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Digitally Supported Participation Processes and Tools to Promote Gender-Responsive Public Spaces

Flora Fessler, AIT Austrian Institute of Technology, Center for Energy, Digital Resilient Cities Unit, Vienna, Austria*

https://orcid.org/0009-0002-3385-0485

Florian Reinwald, University of Natural Resources and Life Sciences, Department of Landscape, Spatial and Infrastructure Sciences, Institute of Landscape Planning, Vienna, Austria

Roswitha Weichselbaumer, University of Natural Resources and Life Sciences, Department of Landscape, Spatial and Infrastructure Sciences, Institute of Landscape Planning, Vienna, Austria

Jana Wentz, University of Natural Resources and Life Sciences, Department of Landscape, Spatial and Infrastructure Sciences, Institute of Landscape Planning, Vienna, Austria

Ernst Gebetsroither-Geringer, AIT Austrian Institute of Technology, Center for Energy, Digital Resilient Cities Unit, Vienna, Austria

ABSTRACT

Planning is faced with the challenge of designing public open spaces that meet the diverse needs of everyday life. Gender-sensitive planning can facilitate the development of gender-responsive public spaces by considering the specific needs of different groups. Innovative digital tools are available for collecting and analysing the use of open spaces. However, most of these tools do not integrate group-specific requirements. This article explores what such integration might entail in terms of tool use and the design of the participatory process. It describes the typical planning phases and provides an overview of digital tools classified according to the intensity levels of participation. The application of the tools is then described based on two use cases. The research findings indicate that the primary advantage of using digital tools is the multiple use of the gender-disaggregated data generated. To fully exploit the benefits of digitally supported participation processes, it is necessary to develop seamless tool chains that allow for differentiated data collection and processing.

KEYWORDS

Digital Participation Tools, Gender-Sensitive Planning, Procedural Justice, Public Space Use, Tool Chain

1. INTRODUCTION

The project “DraussenDaheim” (DDH) [German for: “At Home Outside”] aims to test and develop digitally supported participation processes and tools that can ultimately benefit the gender-responsive development of urban public spaces. It takes a group and gender perspective, with a special focus on caregivers, to develop a methodology for differentiated data collection and analysis of open space use. The general applicability of this research approach and the developed tool chains is tested as

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part of a "proof of concept" using the example of two Austrian use cases. The research questions are embedded in the theoretical and practical discourses on gender-sensitive planning, procedural justice, different forms of participation andthe use of information and communication technology (ICT) tools in participation processes.

1.1 Gender-Sensitive Planning

Gender-sensitive planning is based on a differentiated, everyday-oriented approach. It assumes that people have different and diverse demands on urban space in their everyday lives. Therefore, gender-, age- and group-specific needs, interests and impacts are specifically examined in all planning steps and tasks. The goal is to create spaces that are as flexible as possible, that can adapt to the everyday demands of different groups, and thus meet as many needs as possible (Damyanovic, 2007; Damyanovic et al., 2013). Gender-sensitive planning focuses on groups of people who are particularly vulnerable or often forgotten in planning. These are people who, for example, have particularly tight daily routines and little scope for action because of their living circumstances, social, cultural, or economic background, health or family situation, or material or time resources (ibid.). Vulnerable populations tend to be less mobile in their daily lives (Joelsson & Ekman Ladru, 2022) and are particularly locally oriented, have less access to high-quality green and open spaces (Honey-Rosés et al., 2020) and are therefore particularly dependent on the quality of their living environment (Reinwald et al., 2019). In this article, the authors apply the extended concept of gender^{+}-sensitive urban planning (Damyanovic et al., 2021; Tummers & Wankiewicz, 2021), whereby gender-, age- and group-specific requirements (e.g. in relation to care work) are taken into account. The term 'gender^{+}'[1] indicates that gender is always overlaid by other characteristics, such as age, origin, skin colour, education, profession, disability, sexual orientation or religion, and should therefore be understood intersectionally (Verloo, 2009). Only some of these attributes and their interaction can be discussed in this research paper.

1.2 Different Concepts of Justice

Amidst the increasing demands for more environmental and social justice, urban public spaces in cities have a key role to play. They are seen as sites of public engagement and are constantly shaped and re-produced through various social interactions.

Within the sphere of urban planning, social justice is influenced by three different dimensions: distributive, procedural and recognition-based conceptions of justice (Schlosberg, 2007). Distributive justice corresponds to equity and ensures fair distribution and equal access to urban resources (Rawls, 2005). Furthermore, procedural justice (Fainstein, 2010) refers to planning processes and fair participation opportunities within these processes. Finally, recognitional justice involves the recognition and appreciation of different interests and needs (Nussbaum, 2013). This article centres on procedural justice, specifically the potential for engagement in participation processes through the aid of digital tools.

1.3 Forms of Participation Processes

Taking a closer look at procedural justice and thus the question of who has a say in participation processes means an equally informed examination of the nature of participatory processes. Various forms of participation can be categorised based on different criteria. Schoßböck et al. (2018) offer classification options according to emergence (top-down or bottom-up) and legal basis (formal and informal procedures).

Various authors, including Rowe and Frewer (2000, 2005), categorise participation processes based on the form of communication or type of information flow. The spectrum spans from one-way communication through active gathering and consideration of knowledge and opinions (consultation) to mutual exchange and the joint formulation and development of goals (participation). This classification can be found in several models, particularly in practical guidelines (see e.g. Arbter, 2012; Fels, 2015;

OECD, 2001), which distinguish between information as one-way communication, consultation as two-way communication, and collaboration as dialogue-like communication.

Participation processes are often also classified according to intensity levels of participation. The oldest and most frequently cited model is that of Sherry Arnstein (1969). In her "Ladder of Citizen Participation", she distinguishes 8 levels of participation, ranging from non-participation (manipulation), in which citizens are merely convinced of an idea, to information, to citizen control, where citizens gain decision-making power. However, well aware that her model is criticized for its linear and hierarchical structure, the authors draw on other models based on it as a basis for the research (see OECD, 2001; IAP2, 2007).

With the emergence of digital participation methods and tools, participation models have been adapted or reformulated to reflect the latest digital developments. For example, authors such as Carver (2001), Kingston (2002), Hudson-Smith et al. (2002), Bernoff and Li (2010), and Krabina (2016) have adapted Arnstein's ladder model and formulated stage-like participation models for online participation.

1.4 Use of ICT Tools in Participation Processes

The development of digital information and communication technologies has changed ways of communicating, creating new digital (public) spaces and virtual, interactive environments that now shape our everyday lives (Turken & Eyuboglu, 2021). Communication between the public sector and the population has also changed with digitalisation, leading to concepts such as e-democracy, e-governance, and e-participation (Kingston, 2002; Schoßböck et al., 2018). Digital geographic information system (GIS) technologies, which have been developed and used for data preparation, visualisation, and analysis since the 1980s/90s, can address complex urban planning issues and have become an integral part of planning and participation processes (Schinagl, 2022; van Maarseveen et al., 2019). With the development of Web 2.0. the public stakeholders are increasingly involved in the creation of digital content in a participatory manner, e.g., in web-based online GIS and public participation geographic information systems (PPGIS) (Brown & Weber, 2011; Czepkiewicz et al., 2017; Hofmann et al, 2020; Lybeck, 2018; Turken & Eyuboglu, 2021; Zhang, 2019). Digital methods and tools of participation have been further developed and now complement conventional processes and analog methods (Hertling et al., 2020).

1.5 Aims and Research Questions

With the aim of creating a methodology for (digital) participation processes and tools that promote the gender-responsive development of public space, the research project DDH sets an example for more right to a good living environment for all. This right is derived from the human rights to housing (Heindl, 2022), includes public space and should enable all groups to feel "at home outside".

By focusing on gender-relevant groups in vulnerable situations[2], the DDH project explores the extent to which digitally supported participation processes and tools can contribute to a gender-sensitive planning perspective.In this context, the following research questions arise with regard to opportunities and challenges in the specific design, implementation and further development of such processes and tools:

- Which (digital) tools or tool chains are suitable for the different steps of a participation process and how can they be used in the respective use cases?
- What insights can be gained by integrating gender and group-specific aspects into digital participation tools and processes?
- What requirements does the gender-responsive and needs-based approach place on the digitally supported participation processes and tools used?
- What specific lessons can be learned from the use cases for process design and tool (chain) use and development?

2. RESEARCH DESIGN AND METHODS

The research design involves inter- and transdisciplinary collaboration, as well as the use of practical applications. Planning, social and technical sciences work together and employ a range of methods, including qualitative and participatory methods, quantitative methods and the technical development of tools and interfaces. The research is based on a literature review, which provides an overview of the forms of participation, phases of urban planning, and potential digital tools. It then defines use case-specific tool chains that include surveys and tool workshops using digital participation and analysis tools aiming for gender-responsive development of urban public space. Finally, a follow-up survey and internal reflections on tool use and process development provide an outlook on the need for further research.

