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Communications of the
Association for Information Systems

Accepted Manuscript

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Please cite this article as: Becker, Felix; Siemon, Dominik; Robra-Bissantz, Susanne: Smart Participation Design: Prescriptive Knowledge for Bottom-Up Participation, *Communications of the Association for Information Systems* (forthcoming), In Press.

Communications of the Association for Information Systems

Research Paper ISSN: 1529-3181

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Abstract:

Citizen participation is a vital aspect for smart cities, as solutions developed by and with citizens promote transparent and participatory collaboration within a city and foster the development and construction of a meaningful living environment. However, design knowledge on citizen-initiated and at the same time ICT-supported participation projects (referred to as *Smart Participation*) are scarce in practice and under-researched. In this paper, we follow a Design Science Research approach to create design knowledge for smart participation scenarios. Based on ten conducted expert interviews with active participants and issues identified within the literature, we create seven design principles. We subsequently evaluate the design principles with four additional experts who designed and are currently operating a large participation platform. Our results contribute prescriptive design knowledge for both practice and research on how to design and beneficially facilitate smart participation in the context of smart cities.

Keywords: Smart Participation, Bottom-Up Participation, Smart City, Design Principles, Design Science Research.

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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This manuscript underwent [editorial/peer] review. It was received xx/xx/20xx and was with the authors for XX months for XX revisions. [firstname lastname] served as Associate Editor.] **or** The Associate Editor chose to remain anonymous.]

1 Introduction

Although geographical factors usually define cities, another essential component that makes up a city is its people, because citizens influence the appearance, identity, and culture of their city. The influence of citizens on decision making, the engagement in activities, and the shaping of the city by its citizens is commonly referred to as participation (Roberts, 2004; Viale Pereira et al., 2017). The way citizens interact with or take part in participation scenarios can take many forms and is necessary to create a living environment that meets the inhabitants' needs. Thus, the creation of a common living environment by its citizens is a fundamental condition for a good life and every citizen's right (UN General Assembly, 1948). Participation is a crucial aspect of this joint creation, so the right to participate is even mentioned within the UN Charter of Human Rights (UN General Assembly, 1948 Art. 21:1).

Nowadays, information and communication technologies (ICT) support or even replace real-life participation activities. The use of ICT can yield advantages in reducing participation costs (Masuda, 2007) and promote collaboration among all stakeholders (Barki & Pinsonneault, 2001; Randrup et al., 2016). Furthermore, ICT-enabled participation is an integral part of the smart city concept, referred to as e-participation (Viale Pereira et al., 2017). Simonofski et al. (2021) define the smart city as "[…] a city that provides innovative solutions, in collaboration with its citizens and with the support of technology, to solve the specific challenges of its territory in the domains of mobility, economy, governance, environment, living, and people", although, various disciplines define the smart city concept differently (Ninčević Pašalić et al., 2021). The concept of smart cities has attracted a lot of attention from researchers in diverse fields, including information systems, as it considers stakeholders and the benefits and challenges associated with its implementation (Ismagilova et al., 2019). However, the current knowledgebase on how to design information systems for participation is small and mainly focuses on a top-down view of ICT-supported participation, mostly through the provision of some sort of participation platform (Alverti et al., 2016; Bricout et al., 2021; Kersting & Zhu, 2018; Monachesi & Witteborn, 2021; Reed & Keech, 2019; Van der Graaf & Veeckman, 2014). The use of ICT in participatory contexts to date has often been aimed at replacing offline or personal activities with digital offerings, such as participation platforms or dialog-centered solutions. Participation *through* digital offerings is thus the predominant approach. These predefined methods, interaction patterns and participation mechanisms which are inscribed in the provided participation platforms restrict collaborative problem-solving from the community and do not meet the highest level of participation, namely collaboration of all stakeholders (Arnstein, 1969; IAP2, 2021).

That is why we want to shift the focus from a top-down to a bottom-up approach of ICT-enabled participation in the smart city, which means that a participation project is both stakeholder-initiated and stakeholder-centered (Felt & Fochler, 2008). We want to focus on the participation scenario where stakeholders collaborate on self-selected topics that are relevant to them and their community. The outcomes of collaborative, bottom-up participation efforts can be physical products, like a community garden or a Do-It-Yourself seating arrangement, but also non-physical, such as services, e.g., events or neighborly assistance. Additionally, outcomes can be events or activities from the participation group for the whole community. This form of participatory behavior in which citizens take responsibility for their living environment and public administrations transfer responsibility back to the community is fundamentally essential for the smart city (D'Onofrio et al., 2019) and for the society in general (Roberts, 2004).

The participation of citizens in the smart city and the bottom-up approach of participation are essential criteria for creating a smart city that exceeds technology- and efficiency-driven models of smart cities. Since citizens' bottom-up participation is the foundation for holistic smart city development, said participation needs to be smart as well (Moyser & Uffer, 2016).

To enable this form of participation, it is of fundamental importance to broaden digital participation capabilities for all citizens and design holistic information systems to support participatory efforts. Besides others the design of ICT-enabled participation can be a hurdle, that prevent citizens from participating (Rodríguez-Bolívar et al., 2018). While approaches for the digital support of top-down participation already exist (Cecchini & Plaisant, 2015; Khan et al., 2017; Olphert & Damodaran, 2007; Simonofski, Hertoghe, et al., 2021), as of yet, design knowledge for the design of information systems that aim to enable and support bottom-up participation, has not been recognized by scholars. In doing so, we view information systems as sociotechnical systems composed of task, people, structure, and technology (Sarker et al., 2019; Winter et al., 2014). Our objective is therefore, to provide design knowledge for designing information systems to support smart participation and take a holistic view of how ICT can be arranged,

selected, and designed so that people can use it effectively to accomplish this specific task, namely smart participation.

Therefore, the research question this paper wants to answer is:

RQ1: How to design information systems that enable and support smart participation?

To address our research question, we follow a design science research (DSR)-oriented approach that aims to develop “concrete prescriptions that enable IT researchers and practitioners to understand and address the problems inherent in developing and successfully implementing information systems” (Hevner et al., 2004, p. 77). Thereby we develop seven design principles (Gregor et al., 2020) for the design and utilization of information systems that aim to enable and support smart participation.

First, we introduce the term of smart participation to achieve a solid foundation for our structured literature review with which we want to gain an overview of the state of the art in digital participation support for bottom-up participation. After that, we conducted a series of expert interviews to understand participants' needs and requirements for smart participation information systems. Together with relevant theoretical assumptions, we create meta-requirements for smart participation information systems and recombine those to seven design principles following the structure suggested by Gregor et al. (2020). In a second step, we assess and subsequently refine the design principles through an expert evaluation approach (Peffers et al., 2012). First, with a senior DSR researcher, who provided us with insights towards aspects such as formulation, generalization, and structure of the initial design principles. Second, we conducted a structured open questionnaire with three additional experts that designed and are currently operating a large bottom-up participation platform. The paper ends with our approach's limitations as well as suggestions for future research activities.

