Digital Citizen Participation

Involving Citizens Through Immersive Systems in Urban Planning

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Jonas Fegert (M.A.)

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Abstract

Citizen participation is a democratic practice that became, especially on a local level, an important mean for the public to be included in the development of their immediate surrounding. With the digitalization of work and social life also the digitalization of the public sector, including governmental action, began. This process, as a research discipline called digital government, includes addressing how the interaction between citizens and their state should be designed. A meaningful way to do so are digital platforms that enable participation in governmental action. *Digital Citizen Participation*, a concept introduced in this dissertation, tries to include recent technological innovations in e-Participation platform design. This dissertation argues that these innovations might help overcome general barriers in participation processes. When it comes to construction projects in urban environments for example, public debates and protests may arise if architectural plans remain unshared or are not sufficiently accessible for the citizens they might affect. To involve the public affected by urban planning, offering easily graspable visualizations for citizens is key. This dissertation deals with the participation of citizens in urban planning through an e-Participation platform that makes use of immersive technologies such as Augmented and Virtual Reality. In this work, this idea is investigated through a design science research approach that uses qualitative and quantitative methods. While the first qualitative study puts forward a set of meta-requirements and design principles based on interviews with 27 individuals, the second study (n=339) and third study (n=382) evaluate quantitatively a prototype based on those design principles. The used methods are adequately contextualized and, in the end, a final prototype of the platform is demonstrated. This allows to show findings concerning the forms and levels of participation citizens and initiators are interested in when using immersive systems for public participation, and how an ideal platform should be designed. Among many other findings, the studies show that citizens have a high interest in using immersive systems for public participation and find their qualities for visualization to be highly valuable.

Acknowledgements

Research is in itself a participative process, which always includes the collaboration of many individuals. Therefore, in my case, writing and defending this dissertation would not have been possible without the support of academic mentors, friends and family. I am grateful for their ongoing encouragement, which kept me and keeps me motivated to work on this topic. I would like to share my personal appreciation in the following.

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Jonas Fegert

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Part I

Foundation

1 Introduction

Liberal democracies and its citizens had this notion of a brighter future in the 1990s: After the end of the Cold War, European States and the United States of America (USA) looked forward to more democracy, more universal human rights, greater freedom to travel and more economic interconnectivity (Fukuyama, 1992). It was not until the 2010s, when this idea of a more prosperous future clashed with populists being elected among others in Brazil, the US and the United Kingdom (UK). Their nationalist claims symbolized the exact opposite of the bright future imagined in the 1990s. The British Brexit movement and Donald Trump's 2016 election campaign are just two most prominent examples of movements with strikingly protectionist claims and strong advocacy for a less intertwined world.

Paradoxically, since the early 2000s, a technological innovation, the internet, brought people across the world in touch with each other. The transformation caused by the digitalization disrupted and continues to shape the way we do business and interact with each other, and has thereby implications on almost every aspect of life. The deliberative force that the internet was believed to be back then (Gimmler, 2001), however, has become not merely deliberative. Exactly for the mentioned populist movements, the social networks became powerful tools for community organization, also through the use of phenomena like filter bubbles and the distribution of disinformation (Farkas and Schou, 2019). Taylor and Nanz say that social networks in their current form "provide fertile ground for electronic populism" (2020, p. 3). Apart from "enhancing and reinvigorating democracy at the base" the authors suggest the "establishment of public platforms […] to rein the distribution of deliberately misleading information" (2020, p. 5).

During the 2010s, the social networks or respectively the technology conglomerates behind them, became so powerful that they are compared with states (Papazoglou, 2019). Here, a shift from real places to the digital sphere took place: Exchanges at the local marketplace, in the family or in coffee houses, as well as in the established media such as newspapers and radio, whether private or state-run, moved to private platforms hosted by technology companies. Thereby public discourse changed tremendously in form and style.

With their data-driven business model, their intentions to host citizens on their platforms are far from altruistic. Nevertheless, their de facto dominance and power make the users ignore alternatives which might fit better to the prosperous, democratic, and egalitarian future once aimed for.

The Silicon Valley type of social networks (Twitter, Facebook and Instagram) became the standard for interactions in politics, media and science. In academia, especially in communication and political science, their overall societal impact is reflected critically. Nevertheless, their market position leads to a state in which scholars often focus on the newest trends or effects of interactions on these platforms (e.g. the use of new media in the Arab spring uprising 2010-2012 (Wolfsfeld et al., 2013) or the instrumentalization of social networks in Donald Trump's election campaign 2016 (Enli, 2017)), instead of researching alternatives to those prominent platforms.

The missing research in the field of platform design for public administration and their agencies has practical implications: Although the United Nations (UN) consider Germany and other countries of the European Union (EU) as leading within their e-Government Development Index (United Nations, 2020a), the COVID 19-Pandemic has made dramatically clear that there still is a long way to go to establishing meaningful, user-friendly digital citizen-state interactions. Positive examples of citizen involvement in governmental action that would allow them to constantly participate in the state's operations, still appear to pose an exception rather than a rule, in the UN E-Government report (United Nations, 2020a).

It can be assumed that there will be a lot of change in this regard over the course of the next decade, but for now, when comparing governmental digital platforms to private platforms solely in terms of their general state of development, major differences in terms of quality quickly become obvious. Given the success with which private platforms implemented experimental research in their platform design, which thereby made them very appealing for users (Luca and Bazerman, 2020), this dissertation will argue for making use of the very same methods that are deployed in the private sector, when designing successful non-profit platforms for the public sector.

Thereby, this dissertation should add to the scientific discourse by showing alternative digital democratic and deliberative spaces through concrete examples. This work is meant to propose a contribution to Information Systems (IS) research about digital government and, more concretely, platform design for public participation, using the – in this field – innovative technologies Augmented and Virtual Reality (AR and VR, or more generally Extended Reality, XR). These immersive technologies, which have only established themselves in the mainstream market in the recent years, are researched in this dissertation for the context of participatory urban construction planning.

Thus this dissertation follows the overarching research question:

- *RQ0: How should an immersive, AR and VR-based digital citizen participation app for urban and construction planning be designed to strengthen the citizens' willingness to participate?*

This dissertation will further address the following subordinate RQs[1-4]:

- *RQ1: What are the general challenges and interests concerning the use of digital technologies for citizen participation?*
- *RQ2: What are – from a user perspective – the strengths and weaknesses of the use of AR and VR for public participation in urban planning?*
- *RQ3: To what extent can the combination of immersive systems with e-Participation increase the citizen's participation in and acceptance of public construction projects?*
- *RQ4: How can citizens be informed about construction projects at an early stage and in a low-threshold manner with the help of immersive systems, and can this create an incentive for citizen participation in order to contribute to decisions that avoid conflicts later on?*

This dissertation is built on the popular Design Science Research (DSR) methodology. DSR "creates and evaluates IT artifacts intended to solve identified organizational problems" (Hevner et al., 2004, p. 77). DSR is used in this dissertation to research the design of an immersive participation platform. Within the aforementioned DSR framework, a mixed-method approach (Figure 1) is incorporated, where qualitative methods from political science (Kaiser, 2014) are combined with quantitative computer science and Information Systems methods of platform evaluation.

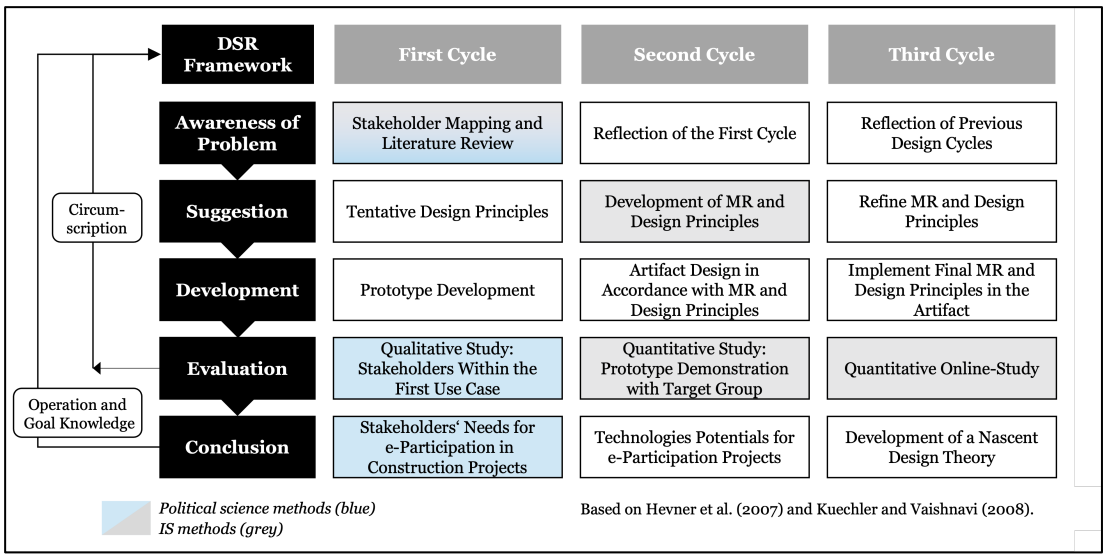

Figure 1. Design Science Research cycle including the varying methods used for this dissertation.

While the qualitative methods are used for capturing the motivation and the problem space (esp. social realities) and for creating the respective design requirements, the quantitative methods (field experiment and an experimental online study) are used to evaluate the artifact and test its performance in manifold ways.

The structure of the dissertation consists of five parts (Figure 2). These five parts will introduce the topic of (digital) citizen participation, describe the methodological approach of the studies as well as the studies themselves and present their findings. Finally, the conclusion will give an assessment of involving citizens with immersive systems in urban planning.

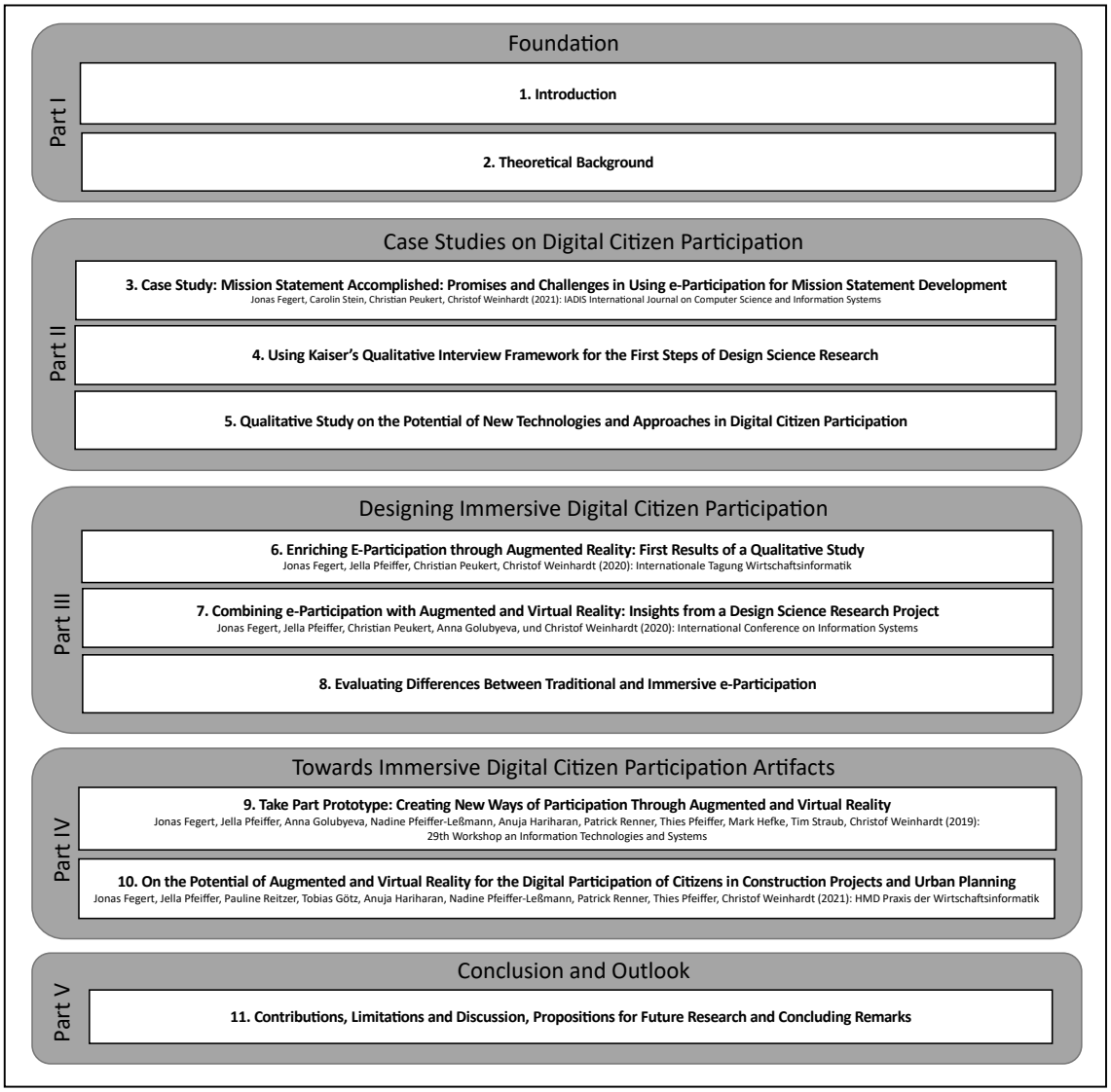

Figure 2. Structure of this dissertation.

The first segment of this dissertation, **Part I**: Foundation, started with this introduction into the topic. In the theoretical background, the second chapter, a short overview on citizen participation and e-Participation will be given to contextualize the object of study more broadly and give the necessary historical background. Based on this introduction to the context of research, Digital Citizen Participation will be introduced as a new concept to extend what is known as e-Participation or online-participation.

Part II: Case Studies on Digital Citizen Participation, consists of three different chapters. It starts in chapter three with a published paper called "Mission Statement Accomplished: Promises and Challenges in Using e-Participation for Mission Statement Development" (Fegert et al. 2021). This paper shows how the research topic was approached in the beginning of this research journey, where IS research on organizational participation was picked up and utilized for a study on the use e-Participation for mission statement development, more importantly for this dissertation, a popular e-Participation platform was evaluated. This evaluation of a current e-Participation artifact gives insights and a basis for the following chapters, where the creation and development of a new e-Participation platform will be researched. Chapter 4 is a based on a working paper with the title "Using Kaiser's Qualitative Interview Framework for the First Steps of Design Science Research". This chapter will outline how qualitative interview methods from political science can be integrated in a DSR cycle, like the one presented in Figure 1, and moreover correctly conducted in an IS research project. In the unpublished chapter 5, the results of the qualitative study will be presented and thereby the potential of new technologies and approaches in Digital Citizen Participation highlighted.

Part III: Designing Immersive Digital Citizen Participation, also consist of three chapters and presents the DSR research settings. While the already published papers "Enriching e-Participation through Augmented Reality: First Results of a Qualitative Study" (Fegert et al., 2020b) (chapter six) and "Combining e-Participation with Augmented and Virtual Reality: Insights from a Design Science Research Project" (Fegert et al., 2020a) (chapter seven) show, how, based on the mentioned qualitative study, requirements and design principles were derived and transferred to the app development, only chapter seven and the unpublished chapter eight show results of the quantitative evaluation of the app. While the seventh chapter shows the results of a field experiment conducted with an early prototype, the eighth chapter presents first findings of a large scale online study. Through their different methodical approach and the varying state caused by the time interval in between the studies, they evaluate and thereby capture different aspects of the app.

Part IV, Towards Immersive Digital Citizen Participation Artifacts, shows within its two chapters in a more practical way the results of the studies. The e-Participation app prototype will be presented focusing on two different steps of the DSR cycle. While the published paper “Take Part Prototype: Creating New Ways of Participation Through Augmented and Virtual Reality” (Fegert et al., 2019) presents in chapter nine a very early prototype of the app, only in chapter ten, the final artifact is presented. Within the published paper “On the Potential of Augmented and Virtual Reality for the Digital Participation of Citizens in Construction Projects and Urban Planning“ (Fegert et al. 2021) final technical specifications including screenshots of the app researched in the previous chapters, will be demonstrated.

The Conclusion and Outlook, **Part V**, brings the results of the various parts together and discusses them (chapter eleven). By placing the findings in a broader context, their relevance will be shown, on the one hand, while on the other hand, the limitations of this work will become visible. This might help to point out where further research could start and pick up on presented ideas. Where one work ends, paths towards future research are often close by.

As shown in this short overview, the monographic dissertation consists of published as well as unpublished material. To meet the demand for rigorous research, the published papers are incorporated in their entirety and are, of course, labeled as such.

2 Theoretical Background

As mentioned in the introduction, democracy itself is at stake in various countries. Interestingly, the mentioned examples of populist leaders and movements show that the dangers democracies are facing today might come from within: Populist leaders with authoritarian tendencies are using democratic means to gain power and control in their respective countries. Such incidents contrast with the rising control through militaristic power – as practiced by authoritarian leaders in the 20th century. Today, "democracies may die at the hands not of generals but of elected leaders – presidents or prime ministers who subvert the very process that brought them to power. […] Democratic backsliding today begins at the ballot box" write Levitsky and Ziblatt (2018, pp. 3–5) in their book "How Democracies Die". Populist leaders with authoritarian tendencies take over control among other things through exploiting their democratic legitimation, e.g. through staffing governmental institutions with their followers and thereby attacking and minimizing their independence (Levitsky and Ziblatt, 2018).

This rather pessimistic analysis presents between the lines another, more encouraging, fact: Democratic practices have become so mainstream that they are regarded as an essential foundation of public governance in many countries around the world. The Freedom House index, which monitors individual freedom and the democratic state of countries around the globe since 1973, shows the general progress made throughout the existence of the study as well as the recent decline of democratic tendencies (Freedom House, 2020).

This raises a more general question: what led to the increase of democratic practices in the last century? As it will be shown in the following subchapters, citizen participation not only played a vital role in the mainstreaming of democratic processes but, furthermore became one of their main results. Therefore, it should be recounted how citizen participation historically became a popular means for democratic practice in many countries and how it is described in theory. Subsequently, the transition from traditional citizen participation processes to e-Participation should be drawn. This chapter will be concluded with the introduction of the new concept of Digital Citizen Participation.

2.1 Citizen Participation – A Concise Overview

2.1.1 Citizen Participation in the Historic Context

The foundation of Western democracy as well as the concept of a political sphere was laid in ancient Greece with Aristotle's and Plato's differentiation between the oikos and the polis. While the oikos meant the private community of a household, the polis signified the public welfare and thereby the interest of the larger social community (Massing and Breit, 2003; Rosenzweig, 2010). Thereby the polis created a first instance where broader sections of the public participated in the self-administration of a common space.