2.1 Literature Research on Digitally Supported Planning and Participation Processes

To create a typology of planning and participation processes using digital methods and tools in the first step of the research and for further classification of the use cases, a systematic literature review was conducted. For this purpose, scientific literature databases and library catalogues were searched for relevant keywords (see Table 1).

Table 1. Keywords of the literature research. Own elaboration (Weichselbaumer 2022)

1. Keyword	AND	2. Keyword	AND	3. Keyword
"participation"	AND	"planning" OR "planning process" OR "planning processes" OR "process" OR "procedure" OR "procedures"	AND	"typology" OR "phases" OR "steps"
		"urban planning"	AND	"typology" OR "phases" OR "steps"
			AND	"ict"
			AND	"process"
"participation process" OR "participation processes"	AND	"typology" OR "phases" OR "steps"		
		"urban planning"	AND	"typology" OR "phases" OR "steps"
"public participation"	AND	"planning"	AND	"typology" OR "phases" OR "steps" OR "framework"
"e-participation"	AND	"urban planning"	AND	"typology" OR "phases" OR "steps"
"participation process" OR "participation" OR "community participation" OR "public participation"	AND	"urban planning" OR "urban development" OR "land use planning" OR "spatial planning"	AND	"stages" OR "typology" OR "systematic"

Based on a rough screening of the search results, suitable articles in scientific journals, contributions in textbooks and dissertations were selected and supplemented with further sources by snowball sampling. In addition, grey literature (guidebooks and manuals) on planning and participation processes was collected in a desktop search. From the final selection of literature, 1.) possible classifications of participation processes in spatial planning and development, 2.) common work phases and steps in planning and participation processes, and 3.) proven digital planning and participation tools and methods were identified. These three aspects were then brought together in a detailed overview.

2.2 Use Case-Specific Participation and Implementation of the Tool Workshops

The methodological core element of the research are two use cases. The use case approach pursued two objectives: analysing the benefits and requirements of the tools and, at the same time, using the tools to analyse the use of spaces and the usage requirements of different groups in a differentiated way. . The elaboration of a methodology for digitally supported participation processes and tools to promote gender-responsive development of urban public space is based on the combined use of carefully selected participation and analysis tools. Accordingly, use case-specific tool chains consisting of survey tools (e.g. analogue questionnaires as well as online surveys), a digital participation platform ('Smarticipate'[3]) as well as mobility simulation and visualisation tools ('Simulate'[4], 'SUMO'[5] (see Lopez et al., 2018)) and a parametric design tool called Rhinoceros 3D/Grasshopper (see Fink, 2018) were developed.

The methodological approach was similar in both cases: the redesign of a square in Vienna (Aumannplatz) and the evaluation of the mobility behaviour as well as the visited open spaces of inhabitants of a housing project in Salzburg/Zell am See (Sonnengarten Limberg). First, an online survey was conducted to obtain socio-demographic information (e.g. gender, age, employment status and household size) as well as information on the mobility and leisure behaviour of the local residents. This also included questions about care responsibility or dependency and – with the help of gender- and care disaggregated data analysis – provided a more accurate picture of the people reached and thus their needs. This was followed by co-creative workshop formats in which individual and group-specific spatio-temporal use patterns were collected and analysed . Immediately after these tool test workshops, participants were asked about the usability of the tool and tool-specific strengths and weaknesses. In addition to socio-demographic data, information on physical and sensory limitations, caring responsibilities and the communication channels and formats used in the process were also requested. The final internal reflection of the process facilitators and tool developers of both participation formats rounds off the tool implementation by highlighting the need for further process-oriented and technical development.

2.3 Tailored Tool Application and Entanglement of Analogue and Digital Tools

In the process of the tool-supported identification and gender- and care-differentiated analysis of spatio-temporal use patterns, different combinations of tool applications were used, the core of which was always the digital mapping platform 'Smarticipate', in combination with pre- and follow-up surveys. As the case-specific use of the selected tools requires smooth interaction, high demands are placed on process design and technical implementation. This involves the integration of analogue and digital processes and, as well as the communication and transfer of data between the tools via customised interfaces. The following sections introduce the two use cases and their process flows, including tool selection.

2.3.1 Use Case Aumannplatz

Due to its problematic traffic situation and outdated design, the central square in Vienna's 18th district can no longer meet the multidimensional demands of its users. Therefore, the District Service of the City of Vienna carried out a functional and social space analysis to identify the main user groups and

the general demographic composition of the population[6] (Plautz, 2020), on the basis of which a large-scale participatory process was initiated to redesign the square. The DDH project team supported the collection of citizens' ideas and identified the spatial qualities of the square, as well as its current and future possibilities of use by specific target groups over time. The evaluation of the public square's features and functionality through participatory methods, such as assessing pedestrian crossings and the overall comfort, was closely linked to the effective collaboration between the tools 'Smarticipate' and 'Simulate'. In addition, hypothetical planning scenarios for the square were formulated using simulation-based methodologies facilitated by these tools. The scenarios included variations in spatial boundaries and design elements.

2.3.2 Use Case Sonnengarten Limberg

The Sonnengarten Limberg use case had a different starting point compared to the Aumannplatz use case. The research was not embedded in an already initiated redesign process. Instead, it provided an opportunity to 'monitor' and evaluate the gender-specific spatio-temporal use patterns of the residents living in the newly developed neighbourhood in Zell am See. An online survey and an open space use diary, created with the participation tool 'Smarticipate', were used to investigate the use of open spaces near and far from the Sonnengarten Limberg, also known as the 'settlement of short distances'. This settlement is of particular interest because, despite offering important basic infrastructure, including open public and semi-public spaces within a 5-minute walking distance, the majority of its residents (approximately 70% under the age of 47) still rely on the car as their primary means of transportation (SIR et al., 2021). To investigate this dynamic, the research team aimed to achieve broad participation through a targeted approach using various communication channels, including personal conversations and digital channels such as e-mail.

2.4 Evaluation Framework for the Case-Specific Process and Tool Development

A framework for evaluating the tool test was developed by the process facilitators involved. The evaluation of the tool application in the use cases comprises three parts: a survey of the participants after the workshop or the tool use, an evaluation form completed by each participating process facilitator after the workshops, and an internal reflection workshop wherethe tool applicationis debriefed and the experiences during the process are exchanged and qualitatively recorded. The survey conducted during the participation processes determines the gender of the users. Additional observations by the process facilitators of the participants' interactions with each other and with the tool provide further context. Procedural justice was observed through how the tool test setting supported the joint negotiation process of needs and use wishes.

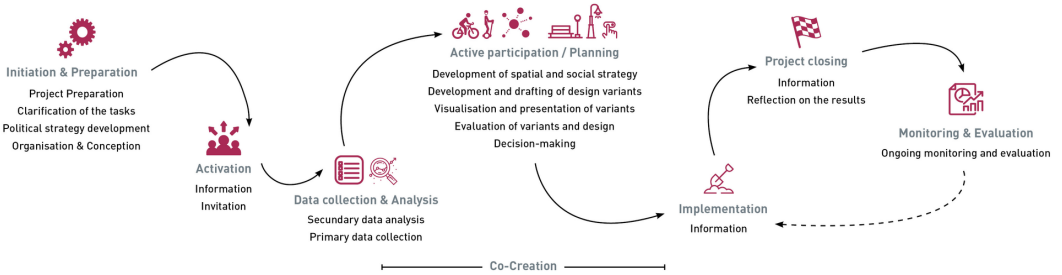
3 RESULTS

3.1 Overview of Phases and Work Steps in Urban Planning and Participation Processes

The typical work steps and phases of participation and planning processes are usually discussed in planning practice and are primarily documented in grey literature, guidelines and manuals (including Arbter, 2012; Fels, 2015; Nanz & Fritsche, 2012; Walz et al., 2012). Although work steps and work phases in planning and participation processes are very specific to the application case and can occur in different constellations, the following ideal-typical phases can be identified. These phases (see Figure 1) offer starting points for the use of digital methods and tools.

After initiating a planning and participation process, the preparatory phase aims to clarify the content-related and organisational questions as well as the technical, legal and financial framework conditions for the implementation of the process. Based on this, appropriate methods are selected, and concepts, work plans and schedules are developed. In addition, teams (e.g., responsible for

Figure 1. Work steps and phases in planning and participation processes in urban planning and development. Own illustration (Fink & Weichselbaumer)



process support and planning) are formed and tasks and roles are coordinated in an exchange between decision-makers, planners and process facilitators. In the activation phase, the affected population and other stakeholders, such as identified target groups, are informed, sensitised to the respective topic or project and invited to participate. This is followed by the data collection and analysis phase in which information about the site and its inhabitants or users is collected. This can be achieved through primary collection of spatial and social data, or through secondary analysis of existing data. During this phase, the planners and process facilitators take the lead while stakeholders primarily provide information, local knowledge and express their interests. In the active participation phase, measures are jointly developed. In most cases, various methods are used to achieve the desired level of stakeholder involvement. The spectrum of participation ranges from providing information to full empowerment, allowing stakeholders to participate not only in the joint design process but also in the decision-making process. Therefore, 'co-creation' refers to all the work steps involved in collaborative design or creation, including the phase of active participation, in which goals, measures and designs are developed cooperatively, and the collection and analysis phase, in which information is collected and interpreted cooperatively with participants. During the subsequent implementation phase, the developed measures and designs are put into action. In the final project closing phase, the results of the process and the implementation are presented and communicated. In the follow-up, participation processes should be accompanied by periodic monitoring and evaluation.