2 Theoretical Background

2.1 Smart Participation

Several scholars have tried to develop a comprehensive definition of what behavior or activities can be described as participation (Halskov & Hansen, 2015). Originating in political sciences, participation can be described as the act of sharing "...power with public officials in making substantive decisions and in taking actions related to the community" (Roberts, 2004, p. 320). Going on, Roberts (2004) stresses that this definition focuses "... on direct participation (when citizens are personally involved and actively engaged) as opposed to indirect participation (when citizens elect others to represent them) in the decision process." (ed.). This approach highlights three aspects which help to describe participatory behavior:

- Members of society carry out participation activities.
- Participation is an active behavior.
- The activities address issues or problems that affect a group or society.

A criterion that is not considered by Roberts (2004) is that the actions are carried out voluntarily. Voluntary involvement that affects the acting participants themselves as well as others, is an essential and distinguishing feature of participation since it allows the separation of participation from activities in contexts, which rely on hierarchy, e. g. employer-employee contexts. Voluntariness of central importance in other participation definitions (Kaase, 1992; Robra-Bissantz et al., 2017; Van Deth, 2014). Combining the four mentioned criteria, our definition is:

Participation is a voluntary and active behavior that works on tasks or solves problems performed by members of a group affected by the same problem or the task's outcome.

If participatory behavior is partially or fully carried with the support of ICT one can speak of e-participation (Abu-Shanab & Al-Dalou’, 2012). Since e-participation is considered to be a part of e-governance within the smart city framework by Giffinger et al., (2007) it hence refers to a top-down understanding of ICT-enabled participation in the smart city (Lombardi et al., 2012) and refers to the integration of various stakeholders in decision-making processes and public services with the aid of ICT (Albino et al., 2015). A different approach to participation in the smart city is to arrange the digitally supported participation and collaboration of stakeholders in urban participation processes in the sphere of the smart people of the smart city dimensions (Giffinger et al., 2007) incorporating the bottom-up approach of participation. Top-down participation processes are often formally enshrined in laws and regulations. These are also referred

to as constitutional forms of participation, whereas bottom-up or grassroots initiatives are unconstitutional or informal forms of participation (Spil et al., 2017). To distinguish smart participation from other forms of ICT-supported participation, smart participation as understood in this paper is an (informal or unformulated) form of participation that arises from the collaboration of citizens or non-governmental stakeholders and in which ICT is used to promote this collaboration among the actors involved. Smart participation, for which design knowledge is to be developed, is thus characterized by three main features:

- In the context of the smart city, smart participation is located in the sphere of smart people rather than in the sphere of smart governance.
- Smart participation emerges from the community instead of being initiated top-down and thus - in contrast to e-participation - follows the bottom-up principle.
- Therefore, smart participation relies on the collaboration of the stakeholders involved.

2.2 Literature Review

Although being a vital topic for the future development of smart cities, the body of knowledge regarding digital participation support for bottom-up participation approaches in the context of smart cities seems underwhelming. To achieve an overview of the current body of knowledge, we conducted a structured literature review (Levy & Ellis, 2006; Vom Brocke et al., 2009; Webster & Watson, 2002). Since our area of interests is the combination of bottom-up participation support within the smart city, our search query is as follows:

("bottom up" OR "bottom-up") AND ("smart city" OR "smart cities") AND "participat"*

The wild card operator (asterisk) allowed us to include search results for adjective, verb, and noun forms of participation (e.g. participate, participative, participable etc.). Besides that, we limited the search requests to abstract, title, and keywords and only considered peer-reviewed publications (journal articles, conference proceedings, and book chapters) in the English language for our analysis. The scientific databases Scopus, ACM digital library, and IEEE-Xplore yielded 38 unique entries for our query. The publication year of the 38 publications ranges from 2014 until 2021. A trend can be identified since only the years 2019 to 2021 are accountable for 50% of all publications. This implies that the subject area of bottom-up participation in smart cities is gaining momentum.

On further investigation, we noticed that from the 38 initially retrieved publications, only 10 discuss bottom-up participation initiatives, including some sort of digital technology. The other 28 are mostly lacking a focus on real bottom-up citizen participation or a form of ICT usage. For the ongoing analysis of the ten matching publications and to pinpoint the focus of our research, it is necessary to distinguish between two forms of ICT use supporting bottom-up public participation; participation *through* ICT (e.g., platform propositions) on one hand and participation *with* ICT support (connection of online and offline activities) on the other.

A typical approach to facilitate bottom-up participation activities is implementing an online platform for citizens to participate through ICT (Alverti et al., 2016; Bricout et al., 2021; Kersting & Zhu, 2018; Monachesi & Witteborn, 2021; Reed & Keech, 2019; Van der Graaf & Veeckman, 2014). Only the publications from Noennig et al. (2020) and Tironi & Valderrama (2018) outline an approach to connect digital participation support with offline activities, hence providing an approach for a combination of online and offline activities.

Another aspect of participation in smart city contexts is crowdsensing. Crowdsensing describes a form of collective data collection that is often utilized as a participatory mechanism (Cardone et al., 2013). However, crowdsensing most often is implemented in a top-down manner, although connecting online and offline activities alike.

Despite our efforts, we could not identify any publications covering the ICT-support of participant collaboration in bottom-up participation scenarios. The introduction of ICT in participatory contexts often aims at replacing offline or in-person activities with online tools like participation platforms or dialogue-centered solutions. These findings motivated us to conduct a series of in-depth interviews with citizens currently or recently engaged in bottom-up participation activities on how such an IT-support should be designed.

3 Methodology

Our research approach follows the DSR paradigm proposed by Hevner et al. (2004) that has the overarching objective “to develop technology-based solutions to important and relevant problems” (Hevner et al. 2004, p. 83) and to create design knowledge, which contributes to the understanding and design of such artifacts (Gregor et al. 2020). Our objective is to contribute design knowledge for the design of information systems that enable and support smart participation, in the form of design principles that "[…] are used to specify design knowledge in an accessible form" (Gregor et al. 2020, p. 1). Design principles are "[...] theoretical abstractions that serve a purpose and have utility" (Gregor et al., 2020, p. 15).

To derive said design principles we adapted the general methodology for design science research by Vaishnavi & Kuechler (2007) consisting of the steps awareness of problem, suggestion, development, evaluation, and conclusion. With our literature review we derived an awareness of problem. We then conducted ten expert interviews with citizens from different participation contexts (see Table 1), furthermore providing an awareness of problem. Based on the results and related literature issues, we derived meta-requirements that serve as the building blocks for our proposed design principles (suggestion). After initial construction (V1)[1] (development), we assessed our design principles (V2) in the first step with a senior DSR researcher to assess the structure and wording, followed by a second assessment step with three additional experts that designed and operate a large participation platform, with currently (August 2021) 567 active participants, 125 projects and 17.246 supporters (evaluation). With the suggestions from the DSR researcher and the participation experts we present and discuss our design principles as our contribution (conclusion). The whole approach is shown in figure 1.