The ancient concept of the public sphere can be found throughout Europe's history, but only fulfills itself, following Habermas (1990), in the modern state. In the 18th and early 19th century, the separation between the private and the public sphere was recreated through bourgeois public spaces. As an antithesis to state power, mass media and coffee houses emerged. There, argument-based exchanges among citizens (of one social class) appeared (Massing and Breit, 2003). Habermas concretizes in "Between Facts and Norms" (1992) the concept of a public sphere and furthermore defines the normative theory of deliberative democracy. The public sphere has in its center the deliberative democracy, which stands for "the argumentative, deliberative, agreement-oriented consultation" (Habermas, 1992, p. 229). Thereby it presents an alternative to the formal decision-making processes that take place in political institutions. Habermas' ideal of a public sphere, and whether individuals can enter a public discourse equally, is being critically reflected by scholars like Nancy Fraser. Fraser introduces the concept of subaltern counterpublics (Fraser, 1990). The counterpublics are in opposition to the bourgeois public sphere. In the counterpublics, critical discourses can develop creatively and only later enter, when strengthened enough, the dominant public sphere. Through recognizing the importance of counterpublics to the politic sphere, Fraser argues, that the ideal of deliberation among free and equal individuals in public would not have been yet historically realized (Fraser, 1990). Following Fraser, especially societal groups like women, ethnic or religious minorities and workers have not been equally represented in the public sphere. Habermas incorporated this critique in 1992 and defined deliberation as a democratic ideal that not necessarily includes decision-making, but rather political opinion-forming (Habermas, 1992). This ideal of a public sphere where equals can exchange their standpoints and thereby contribute to political opinion formulation, is still a theoretical ideal of a vivid democracy, and gave a theoretical foundation for citizen participation in political decision making.

The development of Habermas' theory of public sphere was heavily influenced by the Frankfurt School. Habermas started his academic career after his dissertation with Theodor Adorno and held from 1964 on the chair named after Max Horkheimer at Goethe University Frankfurt. Therefore, Habermas' thinking ever since included the sociological approach of the critical theory. The sociological approach in his philosophy made him very aware of the changing surrounding he witnessed at his university. As a professor in the 1960s in Germany he observed a changing zeitgeist which became clearly visible within the student body. Especially since the 1960s, Western democracies have experienced a growing demand for political participation (Schmidt, 2019). Barnes and Kaase (1979) describe it as follows: "The participation push ranged from the expansion of ‚conventional political participation' such as electoral participation or petitions, to ‚large-scale unconventional participation,' such as demonstrations, strikes, or sit-ins" (cited in Schmidt 2019: 227).

The European social and civil rights movements, which became active in the years around 1968, although aiming to include workers and workers' rights, evolved in Germany and France primarily around universities. Consequently, their protest resulted first of all in action in their immediate environment and can thus be seen in the demand for a more inclusive university or a say in the politics of urban development, which impacted their living conditions. Historically speaking, the achievements of the rebelling young generation cannot be underestimated: The 1968 student protest led for example to the establishment of student parliaments and university self-administration as well as, in case of the city of Frankfurt, the preservation of some older neighborhoods. Without protests and, in certain cases, the squatting of some buildings, urban development in the city of Frankfurt might have looked different in the 1970s. Those very local participatory successes gave rise, also because of their large media coverage, to other protest movements, which emerged in the 1970s like the peace, the environmental and the feminist movement. Their continuing engagement with and protest against the state's governmental action led to new policies and parties in France and especially in Germany. The social-liberal Government led by Chancellor Willy Brandt had to acknowledge the importance of societal protest and movements within Brandt's first government declaration in 1969. In this context, it is worth recalling this declaration in which Brandt responded to the societal activism by saying:

> We want to dare more democracy. We will open up our working methods and satisfy the critical need for information. We will work to ensure that every citizen has the opportunity to participate in the reform of state and society, not only through hearings in the Bundestag, but also through constant consultation with the representative groups of

> our people and through comprehensive information about government policy.[1] (Brandt, 1969)

Thereby, the German chancellor communicated first steps towards enabling more citizen participation in order to complement the representative democracy system. The other well-perceived policy change of the new government, which was also addressed during the governmental declaration, was the policy of détente. Brandt's social-liberal coalition departed from the anti-communism of the preceding federal governments. This change of course in itself was also an incorporation of changing societal realities created through a different perception of the Cold War confrontation, especially among younger citizens, and thereby a hint of the new peace movement that was to emerge only later.

Although the establishment of concrete participatory elements continued to be an ongoing endeavor for the following decades, this statement laid a foundation. The social movements itself started changing policies through entering the party system. Parts of the environmentalist, feminist and peace movement came together in January 1980 in Karlsruhe and founded the Green Party. Their first larger electoral success was in the federal state of Hessen, enabled through the Frankfurt milieu which started and led the student protests in the preceding decade. The Green Party's approach as a basic democratic and self-declared "anti-party-party" with hard gender quotas and a system of rotation in the beginning differed enormously from the already existing German parties (Decker, 2020; Salomon, 1992). Although the reality of party politics lead to compromises also within the party, the Greens' success made the arrival of new social movements and their concerns present. Subsequently, it lead to the establishment of elements of direct democracy especially on a local level.

This relatively late establishment of forms of direct democracy in Germany contrasts with the experience in Germany's neighboring country, Switzerland. When being established as a federal state in 1848, Switzerland was set up as a semi-direct democracy, which works remarkably on the municipal, cantonal and state level (Eschet-Schwarz, 1989; Serdült, 2007). Although women were excluded from the right to vote until 1971 (Raschke, 2020), and questions of representation of minority rights (Moeckli, 2011), as well as the question of representativeness (Kriesi, 2007, 2006) remain topics of ongoing

[1] In the German original: "Wir wollen mehr Demokratie wagen. Wir werden unsere Arbeitsweise öffnen und dem kritischen Bedürfnis nach Information Genüge tun. Wir werden darauf hinwirken, daß nicht nur durch Anhörungen im Bundestag, sondern auch durch ständige Fühlungnahme mit den repräsentativen Gruppen unseres Volkes und durch eine umfassende Unterrichtung über die Regierungspolitik jeder Bürger die Möglichkeit erhält, an der Reform von Staat und Gesellschaft mitzuwirken." (Brandt, 1969, p. 2).

debate, Switzerland can be regarded as an ongoing case study for the operability and effective realization of direct democracy.

In the US, the civil rights movement and the new left were – because of the American context – not only organizing for peace and environmental issues. At the core of the US-based movements stood the struggle for civil and equal rights for women and especially for ethnic minorities, who, for centuries, were excluded from the most basic form of decision-making and representation: voting. Within the US, it therefore came to new alliances inside the movement. Abraham Joshua Heschel and Joachim Prinz, both Berlin-trained rabbis who fled to the United States to escape the Nazis, became active in the US civil rights movement. Thus, it was Joachim Prinz who spoke directly before Martin Luther King's "I have a dream" speech. For at least a short period of time, different parts of the US-American society joined the struggle towards a stronger recognition and more inclusive implementation of human rights that other minorities were waging (Grossmann, 2014).

What shaped both social movements in the US and Europe, was a distrust in the states' governmental action and their institutions. A distrust which was nourished by the aggressive and partly oppressive behavior towards the named movements. Especially the fight for equal rights of Black Americans resulted in confrontations between the civil right movement and armed state executive bodies like the police (Simon et al., 2016). In Germany, the death of the student Benno Ohnesorg, who was shot by a police officer in 1967, led in the following years to a mobilization and radicalization against the state on the students' side (Barclay, 2010). This distrust towards the state became also visible in theories of public involvement.

There are different definitions of public participation: In Arnstein's (1969) "Ladder of Citizen Participation," (Figure 3) which became the standard reference in the field, she argues that participation processes consist of eight steps. The first five steps (e.g. "manipulation" or "consultation") are either considered non-participatory or token forms of participation, and only three steps on the ladder ("partnership," "delegated power" and "citizen control") are "degrees of citizen power" (Arnstein, 1969). In this definition, participation equals power and is built hierarchically (Collins and Ison, 2009).

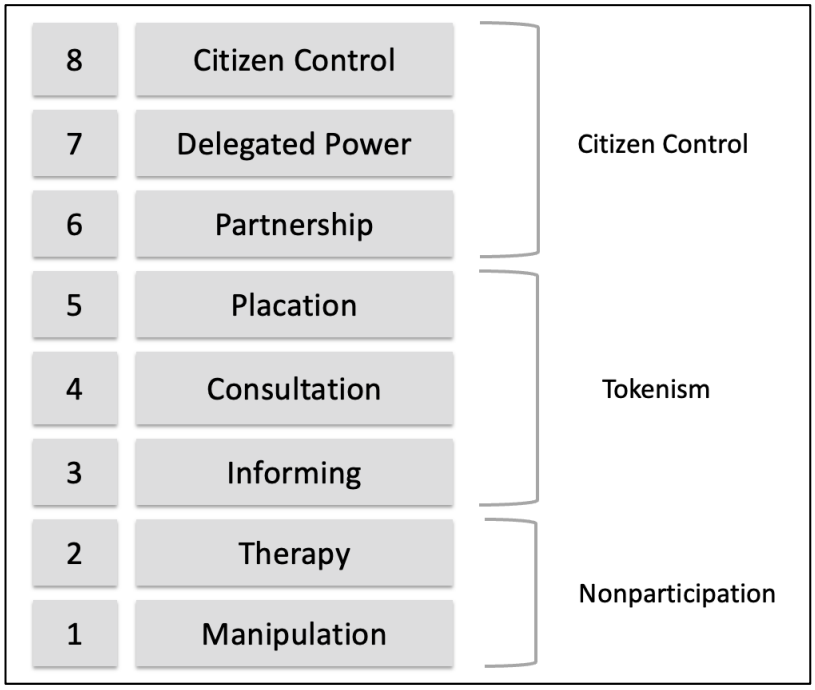

Figure 3. Arnstein's (1969) ladder of participation.

Accordingly, Arnstein warns about „the empty ritual of participation" (Arnstein, 1969, p. 2016) and makes the argument that informing citizens of their rights and responsibilities and inviting them to make their views known, for example through consultation, is already a valid step on the path to full participation. However, she only sees placation as the level of participation where the citizens begin to have some influence. Therefore, following Arnstein, only partnership, delegated power, and citizen control can be considered as active forms of participation. Arnstein's important contribution lies in the critical perspective of showing how governmental narratives of participation can be misused to give the public only an impression of citizen power. Despite its benefits, from today's point of view, her theory appears to be influenced by the 1960s US-American discourse on governmental power.

Another more recent contribution that defines forms of participation was developed by the International Association for Public Participation. Their spectrum (Figure 4) rather focusses on different levels of participation with different impacts on decision-making. The levels are "inform", "consult", "involve", "collaborate" and "empower" (International Association for Public Participation, 2018). The spectrum is appealing and is widely used because it has showed itself as better measurable on several instances (Nabatchi, 2012; Nelimarkka et al., 2014), less judgmental and more suitable for participation processes with many stakeholders (Wirtz et al., 2018).

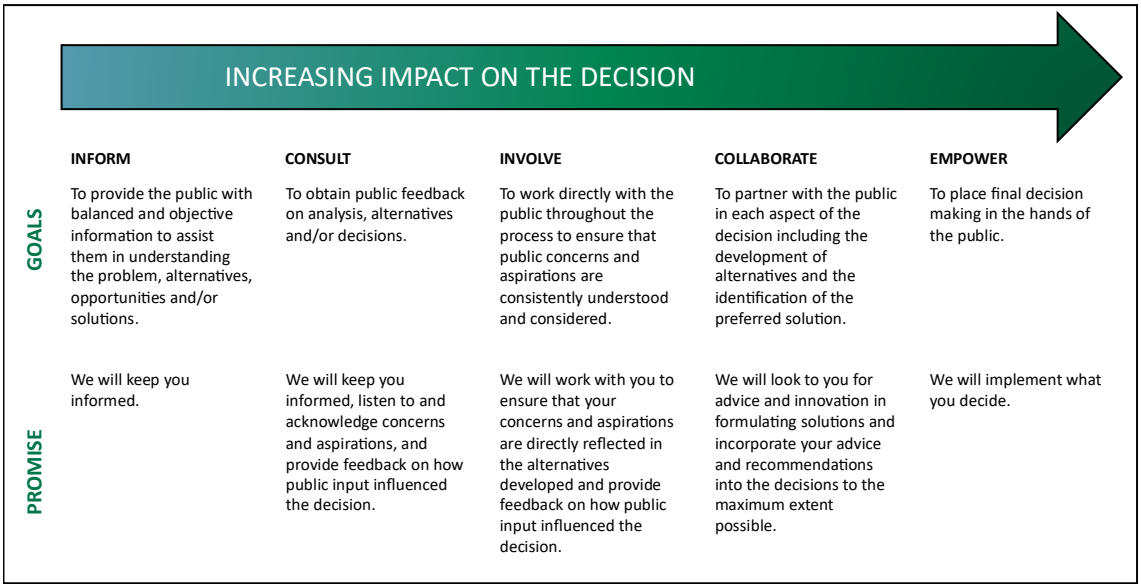

Figure 4. Spectrum of Public Participation (International Association for Public Participation 2018).

Voting is the first association people might have with participation. As the spectrum shows, final decision making could be a dimension of participation process. However, it is important to see that other dimensions, like informing the public, can be, if ventured with democratic intentions, also an important means for the involvement of the public.

A summary by the Organization for Economic Co-operation and Development (OECD) on public participation highlighted the importance of citizen participation and divided it into three forms: Information (e.g. access to public records, official gazettes, and government websites), consultation (e.g. citizens feedback on policymaking, or commenting legislation drafts and surveys public opinions) and active participation (e.g. citizens actively engage in decision and policymaking through open working groups, laymen's panels and dialogue processes) (OECD, 2001). The OECD argues that citizen participation thereby fosters the citizen-government relationship including the government's legitimacy and reliability. What the OECD thereby sees as a means to strengthen the relationship between citizen and their respective government, already encourages critical questioning. Are more than tokenistic approaches of participation meant? For this reason, including theories of public participation like Arnstein's ladder or the spectrum by the International Association for Public Participation is helpful to assure that citizen participation processes are more than merely well-intentioned schemes. The theories can therefore be used for subjecting citizen participation processes to a reality check.

Already in 1996, the political scientist John S. Dryzek wrote: "If democracy is a good thing (as almost everyone everywhere now seems to believe), then more democracy should presumably be an even better thing" (Dryzek, 1996). With the fall of the iron curtain,

many states in eastern Europe were undergoing a transformation towards democracy. Citizens were, for example in Poland with the Solidarność movement or in the Czech Republic with the Velvet Revolution, pushing their states towards liberal democracies. In the meantime, established liberal democracies like Germany and Austria tried to further democratize governmental procedures among others through experimenting with citizen participation.

Nevertheless, the process seems to be quite slow: What Brandt argued for in 1969, only surpassed level of federal states in 2020, when the German Bundestag established citizen panels as a way to consult the German public annually on specific topics (Schmid, 2021). Although the so called Bundestag Enquete Commissions already created a way to include experts knowledge in parliamentary decision making, these recent approaches of direct democracy on a state level were a novum. Success stories as well as important learnings from failed attempts of citizen participation can be observed particularly on a local level and are elaborated in the following subchapter.

2.1.2 Citizen Participation as a Means for Local Problem Solving

In their book "Reconstructing Democracy" (2020), Taylor, Nanz and Taylor present local citizen participation as an important means for representative democracies, to assure that citizens feel heard. That might be, argue the authors, especially crucial in times where the changes caused by a more globalized world and the transformation of certain industries (e.g. energy and mobility sector) might make individuals feel left behind. The authors present many examples of changes created through local citizen participation. As one of those changed environments they present the Austrian village of Langenegg. Langenegg, as part of the Austrian countryside very much affected by a general population decrease, had a governing body that decided to inform, consult and involve the public on creating a vision for the future of the village. Without delegating the decisive power, the local politics gave space for structures of citizen involvement, which resulted in concrete measures that helped to keep the village attractive for its residents and even positively affected the general population development (Statistik Austria, 2021; Taylor et al., 2020).

The debate about the rebuilding of the Stuttgart train station (Stuttgart 21), made the German public very aware of the costs of missing early citizen involvement.[2] Stuttgart

[2] This paragraph on Stuttgart 21 is taken from the paper "On the Potential of Augmented and Virtual Reality for the Digital Participation of Citizens in Construction Projects and Urban Planning" published in the Journal HMD Praxis der Wirtschaftsinformatik (Fegert et al., 2021a chapter 10).

21 can be described as "one of the most controversial infrastructure projects in Germany" (Brettschneider, 2013). The redesign of the train station began in 2010, primarily through a partial demolition of the building, which led to numerous protests, that were observed by a broad public beyond the city of Stuttgart itself. The conflict could only get resolved through an arbitration and a referendum, and, as a consequence, researchers increasingly investigated what exactly had gone wrong in Stuttgart and how such mistakes could be avoided in future (Schuster, 2013). One reason that repeatedly came up in research was poor communication (e.g., construction plans were not available for citizens to see on site) of the initiators, who made the construction appear as if it was set in stone (Thaa, 2013). The lack of involvement of citizens and non-transparent communication by the initiators can have a lasting impact on trust in politics and administration. This local conflict was important for the development of the research project described in the following. The Take Part research project, which this dissertation is closely related to, was funded by the German Federal Ministry of Education and Research[3], and somehow created in response to the Stuttgart involvement failures.

While the conflict in Stuttgart could be deescalated and partly resolved through a public referendum and satisfied for the electorate through a change in the federal states and city's government, this example shows that public opinion on construction projects can become so negative that they might impact their entire planning. Another interesting example is the planned headquarters of the tech giant Amazon in New York City. In fear of gentrification and neighborhood change, the residents organized a protest, which led to the cancellation of this construction project (Goodman, 2019). Although the affected citizens' involvement succeeded, the announcement of Amazon's plan had an immediate effect on the local housing market – thereby leaving the residents in an uncomfortable position, where their engagement had little impact on the general future and development of their local environment (Zhou, 2021).

Governmental power also manifests itself through its budgeting competences. What is often hidden behind numbers from the citizens' perspective is, for politicians, the possibility to leave an own mark through investing or defunding certain fields. The US government shutdowns are a prominent example of how such debates not only impact the states' ability to act but also the life's of many individuals who rely on government contracts (Slaughter, 2020). Less well known, also in the German public, are the Bundestags' so called house cleaning sessions. In night long lasting sessions, budgeting experts of the oppositional parties try to influence the government's course through finances. As these

[3] The Federal Ministry of Education and Research (BMBF) should be explicitly thanked for supporting Take Part with funding between 2018 and 2021. Without the generous support, the research on the combination of immersive systems and e-Participation would not have been possible to this extent.

two example show, budgeting is an important means to influence the course of politics and thereby shape society. Therefore, putting this responsibility in the hand of the citizens itself is a courageous form of citizen involvement.