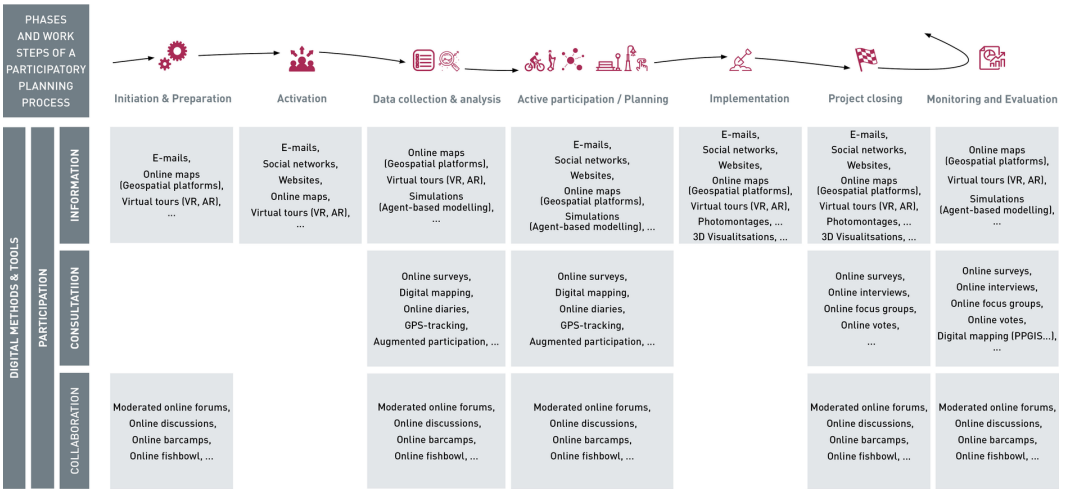
3.2 Typology of Participation Forms and Work Steps in Urban Planning and Participation Processes Using Digital Methods and Tools

The typology is divided into two parts: Typology A (see Figure 2) lists digital methods and tools that can be used in various phases of planning and participation processes. They are classified according to the intensity levels of participation (information, consultation, collaboration) which correspond to the form of communication or the type of information and knowledge exchange (one-way communication, two-way communication, deliberative communication). Furthermore, Figure 3 displays Typology B which outlines the digital methods and tools that can provide essential information about both the space and its users.

Figure 2 shows that a variety of digital methods and tools can be used in planning and participation processes. The same methods and tools are often suitable for multiple phases. Information dissemination tools, such as e-mails, newsletters, websites, and social media, as well as online maps, virtual tours, scenarios, or simulations, are primarily used in the activation phase. This is after the creation of planning variants and drafts, as well as before and after implementation.

Online maps, virtual tours, scenarios, and simulations can also be used for consultation to collect information or opinions from stakeholders as a basis for planning or decision-making. Other methods of information collection and consultation used in the data collection and analysis phase include online diaries, GPS tracking, online interviews, online surveys, digital mapping or augmented participation.

Figure 2. Typology (A) of digital methods and tools, by phases of urban planning and participation processes and intensity level of participation. Own illustration (Fink & Weichselbaumer)



They may also qualify for the phase of active participation in spatial and social strategy development, design and variant planning, as well as monitoring and evaluation phases.

Collaboration methods and tools that facilitate cooperation and dialogue between stakeholders include online forums, online discussions, and online fishbowls. These toolsare used in both the preparatory phase and during active participation, when joint ideas and measures are developed or decisions are made. They are also useful for monitoring and evaluating spatial transformation processes. Planning and participation processes often involve the use of digital tools that do not facilitatedirect exchange and cooperation, but provide essential spatial and social foundations for planning and decision-making through secondary analyses of existing data. These tools include all digital socio-spatial survey and analysis methods and tools, such as WebGIS and geospatial platforms, geographic information systems (GIS), CAD modelling, and statistical and analysis tools.

3.2.1 Selection of Methods and Tools for the Use Cases

Following the creation of a basic typology of digital methods and tools for phases of participation processes, the methods and instruments for the use cases were chosen (see Figure 3). The objective was to facilitate an analysis of spatio-temporal uses by different groups and to incorporate diverse needs into the analysis. Expert tools such as online maps, virtual tours, simulations, and scenarios, can primarily serve to collect and provide the necessary spatial information. Meanwhile, information collection and consultation tools such as online diaries, GPS tracking, and online surveys, can be used much more to collect residents' and users' requirements and needs.

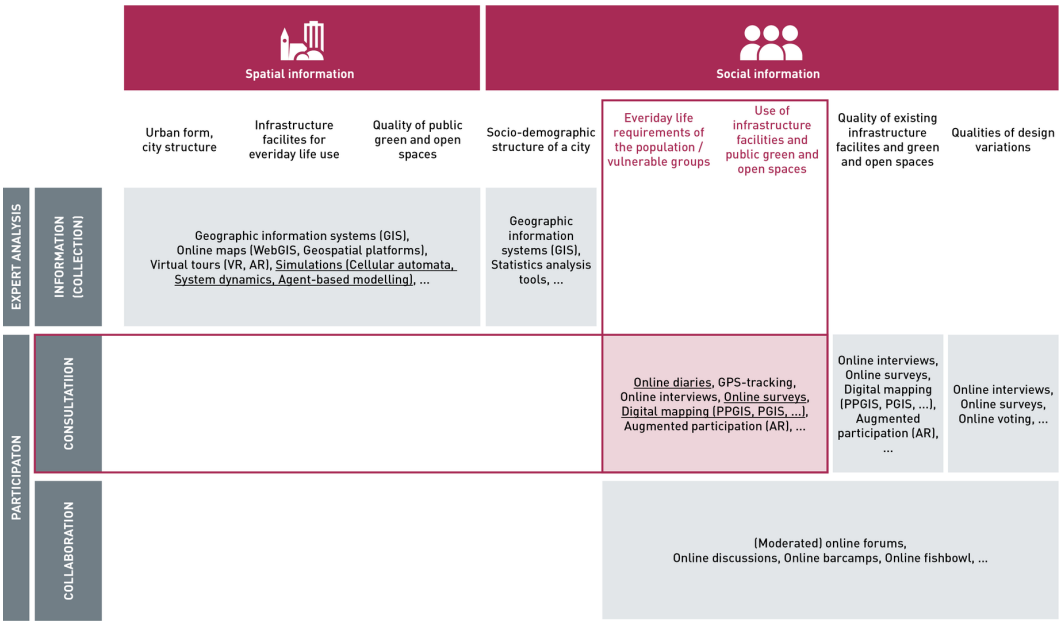
Based on these insights, survey and analysis tools were selected for the use cases and their use was coordinated. These tools included online surveys, online diaries and digital mapping tools, which were combined for post-processing with expert tools for simulations and visualisation (marked in red in Figure 3).

3.3 Results of the Use Case Aumannplatz

3.3.1 Results of the Pre-Survey on Demography, Open Space Use, and Mobility Behaviour

The preparation phase of active participation at Aumannplatz involved conducting an initial comprehensive online survey to gather information on the actual and desired use of space. The survey

Figure 3. Typology (B) of selected digital methods and (expert and participation) tools, providing spatial and social information, by intensity of participation. The tools selected or suitable for the use cases are highlighted in red, Own illustration (Fink & Weichselbaumer)



(n=56, of which 33 female, 23 male) also linked various socio-demographic attributes such as gender, age or employment. The results provide insights into complex spatio-temporal use patterns (e.g., the use of space over the course of the day during the week and at weekends) and mobility behaviour (e.g., preferred mode of transport) and additionally allow to link public space use with the care responsibilities of respondents. The analysis of the results indicates that although over one third of the respondents have care responsibilities, the square is rarely used with children or elderly people in need of care. Approximately 40% of female respondents and 26% of male respondents reported having caring responsibilities. The majority of people with care responsibilities (52.6%) cross Aumannplatz several times a day, while only 24.3% of people without care responsibilities do so. Aumannplatz is most frequently used in the afternoon during the week and at weekends (gender balance). However, Figure 4 shows that women use the square more in the mornings during the week and at weekends.

Figure 5 shows that at weekends in particular, people with care responsibilities use the space more than people without care responsibilities.

