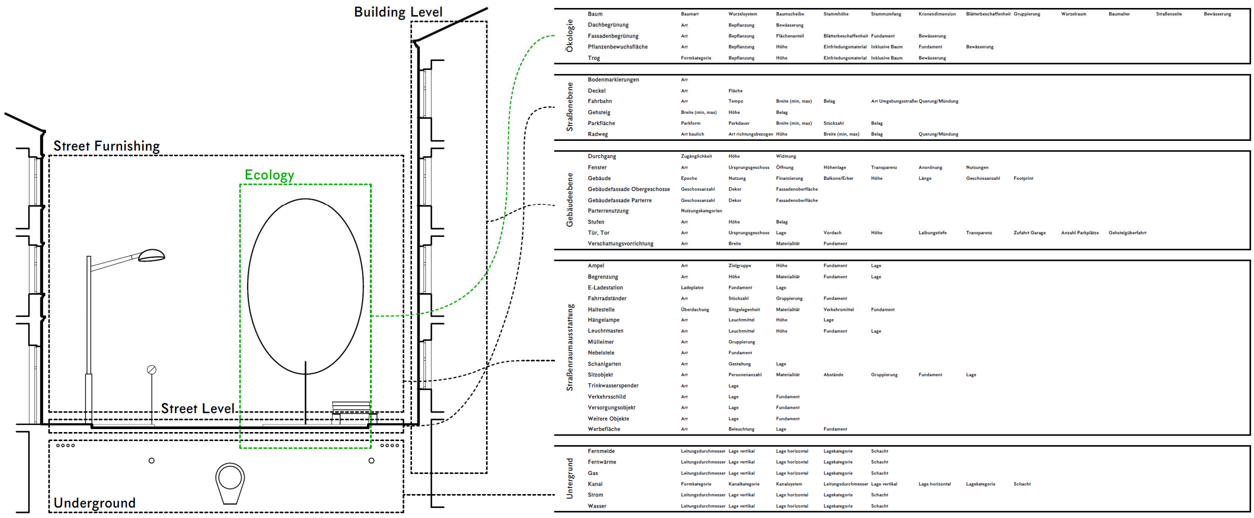

Fig. 3: Street spaces can be divided into different spheres of intervention in order to facilitate collaborative processes (Loeschenbrand, Tobisch, Psenner 2024)

The physical objects identified within the street space were described by modelling parameters in the categories of types, dimensions, and surface characteristics. Using a tree as an example, the parameters in the category of types include tree species, deep or shallow rooting, the tree pit and tree age; the dimensions include tree size, trunk height, trunk circumference and crown diameter; and the surface characteristics relate to the leaf character and size. Each of these parameters has been equipped with a list of up to 10 options (based on their occurrence in Vienna) e.g. the most common street tree species or the crown dimensions from 1m to >10m. This allows for a straightforward and, above all, standardised recording of the street space, which ensures subsequent evaluability.

While this concept was already capable of enabling the accuratele recording of the physical characteristics of street spaces in theory, the important semantic level was still missing from the theoretical concept. There was not yet an understanding of the relevant interrelations and utilizations of the parameters.

The interviews and workshop confirmed the previously held assumption that many real-life qualities are only achieved through a combination of elements. For example, in terms of the street climate, it is not only the presence, but the continuity of the tree shade that is relevant. Therefore, it cannot be assumed that recording individual trees is sufficient to fully capture this quality – a tree needs to be put in context with its neighbouring trees. Hence not only the distance to the nearest tree is taken into account, but also the number of trees in a group. Again, the statements of the experts interviewed were used to identify these cases. The category context was added and equally equipped with options.

3.2.3 Evaluation Parameters

Evaluation parameters are the least constrictive category; their parameters are characterized by the fact that the data must be considered in a much broader context and cannot be linked to specific objects or even the street segment. It includes aspects such as wind, microclimate, acoustics, traffic, public transport, air pollution, C02 values, life cycle analysis and social environment analysis. In most cases, the data can either be measured on site or recorded on the basis of evaluations or simulations. Although this data cannot be isolated at the fine-grained scale of the other parameter categories – due to the large number of interrelations and exogenous influences – it is nevertheless of equal importance, especially with regard to the potential for adaptation of street spaces.

As a result of the interviews and the collaborative workshop, a total of 10 meta parameters, 20 evaluation parameters and 227 modelling parameters (relating to 42 distinct objects) were identified.

3.3 Proof of Concept – Creating a computer-based 3D model

In a next step the theoretical concept was implemented in a computer-based 3D model. The model was based on a segment of a street in the 16th district of Vienna, an area developed during the Gründerzeit. The block divisions, street widths and building structure are all characteristic of this area. This enabled the direct transfer and incorporation of the extensive knowledge of these structures from the UPM project, which focused exclusively on structures from this period.