A city that combined direct democracy with budgeting was Porto Alegre. The Brazilian city introduced in the 1990s public participatory budgeting. At this time even more courageous, since the country just overcame the rule of the 21 yearlong military dictatorship (1964-1985). At neighborhood meetings, citizens were informed about the budget and funding possibilities. They chose delegates from within their community and equipped them with a list of priorities. Interestingly, normally underrepresented or excluded groups and individuals participated in the public budgeting activities (Novy and Leubolt, 2005). In 1995, as many as 15,000 residents took part in these meetings (Abers, 2000). Two of those delegates were then send to the so called participative budgeting committee (Conselho do Orçamento Participativo), where they met with their equivalents from other districts. The committee developed a budget plan based on the participative neighborhood meetings and only then passed on this budget to the city council, which held the final say about the budgeting. Porto Alegre's public budgeting certainly improved the transparency of government spending and led to an increase in the municipal budget from 3.2% in 1989 to 17.5% in 1991 (Novy and Leubolt, 2005). Although there are doubts as to whether participatory urban planning in Porto Alegre had long-lasting effects (Rodrigues Mororó, 2014) the example is of interest in order to demonstrate extensive forms of political participation that blossomed already in the 1990s. Interestingly, part of the city's efforts exist throughout today – an e-Participation platform based on the platform Consul is in place to consult with the citizens on public budgeting (Prefeitura Municipal de Porto Alegre, 2018).

Those practical examples presented a brief overview on how citizen participation processes have been organized in the past, prior to the digitalization of participation processes.

2.2 E-Participation

The advent of the internet also created many new ways of learning about and participating in government. In this regard an early definition might help understanding the concept of e-Participation.

> eParticipation involves the extension and transformation of participation in societal democratic and consultative processes mediated by information and communication technologies (ICT), primarily the Internet. It aims to support active citizenship with the latest technology

> developments, increasing access to and availability of participation in order to promote fair and efficient society and government. (Sæbø et al., 2008, pp. 400–401)

In general, e-Participation is classified as a sub-branch of e-Democracy, which is a form of Digital Government or formerly known as e-Government (Figure 5).

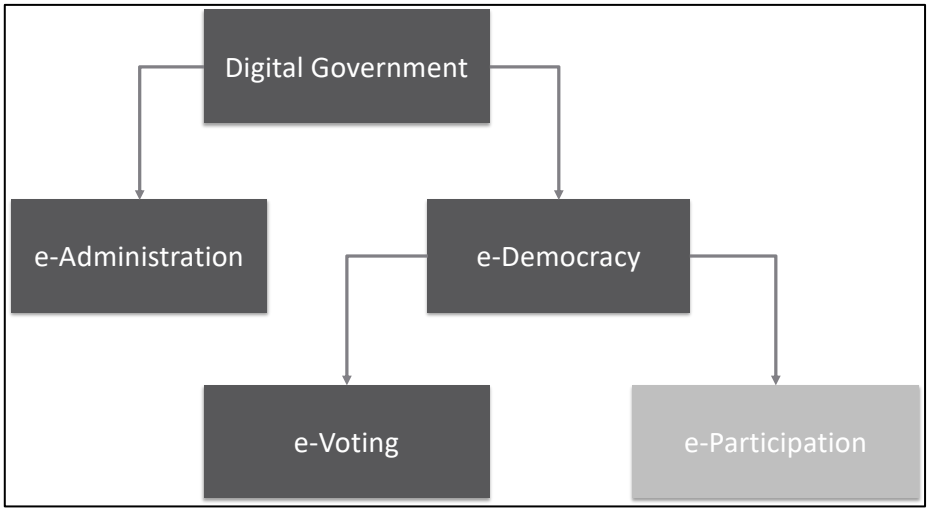

Figure 5. Visualization of the e-Participation research context (Illustration based on Macintosh 2004).

While Digital Government is the broad term to describe interactions between the citizen and it's governing body through the use of ICT, Macintosh defines e-Democracy as „the use of ICT to support the democratic decision-making processes" (Macintosh, 2004, p. 1). Whereas Hacker and van Dijk prefer the term Digital Democracy, which they describe as „a collection of attempts to practice democracy without the limits of time, space and other physical conditions, using ICT or CMC instead, as an addition, not a replacement for traditional 'analog' political practices" (Van Dijk and Hacker, 2000, p. 3). Therefore, e-Democracy or Digital Democracy is not replacing democracy, but rather enhancing it with digital means. In the following sub-chapter e-Participation will be defined before practical examples are shown.

2.2.1 Defining e-Participation

E-Participation "involves the extension and transformation of participation in societal democratic and consultative processes mediated by information and communication technologies" (Sanford and Rose, 2007, p. 406). In this context, the theory of the public sphere by Jürgen Habermas is used as the theoretical foundation for e-Participation re-

searchers in IS. Regarding the influence of Habermas' ideal of democracy on online participation processes, Sanford and Rose state, based on an Information Systems literature review:

> Whilst Habermas takes a critical, emancipatory stance, this is not so well reflected in the literature. The research style is mainly normative, reflecting a practical interest in furthering participation through technological means: the instrumental justification for research. (Sanford and Rose, 2007, pp. 416–417)

However, who should be reached with e-Participation? Sanford and Rose argued that e-Participation, as one of those participative forms which emerged with the internet, should improve communication and decision-making and thereby navigate between politicians, civil servants, citizens and other stakeholders. Macintosh (2004) breaks down the different levels of the spectrum of public participation or respectively Arnsteins' ladder for using it in e-Participation (Figure 6).

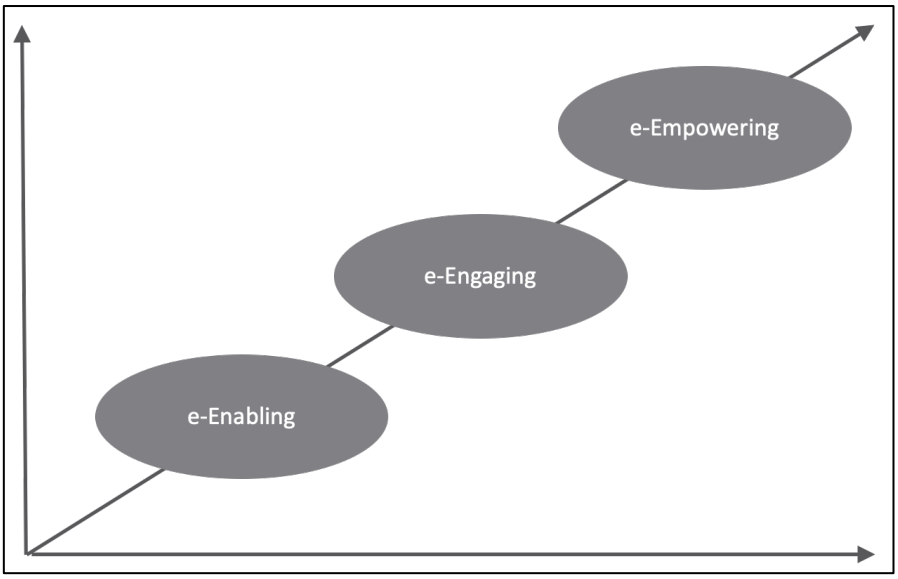

Figure 6. "Levels of Participation" (Macintosh, 2004)

In their defining paper, Macintosh describes e-Enabling as „supporting those who would not typically access the internet and take advantage of the large amount of information available." (Macintosh, 2004, p. 3). Thereby, e-Enabling stands for the "accessibility and understandability of information" (Macintosh, 2004, p. 3). E-Enganging is defined by Macintosh as "consulting a wider audience to enable deeper contributions and support deliberative debate on policy issues" (Macintosh, 2004, p. 3). Macintosh themselves mentions the "top-down" (Macintosh, 2004, p. 3) approach of this dimension of e-Par-

ticipation, as citizens are consulted based on the will of governmental actors. In e-Empowering Macintosh sees a "bottom-up" (Macintosh, 2004, p. 3) approach, where citizens find themselves in an online setting where they can influence policy-making through their contributions. In this setting "citizens are emerging as producers rather than just consumers of policy" (Macintosh, 2004, p. 3).

2.2.2 Forms of e-Participation

In the third chapter of this dissertation, an existing e-Participation platform will be evaluated in detail. Therefore, this sub-chapter aims for discussing the gap between theoretical aspirations and the reality of e-Participation. In the following, different forms of e-Participation are presented and highlighted through two examples.

Van Dijk (2012) made early attempts to categorize forms of e-participation by creating a classification, which still seems accurate for most on the e-Participation platforms on the market (Table 1). This classification, which differentiates between "government-centric and citizen-centric approaches" (Van Dijk, 2012, p. 9) is hereby presented completely:

Phase in the policy process	**Application of e-Participation**
Agenda setting	• Open Online Consultations (governments and public administrations) • ePetitions and eActivism (citizens)
Policy preparation	• Online Plan Consultations (Governments) • Online Forums for Policy Making (Citizens) • Online Knowledge Communities and Social Media serving Policy Making (Citizens)
Decision making	• eVoting (governments; election committees) • eCampaigning (citizens and politicians)
Policy execution	• eMaintenance of the Law (by citizens invited by governments) • eGovernment services following the needs of citizens and including participation (government initiative) • eGovernment services with participatory user-design (government initiative) • eComplaints and eSurveillance (initiated by citizens)
Policy Evaluation	• Quality panels and individual evaluations of online public services (government initiative) • Citizen control sites and information services for public or government policy (citizen initiative)

Table 1. "Main applications of eParticipation in the Policy Process" (van Dijk, 2012, p. 10).

Based on this differentiation the literature on e-Participation still refers to state-run participation platforms (online platforms and forums that are linked to state action) (Große,

2018) and others, which support public opinion-forming (Porwol et al., 2013). Examples of e-Participation platforms should be shown in the following to illustrate van Dijks categorization and point out the different characters of e-Participation.

As one of the first successful examples of e-Participation, in terms of user acceptance, a platform for “policy execution” and “eComplaints” (Van Dijk, 2012, p. 10) could be named. The British “FixMyStreet” e-Participation tool was funded by a governmental organization, the UK Department for Constitutional Affairs and created by the mySociety initiative (Centre For Public Impact, 2016). It helped practically to report on a map potential sources of danger such as road damage or other local problems needed to be reported to local authorities. The tool, which would be considered “e-Empowering” by Macintosh (2004) standards gives the citizens the opportunity to directly influence governmental action on a local level. On the other hand, it could be argued that it crowdsources governmental responsibilities and thereby holding citizens co-responsible for the development of the local surrounding.

Figure 7. Early version of FixMyStreet (Blakeman, 2010).

15 years after its initial launch, FixMyStreet is still in use (Figure 8) and proclaims to receive roughly 10.500 reports each week (SocietyWorks, 2021). The establishment of a platform which is continuously in use is already a huge success for e-Participation platforms. The initial idea of this policy execution tool inspired other startups and research institutions to create similar tools. There, the Technical University of Darmstadt spin-off wer|denkt|was (founded in 2010) and the FZI Research Center for Information Technology tool KA-Feedback (released in 2013) should be named as other prominent examples of participatory tools for complaint filing.

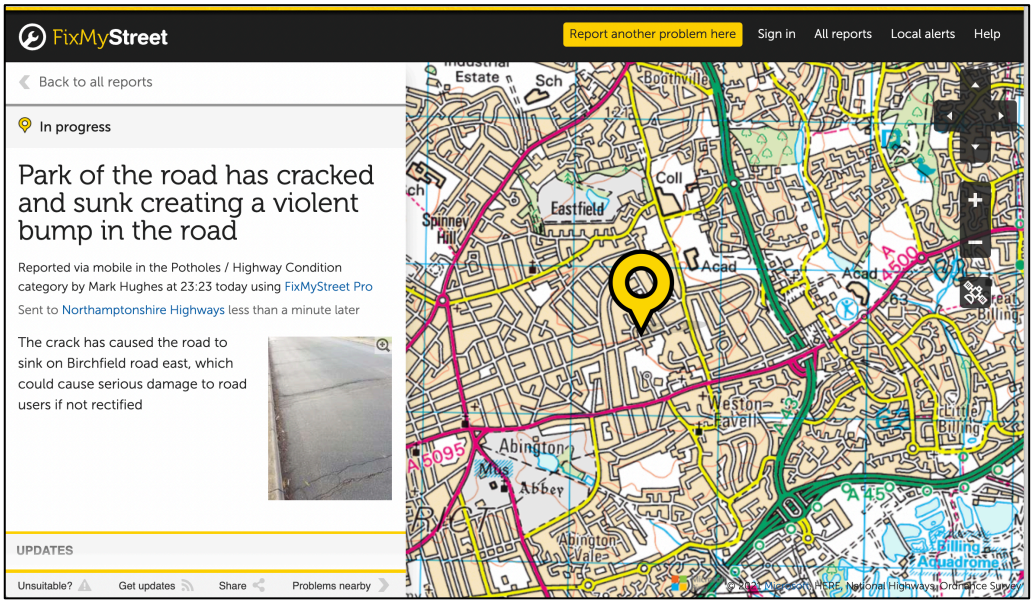

Figure 8. FixMyStreet in 2021 (FixMyStreet, 2021).

More discourse oriented forms of e-Participation are shown in the next example. The city of Berlin's e-Participation platform on the Tempelhof Field (Figure 9) can be categorized as a "policy preparation" (Van Dijk, 2012, p. 10) forum, which gave citizens the possibility to influence policy making. From 2014 to 2016, this platform enabled Berliners to exchange ideas on how the widely known former airport site – the Tempelhof Field – could be used for leisure activities. The platform was based on Adhocracy, an e-Participation platform, run and marketed by Liquid Democracy.

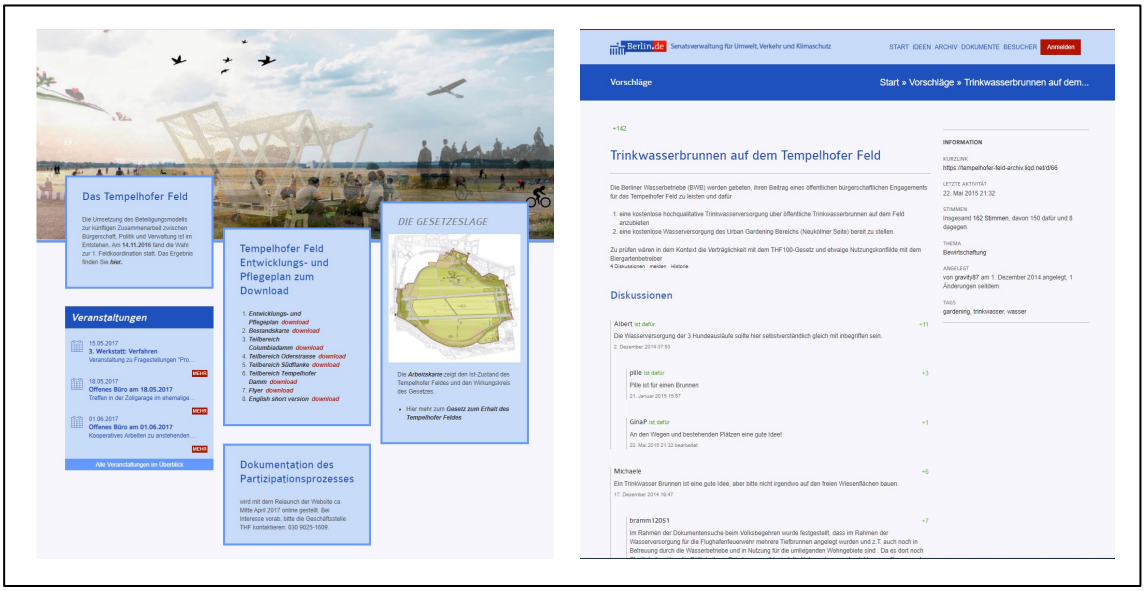

Figure 9. Tempelhof Feld e-Participation platform by Liquid Democracy based on Adhocracy. (Senatsverwaltung für Umwelt, Verkehr und Klimaschutz, 2016).

Comparing the platform from 2016 (Figure 9) with the 2021 version (Figure 10), the progress in platform design which has been made over 5 years becomes visible. Nowadays, platforms have evolved in terms of their design, but also in terms of the simplicity with which municipalities and other operators can set them up. Especially their backend, with a design, that reminds of content management systems, like WordPress, allows an easy adaption of the participation process. Regarding the front end, Adhocracy+ has in the 2020s a more interactive design and already includes elements of gamification like progress bars. Although its design is already responsive to different browser sizes, some mechanisms, like voting, do not work from smartphones and an app remains not available. While this points out further steps of potential development in e-Participation, it also reveals severe shortcomings in its current state.

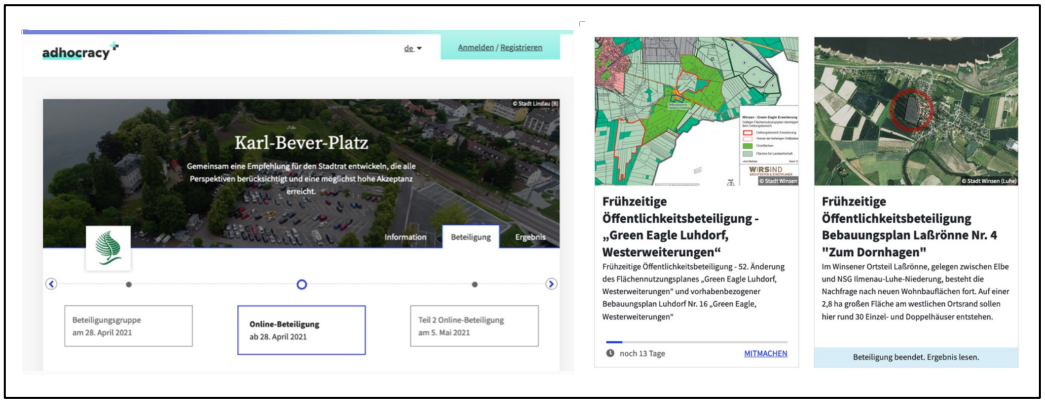

Figure 10. Liquid Democracy's Adhocracy+ platform in 2021 (Liquid Democracy, 2021).

Besides the platform design, sociological findings show that e-Participation platforms are still ambiguously evaluated when it comes to their overall success. A study by Rottinghaus and Escher (2020) shows that the use of online participation platforms is still very limited and tends to appeal to people between 30-59 years of age, with a higher level of education and more often to male individuals (Rottinghaus and Escher, 2020). An important motivating factor of participation is the previous political involvement or personal interest or concern of the individuals (Rottinghaus and Escher, 2020).

Socio-economic factors still impact political participation, although the example of Porto Alegre shows, that public participation can be designed that it is more inclusive in terms of representation. There are concepts and mechanisms that can be used to include a broader part of the society, including different socio-economic milieus. In this dissertation it should be argued, that digital platforms and their design should also play a decisive role in offering public participation to the broader population. Therefore, it should be asked: How could e-participation platforms become more appealing and more inclusive?