The analysis of mobility behaviour by gender shows that the majority of female respondents (almost 58%, compared to 30% of male respondents) use public transport as their main mode of transport within the city. In total, 21% of respondents said that they mostly travel by bike (or scooter) and 18% on foot. The car is only favoured by 3%. The majority of people with care responsibilities use public transport (47.4%), followed by walking (31.6%) and cycling (21%).With the help of the survey, the local population could be personally addressed at an early stage and motivated to participate in the follow-up workshop. Besides the online survey, analogue questionnaires were used to extend the outreach and target diverse groups, including vulnerable people. Personal assistance was provided for the elderly, people with visual or speech impairments and people with young children.

3.3.2 Tool Use in the Workshop Setting and Visualisation of Results

The tool workshop was held in the late afternoon on site in a retail shop on the square to enable working people and people with caring responsibilities to participate. The participants (n=11) were

Figure 4. Use of Aumannplatz during the week and at weekends by gender; results of the pre-survey (n=56, multiple answers possible for this question). Own illustration (© AIT)

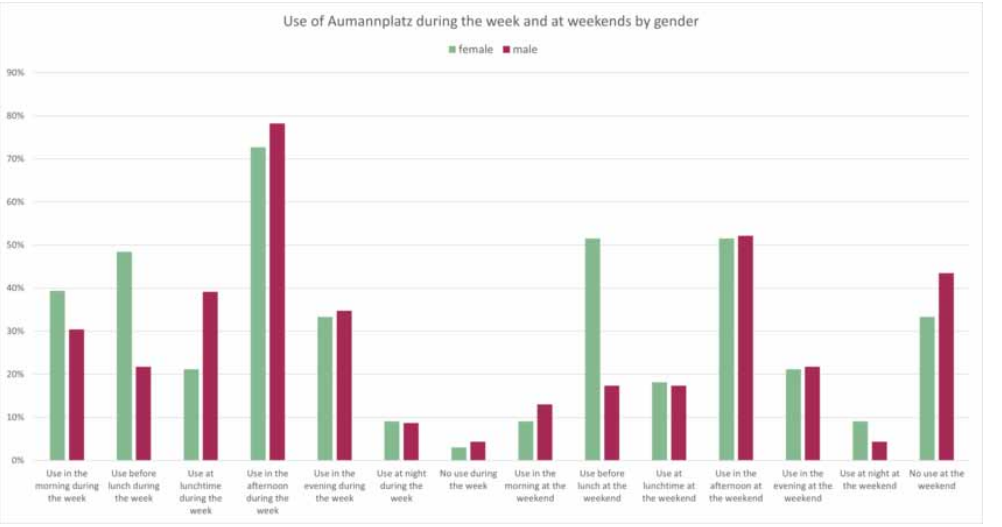
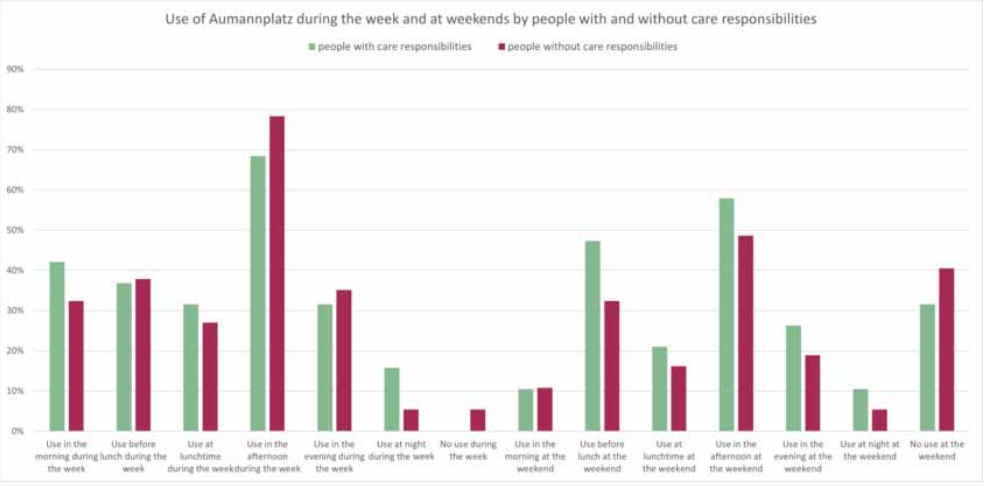


Figure 5. Use of Aumannplatz during the week and at weekends by people with and without care responsibilities; results of the pre-survey (n=56, multiple answers possible for this question). Own illustration (© AIT)



recruited through the preliminary survey and other channels, e.g. the mailing list of the District Service. During the workshop the 'Smarticipate' tool was used to identify current uses and wishes for the redesign (see Figure 6). By mapping current footpaths in small groups of mixed age (between 25 and 84 years) and gender (4 female, 7 male), overlapping spatial and temporal patterns of use emerged.

In addition, the participants were free to use their imagination, with no specific restrictions other than the outer spatial boundaries of the square, to draw their desired paths across the space and propose new designs[7] in a joint negotiation process. A pedestrian simulation was then shown using the tool 'Simulate' to see how these exemplary design objects would affect movement flows in real time. This included the usual movements of people getting off the tram, going to work or school, etc., giving the participants an idea of the current dynamics of the square at different times. Figure 7 shows

Figure 6. "Smarticipate" tool test at Aumannplatz (left); Screenshot of the mapping of a desired footpath and cycle path connection created with the 'Smartcipate' tool (right). Own illustration (© AIT)

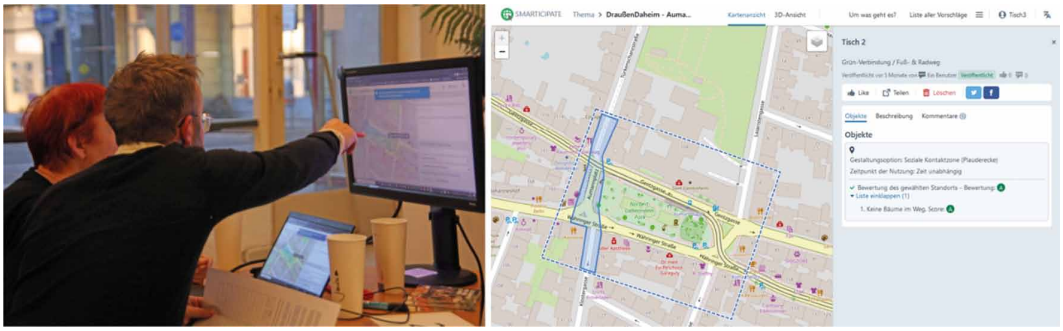
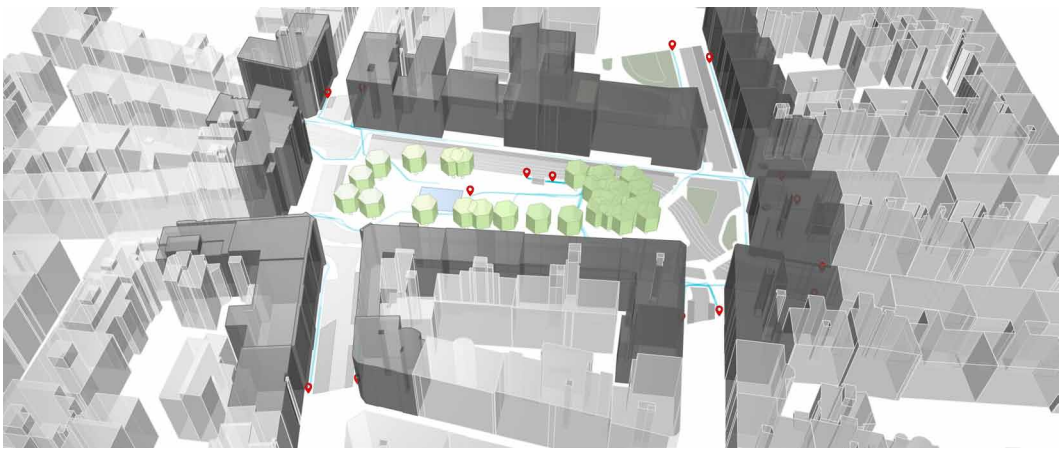


Figure 7. Status quo of Aumannplatz and simulated movement flows (left), simulated movement flows at Aumannplatz without any pathways and facilities (middle) and effects of proposed design objects introduced by the participants via 'Smarticipate' on the movement flows. Own illustration (© AIT, Map basis: OpenStreetMap (OSM) CC-BY-SA 2.0)

Figure 8. 3D modelling of Aumannplatz and its surroundings with integrated water playground and simulation of pedestrian flows to and from defined points of interest. Own illustration (© AIT)



a scenario in which a new water playground – as input from the 'Smarticipate' tool –, influences the current situation by creating new spatial boundaries.

Finally, the tools 'Smarticipate', Rhinoceros 3D (including the Grasshopper plug-in), and 'Simulate' were combined to demonstrate the effects of the ad hoc integrated design object on the surroundings and the flow of movement.