Design principles can be used by design professionals to apply prescriptive knowledge in their design activities (Chandra-Kruse et al., 2022). In doing so, prescriptive information is interpreted and put to use, creating further, more specific design knowledge. Consequently, design principles can be further evaluated and developed. This concrete application in a specific problem space creates a design knowledge life cycle, or journey of design knowledge (vom Brocke et al., 2020), which describes the interplay between problem space and solution space, as well as generalized design knowledge and specific (applied) design knowledge. In addition, this demonstrates the nature of design knowledge that "is prone to rapid aging" (vom Brocke et al., 2020), which is why it needs constant updates in the form of revisions and further evolutionary development. This happens, for example, through concrete implementation or through assessment and scientific evaluation. In our research, we therefore present an excerpt from this journey (“chunk” of design knowledge as defined by vom Brocke et al., 2020), in which design knowledge is constructed and initially assessed. With our experts we thus assess the accessibility, importance, novelty and insightfulness, actability and guidance as proposed by Iivari et al. (2020), but do not address the effectiveness in specific, which can only be done by the concrete implementation of our design principles and subsequently evaluation. Venable et al. (2016) define this as artificial evaluation, which may be a criteria-based analysis with theoretical arguments but without an actual instantiation of the design principles using interpretive techniques such as with expert interviews.

Since the term expert is often used inflationary (Meuser & Nagel 2009) and is justified with "every day" and "common-sense knowledge", specific criteria, such as expertise and experience, should be specified. To choose our experts for our interviews, we specified experience as having at least one year of experience and as being active in a bottom-up participation setting, where some form of IT-support was utilized. Due to this project's novelty, the initial interviews were used as an exploratory instrument and therefore conducted as openly as possible (Bogner et al., 2009).

The interviewees, four women and six men, were between 21 and 37 years old. An overview of our interview panel can be found in Table 1. Before the actual interviews started, we conducted a pretest to validate our interview guidelines as well as testing the interview strategy and the technical setting. The interviews, which lasted an average of 60 minutes, took place between July and October 2020.

[1] The initial Design principles are shown in appendix B. Please note, that the initial version of the Design principles only consisted of five principles. After the first revision with a senior DSR researcher the Design principles were restructured and extended.

Table 1. Interview Panel Overview[2]

ID	Gender	Age	Participation Context
IP1	female	22	University participation project, A concert where students can perform
IP2	male	21	University participation project, video conference Training for elderly citizens during the CoVid-19 pandemic
IP3	female	27	Regional chapter of a nationwide environmental organization
IP4	male	22	University participation scenario, installment of a public water fountain at the library
IP5	male	30	University participation scenario, Open Air Cinema
IP6	male	26	National Board Member German Scout Association
IP7	male	25	Regional youth group leader
IP8	female	24	University participation project, installment of a public water fountain at a library
IP10	female	37	University participation project, creation of room for young mothers to breastfeed their children
IP11	male	25	Regional youth group leader

The initial interviews were conducted with the support of a semi-structured interview guideline (see appendix A). Mayer, (2013) states that this approach is beneficial if the aim of the interviews is to make specific statements about an object, which in our case were insights and experience about ICT-support in bottom-up participation settings. Interviews that follow a guideline are based on open formulated questions, to which the interviewee can give an honest answer. The guideline helps the interviewer with the orientation and thus ensures that all critical aspects of the research question are included. On top of that, inquiries and deviations are possible (Mayer, 2013).

Afterward, the audio recordings were transcribed and coded with the qualitative data analysis software MaxQDA. Following suggestions from Saldaña (2013), two researchers coded the data material individually and compared the retrieved codes and sub-codes because "multiple minds bring multiple ways of analyzing and interpreting the data." (ed., p. 34). Whenever the results differed, a discussion was established until a consensus was reached. All in all, we coded six main categories and assigned 390 code segments within the ten interview transcripts. The main categories reflect the areas of interest we embedded in our interview guide, namely: motivation, team features, team phases, collaboration, ICT-tools and features for scenario-specific digital participation support.

The coding process resulted in two kinds of findings. First, we retrieved general interview insights (II), and secondly, we captured user stories (US) through interview statements. The differences between II and US lie within the specificity of the statement. II emerged through the comparison of the codes and the overall statements by the interviewees (II1-II12). In contrast, US are specific digital participation support requirements that were mentioned during each interview.

Combined with literature-based theories (Literature Issues, LI), we created eleven meta-requirements (MR1-MR11) for the design of information systems that enable and support smart participation, which were again synthesized to form the design principles. A full graphical representation of the synthesis process (i.e., mapping diagram) is shown in appendix C. With this procedure, we follow a supportive design principle development approach suggested by Möller et al. (2020). Similar research designs have already been successfully applied (Strohmann et al., 2018; Wambsganss & Rietsche, 2019).

[2] Interview 9 (IP9) had to be left out of the analyses because of a corrupted audio recording.