2.3 Introducing Digital Citizen Participation

Already in 2008, Scholl wrote in an article on the future of e-government the following:

> Like its siblings "e-Business" and "e-Commerce" the once "electrifying" acronym "e-Government" is seemingly losing its magic. Despite (or, perhaps because of) the initial absence of a clear definition, the term's primary appeal in the late 1990s must probably be ascribed to the notion of doing something radically new and far apart from traditional business models and likewise something very different from traditional Information Systems (IS) and information technology (IT). […] During those years, "e-xcitement" spiraled out of proportion and the list of ever-new e-words grew long with hilarious "e-xaggerations." (Scholl, 2008, p. 22)

Thereby Scholl pointed out how e-Government and its subordinated e-Services were perceived in its early stages – as a novelty in itself. A novelty that was overloaded with expectations. In the beginning of the 2020s, it became evident that e-Government and e-Participation did not succeeded in meeting those expectations. Therefore, after giving an overview of public participation and showing early attempts to involve citizens through e-Participation, a new concept should be introduced called Digital Citizen Participation. In the following, it will be elaborated, why a new scientific term should be established. Previous to this elaboration, it should be said, that it is not intended to completely overcome e-Participation, a term continuously used in this dissertation. Rather than getting rid of the old term, the new concept should give an outlook on a concept, how future digital participation could be designed.

Introducing a differentiation seems adequate to counteract the "e-xaggerations" Scholl warned already in 2008 about and to create a concept that includes, far from judgmental expectations, social realities. In the following, three key features of Digital Citizen Participation should be defined. These include interdisciplinarity in research and development, technological innovativeness and interoperability, as well as incorporating, an inclusive democratic approach.

Since the creation of the first online participation platforms, new technological innovations emerged and entered the mass-market. Interconnectivity (often through various devices) became in many societies the status quo. Access to the digital technologies are not anymore the limiting factor when it comes to digital participation. Internet access and hardware are today mainstream. Therefore, the main limiting factor to make use of

state of the art technologies are resources and knowledge. The main initiators (governmental agencies etc.) still seem to lack competences when it comes to designing and developing artifacts. To overcome those limiting factors, the concept of Digital Citizen Participation should give guidance on designing public participation for the digital age.

Today, there are plenty of technological possibilities – although their applicability still needs to be researched and proven. That is what Digital Citizen Participation should be about as well – a concept to research digital public participation. In this dissertation immersive technologies are researched as one prominent example of new digital technologies.

2.3.1 Interdisciplinarity as a Means to Counter Dominant Platform Mechanisms

The normative ideal of deliberative democracies, as it is presented by Habermas, aims at transforming the needs of citizens from an individual level towards an orientation for the common good (Young, 2004). However, an objective assessment of the common needs can only happen if the inclusion of a diversity of perspectives is ensured since only the different perspectives reflect the pluralistic societies in which we live (Young, 2004). Sanford and Rose (2007) already suggested research disciplines, which should play a role in broadening the perspective on e-Participation. Following the authors, Communicational Science, Computer Science, Information Systems, Political Philosophy, Political Science, Public Administration and Sociology are research disciplines, that should be involved in research on political participation using ICT. In contrast to Sanford and Rose, this dissertation argue, sthat those disciplines should be involved in the design of those platforms itself. For non-tokenistic and successful forms of political participation in the digital age, it is necessary to include different disciplines into designing platforms. Thereby a platform logic can be established, that does not purely follow full profit market mechanisms.

Platforms such as Facebook, Uber and Airbnb pursue the goal of winning against the competition in their industry. They strive for dominance, as this increases the attractiveness of their networks. Therefore, they are dependent on reaching a certain dominance if they want to operate their platforms sustainably (Srnicek, 2016). In recent times, calls for regulation of platform providers grew more vocal. For example, Scott Galloway, a professor of business administration, called for large Internet companies to be broken up and suggested that the U.S. Department of Justice should take appropriate measures (Galloway, 2018). But how could this point be reached? In his book "Platform Capitalism" Srnicek (2016) points out that the commercialization tendencies of platform providers would not have been possible without the collapse of the dotcom bubble in the early

2000s. Its collapse forced internet companies to shed their investor earnings. While Google still used user data to improve its search function in its early years, the company began to use the data for targeted advertising after the collapse of the dotcom bubble (Srnicek, 2016).

Therefore, it seems clear that the current factors that measure the success and value of platforms need to be revisited when it comes to designing platforms for societal participation of a population in political affairs. In the following, an exemplary framework for the involvement of different disciplines in platform design for Digital Citizen Participation is suggested (Figure 11). Thereby, it is argued, that the mentioned disciplines can become with their methods, in Digital Citizen Participation, part of the design process itself. This could help to counter dominant platform mechanisms. If participation processes are to be implemented (more) successfully, then the translation work between disciplines is crucial and should be implemented in platform design for Digital Citizen Participation.

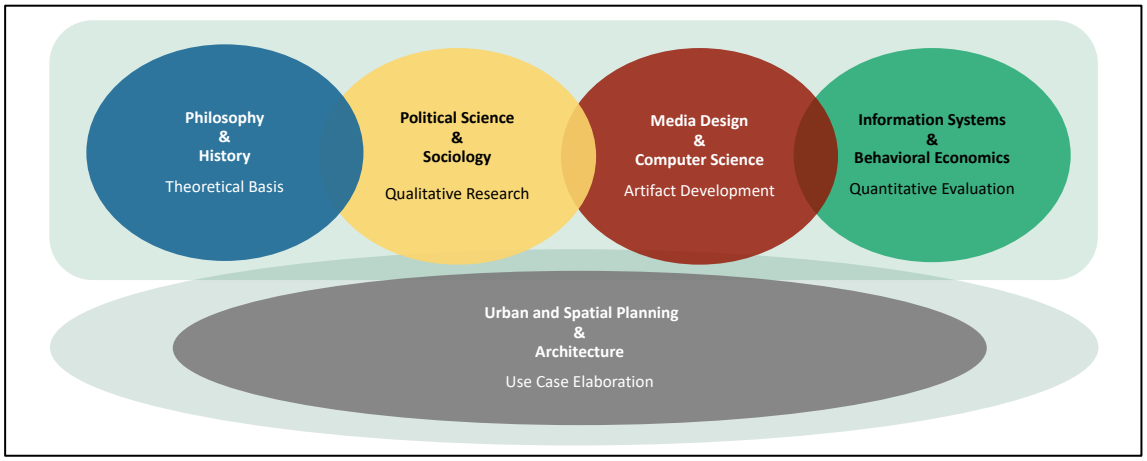

Figure 11. Interdisciplinarity in Digital Citizen Participation.

Including the **philosophic and historic** context into platform design does not seem to be an obvious choice. Therefore, what is the benefit of including this perspective when starting designing Digital Citizen Participation? What is to be considered an ideal form of discourse and public is something suggested and debated in (political) philosophy and history of thought. As shown in this and the previous sub-chapters, Habermas theory of the deliberative public still is the theoretical foundation for scientific work on public participation. Every work must either incorporate or differentiate itself from this theoretical basis. Including those core thoughts of how a deliberative form of participation can be reached in a digital setting, is something already acknowledged in early literature on e-Participation (Sanford and Rose, 2007).

Furthermore, it should be argued to put platform design in a historic context to become aware of the origins of some phenomena in the present. A genealogical approach takes a contemporary question as the starting point of analysis and thus makes historical processes and orders of knowledge visible for a critique of the present (Kerchner, 2006). To give an example: Foucault's first volume on "Security, Territory, Population" (Foucault, 2006) is based on a lecture he gave in January 1978. In regard to the 18th century, it deals with security mechanisms and the relationship between law and norm, as well as how techniques of empiricism and probability theory took hold. The origins of empiricism are of interest for an examination of current digital platforms, as their algorithms are based on data collection and probability calculations in order to implement, for example, recommender systems. Statistics appear more extensively in Foucault's tenth lecture as the "knowledge of the state" (Foucault, 2006, p. 396), where it is described with a reference to coding empirical data as a new instrument of power for the state in the eighteenth-century. If we want to be aware of the instruments of power of today's economy and the internet corporations as a cornerstone of this economy, we cannot avoid being aware of the origin of these mechanisms. The mechanisms of power can be consciously taken up or intentionally avoided in platform design, but being aware of them, seems necessary.

A core part of this dissertation is the incorporation of **sociological** methods and methods from **political science**. As explained in more detail in the fourth chapter of this dissertation, especially qualitative methods used and developed in these disciplines can help to develop realistic and true-to-life designs of platforms. When it comes to designing platforms that should not only be adopted by a specific demographic or sociological milieu, the detection of exclusion mechanisms is key. Therefore, using qualitative methods from those disciplines is especially advantageous. Trust in government and different understandings of the role of government and state have an impact on the willingness to participate (Lee and Schachter, 2019). Evidently, those conditions vary from place to place and are also differential within a state. For this reason, it is important to explore those different starting conditions to design Digital Citizen Participation accordingly. Moreover, for understanding different participation paths and formats, the knowledge of political specifics on a local and federal level is crucial. Understanding political systems and structures on a local and communal level, consequently, appears necessary for designing Digital Citizen Participation. Political science and related disciplines such as **public policy** and **governance** have an understanding of those political realities and therefore can and should contribute by staking out the framing conditions.

The most obvious disciplines involved with the design of Digital Citizen Participation are those who are practically involved with constructing the artifact. The expertise of **media**

design and **informatics** are necessary for the development of advanced and attractive platforms. Structuring the process of artifact design is well researched in Information Systems. In this dissertation, Part III is using methods like Design Science Research based on Peffers (2007) and Kuechler and Vaishnavis framework (2008a) which are immensely helpful to structure the design, development and evaluation of a software project. Other methods like participatory software design, a method explored since the 1990s, also puts the user in the center of the development process (Bossen et al., 2016; Muller and Kuhn, 1993; Sanders et al., 2010; Sanders, 2002). Various current system programming approaches seem necessary in informatics for developing Digital Citizen Participation projects. Although they are in detail presented and discussed in Part IV of this dissertation, which is about artifact design itself, here are a few examples that demonstrate the overall perspective brought in by informatics. A precondition for developing those artifacts is expertise in one or several of the following development fields: backend-, frontend-, full-stack-web and mobile device-development, as well as data science. To conduct and coordinate smooth software engineering processes, today agile forms of software development, which can be found in frameworks like Scrum and Kanban, seem adequate for the development of Digital Citizen Participation. Especially the following basics of agile development are fitting to software developments which should cater the needs of a broader population: customer satisfaction, prioritizing software operability and simplicity over complexity (Hazzan and Dubinsky, 2014). When it comes to more complex developments (e.g. adapting voting mechanisms) platforms are built by those who have a clear understanding of roles and access control. This knowledge is crucial for writing fitting code. For this reason, it seems necessary to include Information Systems and informatics in developing Digital Citizen Participation. Design experts, such as graphic and media designers, should assure that the information provided within the Digital Citizen Participation platform are presented in a thoughtful and pleasant way. Don Norman describes in his book “The Design of Every Day Things” (2013) the importance of considerate design choices. Including design experts can help, when it comes for example to forms, typography and color schemes to create user friendly platforms. Therefore their expertise is crucial to successful platform design.

In their book “The Power of Experiments – Decision Making in Data Driven World” Michael Luca and Max Bazerman (2020) show how mainstream **behavioral economics** became as a way for platform providers to test, evaluate and improve their platforms. The authors demonstrate that systemic experimentation is something which e-Commerce businesses can conduct even more easily compared to classical businesses, since their businesses rely on the systemic processing of data. In contrast, however, the authors also provide insights on how traditional institutions, such as government agencies, use

experimentation to achieve successful policy making. As an example they present experiments conducted by British government agencies under Tony Blair and David Cameron with the aim of nudging citizens into paying taxes. To name one success: through randomized controlled trials they rewrote and -designed letters asking the citizens to pay their taxes and thereby assured significantly higher tax revenues (Luca and Bazerman, 2020).

Finally, it is necessary to involve those disciplines who have the expertise to elaborate use cases. **Urban or respectively spatial planning** as well as **architecture** are the disciplines who can support designing Digital Citizen Participation by adding their knowledge on participatory urban planning as well as construction projects. Including those disciplines means to tackle current questions of urbanism together with the affected citizens. Furthermore, including architecture as a discipline might contribute to design architectural competitions in a way that they are mindful about a possible digital participation process. Thereby, architects can use digital formats that guarantee interoperability between their architectural designs and possible digital participation platforms.

For Digital Citizen Participation, it should be argued, that it seems quite important to engineer platforms that are easy to use and well accepted by the users. Smaller technology companies, like those who design e-Participation platforms tend to not have the resources to research and test the effectiveness of their products, as shown in the third chapter. Accordingly, the initiators of digital participation process might have to become more active. In experiments it could be researched and established which mechanisms work to keep a broad demographic interested in participating, as e.g. mechanisms of gamification might help to foster interactions on participation platforms. Since governmental agencies are, especially in larger urban contexts, often overwhelmed with the task to create meaningful interactions with their citizens, having perspectives from psychology, behavioral economics and Information Systems, included in the design of Digital Citizen Participation seems essential. In different chapters of this dissertation, artifacts are evaluated with methods coming from those disciplines. If communicated properly to the software developers involved, it could enhance the general user experience of the artifact. Nevertheless, experimental methods have to be used carefully and consensual. Therefore, involving an ethics committee can be of assistance to become aware of certain ethical challenges that might arise. Instead of running experiments without knowledge and proper consent of the participants, like some tech companies do, there are other options to test platforms in realistic settings. Besides field experiments, behavioral economic labs, like the KD2Lab, which was used for the experiment in chapter 8, pose a valid alternative for conducting ambitious and ethically responsible experiments.

Using data based on experiments can be very powerful for improving platform design. Nevertheless, this power could be – in the hand of state agencies, as shown with the historic example of the eighteenth century – misused by states to control their citizens. Thus, it can be concluded, that using experiments in Digital Citizen Participation should be generally about designing software artifacts that empower citizens by making them as useable as possible.

This subchapter can be understood as a plea for the translation work between a number of different disciplines. It is argued that connecting different theories and methods from philosophy, history, sociology, political science, Information Systems, informatics and behavioral economics / psychology can help to create meaningful Digital Citizen Participation artifacts that truly are in the citizens interest. Through this incorporation of pluralist perspectives on platform design, the transformation of individual needs and requirements towards the common good, as highlighted by Young (2004) could be realized.

2.3.2 Technological Innovations and Interoperability

In the third chapter a thorough evaluation of a popular e-Participation platform is conducted. Therefore, this chapter points towards the discrepancy in platform design innovations that exist between current e-Participation and other digital platforms. The pleasant world of Android and iOS apps, as well as e-Commerce platforms, made customers used to seamless and user-centered platform design. When it comes to games or commerce the adoption of technological innovations, like for example immersive systems, is in full swing. Already in 2016, a former branch of Google, Ninantic, launched the app Pokémon Go which combined location based GPS technology with AR (Paavilainen et al., 2017). Ikea created with their app Places, for both mobile phone operating systems, a popular app for the visualization of the Ikea furniture catalogue in the homes of their customers using AR. A study, that builds on various other studies on the effectiveness of virtual shopping environments, has already established that the use of the immersive Ikea app increased the customers general interest in products and a purchase (Alves and Luís Reis, 2020). With its rebranding respectively its restructuring from Facebook into Meta, the platform giant also announced to put the company's efforts into immersive systems (Roose, 2021). Apple in contrast broadened the spectrum of its hardware from notebook and desktop computers to portable music players to phones, tablets and watches, which are all connected (Jacobsen, 2017). Google pioneered from early on with collaborative cloud services like Google Docs, Forms etc. and thereby shifted the industry towards comparable cloud solutions.

Compared to this world of technological innovations, what can be found in e-Participation today seems relatively dull. With the new concept of Digital Citizen Participation it is reasoned, that the integration of state of the art technologies and hardware needs to become part of designing digital participation platforms. As the results on the acceptance of immersive systems in the public participation setting in the following chapters show, there is great interest and curiosity when it comes to using different technologies for public participation.

Another necessity for enabling Digital Citizen Participation seems to be system interoperability. This wish for high interoperability appears to stand in contrast to the claim for innovative artifacts, but it is the other way around: Interoperability means to be mindful about different access towards technology and to bridge existing gaps between systems and frameworks and thereby making platforms as usable and accessible as possible. Key in including broad parts of the population in participation processes is assuring the ability to use the platform from different operating systems, browsers and hardware. Especially in the search for common standards in e-Government, interoperability has been discussed, mostly for unique states like Brazil (Alves Oliveira and Eler, 2017), South Africa (Manda, 2017) and Uganda (Kanagwa et al., 2018). As a general takeaway of those studies it can be concluded that there is a need for some standardization, which is mindful of different access to soft- and hardware. To guarantee social cohesion, also in Digital Citizen Participation the standards need to be as basic as possible to be attentive towards those users who have older soft- and hardware or only use a certain kind of hardware like mobile devices.

Table 2 shows an overview of twelve e-Participation platforms, which can be considered market leaders. It presents e-Participation platforms that have a quite similar range of features and interfaces (mostly websites), while having varying approaches when it comes to the transparency of their code. While some of those platforms are open source, others do not share information on their code. Open source codes are in e-Participation not related to the business model of the platform operators. While they are partly running their endeavors as full profits (Consider.it, CivicPlus, Isights, CitizenLab, Dialogzentrale by Zebralog, LiquidFeedback by FlexiGuided and wer|denkt|was), others are organized as NGOs (Decidim by Decidim Association and democracia OS by Democracia en Red, FixMyStreet by mySociety, adhocracy+ by Liquid Democracy) or by a foundation (Consul by the Consul Democracy Foundation). Furthermore, Table 2 shows if the platforms offer any non-conventional, deviating technical innovations. Some of them do, but if those features are compared to other platforms or websites, data visualization, web embedding and Natural Language Processing (NLP) can hardly be considered innovative features. Other features like advanced voting mechanism and mapping features

are innovative in the sense that they are truly developed for the e-Participation context and could be useful for other settings as well. Bonitz et al. (2018) pointed out that e-Participation platforms should rely, in order to address the broadest possible spectrum of the population, on web applications that can be connected to mobile applications using standardized web frameworks. In 2022, even in this regard there seems to be room for improvement. Many of the bigger e-Participation platform providers do not even offer apps for their web based platforms.

Platform	Type	Website/ App	Open Source	Deviating Technical Innovations
Consider.it (USA) www.consider.it	Consultation	Website	Yes	Sorting of opinions in a histogram
CivicPlus (USA) www.civicplus.com	Consultation	Website and app	No	-
Insights (ISR) www.insights.us	Consultation	Website	No	Advanced data visualization
Consul (NLD) www.consulproject.org	Consultation and decision making	Website	Yes	-
Decidim (ESP) www.decidim.org	Consultation and decision making	Website	Yes	-
CitizenLab (BEL) www.citizenlab.co	Consultation and decision making	Website	Yes	NLP for insights on data
Liquid Feedback (GER) www.liquidfeedback.com	Primarily decision making	Progressive Web App (PWA)	Yes	Vote delegation, transitive proxy voting, platform independency through PWA
Adhocracy+ (GER) www.adhocracy.plus	Primarily Consultation	Website	Yes	Embedding on other websites
Dialogzentrale (GER) www.streifentechnik.de	Consultation	Website	No	-
wer|denkt|was (GER) www.werdenktwas.de	Complaints and Consultation	Website	No	Advanced mapping features
FixMyStreet (GBR) www.fixmystreet.com	Complaints	Website and app	Yes	Advanced mapping features
democracia OS (ARG)	Consultation and decision making	Website	Yes	-

Table 2. Overview currently successful e-Participation platforms.