3.3.3 Results of the Follow-Up Survey on the Use of Tools

A follow-up survey of nine tool users (5 female, 4 male; only three participants reported having caring responsibilities for children or elderly people; no sensory or visual impairments were reported) immediately after the on-site workshop showed that most participants found digital programmes or tools easy to use. This is rather surprising, especially as 4 of the 9 participants are retired (the remaining 5 are in full-time employment). The specific use of the 'Smarticipate' tool was also not considered particularly difficult by the 6 participants aged between 55 and 84. This could be due to the fact that in almost all small groups, the younger and more tech-savvy participants took over the operation of the tool. It was confirmed that the tools have helped most participants to improve their understanding of space, as well as the possible spatial changes and their impact on the use of space. All respondents, except for one, highlighted the improved understanding of the usage needs of different people and groups. Similarly, most participants have gained a better understanding of potentially conflicting or competing demands for use. Two-thirds of the participants expressed interest in using such a tool again, although it was noted that due to time constraints not all ideas and contributions could be considered within the small groups.

3.3.4 Reflection on the Use of the Tools From the Perspective of the Process Facilitators

Based on the observations and reflections of the process facilitators, it was found that most participants, particularly those with digital affinity, found the tool 'Smarticipate' easy and fun to use. However, some older participants, both male and female, were reluctant to use. They were offered more support. Overall, the use of the tool greatly facilitated communication among the participants within their respective groups.

Compared to the use of analogue methods, process facilitators do not estimate the preparation effort to be lower, but they do estimate the effort during the event and the post-processing effort to be lower.

The fact that the combination of digital tools supports the immediate feedback of the results to the stakeholders, thus creating awareness and also promoting communication with decision-makers, is seen as a major added value.

3.4 Results of the Use Case Sonnengarten Limberg

3.4.1 Results of the Pre-Survey on Demography, Open Space Use, and Mobility Behaviour

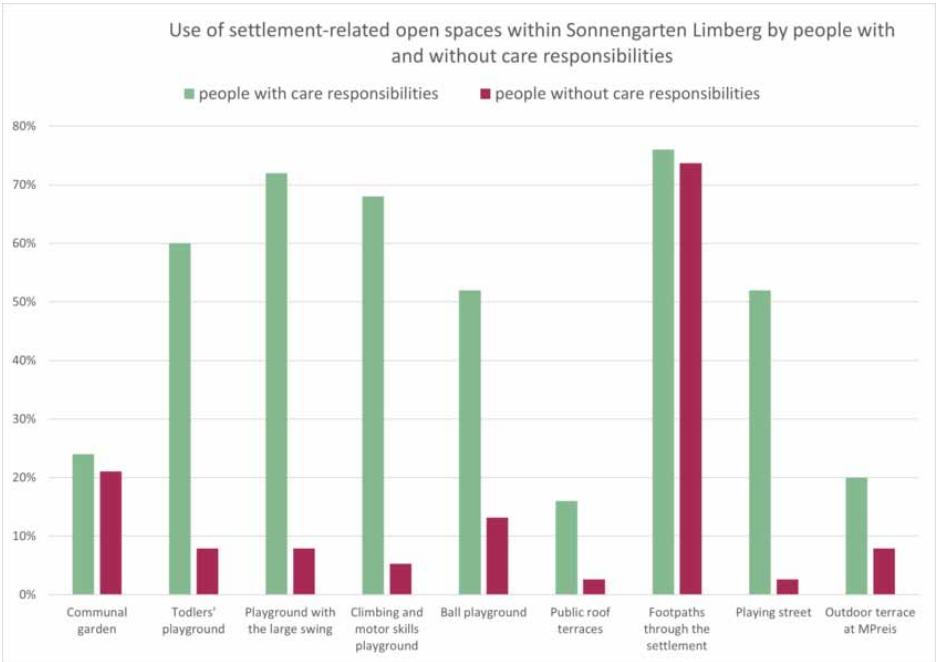
The evaluation of group-specific patterns of open space use in Limberg was initiated through an online survey (n=63). The survey was mainly promoted through various channels, including the housing management's e-mail distribution list, an instant messaging group run by residents, and personal conversations. It focused on leisure and mobility behaviour and also collected information on the social background and the housing situation of the participants This additional information provided valuable insights into the composition of the group. Almost twice as many women (n=41) as men (n=22) participated in the survey. The majority of respondents (74.4%) were aged between 25 and 44, reflecting the relatively young resident population. 25 people say they have care responsibilities for children, while 7 people look after the elderly. Regarding mobility behaviour, it is worth noting that 63.5% of respondents reported using a car as their primary mode of transportation. The analysis results indicate that both men and women use the open spaces inside and outside the settlement to

a similar extent. Specifically, 22.7% of men and 26.8% of women surveyed use open spaces more than 50% inside the housing estate, while 77.3% of men and 73.2% of women use them more than 50% outside the settlement. However, there is variation in usage based on care responsibilities. The study found that 90% of individuals without care responsibilities tend to use most of the open spaces outside of Sonnengarten Limberg, whereas those with care responsibilities use the open spaces inside and outside the settlement in a more balanced manner.

Regarding the use of open spaces within Sonnengarten Limberg (overview plan see Figure 9), the footpaths through the settlement are the most popular, followed by the playground with the large swing, the climbing and motor skills playground, and the toddlers' playground. Figure 10 shows that

Figure 9. Overview plan of Sonnengarten Limberg. Own illustration (© AIT, Map basis: OpenStreetMap (OSM) CC-BY-SA 2.0)

Figure 10. Use of settlement-related open spaces within Sonnengarten Limberg by people with and without care responsibilities; results of the pre-survey (n=63), multiple answers possible for this question). Own illustration (© AIT)



this is especially true for people with care responsibilities, which is why the design and quality of functionalised open spaces such as playgrounds are very important for this group.

Figure 11 illustrates that women refer to the open spaces highlighted above more frequently than men, except for the footpaths through the settlement and the community garden.

At the end of the survey, participants were asked if they wished to participate in the following tool test using the digital tool 'Smarticipate' for a playful creation of an open space use diary.

3.4.2 Tool Use in the Workshop Setting and Visualisation of Results

The on-site participation was organised directly in the premises of the housing management. This communal space in the centre of Sonnengarten Limberg provided the ideal setting to introduce a handful of participants to the ' Smarticipate' tool, which the participants (7 female of which 3 have care responsibilities, 7 male of which one has care responsibilities) were required to use for at least one week during the summer to keep an online diary of their use of open spaces. The hands-on session was attended by a young mother with a digital affinity, a childless gay couple (2 men) interested in sustainability issues, a young female resident and an elderly lady with little technical competence. The other 9 participants received a handout on how to use the tool independently to create the diary.

During the tool test, the participants (each equipped with one laptop) practised the mapping of points of interest (Figure 12) and additional information (e.g., choice of transport, time, duration and purpose of open space use), which allowed them to reconstruct their typical weekly and weekend routines.

To processand visualise all the data collected with ' Smarticipate', a WebGIS application was programmed. This enables the participants as well as urban planners or other interested stakeholders to analyse the results in more depth. As the following images show, heatmaps for the data collected

Figure 11. Use of settlement-related open spaces within Sonnengarten Limberg by gender; results of the pre-survey (n=63), multiple answers possible for this question). Own illustration (© AIT)