The basis of the computer-based 3D model was created using publicly available, open government data (OGD)[2], using the terrain model (Geländemodell Dreiecksvermaschung) as a base, the roof model (Generalisiertes Dachmodell LOD2.1) for the 3D building shapes, the records of the cables and pipes (Zentrales Leitungskataster/Digitales Kanal Informationssystem) and the tree cadastre (Baumkataster). The 2D city plan (Mehrzweckkarte) was also used for the spatial distribution of street space. The city plan was also used to add more detailed information, such as the height of the kerb and the position of manhole covers.

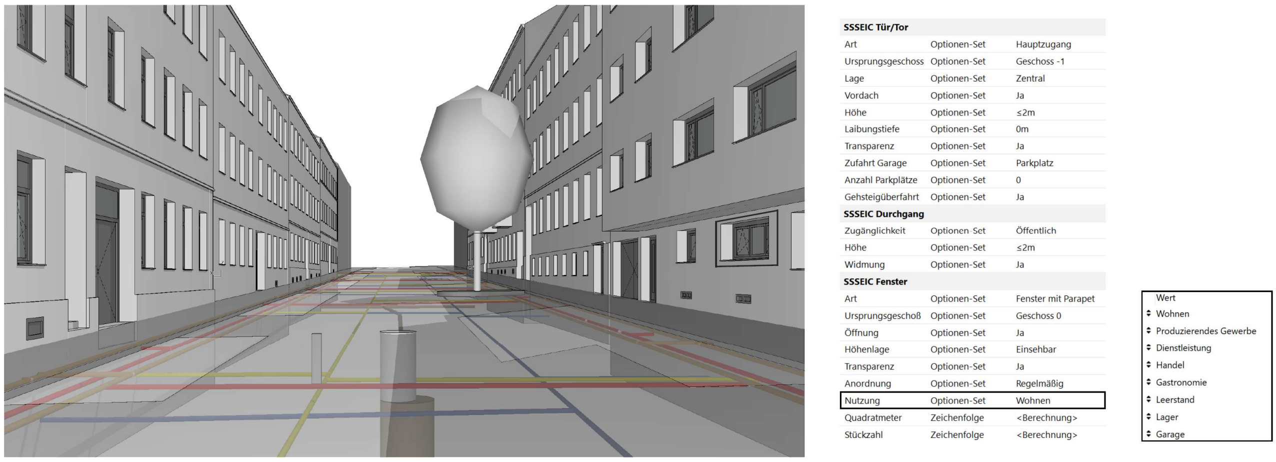

Fig. 4: View of the research street in the computer-based 3D model, featuring parameters and corresponding list of options using the example of a window (Loeschenbrand, Tobisch, Psenner 2024)

This very rough model (see fig. 4) was then enhanced with manually collected data. Analogue plans of all the buildings adjacent to the street, obtained from the Building Department (MA37) facilitated the three-dimensional construction of the facades and, on the ground floor, the spatial structures behind them. In addition, the public space was meticulously recorded on site, and street furniture such as lighting, street signs, waste bins and power distribution boxes were complemented. In accordance with the theoretical concept, all elements of the 3D model were equipped with their corresponding parameters and lists of options to be selected.

The computer-based 3D model represents a proof of concept, that allows the input of the relevant data for all parameters identified to date. Currently, only the parameters that could be collected and recorded by the authors have been entered for the research street. Further research and collaboration with interdisciplinary partners is needed to extend the model to include all the known parameters.

[2] Geländemodell Dreiecksvermaschung Wien (https://www.data.gv.at/katalog/en/dataset/bb86970f-3cef-4f9a-a79b-ff277ea925c8), Generalisiertes Dachmodell (LOD2.1) Wien (https://www.data.gv.at/katalog/dataset/86d88cae-ad97-4476-bae5-73488a12776d), Zentrales Leitungskataster (https://www.wien.gv.at/verkehr/strassen/leitungskataster/), Digitales Kanal Informationssystem (https://kanis.at/), Baumkataster bzw. Bäume Standorte Wien (https://www.data.gv.at/katalog/en/dataset/c91a4635-8b7d-43fe-9b27-d95dec8392a7) , Mehrzweckkarte Vektordaten Wien (https://www.data.gv.at/katalog/dataset/stadt-wien_mehrzweckkartevektordatenwien)

4 DISCUSSION

4.1 Scope and Limits

In order to test and improve the applicability of the theoretical concept and the computer-based 3D model, further research streets will be recorded and analysed. The current research street dating from the Gründerzeit has the typical proportions and associated architecture, the public space itself has been adapted to incorporate the motorisation in the second half of the 20th century, but has not been significantly updated since. This allows the potential of the tool to be explored in some areas, for example in terms of building-related parameters, but not fully exploited in other areas, such as street furniture. It is therefore planned to integrate further research streets from different periods. A street segment that features municipal housing from the era of Rotes Wien (Red Vienna) and one from a recent urban development project are currently being processed.