What should be argued for is a differentiation between classical e-Participation platforms, and something that could be considered to be the next generation of digital participation platforms, which can be classified as Digital Citizen Participation. Thiel et al. (2018) already explored some technological innovation and trends such as using

smartphones, GPS, wearables, public displays, immersive systems and crowdsourcing. Furthermore, the authors discussed gamification in e-Participation (Thiel, 2016; Thiel et al., 2018) as a promising concept to assure the interest of the population in public participation. That kind of innovative inclusion of up to date technologies is meant when arguing for more play- and joyful use of technologies and their incorporation into public participation processes.

Figure 12. The platform Stimmen auf Knopfdruck and its application of voice messages (Stimmen Auf Knopfdruck, 2021).

The German platform Stimmen auf Knopfdruck, developed for a participation process in the city of Berlin, made use of an already existing and widely used technology – voice messages (Figure 12). Citizens could leave their comments additionally to classical written content through a recording. Although a study on the effectiveness of this technology is missing, the idea of opening up the dialogue to new forms of interactions seems promising, especially, when it comes to the inclusiveness of participation processes and the question who feels entitled to participate.

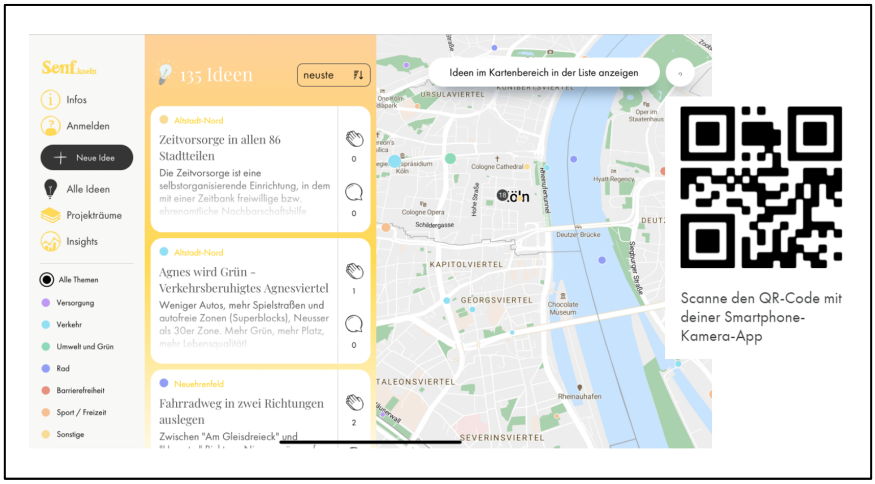

Figure 13. UPLab's Senf.Koeln platform (UPLab, 2021).

Another interesting example is the platform Senf.Koeln developed by UPLab, which placed QR Codes in the city of Cologne and showed an interactive map on a mobile device only webpage (Figure 13) to allow the use on the spot of interest. Those specifics alone turned what is shown as a standard in Table 2 upside down: the participation process was accessed through mobile devices, making it more accessible at the site. It can certainly be a barrier to re-envision an urban planning debate at home. Offering opportunities for on-site debates therefore seems overdue.

This sub-chapter argued for more interoperability and including technological innovations into participation processes. In the following chapters, research results on using a smartphone based platform, an app that includes AR and VR and for the visualization of urban planning combined with on-site debates, will be laid out for local public participation processes.

2.3.3 Incorporating an Inclusive Democratic Approach

According to Habermas, the "political public sphere [...] can fulfill its function of perceiving and addressing problems of society as a whole [...] only to the extent that it is formed from the communication contexts of those potentially affected. It is carried by an audience recruited from the entirety of citizens" (Habermas, 1992, p. 441). The politically relevant challenges are thus based on processes of public negotiation. According to Habermas, they have their origin in the "biographical experiences" (Habermas, 1992, p. 441) of the citizens who come together to form such an audience. Therefore, equal access to the public sphere seems to be of central importance for deliberation (Schmidt, 2019).

However, studies on e-Participation processes in Germany show that men participate more often than women and that the degree of participation depends, among other things, on the level of education (Rottinghaus and Escher, 2020; Send et al., 2014). This assessment is not at all satisfactory, considering that public participation is supposed to enable an equal discourse between all citizens and decision-making processes for them. As already mentioned and discussed when arguing for using approaches (theories and methods) from sociology and political science, the last pilar of Digital Citizen Participation, suggested in this dissertation, is the inclusion of inclusive democratic approaches.

Online participation undoubtedly created new opportunities to quantitatively involve more citizens, but it seems unclear whether this also leads to more inclusive participation (Schlozman et al., 2018). Qualitative research methods from social science are often used to investigate the inclusivity of deliberative participation platforms (Frisch, 2007; Kies, 2010; Weinhardt et al., 2015). There are obvious mechanisms of exclusion, that

come to mind, like the use of language. In German, through the generic masculine version of the third person, the gender neutrality is not given as a default. Weinhardt et al. (2015) therefore rightly point out that the use of gender neutral language can promote inclusion. Other language based aspects need to become center of attention. While, especially in journalism, web accessibility, is already in the focus of research (Giannoumis and Nordli, 2020; Karhunen, 2017), a debate about accessibility of digital participation platforms is urgently needed. How can it be achieved to be mindful about language barriers and how can they be overcome? How can plain language be used to be sensible towards citizens with disabilities? Already in 2015, Weinhardt et al. suggested to use translation tools to include parts of the population that do not feel confident about their language skills when it comes to written debate based e-Participation forums. Also the platform design itself can be more or less inclusive. Certain color schemes can exclude citizens who are not able to differentiate between certain colors. Here it is reasoned, that the inclusion of a diverse set of citizens into the design of Digital Citizen Participation platforms can prevent mechanism of exclusion. A concrete method of inclusion is presented in the fourth chapter, while the fifth and sixth chapter present the translation of the conversations with a diverse set of citizens into so called meta-requirements.

Why does this seem relevant? As shown in the previous sub-chapter e-Participation platform providers are not the most progressive and innovative ones when it comes to incorporating new technologies or design approaches. In this dissertation is formulated, that what is missing is that user-centric design should mean to keep the broader population in mind and not only the interest of the initiators of participation processes. There seems to be some kind of misunderstanding, as it appears unclear if the current mostly forum based e-Participation platforms succeed in catering the needs of the broader population.

As explored in the previous sub-chapter, some kind of hesitancy in e-Participation concerning technological innovations seems obvious. Although, in 2021 mobile devices are globally clearly the preferred form of internet access and interaction and the one with a higher market share compared to desktops (Enge, 2021; Petrov, 2019), e-Participation platforms continue to be browser based with interfaces that are mostly made for notebook and desktop computers. Including the realities of general hardware usage into the platform design itself can help to overcome some of those non-inclusive tendencies described by researchers (Rottinghaus and Escher, 2020). The fact that the population prefers the casualness of using their mobile devices, should be utilized for public participation. In this case too, research on journalism and technology can help understanding how to create inclusivity (and thereby general relevance) through platform design. Mobile applications showed great potential for local journalism as well as challenges in the

example of local news sites in Portugal. Accessibility remains an issue not easily resolved (Santos Gonçalves et al., 2021). Therefore, evaluating platform design and including a pluralistic set of voices into the design process seems highly relevant if digital participation processes claim to be democratic and representative.

Furthermore, new technological possibilities open up new forms of approaching citizens. Advanced data analytics can be used to get in contact with the relevant stakeholder groups in a participation process or can help to target unrepresented or underrepresented groups. Obviously, the practice of advanced data analytics and targeting is debatable. Due to the fact that mostly right-wing extremist took and take advantage of those technological practices (King, 2019; Ramos and Torres, 2020; Wylie, 2019), those who would like to foster democratic practices with their platforms also must become aware of those technics and using data analytics for guaranteeing representativity.

2.4 Conclusion

The chapter on the theory and background presents the theoretical basis for this dissertation. An overview on citizen participation and e-Participation was given and both, the historical context and theoretical concepts, were presented. Based on this, the new concept of Digital Citizen Participation was introduced. Thereby, a differentiation between classical e-Participation platforms and Digital Citizen Participation platforms, which are based on interdisciplinary research, incorporate innovative platform design standards and also aim for inclusive design – also through interoperability – is established and a theoretical basis for the following chapters given.

Part II

Case Studies on Digital Citizen Participation

3 Mission Statement Accomplished: Promises and Challenges in Using e-Participation for Mission Statement Development[4]

3.1 Introduction

For the purpose of defining shared values, mission statements became a trusted instrument for profit- and non-profit organizations worldwide. They are used as a tool to motivate employees (Klemm et al., 1991), involving them in the strategic management of an organization (Campbell and Yeung, 1991), and to create a common understanding among them (King and Cleland, 1978). Since the effectiveness of the mission statement is closely related to its content (Blair-Loy et al., 2011; Sattari et al., 2011), research mainly focuses on textual aspects and elements of the mission statement. However, employees seem to value the development process as equally or even more important than the resulting document (Desmidt and Prinzie, 2009). Baetz and Bart (1996) show that employees wish to be involved in the development through active discussions and feedback opportunities and appreciate when the process makes an effort in bringing the team together. Similarly, the organization and the mission statement itself may profit from the discussion of potentially conflicting opinions and ambitions (Mark C. Baetz and Bart, 1996). These findings are also echoed by newer research endeavors highlighting the innovative and transformative power of participatory approaches in organizations (Wagenknecht et al., 2017a, 2017b, 2017c), e.g., using methods like open innovation (Adamczyk et al., 2012).

As social networks create more spaces for political engagement and discussions (Lindner and Aichholzer, 2020), people receive more opportunities to get involved politically and voice their opinion online. The 2030 Agenda for Sustainable Development of the United

[4] This chapter comprises an article that was published by Jonas Fegert, Carolin Stein, Christian Peukert and Christof Weinhardt in the following outlet with the following title: Mission Statement Accomplished: Promises and Challenges in Using E-Participation for Mission Statement Development. In Iadis International Journal on Computer Science And Information Systems, 2021. Note: Tables and figures were renamed, reformatted, and newly referenced to fit the structure of the dissertation. Chapter and section numbering and respective cross-references were modified. Formatting and reference style was adapted and references were updated.

Nations reacts to this development by aiming to “ensure responsive, inclusive, participatory and representative decision-making at all levels” (United Nations, 2015, p. 25). In relation to that, the United Nations (United Nations et al., 2019) also declare that “online tools can enhance access to information and public services, as well as promote better public policy decision-making” (p. 33). This goes in line with the increase in digital government projects hosted by governmental institutions in the last decades (United Nations, 2020a). E-Participation, a form of e-government (also known as digital government), established itself as a way of facilitating citizen involvement in “democratic decision-making” (Macintosh, 2004, p. 2) by employing information and communication technology (ICT). Cities, municipalities, companies, and research institutions use e-participation to involve stakeholders in certain processes and decisions (Thiel et al., 2018). By that, they often aim at improving the overall acceptance of certain projects. E-participation research proved that the use of new digital technologies could strengthen the interest in projects and increase the motivation to participate (Chapter 7).

When temporary lockdowns prevent face-to-face interactions – as we have globally observed during the COVID-19 pandemic – involving employees in mission statement development must inevitably be carried out online – as opposed to conventional participatory settings like workshops. In addition to that, it appears plausible that the employees’ identification with their team and the organization they work for might decrease, when the workspace shifts into the private sphere, thereby leaving interaction with colleagues behind. In such times, e-participation naturally emerges as a means to facilitate remote collaborative work (United Nations, 2020b). One effect of the pandemics is that for many people, remote working increasingly poses itself as a viable option to working in the office (Bonacini et al., 2021). In Germany, politicians called for an introduction of a right to work from home (Deutsche Welle, 2020). Furthermore, remote working can pose an option for online conference and meetings, which can help address global carbon emissions (Ekstrom et al., 2020; Klöwer et al., 2020). However, translating long-established ‘offline’ formats like workshops into online meetings requires suitable digital environments that can go beyond regular chat or videocall options. Due to their deliberative character (Sanford and Rose, 2007), e-participation platforms promise to introduce an appropriate environment for participatory mission statement development outside of the office, making place for online-consultation and transparent decision-making (Macintosh, 2004).

In this paper, we provide insights from a participatory mission statement creation process that was realized with an e-Participation platform. We present a process consisting of eight activities for the purpose of mission statement development using e-Participation. Furthermore, our use case, a research institute at which 32 full-time employees

used an existing e-Participation platform to create a fitting mission statement, allows us to outline design guidelines concerning the general design of e-Participation platforms for that purpose. Three survey-based evaluations were used to examine users' experience throughout the participation process. Based on the evaluations, we demonstrate promises and challenges that arise from using e-Participation for mission statement development. Through designing, implementing, and evaluating a process for the given use case, we intend to derive first insights potentially leading towards a design theory for mission statement development with e-Participation platforms.

3.2 Theoretical Foundation

3.2.1 Mission Statements

Mission statements are documents summarizing the core values and strategies of an organization (Mark C Baetz and Bart, 1996). The mission statement is an important factor in the strategic management also due to its visibility and public accessibility (Cochran et al., 2008). Overall, it provides guidance towards the orientation and goals of an organization, bearing the potential to influence its effectiveness (Desmidt and Prinzie, 2009). However, the degree to which a positive impact is reached depends on the design, content, and wording of the mission statement (Desmidt and Prinzie, 2009). The respective literature suggests that the following aspects should be included in a mission statement: "target customers and markets," "principal products/or services," "specification of geographic domain," "identification of core technologies," "key elements in the companies' philosophy," "identification of the self-concept," and "identification of the […] desired public image" (Pearce and David, 1987, p. 112). With the message often being the center of research, less attention has been paid to the development process of the mission statement. A literature review on mission statement research conducted by Alegre et al. (Alegre et al., 2018) distinguish different types of mission statement articles, one of them concerning the "definition, creation and implementation" (p. 460) of mission statements. According to Alegre et al. (2018), most of these work emerged in the 1980s and early 1990s – a time when mission statements were commonly developed by top management, offering a draft to their subordinates for subsequent reviewing "until the CEO was satisfied" (Alegre et al. 2018, p. 461). Already then, however, missions statements were observed to be rather top-down and lacking the involvement of various stakeholders (Alegre et al. 2018). At the same time, Alegre et al. (2018) record a decline in high-quality papers dealing with the initiation of a mission statement creation, suggesting a scarcity in more recent research on this topic. Moreover, research has shown that the creation process is valued as more important or equally important as the

actual resulting mission statement (Mark C Baetz and Bart, 1996) and that the process of developing a commonly accepted message is just as vital as the message itself (Cochran et al., 2008). Baetz and Bart (1996) showed that within processes of mission statement creation, when stakeholders felt isolated and not sufficiently involved, they usually ended up being unsatisfied with the process. Furthermore, collecting input from everyone was often named as a reason for satisfaction. These results indicate that top-down approaches might be outdated for mission statement development and that there is room for improvement. Therefore, we argue that a more participative and inclusive development of a mission statement could solve a few of the mentioned problems.

3.2.2 E-Participation

With the emergence of ICT, e-democracy or digital democracy has evolved as an extension of "classical" democracy and participation theories, conceptualizing normative ideas about democratic societies (Lindner and Aichholzer, 2020). E-democracy is a form of e-government, which encompasses technologies that aim at engaging citizens in democratic decision-making (Macintosh, 2004) and shall be differentiated from e-administration, which focuses on online public services provision. E-participation, in turn, presents one form of e-democracy, which is defined as the possibility to participate in and influence policy decisions using ICT (Macintosh, 2004). Although e-Participation makes use of certain ICTs, no single e-Participation technology exists (Sanford and Rose, 2007). Instead, various online participation platforms and tools implement ICTs and various software solutions in the projects.

Overall, three main models of democracy can be differentiated: the liberal, the republican, and the deliberative model, and they can guide the aims of e-Participation respectively (Lindner and Aichholzer, 2020). In their literature review on e-Participation artifacts, Sanford and Rose (2007) demonstrate that e-Participation "research tends to focus on liberal, collaborative forms of participation [...] rather than [...] more direct form[s] of democracy" (Sanford and Rose, 2007, p. 416) like e-voting. As a result, e-Participation produces more participation, but not automatically more democracy and has therefore to be differentiated from e-democracy (Grönlund, 2009). This explains why e-Participation platforms were in their beginning especially popular in non-democratic states, in which e-Participation might be used as a token and public relation tool to draw a picture of modernity and democratic participation (Åström et al., 2012).

Besides the use for public participation projects, e-Participation has already proven its merits for corporate participation (Niemeyer et al., 2016; Wagenknecht et al., 2017c), where it can support idea creation processes. With its specific orientation towards democratic and socially interactive elements, e-Participation and its platforms go beyond

classical computer-supported cooperative work (CSCW). While cooperative work generally refers to the elaboration or revision of artifacts through joint interactions between individuals (Grudin, 1994), e-Participation tends to focus on the exchange of opinions and consensus building. Existing frameworks provide guidance for a successfully execution of e-Participation projects (Niemeyer et al., 2016; Scherer and Wimmer, 2011). Taking into consideration the many opportunities that e-Participation offers for collaborative settings, we want to research the combination of missions statements and e-Participation.

3.3 Methodology and Use Case

Schererer and Wimmer (2011) follow a holistic approach to the design of e-Participation projects. They accordingly suggest a reference design framework that consists of the following four phases: *initiation and design*, *preparation*, *realization*, and *evaluation* (Scherer and Wimmer, 2011, p. 7). In the course of this section, each phase should be described by recounting the conducted activities, highlighting related literature, and presenting the respective results. The different phases of this framework will be described after a brief introduction of the use case.

The participatory process will be tested within the development of a mission statement for a technology-oriented institute of a large public European university. The institute is headed by a professor and co-led by a team of six postdoctoral researchers (leadership team), representing different research groups, which consist of several PhD students as well as graduate student researchers and student research assistants. In total, the research group involves 32 full-time staff members, including administrational staff members. All team members are well experienced with technology usage since it is an Information Systems institute. The project itself was conducted over two and a half months, starting in July 2020 and administered by the authors of this paper.

Initiation and design: The initiation and design phase resulted in finding a suitable structure and platform for the participatory mission statement development process. A framework for an effective development of a mission statement is given by Cochran et al. (2008). Their four-step process includes an *orientation phase*, a *component analysis*, a *communication analysis*, and an *applicability analysis*. Facing the problem of the absence of shared workspaces due to the COVID-19 pandemic, the institute started rethinking practices and values (Table 3, Activity 1). Once the institute's leadership team decided to work on a mission statement, following Cochran et al. (2008), the major headlines framing the mission statement were decided on, to provide a guideline for the

following participatory process. Based on the set of relevant aspects of mission statements by Pearce and David (1987), the leadership team structured the discussion into four topics (Activity 2): *students* ("target customers and markets," "services," "specification of geographic domain"), *leadership* ("identification of self-concept"), *team* ("identification of self-concept," "philosophy"), *public relations* ("identification of 'core technologies' and the 'desired public image' ").