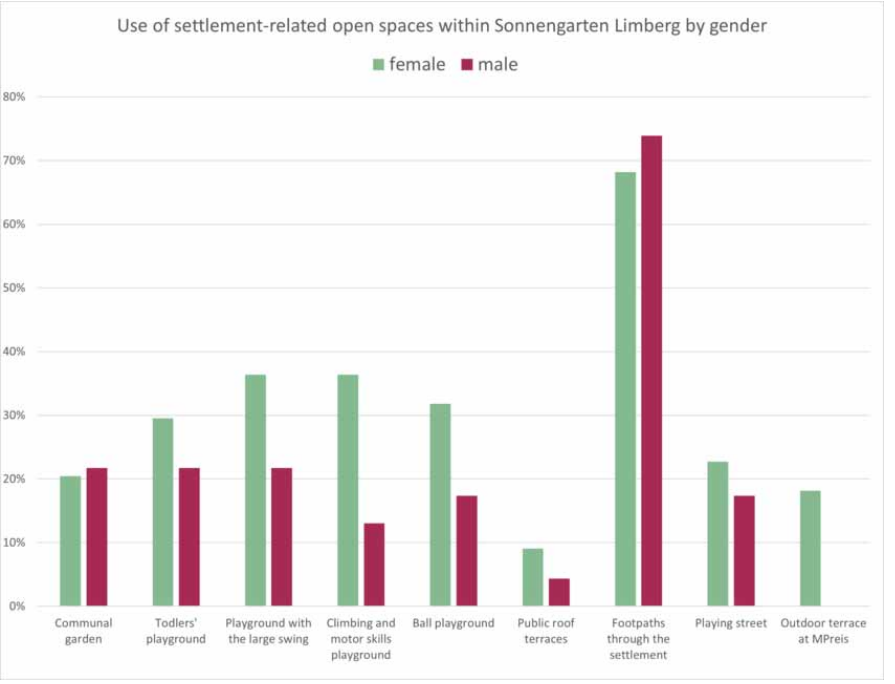
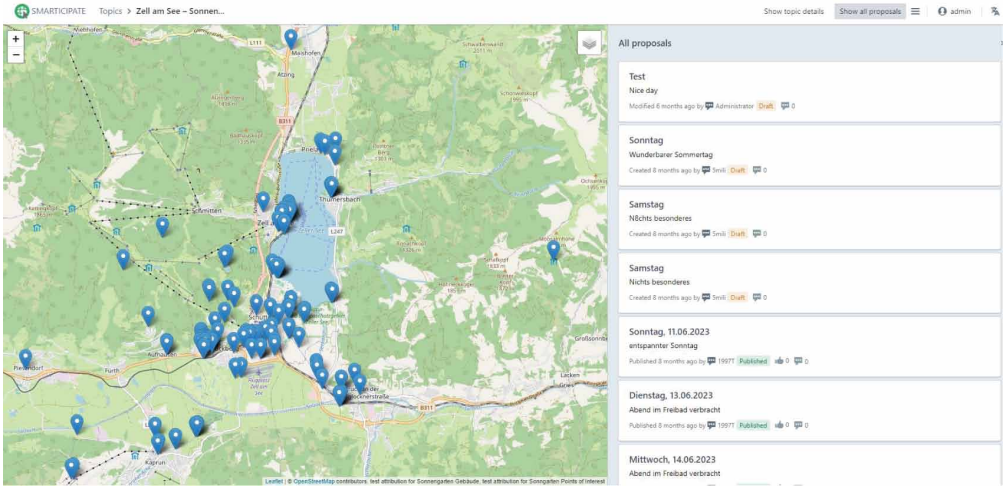


Figure 12. Points of interest in open space use outside the settlement, marked by all participants (n=14) on different days of the week using 'Smarticipate'. Own illustration (© AIT, Map basis: OpenStreetMap (OSM) CC-BY-SA 2.0)



with the help of the open space use diary can be created for different periods (weekdays, weekends, times of day), but also for user groups.

The analysis of individual diary entries, which can be linked to the mobility behaviour data collected in the pre-survey, enables the representation of group-specific use. Although there are no significant gender-based differences in the spatial distribution of visited open spaces, a slight variation related to care responsibilities is apparent (see Figure 14 and 15). The use of open space

Figure 13. Heat maps to analyse and visualise collected open space use diary data with 'Smarticipate': Used open spaces in the region of all users (n=14) from Monday to Friday during the entire day (top left); Used open spaces in the region of all users from Monday to Friday in the morning (top right); Used open spaces in the settlement area of all users from Monday to Friday during the entire day (bottom left); Used open spaces of all users in the settlement area from Monday to Friday in the morning (bottom right). Own illustration (© AIT, Map basis: OpenStreetMap (OSM) CC-BY-SA 2.0)

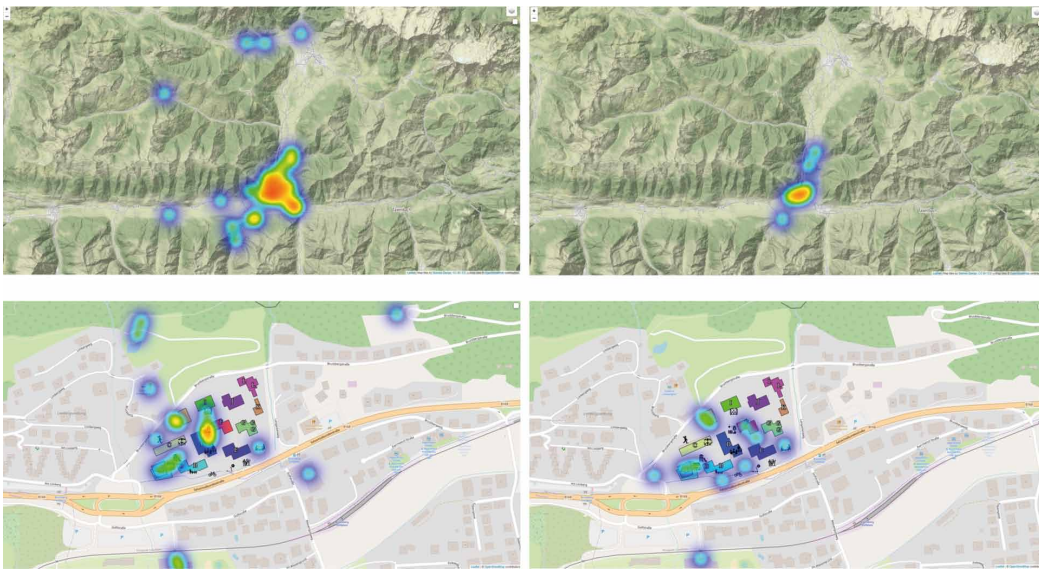


Figure 14. Heat map showing open space use of all users without care responsibilities. Own illustration (© AIT, Map basis: OpenStreetMap (OSM) CC-BY-SA 2.0)

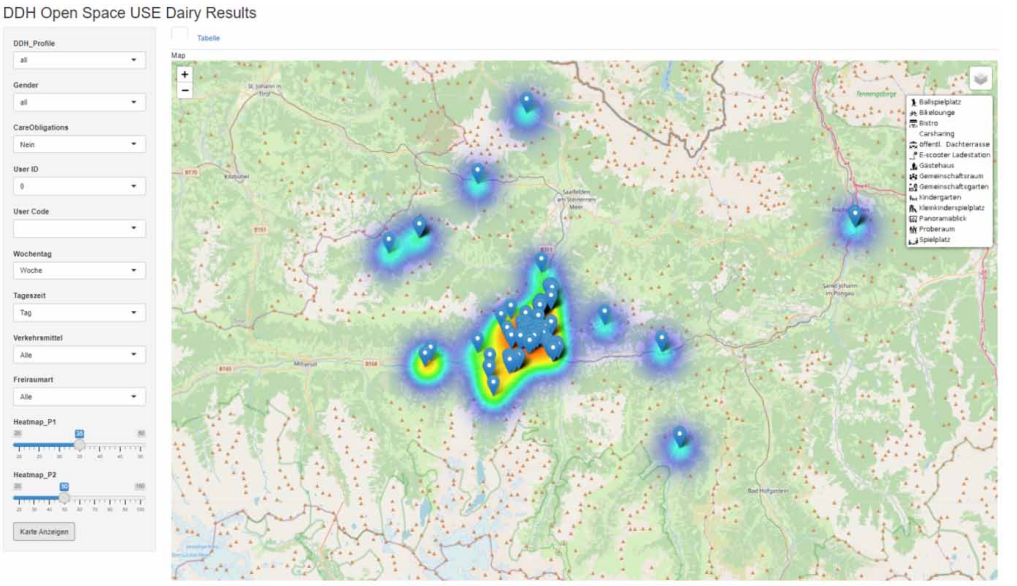
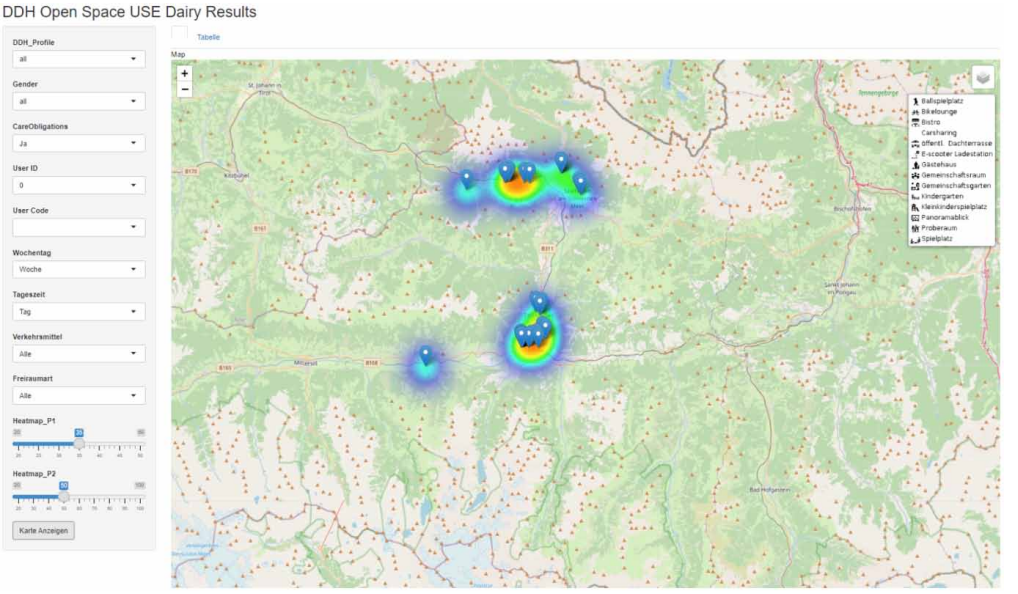


Figure 15. Heat map showing open space use of all users with care responsibilities. Own illustration (© AIT, Map basis: OpenStreetMap (OSM) CC-BY-SA 2.0)



by participants with care responsibilities appears to be much more concentrated than the dispersed pattern of those without care responsibilities. As confirmed by the pre-survey, the majority of the latter have a wider radius of movement and use open spaces outside the settlement.