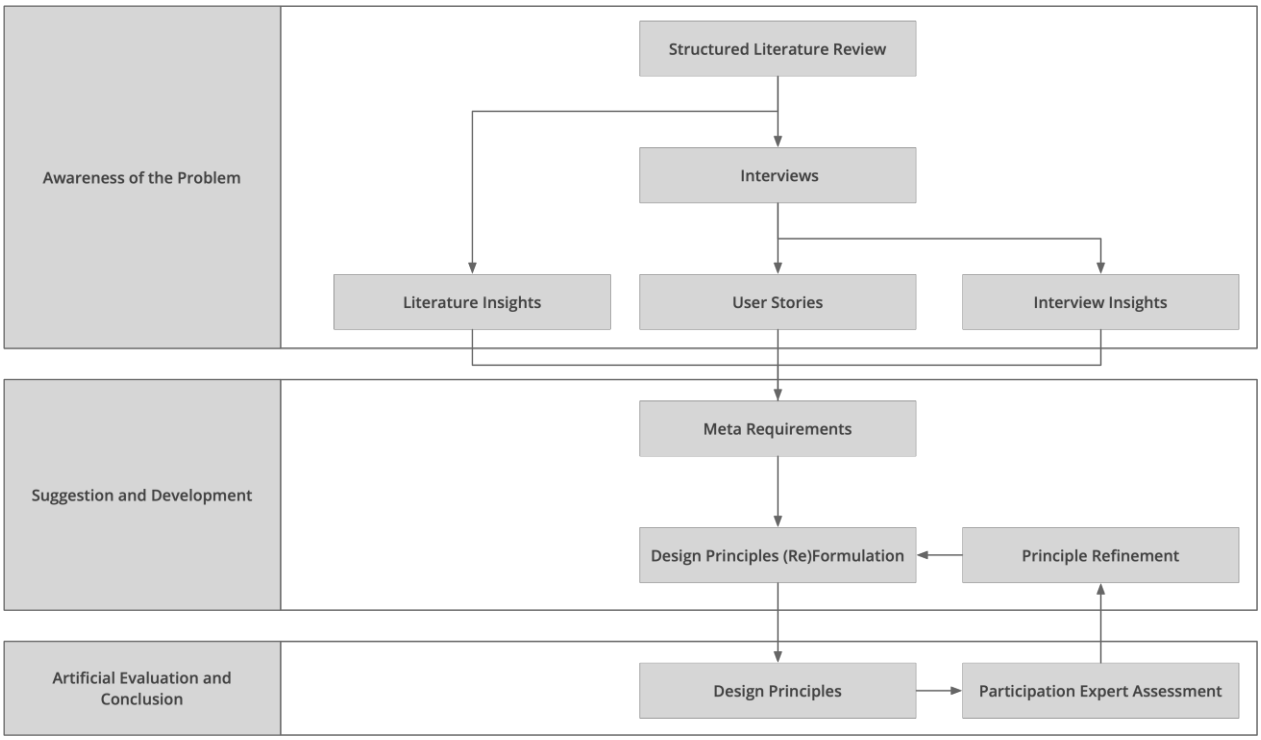

Figure 1. Methodological Approach (guided by Vaishnavi & Kuechler (2007))

4 Smart Participation Design Principles

The design principles are presented in the form of heuristic rules and are thus applicable to multiple project types and sustainability areas. We construct the design principles based on the proposed anatomy by Gregor et al. (2020), who analyzed existing formulations of design principles and identified the most important components. A design principle's anatomy consists of the aim, implementer, and user; context; mechanism and rationale. Furthermore, different categories of design principles can be formulated. These are "design principles that encapsulate users' use of artifacts, design principles that encapsulate artifact features, and design principles that describe both (i.e., that are focused on both artifact features and user activity)" (Gregor et al. 2020, p. 12). The problem class of our design principles is conceived by stakeholders, which include all citizens as well as political institutions and decision-makers who are involved in decision-making processes and want to participate in them independently and shape their implementation and process. The goals to be achieved are self-determined, easy, and individualized citizen-initiated smart participation activities (Maedche et al., 2019). Each design principle is preceded by an objective that can be achieved through independent implementation and thus contributes to the overall goal of designing information systems to enable and support bottom-up participation.

After the initial construction of the seven design principles, they were assessed in a second step guided by the proposal for design principles evaluation by Iivari et al. (2021). First, our design principles were discussed with a DSR-expert to ensure the consistency of our design principles for the DSR process, which led to a refinement of the design principles wording and structure (evaluating the accessibility and guidance (Iivari et al. (2021)). After that, we assessed them with an open questionnaire approach as a form of artificial evaluation with theoretical arguments using interpretive techniques (Venable et al. 2016). For the assessment, three experts were selected who have designed and actively operate a bottom-up participation platform. Also, they met all the requirements we compiled for our first round of experts (i.e., at least one year of experience and being active in a participation setting). The experts are operating a bottom-up participation platform that has been in use for more than six years and are all responsible for different tasks. A description of our second expert panel can be found in Table 3. Table 2 shows the questions we asked to the experts and the evaluation dimension by Iivari et al. (2021).

Table 2. Participation Expert Questions and Evaluation Dimension by Iivari et al. (2021)	
Question	**Evaluation dimensions by Iivari et al. (2021)**
What are the gains/benefits of implementing the design principle for participation?	Importance, Novelty, Insightfulness
Where do you see challenges in implementing the design principle?	Accessibility, Actability, Guidance
How relevant is the design principle to you?	Importance, Novelty, Insightfulness
Do you have any other suggestions, hints, or comments about the design principle?	Accessibility, Importance, Actability, Guidance, Novelty, Insightfulness

All three experts answered all questions in a comprehensive manner, which were again analyzed and compared. We reviewed the answers from the evaluation questionnaire individually and used the comments to review and subsequently refine our seven design principles. The question of relevance furthermore allowed us to assess the perceived relevance of each design principle for the participation process.

The following section provides the final version of our proposed design principles and an explanation of their composition. Additionally, we summarize the experts' evaluation covering benefits, challenges, relevance, and suggestions for possible instantiations. No additional aspects for the proposed design principles emerged from the experts' evaluation, nor did the experts identify further aspects that would lead to additional design principles.

Table 3. Design Principle Evaluation Panel

ID	Gender	Experience	Participation Facilitator Activities
EX1	male	5 years	strategy and evaluation
EX2	male	4 years	project coordination
EX3	female	2 years	project coordination & back office

4.1 Principle of Stakeholder Communication

Objective: Participants need a digital place to go to for their participation endeavors and to provide transparent communication for all stakeholders.

Active Participants expressed their wish to obtain information about participation projects beforehand (US2). This kind of information offering fulfills several purposes. In general, it creates a platform and a transparent way for communicating new project opportunities, provides a way to engage potential new active participants from the community, builds a vision for the future of the stakeholder community, and presents a track record of completed participation projects (II12, MR1). Active participants can develop a sense of belonging to the community and hence fulfill their need for affiliation and relatedness (Ryan & Deci, 2000) (MR2), regardless of whether they perform any participation activities. On top of that, transparent external stakeholder communication can foster acceptance of participation efforts among stakeholders (Butt et al., 2016) and shows which supposedly unreachable goals are realizable and, in doing so, motivates stakeholders to take an active role in participation activities (MR3) since information accessibility vital for participation (Webler & Tuler, 2002). Means for stakeholder communication can also be used for providing Task Support Knowledge and Participation Domain Knowledge.

Table 4. Principle of Stakeholder Communication

Aim, Implementer and User	To reach potential participants, inform all stakeholders and present participation possibilities,
Context	in bottom-up participation contexts,
Mechanisms	provide a digital place to go, where project results, new participation opportunities, or a digital community can form.
Rationale	In contrast to top-down participation scenarios, bottom-up participation efforts need a first point of call to build a participation community. The purpose of a digital place to go to is to give citizens information about possible participation opportunities, provide transparent communication of project results for all stakeholders and motivate citizens to take responsibility for their community.

The experts emphasize that a digital contact point facilitates several positive effects in the whole community, such as feedback opportunities, networking, transparency, and a sense of belonging. One

expert also mentioned that "when more people learn about the projects, it ensures that diverse competencies, skills, resources come together" (EX2). Hence, the relevance is considered to be very high. The ongoing challenge in participation projects is to get the stakeholder community members to be involved as active members of participation projects. Furthermore, the experts point out that "it is also dangerous not to overload the networks and communities" (EX2) and that the "step from sitting in front of the laptop and seeing the project, to actionism" (EX3) is essential.