Reflecting the participants' roles is essential for each e-Participation project (Kalampokis et al., 2008). It should thus be differentiated between the input provider, the decision makers, the moderator, and the owner of the process. The structure of the institute directly implies a certain role distribution: the process is headed by the professor, implying that strategic process decisions require his approval. The professor is in the position to initialize the process and agree with the institute's team members on the necessary working time required for participation. The moderating role was split among the postdoctoral researchers to profit from their position and influence on their groups. They were expected to motivate the employees and be a point of contact in case of any concerns. Since the goal of the project is a participatory and democratic process, the input and decision roles belong to all team members equally.

Preparation: The preparation phase mainly included the search for a suitable e-Participation platform. The choice was based on a requirement analysis made by the institute leadership team, agreeing on the following essential characteristics: facilitating idea collecting, group discussions, and voting mechanisms. Phang and Kankanhalli (2008) present a three-step procedure to implement e-Participation initiatives that identifies the (1) objectives, (2) techniques, and (3) ICT tools which support the techniques and thereby the objectives. Phang and Kankanhalli (2008) suggest a structured participatory technique named "decision-making supplement", which fits the intentions of the project at hand and is defined by a nominal group process. A nominal group process is a step-by-step process in which suggestions are ranked and the outcome of one stage works as a recommendation for the following stage. An ICT tool could, for example, support an idea collection on a predefined topic, which then merges into a discussion of the ideas and underlying concepts to achieve a consensus through a voting mechanism as a final step. We combined those suggestions with some structural ideas on mission statement development made by Cochran et al. (2008; see Table 3).

Based on the described requirements and activities, we decided to use a platform developed by a European startup, which is used by public institutions, political parties, and international organizations. The choice of the platform was finalized in a meeting with the startup's CEO and several staff members, who guided us through the characteristics

of their platform. The platform claimed being able to support mission statement development processes, while the suggested participation modules resembles our requirements.

Realization: The e-Participation project was conducted over a period of eleven weeks, accompanied by three weeks of offline preparations. The initial platform setup was done by the authors in agreement with the postdoctoral researchers. Participants received an e-mail invitation for the online project, providing the option to create a pseudonymized profile. After logging in to the platform, they were welcomed with an overview screen of the project consisting of a project timeline and the overview of the participation modules. Clicking on the different modules would take them to the respective activity, where clear indications ("Join now") were given to guide the users to the participation opportunities. The realization started with a hybrid offline and online kick-off workshop. In the workshop, which gave an introduction into the e-Participation project and the platform, overall, 86 ideas across four categories were collected (Activity 3) and transferred to the platform. For several weeks, this initial idea collection was discussed online (Activity 4). Following an online voting (Activity 5), the postdoctoral researchers created sixteen mission statement alternatives out of the top voted proposals (Activity 6). For each of the four categories, these differed slightly in wording and phrasing. This was followed by another online voting (Activity 7), which resulted in a finalized version of the mission statement with one statement for each category. The last step of the idea collection process consisted of working out actions for operationalizing the mission statement into the daily business of the institute (Activity 8). This step led to 131 initiatives on how the mission statement could be operationalized and used in the future. During the whole participation process, a weekly e-mail newsletter was sent out to the participants to motivate and remind them to stay involved and offering them a point of contact in case of problems. Activity six and seven of this process replace the communication analysis suggested by Cochran et al. (2008) though we believe that the suggested democratic process will bring up the most convenient mission statement out of the alternatives.

Activity	Expected Outcome	Module
1. Orientation	Moderators and owners become aware of their role	-
2. Component analysis	Component categories for the idea collection are specified	-
3. Idea collection	Ideas concerning the different topics are collected	Debate [a)]
4. Discussion of ideas	General understanding for different ideas is developed	Prioritization [b)]
5. Vote on ideas	Ideas are prioritized via up- and downvotes	Prioritization [b)]
6. Formulation of mission statement	Different textual mission statement alternatives are developed by the leadership team	-
7. Vote on mission statement	Decision on the mission statement	Prioritization [b)]

8. Idea collection on applicability and operationalization	List of ideas for specific application of the mission statement	Debate [a)]
Techniques used: a) Proposals are condensed to predefined categories; possibility to up- and downvote or comment proposals; filtering and tagging of proposals; b) Opportunity to comment and up- or downvote predefined proposals; new proposals cannot be added; other users' comments can be up- or downvoted.		

Table 3. Activities, expected outcomes of the nominal group process, and modules.

Evaluation: The first process evaluation (Evaluation Phase 1) was conducted after Activity 5 and was included as a module in the e-Participation process. As the preliminary analysis of the first questionnaire has to some degree already indicated signs of dissatisfaction among the participants, we decided to examine the attitude towards the overall user experience of the platform in an additional non-obligatory questionnaire (Evaluation Phase 2). In doing so, we adapted a theoretical model by Naranjo-Zolotov et al. (2019), which evaluated an e-Participation tool relying on the unified theory of acceptance and use of technology (UTAUT) (see Venkatesh et al., 2003), followed by three open questions (Table 4). The final evaluation (Evaluation Phase 3) was designed as a follow-up questionnaire, after the participants had settled with the mission statement. To measure the quality of the mission statement and the qualitative influence of the participatory process, we used the theoretical construct "Congruence between values" adapted from the "Questionnaire of personal and organizational values congruence for employee" (Q-POVC), followed by self-developed items. The construct uses abstract phrasings in order to assess how much personal values of an employee match the ones present in an organization (Vveinhardt and Gulbovaitė, 2016). The evaluation results are presented in the results chapter of this paper.

Evaluation Phase	**Construct (Number of Items)**	**Item/Statement**
1	Satisfaction (1) *(self-developed)*	I am satisfied with the participation process for the mission statement.
	Process Support (1) *(self-developed)*	The e-Participation tool has provided useful support for the participation process.
	Structure (1) *(self-developed)*	The e-Participation tool has structured the participation process.
	Prioritization Module (1) *(self-developed)*	The prioritization module allowed me to clarify my weighting of the subjects.
	Debate Module (1) *(self-developed)*	The debating module allowed me to formulate new ideas.
2	Performance expectancy (3), Effort expectancy (4), Social Influence (3), Facilitating conditions (3), Intention to use (3), Competence (3); Meaning (3);	See Naranjo-Zolotov et al. (2019)

	Impact (3); Self-Determination (3), Intention to recommend *(adapted with e-Participation platform name specification)*	
	OQ1: Open Questions on the Participation Process *(self-developed, free text answer)*	Which parts of the participation process are important to you? How do you think an optimal participation process looks like?
	OQ2: Open Questions on Features *(self-developed, free text answer)*	Which features do you expect an e-Participation platform to have? Which features did you use or for what reason did you not use others?
	OQ3: Open Questions on Aspects of Usability *(self-developed, free text answer)*	Which aspects of usability are particularly important to you on an e-Participation platform?; What specific recommendations do you have for the design of an e-Participation platform?
3	Congruence between values (5) *(adapted)*	Things that I value in life are very similar to the things that the institute values in its mission statement. I agree with the values of the institute in its mission statement. My personal values match values of my institute in its mission statement. The values noted in the mission statement of the institute do not fully correspond with those that are declared, therefore I do not agree with the current values. I find that sometimes I have to compromise personal principles to conform to the institute's expectations noted in its mission statement. (Vveinhardt and Gulbovaitė, 2016)
	Participation Influence (5) *(self-developed)*	It was important to me that the mission statement was developed in a participatory manner.
		The participatory development process had an impact on my value congruence with the mission statement.
		The participatory nature of the development process improved my personal identification with the mission statement.
		My participation in the development process had no influence on my congruence with the mission statement.
		I would have identified more poorly with a non-participative developed mission statement.
	OQ4: Open Question on Effects on Daily Life *(self-developed, free text answer)*	What does the mission statement mean to you in your daily work?

Table 4. The two phases of the e-Participation evaluation. Note: We used seven-point Likert scales ranging from "strongly disagree" to "strongly agree" to measure the theoretical constructs if not stated otherwise.

3.4 Results

With this paper, we aim at revealing promises and challenges of the use of e-Participation for mission statement development. For this, we build upon the results of the three evaluation phases. Given that we only evaluated the platform and method by means of one organization and a small sample size (valuation phase one: N=10; evaluation phase two: N=21, evaluation phase three: N=27), we do not strive for generalizability of the evaluation results. However, we believe that the evaluation can identify some trends and thereby provides avenues for further research. Taking the evaluation results into account, we have to keep in mind that the assessment of the usability of an e-Participation platform varies depending on the different stakeholders involved in the use of the tool (Axelsson et al., 2013). In particular, stakeholder groups with lower urgency for the introduction of a new platform may be more reluctant to accept it, while the beneficiaries tend to be more optimistic and develop higher acceptance intentions.

3.4.1 Evaluation Phase One: Evaluation During Participation

The first evaluation was conducted during the participation process and gave a rather positive impression although it has already shown mixed results in the sense that it became clear that there was no distinct endorsement for the platform, which became even more visible in the second evaluation phase. The overall satisfaction with the process was rated above average, given that the middle point of the Likert scale is 4 (M=4.30, SD=1.19). Asking about the specific modules, they seem to have fulfilled their purpose: Participants mostly agreed that they could formulate new ideas (M=5.10, SD=1.37) using the module for debate and that they could clarify their weighting of the subjects using the prioritization module (M=4.50, SD=1.56). Although a majority agreed that the platform was useful to support the process (M=4.70, SD=0.90), only some participants believed that the platform is structured logically (M=3.60, SD=1.28).

3.4.2 Evaluation Phase Two: UTAUT-Based Platform Assessment

In light of the partly inconclusive results of the first evaluation, we wanted to get a better understanding of the problems the participants see with the e-Participation platform. Therefore, we used the constructs of the UTAUT-model based framework of Naranjo-Zolotov et al. (2019) (Table 4) to evaluate the e-Participation platform. Due to the sample size, we stick to report descriptive results for the variables of interest, since the sample size requirements for a sound structural equation modelling analysis (in accordance with Naranjo-Zolotov et al. (2019) for testing their theoretical model in our context) are not met. Furthermore, we asked some open questions to get feedback that is specifically

tailored on the participation process, the usability of the platform as well as its features, and how those aspects might be improved. When we interpret the duality of the results of the second evaluation, we have to keep the technical proficiency of the participants in mind – all are associated with an Information Systems institute. The facilitating conditions like the knowledge and resources necessary to use the platform were evaluated as strongly positive (M=6.39, SD=0.82; please note: Due to an insufficient Cronbach's alpha value (.64), the item "the platform is compatible with other technologies I use" was removed before aggregating the single item's values to one measure; after removing the item, the construct's Cronbach's alpha value (.77) met the commonly applied threshold value of .7). The effort expectancy (M=5.11, SD=1.45), which captures the ease for the users in learning and understanding how to use and interact with the system, was evaluated positively as well. Furthermore, the users were confident about their abilities and skills to use the e-Participation platform, shown by the positive competence outcome (M=5.70, SD=1.16). Only slightly above average was the self-determination (M=4.37, SD=1.56) the users perceived over their platform use. Self-determination measures the autonomy and independence in the usage and since decision-making processes should rely on the freedom of choice, we would have expected a better outcome. Both constructs, meaning (M=4.43, SD=1.53) and social influence (M=4.00, SD=1.36), revealed more details about the process itself: The participants apparently saw the project's meaningfulness (the value for the using person) above average. That being said, a social influence (the extent to which a person perceives that others believe that he or she should use the system) outcome on the middle point of the scale showed no clear opinion if the people with an influence on their behavior would like them to use the platform.

In contrast to the prior constructs, the following showed rather negative results: With the construct performance expectancy (M=2.77, SD=1.43), the usefulness of the platform in daily life, the ability to accomplish things more quickly, and the increase of productivity through the tool is captured. The remarkably low results emphasize that the participants did not see the e-Participation platform as a valuable addition to their set of digital tools. In this regard, it could be argued that a mission statement development process is not an everyday activity and, thus, limitations in the user experience are tolerable. However, in the same vein, the results for the intention to use (M=2.19, SD=1.11) indicate serious concerns. The results revealed hesitancy towards using the e-Participation platform besides the presented use case. A below average impact (keeping the users informed about the effects of their participation) result (M=3.44, SD=1.26) showed, that the participants did not see the platform as a strong means to influence what happens in their environment. However, it has to be stated, that interpreting this

result is complex, since it could be seen positively that in a process that has been envisioned as democratic, the participants have not overestimated the personal impact. In line with the low satisfaction with the used e-Participation platform, the value for intention to recommend the platform to others is rather low (M=3.62, SD=1.94). The results for the individual constructs are summarized in Table 5.

Construct	Mean (M)	Median	Standard Deviation (SD)	Cronbach's Alpha
Satisfaction (N=10)	4.30	4.50	1.10	-
Process support (N=10)	4.70	5.00	0.90	-
Structure (N=10)	3.60	3.00	1.28	-
Prioritization module (N=10)	5.10	5.00	1.37	-
Debate module (N=10)	4.50	5.00	1.56	-
Performance expectancy (N=21)	2.77	2.33	1.43	0.89
Effort expectancy (N=21)	5.11	5.00	1.45	0.86
Social influence (N=21)	4.00	4.00	1.36	0.86
Facilitating conditions (N=21)	6.39	6.50	0.82	0.77 (third item dropped)
Intention to use (N=21)	2.19	2.00	1.11	0.86
Competence (N=21)	5.70	5.66	1.16	0.94
Meaning (N=21)	4.43	4.66	1.53	0.93
Impact (N=21)	3.44	3.33	1.26	0.90
Self-determination (N=21)	4.37	4.00	1.56	0.90
Intention to recommend (N=21)	3.62	3.33	1.94	0.97

Table 5. Descriptive statistics.

For analyzing the open questions, we followed the qualitative research approach of a structured content analysis (Gläser and Laudel, 2010). Following our analysis, we were able to sort the answers into three categories: *participation process*, *platform features* and *platform usability*. In the following, we will introduce several summarized ideas that were mentioned in the open questions section. For each question, every participant could express several ideas; therefore, the percentages in the following paragraphs of the evaluation represent the share of participants who expressed a common idea. Consequently, the percentages are not mutually exclusive and always reflect the amount of participants expressing a similar idea in relation to the sum of participants.

Participation process: The responses to the open questions (OQ1) on the participation process showed that the participants valued the general participative character of the process as well its realization on the e-Participation platform. 20.69% of the participants mentioned the online voting positively, 17.24% the online debates, while only 6.90% mentioned explicitly that they liked the possibility to comment. Some participants

(13.79%) positively mentioned the collaborative teamwork. However, others stated explicitly aspects of the offline workshop (13.79%) and that they liked the combination of online and offline participation (10.34%) and thereby showing, that some respondents truly valued the offline components of the presented participatory process and that they partly missed personal interactions. In contrast, 13.79% appreciated the anonymity of the e-Participation process and saw it as strength for inner-organizational participation. Only 3.44% of the contributions highlighted the moderators' role.

Platform features: Regarding the desired features (OQ2) of an e-Participation platform supporting a mission statement development, users showed interest in the following functionalities: voting (30.95%), having surveys (16.67%), discussion forums (11.90%), commenting (9.53%), submitting own contributions (7.14%), and text editing (7.14%). Other desired aspects were personalized filters and sorting options (7.14%), better visualization features to illustrate statistics and user behavior on the platform (4.76%), process tracking (2.38%), and more dynamic moderation features (2.38%). Since many of those suggestions were not or only partly supported by the used e-Participation platform, we consider that the mentioned features can present beneficial extensions for the platforms (or comparable platforms) in future.

Some participants stated important reasons for their hesitancy towards commenting and submitting own contributions, such as doubting the influence of the individual participation, being demoralized by a lack of feedback from other users, or fearing a lack of anonymity. In terms of their intrinsic motivation to participate, having no strong opinion on some topics or a feeling that there is already sufficient representation of one's own opinions also led towards not participating.

Platform usability: Relying on UTAUT-based constructs for platform evaluation, we have already given a broader impression on the tool's usability. With the open questions on the usability (OQ3), we therefore aimed at identifying requirements for an e-Participation platform for mission statement development. The participants value simplicity (19.44%), a clear structure (16.67%), interactivity (13.89%), and intuitiveness (11.11%). Other minor aspects, which each account for 8.3% of the contributions are transparency, efficacy, and the possibility to participate quickly. Specific suggestions for a better e-Participation design addressed mostly a lack of transparent navigation and aimed for a flatter and clearer website hierarchy. Further thought-provoking suggestions were: using aspects of gamification for better user involvement, using icons to make the functions of certain modules directly visible, better tagging features, or even automated clustering of ideas, developing a mobile application allowing to use the e-Participation platform more properly also on mobile devices, and possibilities to switch between anonymous and non-anonymous user interaction.

3.4.3 Evaluation Phase Three: Satisfaction with the Outcome of Participation Process

In contrast to the critical assessment of the platform, the third evaluation, measuring value congruence and participation influence, showed that the qualitative outcome of the process was rated very satisfactory. The items within these two constructs contained several positively and negatively framed questions. With regard to value congruence, the five different framings of the question whether their personal values were reflected in the mission statement, the participants overwhelmingly agreed on the suitability (average positive framing: M=5.67, SD=0.74; average negative framing: M=2.52, SD=1.26). In this context, 92.63% of the participants stated that they concurred with the values formulated in the mission statement (rating five or higher). Due to the lack of a comparative value of a mission statement developed without employee participation, the participants themselves assessed the influence and value of the participatory element. The evaluation of the five different framings of the question whether the participatory element of the process had positively influenced their identification with the mission statement shows a clear tendency that e-Participation improved the participation influence among the participants (average positive framing: M=4.94, SD=1.72, negative framing: M=3.15, SD=1.51). 74.07% of the participants rated the participatory element in the process as important.

Construct		Mean (M)	Median	Standard Deviation (SD)
Value congruence (N=27)	VC Pf (1)	5.44	6	0.79
	VC Pf (2)	5.81	6	0.72
	VC Pf (3)	5.74	6	0.70
	VC Nf (1)	2.89	2	1.29
	VC Nf (2)	2.15	2	1.24
Participation influence (N=27)	IP Pf (1)	5.63	6	1.72
	IP Pf (2)	4.04	4	1.65
	IP Pf (3)	4.96	5	1.60
	IP Pf (4)	4.78	6	1.89
	IP Nf (1)	3.15	3	1.51

Table 6. Descriptive statistics. Note: Pf accounts for positively framed questions, Nf accounting for negatively framed questions.

With the open question “What does the mission statement mean to you in your daily work?” we wanted to get an impression on the influence of the mission statement on the everyday working life of the employees, weeks after it had been discussed. The evaluation of the open question allowed us to differentiate between participants (N=27) to whom the mission statement was *rather less important* in the daily work (48%) and those who valued it (52%) either as a *source of orientation for values and norms* or as a *concrete recommendation in interaction with their colleagues.*

Answer Category	Quotes
The mission statement was not very present in my daily business	*"I thought it was quite good at the time and corresponded to my understanding of our cooperation. But the fact that it now officially exists changes little in the everyday life."* *"It is good that we have it to refer to it – but actually I rarely think about it and it does not affect my work that much."*
The mission statement serves as passive orientation for values and norms for me	*"They are "higher goals / values" that I find good and share."* *"[To me it gives] orientation for the work culture at the chair"*
The mission statement offers concrete recommendations when interacting with my colleagues	*"For me, the mission statement means better cooperation in meetings with many participants."* *"It helps as a communication medium/anchor for conversations with employees."*

Table 7. Selected participant quotes relating to OQ4.