This online visualisation tool is another important step in the entire co-creation process as this enables the discussion of the participants not only looking at their own open space use diary.

3.4.3 Results of the Follow-Up Survey on the Use of Tools

The follow-up survey (n=14) was carried out by all persons who had participated in the workshop or kept the open space use diary. This showed that most of the participants found it (very) easy to use the tool in the workshop and to keep the diary, especially with the help of the handout provided. This is especially true for half of the respondents in the younger age group of 25-34 years. There is no significant difference between genders. For more than a third of the participants, the tools increased their understanding of space, but only for less than a third (all female) did they increase their understanding of potentially conflicting or competing demands on space. Among those surveyed, women, in particular, appear to have become more aware of the open spaces they regularly use in their everyday lives and how these are spatially distributed. All participants found the content easy to read, but orientation within the programme was only rated as good. The use of the programme was self-explanatory for slightly more than half of the testers. For the majority of participants, the design was appealing, and the visualisation of the results was comprehensible. Almost all participants, regardless of age, expressed their willingness to use the tool again. The only suggestion was to simplify the registration process on the platform, the user interface and the entry of points of interest using the search function in the map.

3.4.4 Reflection on the Use of the Tools From the Perspective of the Process Facilitators

The process facilitators reflected on how to use the tools profitably and what changes are needed in the tools and process design to achieve this. Each facilitator supervised and observed one person or small group, documenting the handling of the tool, encountered problems and content discussions. It was observed that the tool use was easier for younger, more tech-savvy participants to use, while older and less experienced users found it challenging. Most of the users were able to use the tool without much assistance, but one female user who lacked digital experience required significant support from the facilitator. In that case, the open space use diary was completed with the help of a family member.

4. DISCUSSION AND CONCLUSION

In the context of gender-sensitive planning, it is important to measure the quality of a city and the usability of green and open spaces, according to the requirements and needs of groups in vulnerable situations (Damyanovic et al., 2013). As relatively few participants were involved in both use cases, the results must be interpreted with caution. However, as the focus was on a basic proof of concept, at least some of the findings can be generalised and previous research results confirmed

The analysis of the work steps in participation processes and the digital methods and tools has shown that digital surveys, online diaries and various forms and methods of digital mapping primarilysupport the consultation in participation processes. This is also confirmed by the use of these tools in the use cases. A differentiated collection of socio-demographic data during the online surveys with an (anonymised) connection to other tools allow a group- and gender-specific evaluation of usage requirements and current usage. The tools developed and used for online diaries and digital mapping have been proven effective in recording age and group-specific aspects, as well as in analysing spatio-temporal usage patterns.

4.1 Presentation of the Learnings Concerning the Design of Participatory Processes

The use cases confirm the previous findings in this research field: ‘no online without offline’. Both forms still need to be used to reach a wide range of different people (Czepkiewicz et al., 2016; Li et al., 2020; Schoßböck et al., 2018; Gurstein, 2003). The (gender) digital divide is narrowing, but it persists as women worldwide have less access to resources and skills to use digital tools (Ali Acilar & Øystein Sæbø, 2023; Faugoo Deepika & Adaora Onaga, 2022). In the Limberg use case, there is

less of a digital divide between genders and much more between age groups. This may be because they have been appropriately empowered (by process facilitators and analogue support materials such as the handout) to navigate the digital tool landscape. However, based on the limited sample of test users, further research is needed in this area.

Many researchers point to the key advantage that digital tools enable participation regardless of time and place. This holds true especially for gender-responsive participation processes taking into account the limited time availability of caregivers or the requirements of elderly people, who are typically less digitally inclined (Reinwald et al., 2014; Kubicek H., 2010). The Limberg example illustrates that while digitally savvy individuals can easily operate the comparatively complex 'Smarticipate' tool, there remain certain target groups, particularly older individuals, who are less accessible by digital means. Hence, a broad repertoire of methods must be used from the first contact to recruit participants for the workshops (Tomor et al., 2019). 'Smarticipate' impresses with its flexible remote access to the open space use diary, which the majority of diary keepers like to use. It is therefore obvious that the advantage of online participation lies in the fact that it enables participation independent of time and place (Steen Møller & Stahl Olafsson, 2018) The results suggest that procedural justice is supported, as previously underrepresented groups are at least given the opportunity to participate.

The number of participants is too small for a representative evaluation of the results of the individual tools used. What can be confirmed with the results, however, is that the tools in principle make it possible to record the different daily routines, the spatio-temporal use of space and the recording of group, age and gender-specific requirements, i.e. they are suitable for gender-responsive participation processes. The basic prerequisite is the combination of socio-demographic characteristics with all other analyses carried out.

Furthermore, the study reaffirms previous findings regarding the required effort. The effort involved in preparing a digitally supported participation process is greater than when using exclusively analogue methods (Bizjak, 2012). However, the effort required for implementation remains relatively the same, although it is easier to scale up participation procedures when digital tools are used (Hofmann et al., 2019). However, during the research, a limitation became apparent: additional experts are required to adequately prepare and use digital tools, as the competencies of 'normal' process facilitators are insufficient. These experts cannot be paid via the usually available participation budgets (Bizjak, 2012). Finally, the follow-up of the digitally supported process is less time-consuming because the data is already available in digital form. This is particularly beneficial when dealing with large numbers of participants or large amounts of data.

The research results indicate that digital tools have a key advantage in the manifold use of generated data. This allows for easier and quicker importation into downstream analysis tools, enabling complex cross-evaluations and gender or care differentiated analyses to be carried out. However, digitally supported data collection also offers direct advantages for the participation process, particularly for immediate simulations and impact analyses, as demonstrated in the Aumannplatz case through the use of 'Simulate'. The combined use of tools facilitates data-driven information transfer and communication and helps laypersons to understand the implications of planning decisions. It can be challenging for laypersons to understand the spatial implications of such decisions. Immediate feedback of the results, such as different design options and their consequences for spatio-temporal use patterns, can support negotiation processes between stakeholders with differing needs and opinions (Müller, 2021). This is an advantage that analogue tools cannot offer.

From a process design perspective, one aspect that requires further investigation is the advantage or disadvantage of individual versus group work, as well as the group composition. The digital tool test conducted at Aumannplatz showed that in mixed groups, more dominant or technically proficient individuals tend to assert themselves more strongly. However, less digitally proficient individuals are also supported and different perspectives are brought in or negotiated, enabling a more nuanced discussion. Individual work, such as further processing of the diary in the Limberg case, leads to

unbiased information and allows for quieter perspectives to be given equal consideration. However, it is important to note that participants cannot negotiate or weigh different or contradictory interests, unless these possibilities are considered in future tool development (e.g., via comment functions). The application of the tool should be set within participatory processes, taking into account a thoughtful group composition, including representation of vulnerable groups, and the choice of low-threshold participatory methods should be carefully considered and coordinated (Geekiyanage, 2021; Hofmann et al., 2019).The careful embedding of the tools in participatory formats is crucial, as it influences both the group dynamics and the results. on the objective it is important to determine whether participants should engage in general discussion, or negotiate individual user interests.

In summary, the digital participation tools used can effectively support the collection and evaluation of gender- and group-specific patterns of use, requirements, and ideas. However, the quality of their results is heavily influenced by the selection and (inclusive) design of the participation process and format (Hofmann et al., 2019), as well as the development of a seamless tool chain. An important task for tool developers is to make their tools more user-friendly and intuitive.

4.2 Presentation of the Learnings Concerning Tool (Chain) Use and Development

The literature research on digitally supported planning and participation processes reveals that currently available tools and data on urban public spaces mostly overlook group-specific needs and demands, as well as spatio-temporal use patterns. Digital tools supporting gender-responsive development of these spaces should offer better opportunities to collect and visualise data in participatory consultation and collaboration processes. This includes gender- or care-specific needs. To ensure gender-sensitivity, both the process design and tools must be designed to be as inclusive as possible. Although it is important to enable as many different people as possible to participate in the survey process, the research results have shown that it is equally important to develop digital tools that are accessible and easy to use, even for those with limited digital literacy. To achieve this, tool developers must optimize simplified applications, particularly with regard to the user interface. However, as there is no single tool which can meet all needs, it is necessary to develop tailored tool chains.