4.2 Principle of Accessibility

Objective: The use of Digital Participation Support must not exclude any stakeholders.

According to the United Nations Goals for Sustainable Development, future societies should be as inclusive as possible (United Nations, 2018). This also implies that the usage of digital participation support must not exclude any citizens from societal activities, like participation, because of physical, mental, socio-economic, or demographic reasons (MR6). A circumstance also manifested in theories about the digital divide (Hilbert, 2011) and the participation gap (Jenkins, 2009) (MR4).

For that reason, digital participation support should follow the inclusive guidelines from Universal Design's concept (Ginnerup, 2009) and Design for All (Aragall et al., 2013). Accessibility thereby not only has to refer to the use but also the ubiquity of the tools in the form of devices or operating systems (US8). These prerequisites also can mitigate the lack of IT skills (also represented in the Principle of Task Support Knowledge) and adoption barriers that team members might face (MR5). Another aspect of accessibility is transparency regarding decisions, processes, and results of participation projects. Since not all stakeholders can be involved in the group that carries out the participation activities but merely deal with the outcome, transparency is an essential aspect of participation. More so, when regular meetings or real-life interactions do not take place in a digitally supported participation scenario.

Although the interviewees did not mention the need for an inclusive Information system, it is necessary to consider accessibility and inclusive design requirements within the digital participation support as a normative precondition for all participation related topics.

Table 5. Principle of Accessibility

Aim, Implementer and User	For any citizen to not be excluded from smart participation because of physical, mental, socio-economic, or demographic reasons,
Context	in participation scenarios, where ICT is used to support participation,
Mechanisms	provide as many barrier-free digital participation support tools as possible. This accessibility has to refer not only to the use but also to the ubiquity of the tools as well as the access to information for stakeholders like decisions, thought processes, activities, outcomes, and results of participation efforts.
Rationale	Participation has to be as inclusive as possible. Therefore, smart participation must not exclude individuals for any reason. This premise also mitigates the lack of IT skills that team members might face.

The experts highlight that by pursuing diversity in a group of active participants, advantages for the outcome of participation projects may occur. Also, accessibility and inclusion are regarded as an essential premise for any kind of participatory activity. They state that it is "basically important not to exclude anyone", "create access for as many people as possible" (EX2) and that there should be "no discrimination or exclusion of persons (groups)" (EX3). Even though the experts assess the principle as highly relevant, they fear that including all stakeholders is an ambitious goal that might not be reached entirely and that being "extremely diverse is also very context-dependent" (EX1).

4.3 Principle of Composition

Objective: Participants themselves should compose their group-specific Digital Participation Support.

The interviews revealed differences between some of the participants wishing to use digital participation support they already know (US4) and others who would prefer to separate the support means they use for participation efforts and the ones they use for their personal life (US5). In that aspect, the interviewees contradict each other. Furthermore, they expressed individual wishes for certain features, such as to be notified of upcoming events (US1), to assess a project's progress (US3), or to have an all-in-one participation system (US6). From these findings, we concluded three meta-requirements. First, digital

participation support has to meet the team's needs to be perceived as useful (MR8). MR8 is in line with general technology acceptance findings for individuals (Davis, 1989; Venkatesh et al., 2003).

Secondly, because the digital support needs of different participation groups may contradict each other (II3, US4, US5), a universal and predefined information system cannot facilitate participation in the best possible way. Therefore, digital participation support should instead be a composition of different digital participation support means, hence: self-composed digital participation support (II2, MR9).

Third, the participation group should decide which kind of support they need and want to use for their collaboration (II1, MR7). This self-determination (Deci & Ryan, 2014; Ryan & Deci, 2000) ensures a better adoption and use of the composited digital participation support, enhancing the probability of satisfying the group's individual needs.

Table 6. Principle of Composition

Aim, Implementer and User	To ensure that smart participation creates benefits for active participants
Context	in scenarios where smart participation tasks are carried out in groups,
Mechanisms	let the group compose digital participation support that meets their needs.
Rationale	The group should decide which kind of support they need and want to use for their participation efforts. This self-determination ensures a better adoption and use of the composited digital participation support and it is more likely that the team's individual needs are met and satisfied.

All three experts think that the consideration of this design principle is highly relevant and valuable for participation processes. One expert stated that, “since every project and every team is different from others and they all have different needs, supporting them with the same mechanisms all the time is not always useful.” (EX2). Although self-determination is usually valuable, it yields the danger of participants not choosing the appropriate support (“when given a choice, project teams might make the wrong decision”, EX2); a challenge that can be addressed with the Principle of Participation Task Support Knowledge.

4.4 Principle of Structure

Objective: Digital participation support composition should be agile.

In contrast to Tuckmann's (1965) work, most of the time, there is no negotiation about how the participation groups' work should be organized, nor are any rules for the group work established (II5). The group instead structures itself during the participation process in an agile manner. Since almost no one is trained in his or her participation domain, the kind of support that is needed cannot be anticipated in advance (II4). These findings underline the differences between business or organizational settings and participation scenarios, as stated in section 2. Therefore, the composition should be agile (MR10). This means that the participants should be able to compose and recompose their means for digital participation support at any time during the participation process.

In contrast to business and organizational settings (de Vreede & Briggs, 2019), participation and collaboration are not entirely planned in advance. Participants are often unaware of which tools can be used beneficially and, at the same time, cannot be imposed to use certain IT-tools. Thus, the digital participation support composition should be enabled whenever a need for specific support arises, regardless of whether the group members compose the support means themselves or not.

Table 7. Principle of Structure

Aim, Implementer and User	To ensure that smart participation creates benefits for the participants
Context	in scenarios where smart participation tasks are carried out in groups,
Mechanisms	the composition of the ICT tools used as well as the re-composition should be agile and should be possible to reoccur over the whole participation.

Rationale	In contrast to business and organizational settings, participation projects cannot be planned entirely in advance. Participants are often unaware of which IT-support means can be used beneficially, and group members cannot be imposed to use certain IT-tools in their digital participation support ecosystem. This is why the IT environment composition should be possible whenever a need for support arises, regardless of whether the team composes the support means itself or not.

The agility which lies within the principle is considered as relevant by all experts for participation processes. One expert especially emphasizes the highly practical relevance by giving an example: "For financial tasks, we have also adapted the system again and again subsequently and made it more flexible, more agile. The advantage is obvious: non-linear project progress cannot be accompanied by rigid processes; thus, agility is extremely important." (EX2). However, not all experts were aware that said composition, mentioned in the Principle of Structure and the Principle of Composition, aims to create an IT environment containing of different, readily available solutions. In this regard, the design principles-environment resembles a group-specific participation technology stack. Nevertheless, the experts also mention that "finding the right mix is the big challenge" (EX3) and that it "sounds like a lot of work and I am unsure if this required diversity is always possible." (EX1).