3.5 Discussion, Future Research, and Conclusion

Based on the general trend towards digitizing the workplace – especially sparked by the COVID-19 pandemic – we argued that there is a strong case for using e-Participation for mission statement development. Within this paper, we demonstrated promises and challenges of using e-Participation for mission statement development, and our contribution lies in presenting a nominal group process, consisting of eight activities, for their deployment. In our evaluation, we investigated the acceptance of the process, the mission statement itself and assessed the ICT tool regarding its features and usability. The study, which consisted of three evaluation phases, showed an interest in using e-Participation platforms for this purpose, but the challenge seems to lie in finding the right platform or respectively in refining the existing ones. The evaluation results allowed us to draw first conclusions about designing and implementing a mission statement process with e-Participation. The results of the evaluation phase one and the open questions showed that the suggested modules (debate and prioritization) were accepted and supported by most participants. We could verify the results of mission statement research (Desmidt and Prinzie, 2009) emphasizing that participants value opportunities to participate. Especially voting mechanism seemed to be an attractive feature of e-Participation. The respondents also liked more time-consuming activities such as discussions, text editing, or commenting. Therefore, we do not see any need to adapt the suggested

nominal group process and do see possibilities for other organizations to reuse it. The users made us aware of the merits of hybrid formats, which connect off- and online activities, since both elements seem important to satisfy various stakeholders and create a certain team spirit.

Moreover, the results of evaluation phase two showed, that the used platform overall did not satisfy the participants. Although users were convinced that they had the necessary resources, abilities, and skills to use the platform, they had a low intention to use and recommend the system. Future efforts to develop or select an appropriate platform for supporting a participative online mission statement process should therefore strongly focus on usability aspects, e.g., those suggested in our results section, in which we showed that platform should be simple and should follow a clear structure allowing a fast and intuitive navigation. State-of-the-art possibilities for a more entertaining user experience and better user interaction should be integrated to provide incentives for using the platform.

The results from evaluation phase three indicate, however, that these additional efforts in applying e-Participation and developing or improving suitable platforms, pay off eventually as the participatory element was not only valued by participants, but also improved their identification with the mission statement. This leads to a majority of participants utilizing the mission statement even in their day-to-day work, which we argue to be a great success in creating a unifying team spirit and a shared mission.

In this paper, we made the case for the combination of mission statement development with e-Participation. Since the used and tested e-Participation platform did not met the requirements, for future research, it would be interesting to explore how other platforms master the described process. Although we primarily focused on mission statement development, we see further potential to use the presented process for other e-Participation initiatives, which aim for the same project objective, namely a decision-making supplement. We believe that combining e-Participation with mission statement development would be an exciting artifact to be developed within a Design Science Research project (Hevner et al., 2004).Thereby, meta-requirements, design principles and a design theory for an e-Participation platform for mission statement creation could be investigated. Addressing the named challenges and aiming to reach the promises in future research, we are interested to see, how our nominal group process for participatory mission statement development will be adopted and refined.

4 Using Kaiser's Qualitative Interview Framework for the First Steps of Design Science Research[5]

4.1 Introduction

Information Systems artifacts were traditionally developed to improve processes in and across companies. Here, however, a change can be observed, as increasingly IS are used for other areas, e.g. for the support of individuals and society (Matt et al., 2019; Sanford and Rose, 2007). For example, to tackle the climate crisis, some IS researchers argued to use the "transformative power of IS to create an environmentally sustainable society" (Watson et al., 2010, p. 24). This call for action was used by others to suggest concrete steps for IS research that incorporates societal developments and work towards a more digital and sustainable society (Gholami et al., 2016; vom Brocke et al., 2015). The COVID-19 pandemic also showed how much the acceptance, design and development of digital infrastructure and artifacts (like the widespread establishment of teleconferencing and new tools for collaborative work) are linked to societal changes. Putting the (potential) users in the center, when developing artifacts in times of changing societal environments seems key if the artifacts shall play a positive role in shaping those transformations. Therefore, it seems even more important and fundamental as before to include the perspectives, knowledge and creativity of different stakeholders from the beginning in the design process of artifacts.

The importance of integrating the user in the design process early on has been recognized for a long time. This can been seen in literature on participatory (Bossen et al., 2016; Mueller et al., 2018; Sanders et al., 2010) and user-centered design (Dwivedi et al., 2012; Silva et al., 2011) among others. Sanders et al. (Sanders, 2002) made in the beginning of this century the distinction for artifact design between designers (respectively developers) and design researchers and furthermore saw the design researchers methodological toolkit relying on a fundament based in social science (Sanders, 2002). When it comes to deploying social science methods for qualitative research, integrating potential users through evaluation techniques, ethnographic methods and prototyping

[5] This chapter comprises a working paper by Jonas Fegert, Anna Golubyeva, Jella Pfeiffer, Christian Peukert and Christof Weinhardt. *Note*: Tables, figures, and appendices were renamed, reformatted, and newly referenced to fit the structure of the dissertation. Chapter and section numbering and respective cross-references were modified. Formatting and reference style was adapted and references were updated.

is popular (Myers and Avison, 2002). Nevertheless, the state of the art resources seem relatively vague regarding concrete interview techniques (Conboy et al., 2012; Myers, 2020; Myers and Avison, 2002; Myers and Newman, 2007; Vaishnavi and Kuechler, 2015). We argue that the integration of qualitative interviews in the first steps of a design science cycle (i.e. before the first design of a prototype) can be of great importance to describe the problem and the motivation that might lead to the design of an artifact. This paper thus aims to present a framework for interviewing techniques that can be used following Kaisers (Kaiser, 2014) approach for expert interviews in political science. Through incorporating this method into a concrete Design Science Research process, we arrive at an interdisciplinary approach to artifact design that relies from the beginning on participation of the future users. By presenting our research approach, on the basis of a concrete use case, we will demonstrate a way to include qualitative interviews at the initial phase of a DSR projects to create user-centered artifacts in a participative manner.

4.2 Theoretical Foundations

Scientific knowledge is based on observations and theories, nevertheless in inductive research the theory-building is always based on observations (Bhattacherjee, 2012). In IS, qualitative methods are widely used for making those observations (Conboy et al., 2012). Qualitative data collection pose a rather accepted method ranked in their popularity after surveys, mathematic modelling and case studies (Mazaheri et al., 2020). Nevertheless, their application does not always follow recent standards in social science (Myers and Newman, 2007) – the field of study which qualitative research originates from. Qualitative methods produce, if conducted carefully, reliable empirical research results (Myers, 2020). Furthermore, through their explorative approach, they can draw attention to new phenomena and help to create more practical relevance (Kruse and Lenger, 2014; Trauth, 2001). To that extent, Weßel (2010) points out that qualitative interviews can involve the interviewees in the development of an IS project and accordingly arouse interest in the project itself. Moreover, if various stakeholder groups are consulted, the research might receive a better overview of the different perspectives on and needs for an emerging artifact (Axelsson et al., 2010). Thereby, they have the ability to support researchers in drawing a more realistic picture of an IS project. This appears especially suitable, when knowledge about a research area is lacking and therefore the problem space cannot be described appropriately. The explorative approach therefore might help to grasp the challenges and the potential of an innovative artifact.

4.2.1 The Use of Qualitative Methods in Design Science Research

According to Hevner et al., DSR "aims to add to knowledge of how things can and should be constructed or arranged (i.e., designed)" (Hevner et al., 2019, p. 3) in order to produce a "solution to a real-world problem of interest to practice" (Kuechler and Vaishnavi, 2008a, p. 492). Maedche et al. (2019) call special attention towards the importance of clarifying the problem space in DSR. In this paper, we focus on the motivation part in DSR projects in which the problem should be properly defined in order to be able to translate these into suggestion. In our research, we started to use the approach by Peffers et al. (2007) and moved to Kuechler and Vaishnavi's framework (2008b), to be able to address the increase of complexity through using the three cycle view in DSR (Hevner, 2007a; Morana et al., 2014), which helped us to keep the artifact development transparent and well-arranged. Table 8 shows the similarities between the two frameworks. What Kuechler and Vaishnavi call "awareness of a problem" and "suggestions" (Kuechler and Vaishnavi, 2008a, p. 493) is comparable to activity 1 and 2 "Problem identification and motivation" and "define objectives of a solution" as defined by Peffers et al. (2007, p. 52) (see Table 8).While in our research, we focused on Kuechler and Vasihnavi (2008b), we would like to make a reference (Table 8) to the framework by Peffers et al. (2007) to show how the suggested method of qualitative interviews could be used in a different DSR framework.

Step/ Activity	Requirements by Kuechler and Vaishnavi (Kuechler and Vaishnavi, 2008a)	Requirements by Peffers et al. (Peffers et al., 2007)
1	Defining a real-world problem to which DSR could offer a solution of interest to practice.	Define the specific research problem. Justify the value of a solution and thereby: • Provide motivation for researcher and reader • Make the researcher's reasoning transparent
2	Work out "various approaches to the problem, informed by prior research on related issues […] to explore the feasibility of each approach" (Kuechler and Vaishnavi, 2008b, p. 7)	Based on the problem identification and knowledge about the state of problems and current solutions as well as their efficacy, propose objectives of a solution for the defined problem.

Table 8. Requirements for activity/ step 1 and 2 of the DSR frameworks.

Vaishnavi and Kuechler suggest in their handbook "Design Science Research Methods and Pattern" (Vaishnavi and Kuechler, 2015) concrete ways to approach the first two steps of their cycle through different patterns. For the problem analysis, they suggest "analysis type patterns" (Vaishnavi and Kuechler, 2015) like cost-benefit analysis or research conversation and furthermore more experimental patterns. For the "suggestions and development patterns" (Vaishnavi and Kuechler, 2015), the authors propose manifold approaches to address this point like iterative prototyping, using human roles or

sketching solutions. A more recent overview on DSR cases edited by vom Brocke et al. (2020) demonstrated the high relevance of qualitative interviews in DSR, but proved our point on the vagueness of their conduction. Although interviews are named, no concrete guidelines for interview techniques are proposed. Elsewhere, Hevner and Chatterjee (2010) recommend focus groups as a concrete qualitative method for DSR. While it has to be acknowledged that this approach might lead to direct feedback on an artifact, in its artificial setting (e.g. the role of a moderator) it keeps out the societal surrounding. Therefore, we would like to put forward a concrete technique for qualitative interviews, based on recent social science standards, for the first steps of DSR. Thereby, we would like to counter a vagueness in DSR, where certain qualitative methods are named but not outlined how they were exactly performed.

4.2.2 Social Sciences Methods for Expert Interviews

In our research, we followed Kaiser (Kaiser, 2014), who suggests a method for the conduct of qualitative semi-structured expert interviews in political science. Kaiser describes in a condensed and systematic manner the theoretical and methodological basics, the practice of interview preparation and execution as well as the methods of data evaluation and interpretation – including typical challenges. For the first steps of DSR, we suggest four steps, namely: Literature Review & Design Science Cycle Creation, Stakeholder Mapping, Expert Interview Conduct as well as Data Preparation and Structured Content Analysis (see Figure 14). The two latter employ the "ten steps of the preparation, conduct and analysis of expert interviews" as suggested by Kaiser (2014).

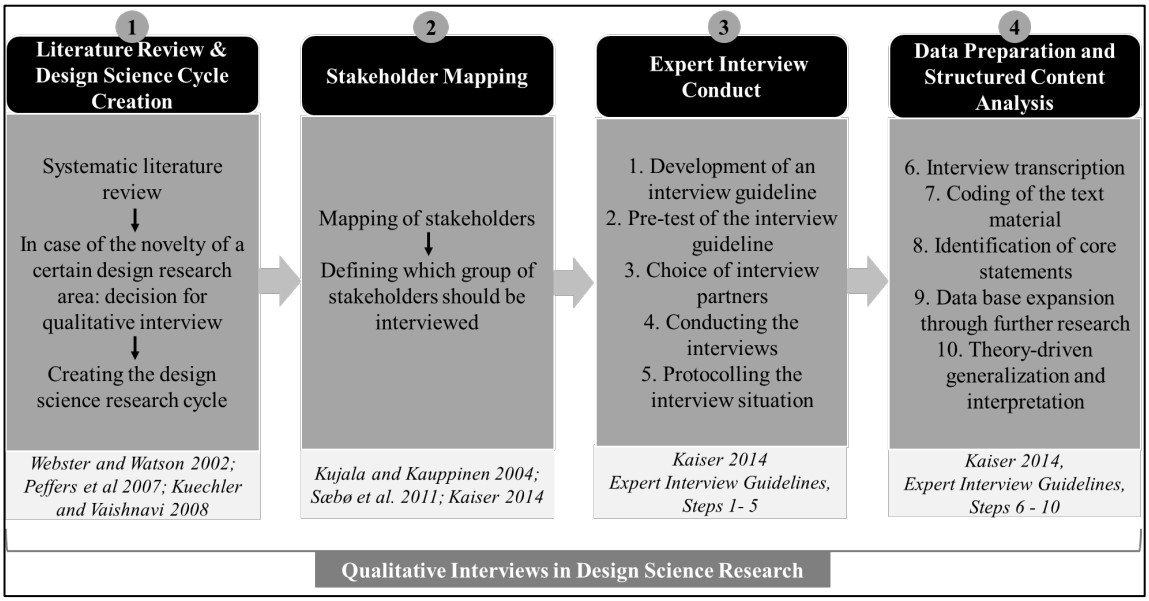

Figure 14. Employing qualitative interviews for the first steps in DSR.

Within the first phase of our process, we conducted a literature review based on the suggestions by Webster and Watson (2002) as well as vom Brocke et al. (2009). Afterwards we created the DSR cycle based on the above mentioned framework by Kuechler and Vaishnavi (2008a).

When speaking of "experts," Kaiser differentiates between experts through "position and status" and experts through "functional knowledge" (Kaiser, 2014, p. 41). The latter include not only those who we normally view as experts – persons qualified through their technical knowledge on a certain topic – but also stakeholders whose common and everyday knowledge is of relevance for the researcher (Kaiser, 2014). We combine this general idea of Kaiser in our adaptation of his approach for DSR with an IS method by Kujala and Kauppinen (2004) for stakeholder identification in user centered design in the second phase of our process. The authors suggest a clear process of identifying and selecting stakeholders and set criteria to describe their characteristics, which is useful for the second phase of our process. Furthermore, we suggest Sæbø et al. (2011) recommendations that illustrate power structures between different stakeholder groups, which are an useful addition since they reveal certain conversational dynamics in the interviews.

With our application of Kaiser, we chose a more systematic approach than the popular grounded theory method by Glaser and Strauss (1995), which is suited for the development of empirically grounded theories (Myers, 2020). Given its strict guidelines and complexity, grounded theory appeared to us less suitable for a deployment outside the social sciences. Even in social science, although often referenced, they are rarely applied in the full and original sense with their multi-level design. Therefore, due to its well-defined and compact framework, Kaiser's approach is from our point of view well suited for DSR. It combines the contextual precision of case study research, which some IS researchers value in qualitative methods (Benbasat et al., 1987) with the phenomenon-describing qualities of grounded theory, which others appreciate (Urquhart et al., 2010). For this reason, if its rigorous application is followed, results of the qualitative interviews could be easily used for developing specific suggestions like meta-requirements or personas.

4.3 Methodology and Use Case

4.3.1 Use Case

We will now show how we used Kaiser's framework for one of our projects. In this project, we aimed to develop an artifact that combines e-Participation with augmented and

virtual reality (AR and VR) for urban planning. the development of an e-Participation artifact, using participatory and user-centered design methods seems like an obvious choice. The decisive factor for choosing qualitative interviews, however, was the finding that there was a lack of research concerning the artifact idea, the combination of e-Participation with AR and VR. As a result of a literature review (Figure 14, phase 1), which pointed out this research gap (Chapter 7), we decided to use Kaisers' qualitative interview method, with its explorative character, to find out about the potential and challenges concerning our idea and eventually "justify the value of a solution" (Maedche et al., 2019) and make suggestions for this solution. After conducting the first steps in DSR with the presented process (Figure 14), we used quantitative methods for the artifact evaluation (e.g., aspects of user experience) in a field and a lab experiment, which we consider the best fit for a comprehensive artifact assessment. In the whole DSR project, we thereby arrive at a mixed-method approach, combining user-centered artifact development in a novel field and extensive testing with quantitative methods.

The aim of this DSR project was to research and develop a mobile application (app), which would allow a project initiator to present a construction project to app users and enable them to contribute to construction planning through the app. The joined use of AR and VR is new, thus, we decided to conduct semi-structured interviews with the retrieved stakeholders of the use case at hand during the initial stages of our project to develop meta-requirements, which guided the development of our e-Participation artifact. Although we already published our DSR project with a focus on the quantitative evaluation of the meta-requirements (Chapter 7), we describe within this paper, how we managed developing them through using qualitative interviews. For this specific field of research (e-Participation belongs to the research domain of digital government), we found support for participatory approaches by Sæbø et al. (2011) Axelsson et al. (2010), and Johannessen et al. (2012), who demonstrated the importance of citizen involvement in digital government projects. Through mapping the relevant stakeholders (Figure 14, phase 2) we wanted to follow their advice and explore the different dimensions.

Our chosen use case was the zoological garden of the city of Karlsruhe which planned to create a new enclosure for ring-tailed lemurs on a yet unused island in their park.[6] In its role as a local zoo, the interest in the construction process by the citizens of Karlsruhe was expectable. Further, the architectural project itself has been a novelty to the zoo. Therefore, the management decided on involving the zoo visitors as direct stakeholders

[6] At this point, a special word of appreciation and gratitude is due to the Karlsruhe zoological garden, its director, public relation manager and staff members. Through their helpfulness, they made it possible to carry out a large part of the conducted studies at their facilities.

into the construction plans from the very beginning on. This participation project promised to serve as a promising use case to us out of three reasons. Firstly, the project by the zoo promised the involvement of a diverse (in terms of age, gender, social background) group of stakeholders with diverging interests. Secondly, the context of the construction project offers special applicability for the technologies and the initiators, the zoo management was eager to involve the citizens with a certain flexibility on their side. For those reasons, conducting qualitative interviews seemed a reasonable approach to start our DSR process.

Interview Guideline Development

Our theoretical findings indicated four different research dimensions that required further specification through the interviews: 'experience and interest', 'degree of participation', 'technology acceptance' and 'incentive concepts' (Chapter 7). In order to develop a user-centered artifact, we directed the interview questionnaire towards the interviewees' previous experience with e-Participation and the technologies at hand, their expectations towards the planned artifact and aspects of the app, which would be of high importance to them or which they consider problematic. We thus arrived at a semi-structured interview guideline containing 24 predefined questions that addressed the aspects of our artifact regarding which we required the potential users' perspective on (Figure 14, phase 3.1).