The workflow and process flow of the participatory application should be as smooth as possible to ensure successful data transfer and maintain the participants' motivation. The development of the interface between digital tools is crucial, relaying on standard data exchange formats and procedures. If successful, the same tools or a combination of tools can be used intentionally in different phases of participation to achieve the desired intensity level (information, consultation, collaboration). Developing a proper user interface (UI) is a challenging task that requires significant effort and a large number of test persons of all genders, which cannot be fully achieved within the scope of this research project. Furthermore, the project has shown that each use case requires a different configuration, depending on the participation phase and the issues to be addressed,, in order to use the tools effectively and meaningfully. Thus, even if the same tool is used in several use cases, a tailored user interface would be ideal for the corresponding participation setting. As this is not feasible (without significant additional effort), the tool engagement phases must be meticulously planned and executed. The varying applications of the Smarticipate tool at Aumannplatz and Limberg, for short and long-term data collection and analysis respectively, highlighted the need for case-specific adaptations of the tool. Analogue tools, such as the supporting handout for tool users, have proven to be very useful. Additionally, personal assistance from process facilitators during the workshops helped to address any weaknesses of the tool.

From these learnings it emerges that one of the core outcomes of this research is the insights into the interplay of different tools in the form of tailored tool chains. These were developed with a focus on specific interfaces for capturing and analysing as well as visualising spatio-temporal usage patterns and refer to a coherent set of digital (and analogue) tools adapted to the specific application context in the use cases. The tool chains developed in this research contain the following elements:

- *Geographic Information Systems (GIS)*, in the case of DDH a *WebGIS-App,* forms the foundation of the digital tool chain. It allows to capture, store, analyse, and visualise spatial data, such as land use, transportation networks, infrastructure, demographics, and environmental factors.
- *Data Collection Apps,* such as *Smarticipate*, or mobile applications designed for data collection enable to gather information on the ground, including citizen feedback, infrastructure assessments, environmental data, or data on spatio-temporal patterns of use as in the case of DDH.
- *3D Modelling and Visualisation:* 3D modelling software, such as *Rhinoceros 3D/Grashopper* used in the use case Aumannplatz, creates virtual representations of urban environments, enabling the visualisation of proposed developments (or design objects), simulate scenarios, and assess their potential impact on the cityscape.
- *Urban Simulation Tools* such as *Simulate* and SUMO applied in the use cases help forecast future development patterns, traffic or pedestrian flows, and environmental impacts, aiding in decision-making and policy formulation.
- *Community Engagement Platforms,* such as *Smarticipate,* can facilitate participatory urban planning by enabling residents and stakeholders to provide input, feedback, and ideas on proposed projects and policies.

It has been shown that one of the biggest advantages of using digital tools is the use of the generated data for the further (evaluation) process by linking it to other tools. This has an added value not only for the project team but also for the participants. The combination with expert tools has improved the understanding of space (women!), of the impact of spatial changes, and of the different (and sometimes competing) demands and needs of different user groups, especially those in vulnerable situations. Immediate simulations of e.g. pedestrian flows or the simultaneous integration and demonstration of effects of design proposals support rapid information flow, fast decision making and impact discussion. However, setting up a tool chain requires more preparation and data exchange due to technical constraints related to performance and reliability. It was shown that a well-developed tool chain can support gender- and group-specific data collection and analysis while also assisting non-experts in to reflecting their use patterns.

It can be concluded that the use of ICT tools within a tool chain is only beneficial when followed by a data evaluation due to the significant additional effort required, such as programming the interfaces between the tools. As far as the effort for the follow-up of participation processes is concerned, the use of digital tools significantly reduces effort. Direct digitalisation enables further impact assessments with combined tools, result visualisation and dissemination.

The methodology developed and tested, is essentially characterised by the successful process design and the development of a seamless tool chain. to support procedural justice, it is necessary to use supported. different communication strategies and a mix of methods need to be used to involve diverse groups of people of different ages, genders, and with and without care responsibilities. Moreover, diverse and well-established communication structures and channels canincrease the reach of participatory processes. This inclusive approach enables the recruitment of various groups of people, including those with less digital affinity, for such processes, thus addressing the digital divide. The combination of tools used in the project allowed allowed for a detailed analysis of the use of space and the identification of group-specific requirements . This enables the representation of diverse life conditions in the development of gender-responsive public spaces, contributing to the right to access open space and promoting the development of gender-just cities.

COMPETING INTERESTS

The authors of this publication declare there are no competing interests.

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Fessler, Flora: Conceptualisation; Formal analysis; Investigation; Methodology; Visualisation; Writing - original draft; Writing - review & editing. Florian Reinwald: Conceptualisation; Funding acquisition; Methodology; Project administration; Writing - original draft; Writing - review & editing. Weichselbaumer, Roswitha: Formal analysis; Investigation; Methodology; Visualization. Wentz, Jana: Investigation; Writing - review & editing. Gebetsroither-Geringer, Ernst: Conceptualisation; Funding acquisition; Methodology; Project administration; Writing - review & editing.

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ENDNOTES

[1] Gender+ groups were defined in the previous project "Smart through Gender+" (Damyanovic et al., 2021; Tummers & Wankiewicz, 2021) and stand for differently rigid or flexible daily routines with different requirements associated with them. In this paper, particular attention is paid to vulnerable groups, including people with caring responsibilities, who tend to be female and make way for the more dominant (young, male) user groups in public spaces.

[3] Smarticipate is an interoperable and expandable platform for interactive urban planning for a more transparent, democratic and inclusive implementation of urban transformation processes:

[4] "Simulation, analysis and optimisation of customer and pedestrian flows": https://www.ait.ac.at/en/solutions/analysis-and-optimization-of-pedestrian-flows/simulate https://www.smarticipate.eu/

[5] "Simulation of Urban Mobility": https://eclipse.dev/sumo/

[6] According to the 2020 population register of the City of Vienna, the percentage of non-Austrian citizens residing around Aumannplatz is lower than the district average, standing at 33% out of a total of 5,946 residents (compared to Vienna's 47% and the 18th district's 41%). The proportion of single-person households is slightly higher than the city-wide average at 52%. Overall, the population distribution by gender and age in the area is similar to that of the city as a whole. The population around Aumannplatz comprises 54% females and 46% males, making it 3% more female than Vienna as a whole.

[7] The participants were informed beforehand that the workshop was primarily intended to test the tools and develop hypothetical scenarios, rather than to submit concrete wishes to politicians or design proposals for implementation at Aumannplatz. However, the research results were provided to the decision-makers for further use.

Flora Fessler is a Research Engineer at AIT's Research Field Climate-resilient Urban Pathways at the Unit for Digital Resilient Cities. She holds a Master's degree in Urban Design from HafenCity University Hamburg and has been working on the intersection of participatory urban development, behavioural analysis and climate change adaptation and mitigation in urban planning since 2019. Her main research focus is on behavioural patterns in mobility and public space, as well as motivational strategies to promote behaviour change. In addition, she focuses on the potentials of digital methods and tools to support gender-sensitive planning and design.

Florian Reinwald is Senior Scientist at the Institute of Landscape Planning at the University of Natural Resources and Life Sciences, Vienna (BOKU Vienna). He is an expert on social oriented, green and climate sensitive urban and landscape planning and leads many national and international (applied) research projects in inter- and transdisciplinary settings. One of his main fields of research are planning and participation procedures using digital tools to support procedural and distributive justice. He also focuses on settlement and community development, planning, steering and legal instruments for the adaption on climate change using eco system services of urban green infrastructure.

Roswitha Weichselbaumer is Junior Researcher and PhD candidate at the Institute of Landscape Planning at the University of Natural Resources and Life Sciences, Vienna (BOKU Vienna). In her research she focuses on spatially differentiated, socio-spatial analysis as a contribution to green space justice as well as (digital) methods and tools for gender sensitive planning and participation procedures. Her second research area is climate change adaptation in urban and spatial planning with a focus on the contribution of public spaces to climate change adaptation taking into account group, age and gender specific needs and requirements.

Jana Wentz is a Junior Researcher at the Institute of Landscape Planning at the University of Natural Resources and Life Sciences, Vienna (BOKU Vienna). She received her master's degree in landscape planning and landscape architecture from BOKU Vienna in 2023. In the same year she was employed by the Institute of Landscape Planning where her research focuses is on gender sensitive planning and sustainable neighbourhood development, as well as climate change adaptation in urban planning, urban green infrastructure and mobility.

Ernst Gebetsroither-Geringer, Senior Expert Advisor at AIT's Research Field Integrated Digital Urban Planning, studied ecology (1991-1997) and mathematics and physics (1998-1999) at the University of Vienna. He focused in his PhD studies on the combination of multi-agent system and system dynamics modelling (2007-2010) at the University of Klagenfurt. He has a longtime experience in the field of qualitative and quantitative analysis of complex systems, modelling and simulation, with a special focus on dynamic spatial systems. In addition, he worked several years in the field of software development (desktop and web applications), especially in the area of spatio-temporal analysis.