4.5 Principle of Collaboration

Objective: Participants need measures to support common collaboration tasks.

The group work in participation scenarios can be described as a collaboration since the preconditions for collaboration are almost always met (Siemon et al., 2017) (II6). As collaboration is the desired mode of operation (ed.), the group can develop needs for digital participation support for common collaboration tasks. To have the necessary digital participation support for a holistic collaboration of a group, provide means for the support for each participation task. This should also include information about the usage and benefits of digital collaboration support. In doing so, the group can decide which aspects of participation they want to support digitally (US7). Our coding showed that each participation group differs regarding the tasks they want to be supported with digitally and which tasks they should work on in real-life (II7). Therefore, it is necessary to provide active participants with resources for every layer of collaboration to foster collaboration among the active participants (MR11) effectively.

Table 8. Principle of Collaboration

Aim, Implementer and User	To have the necessary smart participation ICT-tools to foster holistic group work,
Context	In smart participation scenarios, where participants compose fitting digital participation support?
Mechanisms	provide means (methods and tools) to support common participation and collaboration tasks, including information about their usage and benefits for each task.
Rationale	In doing so, the group is given measures to benefit from implementing IT support in their participation efforts and gain advantages from transferring specific participation tasks in the digital domain.

Even though ongoing technological advancements foster extended possibilities for digital collaboration, experts stress that offline activities should not be neglected. Digital and analog forms of collaboration can rather profitably complement each other. The experts especially point out that it is crucial to "make it clear to the team that they need it [IT tool], without making them feel patronized" (EX2). For this purpose, internal coordination of the group is essential for proposing solutions/options at different stages of the project.

4.6 Principle of Participation Task Support Knowledge

Objective: Participants need knowledge about ways to support common participation tasks digitally.

The interviews showed that the three most prominent reasons why digital participation support is not used more often in participation scenarios are: 1. a lack of knowledge about available solutions (II8, MR12), 2. a lack of IT skills to utilize the available solutions (II11, MR14) and 3. a lack of anticipation of the advantages the use of IT tools can yield (II9, MR13). Furthermore, known tools are misused (II10). To counter the participant's shortcomings, the participation group needs means that show what tasks can be digitally supported with which IT tools and what IT tools are suited best for each support need. This knowledge base should also contain further information on the advantages of digital support for

collaboration tasks and training resources to suggest the best use of support means (US9). By doing so, participants can overcome their lack of IT tool knowledge, their lack of IT skills as well as compensate for their lack of IT tool anticipation, and therefore, acceptance of the digital participation support becomes more likely (Davis, 1989; Venkatesh et al., 2003).

This enables the group to select the right support means for their participation tasks, allows less IT-savvy participants to gain confidence and motivation in digital support usage, and ensures that the participants are not overwhelmed with IT tools and features that do not meet their needs. Hence, increasing the effectiveness of the group's collaboration efforts in participation scenarios.

Table 9. Principle of Task Support Knowledge

Aim, Implementer and User	To have the best possible composition of smart participation ICT-tools for a participation group,
Context	during the composition of a smart participation toolset for a participation group,
Mechanisms	provide the participation group with means that show which participation tasks can be digitally supported with which tools and what IT tools are suited best for each participation task. Said means should also contain further information on why the use of a digital participation support could be beneficial for the participation group as well as training resources on how the suggested tools can best be used.
Rationale	Participants can overcome their lack of IT tool knowledge and compensate for the lack of anticipation of possible process benefits through IT utilization. This enables the group to select the right IT tools for their collaboration tasks, allows less IT-savvy participants to gain confidence and motivation in IT tool usage, and ensures that the group is not overwhelmed with IT tools and their features that do not meet their needs. Hence, increasing the effectiveness of the group's efforts in participation scenarios.

The experts consider the relevance of the Principle of Task Support Knowledge differently. One expert mentioned that if community members are overwhelmed with the knowledge needed for carrying out participation activities successfully, they may be put off from becoming active participants. On the other hand, "a well-designed balance between knowledge transfer and actual participation can solve the challenges introduced from the agile approach" (EX2). On top of that, one has to pay attention not to lose potential active participants who are intimidated by IT tools.

4.7 Principle of Participation Domain Knowledge

Objective: Participants need access to domain-specific knowledge to increase the prospects of success of the participation project.

Whether participation processes are digitally supported or not, having access to domain-specific knowledge like legal, political, or administrative requirements is crucial to the participation effort's success. In our interviews, this need was expressed by emphasizing the importance of experienced participants' knowledge (II12). If participation is transferred in the digital sphere, domain-specific participation knowledge management becomes necessary since the knowledge has to be separated from the individual (MR15). Therefore, digitally supported participation should also provide, build, and maintain ways to access domain-relevant knowledge. Accordingly, the group knows which activities are feasible and can steer their discussions and participation efforts to more successful outcomes. Additionally, gained "knowledge through making" (Tabacchi et al., 2019) can be captured and made available to provide a greater knowledge base for future participation projects to benefit from.

Table 10. Principle of Participation Domain Knowledge

Aim, Implementer and User	To have the necessary knowledge to lead participation projects to a successful outcome,
Context	in participation contexts where smart participation replaces some or all real-life activities,
Mechanisms	Provide the participants with domain-relevant knowledge.
Rationale	In doing so, the group knows which activities within their project are feasible and are able to steer their discussions and participation efforts to a more successful outcome.

The experts generally considered knowledge to be important for participation. One expert mentioned that it is an "absolutely high gain. This also makes participation projects much more tangible and understandable for people as to what they are getting into" (EX1). However, they also mentioned that

knowledge communication has to be target group-specific, as "each of the participants has a different level of knowledge" (EX2). The same applies to the Principle of Task Support Knowledge to obtain common knowledge among the participants.

5 Contribution and Implications

Our design principles contribute to both theory and practice as they provide prescriptive knowledge on how to design information systems to enable and support smart participation. With the lens of sociotechnical systems, we addressed smart participation in a holistic way that consists of technology, people, structure, and task and contributed to the arrangement, selection and implementation of technology in order to enable and support people (in-specific citizens) to bottom-up participatory activities.

We discovered insights and user stories through a series of expert interviews, which we synthesized to meta-requirements. These meta-requirements build the foundation of our derived design principles. As a result, we propose seven design principles that should be considered for designing information systems that enable and support smart participation. With three additional experts involved in a large participation platform's design and operation, we assessed the seven design principles and gained additional insights concerning their benefits, challenges for implementation, and relevance.