The issue of qualities that cannot be represented by only one object has only been partially solved so far. While qualities that apply to several objects of the same type are already captured in the context category of the model parameters, those that refer to objects of different types are not yet represented. An example of this is the quality of stay, while seating elements such as benches generally facilitate a longer stay, the associated behaviour only occurs if the environment is designed accordingly.[3] Consequently, the presence of shade in summer, visual connections or the arrangement of furniture to facilitate communication all play a role in whether people actually spend time at a certain location. A corresponding logical interlinking of the parameters is therefore necessary in order to be able to assess the situation. However, the programme used to create the computer-based 3D model does not allow the reciprocal linking of elements; the context must either be linked to one main element or recorded separately in all the elements involved, neither of which was considered an adequate solution. It is noteworthy, however, that there is a concentration of these context-based qualities in certain research areas, such as microclimate and soundscapes, but also in sociology and gender planning. These are also the fields that have traditionally been less well represented in urban design models.

The programme used – ArchiCAD – is a modelling programme commonly used in architecture. While it was sufficient for the proof of concept in one segment of a research street, it is not equipped to handle the amount of data that would be required to record several interconnected streets. For the analysis of a larger research area, a programme suitable for the scale of urban planning needs to be employed. To enable truly interdisciplinary collaboration, a single programme designed to meet the needs of a particular area is in any case not sufficient. A common platform into which all participants feed the data from their respective specialised programmes – as is already the case with BIM – is essential for a successful collaboration.

As the scope of the project only allowed for the integration of a limited number of relevant disciplines, it is considered necessary to extend the project to other fields. The theoretical concept has therefore been designed to be highly flexible, so that additional objects or parameters can easily be added.

While the theoretical concept was conceived for the analysis of street spaces, it is generally suitable to handle other complex spaces with minor adjustments to the occurring objects and parameters involved and their respective weightings; its application to squares would be a logical next step.

4.2 New syntax for streets

The theoretical concept lays the foundation for the creation of a new street syntax, where streets are recorded not according to their function, as is the case today, but according to their real-life qualities. An additional parameter weighting would enable an evaluation of the existing qualities. For a better overview, the parameters can be grouped in order to visualise shortcomings and potentials in certain areas. The already defined spheres of the modelling parameters would be suitable categories for this. Further categories will certainly be needed to map larger contexts – such as traffic or urban climate – which will then draw on the evaluation and meta parameters.

The workshop was used to prepare for the possibility of conducting a street space evaluation at a later date; the positive, potentially conflicting and neutral elements that were jointly identified are suitable to be further

[3] See the three different types of outdoor activity: While necessary activities have little preconditions to be performed, optional and social activities only occur with high frequency when the physical environment is favorable. (Gehl 1971)

developed into a rating system. Street segments can be rated within the various categories, and a coloured display could be employed to visualise how well the street performs in each category of the new street syntax. This will enable the targeted development of previously untapped potential.

Ultimately, this new syntax enables a city-wide consideration and evaluation of street space, and thus also gives the administration the opportunity to target areas where there is a substantial need for adaptation and, at the same time, significant potential. This facilitates the use of municipal resources in a way that delivers the most value.

5 CONCLUSION

The paper presents the initial results of an ongoing study that (for merely the first time) considers the street as a significant urban space that is NOT limited to public space itself, but rather is considered in its entirety. Therefore, all communicating elements of the urban parterre (Stadtparterre), consisting of the streets, the ground floor zone of the adjacent buildings and the courtyards, must be taken into account. Due to their importance as public space – directly accessible to everyone and the largest urban public sphere – the qualities of urban streets are crucial to the cities' ability to meet future challenges such as climate change and to maintain and improve the quality of life of their inhabitants and visitors.

Interviews with experts served as a basis for identifying qualities of street spaces. By integrating different approaches and expertise and by collaborating with practitioners, researchers and administrators, a comprehensive picture of the qualities of public space is created. Testing the interdisciplinary cooperation in a workshop setting revealed connections and interrelations between the different professional groups. This is also reflected in the resulting theoretical concept, which now offers a holistic and systemic framework that allows for the incorporation of a wide spectrum of qualities. At the same time, its flexible but fine-grained structure allows for a high level of detail, enabling a comprehensive assessment of streets.

The first proof of concept is currently evidend in the implementation and applicability of the theoretical concept to a three-dimensional model, which, supplemented by the extensive database, is to be considered a City Information Model (CIM).

Future work will focus on expanding and improving the concept and model, with an initial step of collecting and analysing additional research streets (and parts or sections of them). In a further step, additional disciplines shall be integrated to enable an even more comprehensive analysis. The final version of the SSSEIC tool is intended to serve as a basis for future inter- and transdisciplinary planning processes and promote a more inclusive, sustainable and integrated urban environment.

6 ACKNOWLEDGEMENTS

The research project "SSSEIC – StreetScapes for a Social-Ecological Inclusive City" is funded by the Jubilee Fund of the City of Vienna for the Austrian Academy of Sciences (ÖAW). It is currently being carried out under the direction of Angelika Psenner at the Urban Design Research Unit at TU Wien in the period 1 April 2024 to 30 November 2025. (https://urbanism-tuwien.at/forschung/projekt/ssseic)

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