Our research thus contributes to the emerging and relevant field of bottom-up smart participation. Our findings show the individual requirements of an ICT environment and especially the self-determined selection and use of tools, which cannot be guaranteed by top-down participation platforms. This is in line with the self-determination theory that is especially relevant in scenarios in which citizens want to participate and have a voice in decisions related to their life's. Further, the desire to design the city they are part of, enhances these needs for structured, collaborative smart participation. Further, our design knowledge contributes to the domain of smart city design and presents principles on how an essential part of the smart city, namely information systems for smart participation, should be designed for maximum positive impact and which matches the needs of all stakeholders. The generalizability of our design principles should also be emphasized, since they also contain design knowledge that could be relevant in other participation scenarios. Even if our design principles were developed in the context of the smart city, more specific participation scenarios such as corporate participation, participation in leisure- or association activities, as well as charitable or development work can also benefit from our design principles, as these are also characterized by a similar problem space.

Additionally, our research contributes to the stream of design-oriented research paradigms in the domain of smart participation. The methodological approach we followed shows that a combination of research methods from social studies (interviews) and design-oriented research paradigms is suitable for creating testable design principles. In the words of vom Brocke et al. (2020), we contribute a chunk of design knowledge that already stands out for its high projectability in the problem space (through close development and assessment with stakeholders) but can increase its fitness and confidence through further application. Through a concrete implementation and subsequent evaluation, our prescriptive design knowledge can then also increase its contribution for practice and therefore further develop.

As our design principles are focused on both artifact features and user activity and as our problem space is conceptualized by stakeholders, which include all citizens, political institutions, and decision-makers, the implementation is complex and needs the involvement and activities of all stakeholders. The implementer of our design principles should be someone who wants to facilitate smart participation. This could be a city official, providing guidance on how to facilitate smart participation, an initiative which tries to facilitate smart participation for their members or just a group of citizens who want to use ICT for their personal participation support needs. On the one hand political institutions, decision-makers and city representative need to provide relevant resources, freedom and flexibility in the tool selection, as well as support in domain-relevant knowledge. Thus, city representatives need to provide a fruitful environment to enable bottom-up participant. On the other hand, citizen implement our design principles by individually selecting and using tools, as well as enabling collaboration and defining their own (agile) structure for smart participation. Subsequently, the implementation of our design principles is a joint endeavor between citizens and representatives of the smart city that needs support, flexibility and freedom from both sides.

6 Conclusion and Outlook

This paper describes our approach for the creation of design principles of information systems for smart participation scenarios. With a preceding literature review, we identified that design knowledge for bottom-up, ICT-enabled participation in the smart city is scarce and under-researched.

The limitations of our design principles lie within our interview panel. The differences in age and social-economic status are moderately small, possibly allowing for bias in the study. However, despite having a relatively young panel who tend to be more ICT-skilled (Berkup, 2014), prominent reasons for non-usage include "lack of IT skills" and "lack of knowledge about available solutions," which contradicts the assumptions of the digital divide/digital participation gap (Hilbert, 2011; Jenkins, 2009) and biased results. Future research should explore design principles deploying artifacts in different participation scenarios and within diverse communities. The applicability of our design principles for other than the covered participation scenario has yet to be verified. Hence, we do not assume that the principles have been fully or definitively explored. Through the derivation of instantiations, future research can discover additional critical design aspects of smart participation and further evaluate the proposed design principles' applicability and importance. Design knowledge in the form of design principles is ideally suited to be further investigated since it can be transferred into design features. Design features represent a specific level and straightforward implementation of the design principles.

Another limitation of our research, as already mentioned, is that we did not specifically empirically evaluate our design principles in regard to their means-end-relationships in a setting which would allow as to show how effective (Iivari et al., 2020) or useful our design principles are in a “real world scenario”. With our participation experts we rather conducted an artificial evaluation following a criteria-based analysis and theoretical arguments without an actual instantiation. Venable et al. (2016) argue that using interpretive techniques can help “to better understand why an artefact works or why it works” (p. 80). Consequently, further research should conduct a naturalistic evaluation which "explores the performance of a solution technology in its real environment". However, smart participation, as referred to in our paper, is a long-term and costly endeavor that can take various forms. This also means that an evaluation of our design principles, that show empirical results and possibly causal relationships between certain design principles and their consequences, is costly and associated with many resources. Future research should address this to reach the “last research mile” principles (Nunamaker et al., 2015), or rather continue the journey of design knowledge (vom Brocke et al., 2020) for smart participation by applying our design principles to real world scenarios, and thus evaluating, refining and specifying our design knowledge.

Some of our design principles are easier to implement in real world scenarios than others because of the nature of the specific design principle. In our work, we not only developed design principles that address artifact features (e.g., principle of collaboration, principle of accessibility) but also design principles that “[…] encapsulate user’s use of artifacts” (Gregor et al., 2020) (e.g., principle of structure, principle of composition). Realizing all seven design principles in a single instantiation is probably not feasible nor intended. For example, the principle of task support knowledge and the principle of collaboration could be realized with a knowledge management system, which contains information about readily available solution for collaboration and group support (e.g., a wiki system such as Confluence). On the other, the principle of composition or the principle of structure are more about the use of the selected IT solutions and are therefore not directly instantiable. Another promising instantiation possibility is the utilization of a conversational agent which can answer questions or make suggestion regarding specific needs for IT support in smart participation scenarios. Additionally, conversational agents could also incorporate additional design principles like the principle of participation domain knowledge or the principle of accessibility. Lastly the principle of stakeholder communication could be realized using social media, weblogs or with other interactive web services.

Although our design principles' observance cannot guarantee that participation efforts result in meaningful outcomes for the community or even for active participants, they at least have the possibility to foster the citizens' participation capabilities (Haenssgen & Ariana, 2018) and could ultimately lead to a better quality of life for all citizens.

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Appendix A: Interview Guideline

Welcome, short introduction

- Can you give a short introduction of yourself?
- How are you involved in the participation project?

General assessment of the teamwork in the participation project

- Even before it started, how did you become aware of the project?
- Then how did your team get together/how did you find each other?
- Was there a conscious decision about who would be a team member and who would not?
- If so, who made that decision? And how was this decision made
- What was the nature of your collaboration?
- Did you meet in person or network more digitally?
- Was the division of labor more hierarchical or was there negotiation about who does what?
- Were your tasks interdependent?
- Did team roles emerge
- Was there agreement on the goal beforehand, or during the project?
- How would you rate the need for coordination in your project?
- Division of labor
- Autonomy of action
- Team membership

Collaboration - statements and please comment on.

- There was/is trust and mutual respect on our team.
- All team members pursued/are pursuing a common goal.
- There was/is goodwill and dedication/commitment between team members regarding the team task.
- There is cohesiveness within the project team.
- When I show a lot of commitment, I get that commitment back from the team in some way.
- There was/is awareness within the project team about the needs and emotions of other team members.

Assessment of existing tools.

- As a team, did you use IT to support your project?
- Communication?
- Coordination?
- Cooperation?
- What are reasons for non-use?

Phase support

- Thinking now about the different points in time of your project:

- Was there IT support when the team initially came together?
- Did you agree on certain principles in the collaboration?
- What tools did you use during the actual work phase of the project?
- How was the end of the project structured?

Requirements for a system that supports you in your participation.

- What features would you like to have in a system that supports your participation?
- How do you feel about using the same IT systems?

How should the system be made available?

- Browser?
- App?
- Android/iOS

Conclusion

- Would you have any other usability/design requirements for IT? Anything that hasn't been mentioned yet?
- Finally, do you have anything you would like to get off your chest?

→ End interview and thank the participant

Appendix B: Initial Design Principles.

To ensure that digital tools enable advantages for the collaboration support

in scenarios where participation tasks are carried out in teams

let the participation team choose the IT tools they want to utilize for their personal IT-toolbox themselves

Because the team should decide for themselves whether they want to use the same or different tools than those they use in their private lives. This self-determination ensures a better adoption and use of the composited toolbox it is more likely that the team's individual needs for digital collaboration support are actually satisfied.

For a collaborating team

in a participation scenario where IT-tools are used to support the team's collaboration efforts

The IT toolbox composition should be agile (happen at any given time in the collaboration setting) and can occur repeatedly over the whole participation project

In contrast to business settings, participation teams do not know all their IT needs in advance and cannot be forced to use certain IT-tools. This is why the IT selection should be possible whenever a need for a specific IT support arises, regardless of whether the team compose the IT-toolbox itsef or not.

For a participation team to make the best IT-toolbox composition decisions for their collaboration support needs

during the IT toolbox composition

provide the participation team with means that show which tools are available for them to use and what tasks a specific tool is best suited for. This should also contain further information which advantages a certain tool could hold as well as training resources on how the individual tool can best be used.

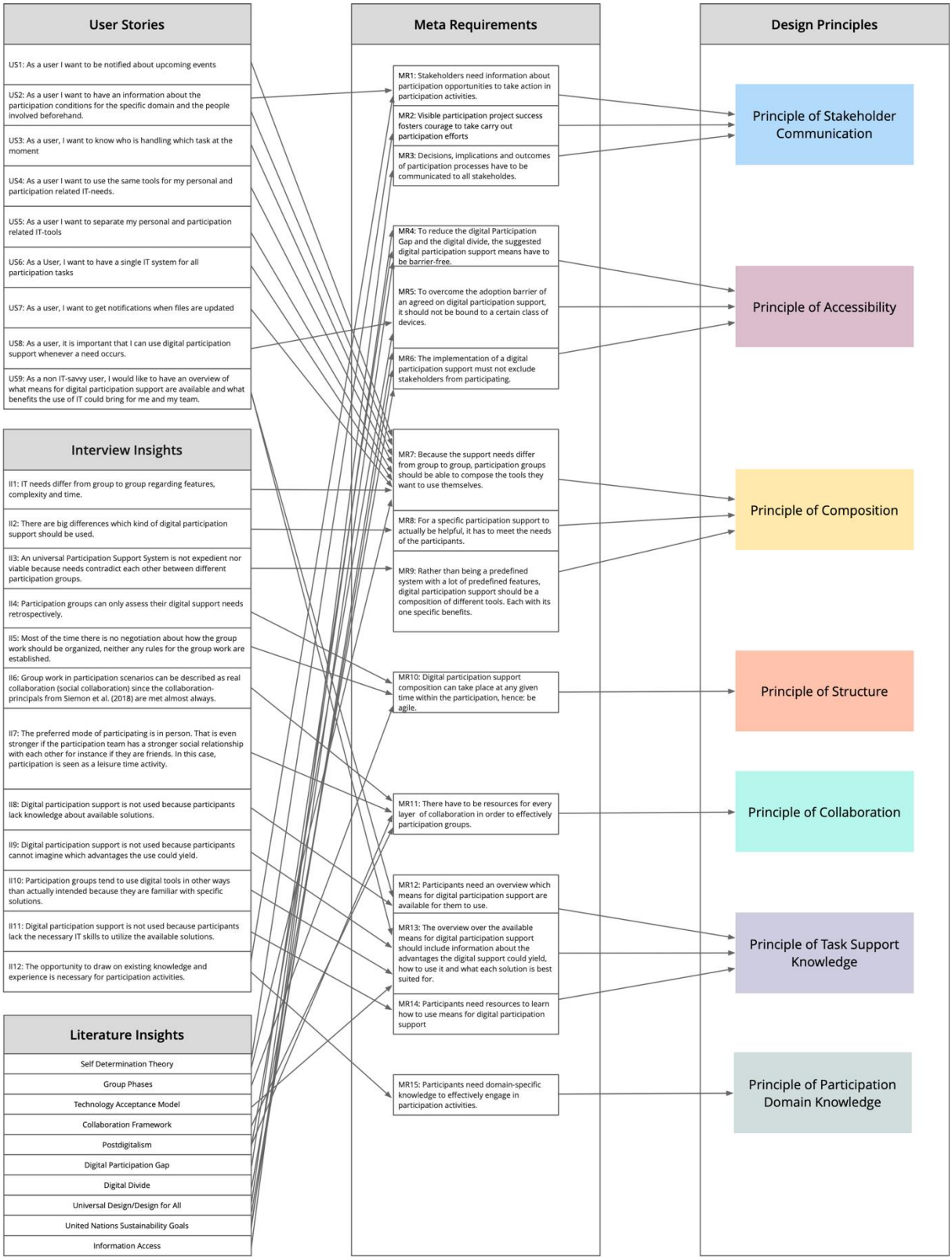
In doing so participation teams can overcome their lack of tool knowledge as well as compensate their lack of tool anticipation. This enables the team to select the right tools for their collaboration support needs, allows less IT-savvy team members to gain confidence and motivation in tool usage and ensures that the team is not overwhelmed with IT and features, that do not meet their needs. Hence, increasing the effectiveness of a digital collaboration support.

For a participation team to have the necessary IT tools for collaboration to be supported in their IT-toolbox

in a team participation scenario where a team composes an individual IT-toolbox to support their collaboration efforts provide IT tools from each layer of the collaboration framework from which the participation team can compose their individual IT toolbox because in doing so the team can decide itself which aspects of collaboration, they want to be supported with digital means	

For any stakeholders to not be excluded from IT-supported participation teams because of physical, mental or demographic reasons in a team participation scenario where IT tools are used to support collaboration efforts provide as much barrier-free IT-tools as possible in the means for the IT -toolbox composition. This accessibility has to refer not only to the use but also to the ubiquity of the tools. By definition participation should be as inclusive as possible. Therefore, the use of digital tools must not exclude certain stakeholder groups. This premise also mitigates the lack of IT skills that team members might face.	

Appendix C: Design Principle Mapping Diagram



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