Contacting the Stakeholders as Experts and Pre-Testing

In our choice of the interview partners, we relied on the stakeholder analysis, which allowed us to identify what groups of stakeholders were interested in the use of the artifact and thus, need to be consulted as experts (Figure 14, phase 3.2). For our use case five groups of stakeholders were determined, namely the zoo visitors, the zoo administration, its charity organization, city council members and technical experts. After the stakeholders were identified, we contacted representatives of each group and arranged the interviews. Prior to data collection, we carried out a pre-test in which we presented the artifact and tested our questionnaire with three different people who were not involved in the project. Afterwards, we refined and clarified certain items.

Introduction and Transparency in Conducting

To create a common foundation, the interviews began with an introduction into the technologies. The interviews were held in a separate room, where the participants were able to familiarize themselves with the technologies. They could test AR with a smartphone with a preinstalled AR app on it. A postcard presenting the construction site contained the markers, which helped to determine the position of the virtual elements

to project through the smartphone. Through the phone camera, the app identified markers printed on the postcard, and hence displayed the different versions of the construction site on the smartphone. Using a HMD, we demonstrated VR to the participants showing them a 3D model of the construction site. The participants were given the time they needed to familiarize themselves with the technologies to create a common understanding of the technologies among the interviewees.

Prior to the actual interview, the interviewer made the goals and the interview structure of the research project transparent to the interviewees. With the interview guideline being semi-structured, the interviewer was able to ask further questions or make sure to understand the participants correctly, thereby leaving space for new thoughts or referral to previous questions (Figure 14, phase 3.3).

The actual interviews were conducted and an attempt was made to ensure that interaction effects (like reactions to the interviewee, paternalistic behavior etc.) were avoided. Using a dictaphone, the interviews were recorded during the entire conversation (Figure 14, phase 3.4). We conducted interviews with interviewing 27 different stakeholders which is in PD considered a moderate group size (Muller and Kuhn, 1993).

Following Kaiser (Kaiser, 2014), the interview protocol which was filled out at the end of an interview, contained some biographic and demographic data about the interviewee(s), the interview atmosphere and the overall state of the interviewee – generally, information of potential future relevance (Figure 14, phase 3.5).

Evaluation

Using a computer-assisted qualitative data analysis software (Kuckartz and Rädiker, 2019), in our case MAXQDA, we were able to digitally transcribe the interviews (Figure 14, phase 4.7). Using a code system that reflected the research dimensions, which guided our interviews, we structured the interviews through assigning statements to respective codes based on Kaisers suggestions (Kaiser, 2014) (Figure 14, phase 4.8). Whenever a piece of information was found in the interview that was yet unknown, we extended our database through further research (Figure 14, phase 4.9). Relying on our complete previous research, we were able to generalize and interpret the interviews in face of our research goals (Figure 14, phase 4.10), thereby allowing us to map out the critical points to be considered in further artifact development through the following DSR activities.

4.3.2 Implementing Interview Results in Artifact Design

The interview results laid base for the meta-requirements, which served as guidelines for the later artifact development. The following examples should demonstrate how the structured content analysis of the interviews, summarized by stakeholder groups, helped us to identify conflicting or diverging opinions between representatives of different stakeholder groups.

One of the results of our qualitative study was that some interviewees from the visitor group raised doubts about making use of certain, more demanding forms of participation like giving feedback or submitting design suggestions, as they feared they might lack the needed technical knowledge. Even more doubts about the citizens' expertise, however, were raised by the other stakeholder groups, i.e. zoo administration or its charity organization. We tried to incorporate this issue in the following meta-requirements (MR) for the artifact: MR-2.4: "Empower the users to participate through increasing their competence" and MR-3.2 "Empower users to feel able to participate, esp. when it comes to voting, participatory budgeting and submitting design suggestions". Through increasing the competence, with unique forms of visualization, we expect to convey to the citizens a feeling of their own ability to share their opinion.

Another example posed the big disparities considering the amount of information that our planned application should provide. Especially participants with a higher technical expertise in construction wanted to be able to see the details, like being able to zoom into a construction plan or get further information, like the type of material used, which would be shown when a user clicked on a certain element of the construction. At the same time, on several occasions the concern was raised that too much information could, in turn, be overwhelming to some. This led us to formulate a meta-requirement for the app to ensure flexibility in the amount of information provided: "MR-2.2 Offer information that addresses different stakeholders (e.g. citizen experts), ranging from general overview to technical details". This is especially relevant due to our aim to create an app that involves citizens as well as initiators or technical experts.

Finally, the interviewees were asked about their opinions on and associations with each of the technologies. The results of this discussion laid the base for our MR 2.1. The overall impression was that, in general, the interviewees associated VR more often with leisure activities and highlighted the virtual and entertaining aspects of the technology; at the same time, AR was rather associated with professional use and its technical features. The interviewed IT experts, too, specifically highlighted the entertaining features of VR. At the same time, they mentioned more fields suitable for application of AR in everyday life, like for driving or as support in work – thereby less leisure-focused. The lower access

barrier of AR-based technologies due to the lack of special equipment needed to use AR, too, was viewed positively.

Despite the differences in the interviewees' levels of experience with either of the technologies and personal leanings towards one of them, in sum, the interviewees recognized the different strengths of AR and VR respectively and therefore saw benefits in each of them. This altogether led us to MR 2.1, demanding to "use the strength of the visualization to inform: (1) in an interactive manner through AR and (2) in an entertaining manner through VR". The interactive aspect of AR is the effect of blending in into real environments and also its everyday-usability due to simple functioning via smartphones. It allows to especially strengthening participation on the site, to which a blended visualization can pose a great enhancement. On the other hand, the effect of VR is rather an immersive one, which allows creating vivid, novel images and transferring the users virtually into a yet non-existent environment. While the presented meta-requirements represent those aspects of our artifact development that evoked controversial viewpoints, we, too, found out about several aspects, like data security, which were considered relevant by most participants.

The meta-requirements, based on our interviews, lead to concrete suggestions for the artifact developers. Surprisingly, the results of the expert interviews showed, that the previously assumed conflicts like a digital divide were not, as feared, a challenge described by the groups as such. Therefore, we are confident, that we could explore attitudes and positions towards our DSR artifact, which could not have been explored using only a method like persona creation. The meta-requirements, based on our expert interviews, were used to develop a first prototype, which was evaluated by using a quantitative questionnaire. The results showed that qualitative interviews are a reliable source to develop elaborated meta-requirements, which could be easily tested in a quantitative study and as DSR project communicated in the IS community (chapter.

4.4 Discussion and Future Research

In this paper, we demonstrated how the first two steps of the DSR cycle can be enhanced with qualitative interviews and suggested a concrete method and process from social science, which can support IS researchers with a reliable procedure. In our research, qualitative methods proved themselves very useful due to their explorative character, which is especially valued in social sciences for exploring emerging research fields (Kaiser, 2014; Kruse and Lenger, 2014; Trauth, 2001). Within the first steps of a DSR cycle, qualitative expert interviews helped us to define the aspects of application development that are crucial for the sought artifact, thereby specify the problem the artifact was

ought to solve. The structured content analysis of the interviews, lead to the formulation of first meta-requirements. Thereby, we presented how meta-requirements can be derived to formulate guidelines for artifact development and in this way, the expert interviews could help to developed objectives for a problem solution in step 2. The rigor of the process shown in Figure 14 helped to develop thereby concrete and well-balanced meta-requirements for an artifact, which stand the needs of its potential stakeholders. In that way we argue, that it is necessary to counter the vagueness of new design research areas through some rigor in the methods we would like to explore them. Thereby, we present a standardized procedure for the integration of potential users in the first steps of DSR, which includes the societal realities they are sounded by. The explorative character of qualitative expert interviews could help design researchers to broaden the spectrum of possible IS solutions, which is especially helpful when they are confronted with research gaps. Particularly for IS systems that aim to serve their final users, expert interviews that include stakeholders can help to find new solutions and strengthen research motivation beyond the initiators' or the funders' artifact-related needs. We thereby arrive at an artifact, which aims to fit the potential users' needs in context of the societal surrounding. Another benefit we experienced, already know as an effect of using qualitative interviews (Weßel, 2010), is that, through involving stakeholders in artifact development, the interest in the project itself was strengthened.

As for the future research outlook, we used the qualitative interview results to derive meta-requirements, which we evaluated and would like to evaluate the developed meta-requirements and thereby retrieve design principles (Chapter 7). Furthermore, we consider a comparative study that compares quantitative methods used in the first steps of DSR with the process suggested by us. The precision of the suggested methods could be verified by using a quantitative questionnaire to evaluate the outcomes of different approaches. Thereby, we would like to research which effect the chosen method has on biases in the own assumptions in formulating the motivation, problem space and suggestions DSR. Through this, a more concrete comparison between the two methods might be established. Furthermore, we are eager to see how the presented qualitative interview procedure might be used by more IS researchers for other domains, since it might be argued that it worked in our case particularly well, due to the fact that method and research topic are particularly coherent. Currently, researchers are using the approach, suggested by us, to develop innovative DSR artifacts in energy markets, digital citizen science and mobility. We are excited to see how the approach works in the mentioned research fields and how those researchers might use and adapt it in the future.

5 Qualitative Study on the Potential of New Technologies and Approaches in Digital Citizen Participation

5.1 Qualitative Interviews as a Method for Research on Citizen Participation

As described in the previous chapter, Qualitative methods can produce, if conducted carefully, meaningful empirical research results for IS research. Furthermore, they can draw attention to new phenomena and help create more practical relevance (Kruse and Lenger, 2014, Trauth, 2001). Thereby, they have the ability to support researchers in drawing a completer picture for use cases through also involving the relevant stakeholders. For the following study, qualitative interviews also seem to be, with their participatory style, appropriate for researching Digital Citizen Participation. Axelsson et al. (2010) and Holgersson et al. (2018) demonstrated the importance of citizen participation in e-Government projects. Consequently, citizens insights need to be brought into the development of the platform itself.

5.2 Use Case, Study Design & Procedure

In this Digital Citizen Participation project, the publicly owned zoological garden of Karlsruhe, planned to create a new enclosure for ring-tailed lemurs on a free island in the zoo area, which shall become a freely walkable enclosure fully accessible for the zoo visitors. Although the zoo is a public institution, financed and controlled by the city, the project is a public-private partnership, funded by private donations of an association affiliated with the zoo. The enclosure is an architectural novelty for the zoo, which is why the zoo wants to encourage the visitors to participate in its development. Besides, many aspects of the design of this enclosure are open for discussion, which is what makes this use case well suitable for our research purposes. Additionally, due to the strong relationship between the citizens of Karlsruhe and the zoo, participation seemed likely. Finally, due to the ambition of making constructions tangible through visualizations, the institutions became especially interested in testing the AR and VR e-Participation application for their construction project. Being a construction project of public concern, while also not overly complex, with initiators eager to involve citizens and interested in using digital technologies, this use case seemed to be a good fit. Nevertheless, the limits in terms of generalizability have to be mentioned. It has to be acknowledge that the study is based

on a single use case, and that a possibility to verify the results through a variety of cases would strengthen the analysis. However, as part of a mixed-method design, it can be argued that the qualitative approach might be a useful basis for further quantitative research.

Before the interview began, a standardized guideline clarified the research project, its goal and made the interview structure transparent to the interviewees. The guideline contained 24 predefined questions, although the interview should be considered semi-structured due to the fact that the interviewer had the possibility to ask additional questions.

The study design tried to answer the following research questions:

- RQ^1: What are general challenges and interest concerning the use of digital technologies for citizen participation?
- RQ^2: Whether and to what extent does the use of AR and VR technology in the planning and design of construction projects increase the citizens' participation in and their acceptance of e-Participation for public construction projects?
- RQ^3: What are – from a user perspective – the strengths and weaknesses of the use of AR and VR for public participation in public construction projects?

RQ1 and RQ2 were broken down into different research dimensions, namely "relevance", "degree of participation", "technology acceptance" and "incentive concepts". The questions towards the "relevance" of an e-Participation platform were regarding the interviewees' perception of using digital technologies for public participation and more precisely, under which circumstances such use is imaginable. The set of questions about the "technology acceptance" were based on Davis (1989) and Venkatesh and Davis (2000) technology acceptance models (TAM 1 and 2) and their adaption for Digital Government research by Pereira et al. (2017). The focus of the questions lay on the "perceived usefulness" (Davis, 1989) and "intention to use" (Venkatesh and Davis, 2000, p. 187 ff.) of AR and VR separately for e-Participation purposes. The "degree of participation" research dimension used the spectrum of public participation (International Association for Public Participation, 2018) to ask the participants about the desired degrees of participation for an e-Participation application using AR and VR. More concretely, the interviewees were asked about different e-Participation techniques (e.g. informing, giving feedback, discussing, voting, etc.) for the context of participating in a construction project. The research dimension "incentive concepts" gave the interviewees the opportunity to respond more openly and exploratively. Thereby, certain elements or design details were tried to identify, that would increase the likelihood of participation in a construction project via an AR and VR e-Participation application.

In June 2019, 20 face-to-face interviews with 27 participants (some interviews included up to three people) were conducted by the author of this dissertation. The interviewees were part of the zoo management, zoo employees in the different branches, like zookeepers, educational staff members or part of the architectural team. Furthermore, zoo visitors, the board members of the friends of the zoo association, city council members, a high-ranking public officer of the city and technology experts of a local tech company participated. The median age of the interviewees was 45 years (min. 18, max. 80) and among the interviewees were 51.85% female.

The conversations were recorded and protocolled (Kaiser, 2014). Afterwards, the recordings were transcribed manually using MAXQDA (Figure 15). With the help of the program, the material was coded and a structured content analysis following Kaiser (2014) conducted.

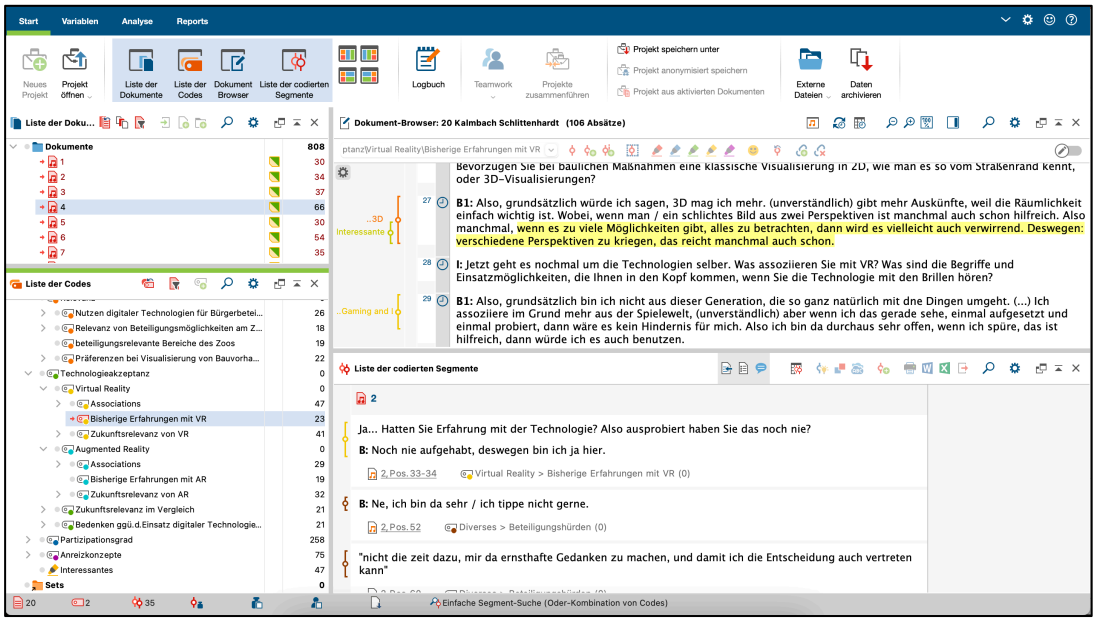

Figure 15. Example of the interview transcription and structured content analysis in MAXQDA.

5.3 Structured Content Analysis

All statements that can be assigned to the category system are coded in MAXQDA (Figure 15). In the stakeholder analysis, no statements are taken into account that a stakeholder makes for another group (e.g. when the zoo director talks about the wishes of the visitors). Such statements are considered in the structured content analysis per se, because they are relevant as design wishes of the interviewees not only in their respective positions, but also as private persons for the use case. For the present investigation

of stakeholder-specific desires, however, the boundary lines are to be clearly established. Stakeholder statements that relate to the assigned stakeholder group are also coded (e.g., statements by the zoo director about the needs of his employees).

5.3.1 Relevance of Immersive Systems for e-Participation

The **zoos staff members** emphasized the importance that the app can be used to involve both, citizens and staff members, in a construction project. Overall, digital technologies can enhance understanding through visualizations, therefore spur interest and participation, and facilitate communication. Young people can be involved as well. While the staff largely viewed itself as equally capable of understanding 2D construction plans, they still saw 3D visualization offered by AR and VR as an enhancement for the visitors and staff members.

With regard to the role of participatory initiatives at the zoo it was seen as at least to some extent, sometimes as very important. One challenge concerned the different perspectives relevant for the zoo: the visitors', the staff's and the animals'. These perspectives need to be in close dialogue, especially because visitors' and animals' needs can conflict at times. The visitors' spheres of influence should be kept general, inquiring about their views on aspects like design ideas and choice of animals. Finally, the zoo, as a public institution, was said to have a certain obligation to inform the citizens about publicly funded projects.

With the **zoo visitors**, a huge divide could be observed matching the age distribution. The younger zoo visitors viewed digital ways to participation as practical, and online donations as quick, easy and, if needed, anonymous. One participant said "Most of the things that I know about, I learn about from the internet" (i4). On the contrast, the older participants had a hard time bringing internet and participation together. When asked about the relevance of digital technologies for participation, one participant answered "Digital, for participation? Oh, god (laughs). Yes, I have a phone, a laptop, I am glad to use them, of course" (i12). Being the only group among others, zoo visitors were divided in their preferences of 2D and 3D visualizations. While some preferred 3D or both types, the older participants tended to prefer 2D. With regard to participation in the zoo in general, everyone considered it important to ask for visitors' opinions and pointed the zoo out as a public place with little opportunities of gaining political influence by the public. The interviewed visitors wished to get involved with the animals of the zoo (well-being, choice of animals etc.) and the design of enclosures.

Zoofreunde e.V. is the **charity organization** raising donations for this project. This group was generally interested in the benefits of digital means for addressing citizens in a better way. The participants believe that technology would produce publicity and enable quick access to information. Social media was seen as an opportunity to address many different people, especially young people, who often use social media as their main source of information. Consequently, the charity organization members preferred 3D-visualizations. They hoped that such participation might enable managers to better understand their visitors' views, while simultaneously informing the visitors about the zoo.

The city council members and representatives of Karlsruhe had a positive opinion on digital citizen participation, and laid out various participation barriers that could be eliminated with the use of an app. For example, people who are less ready to speak up in group discussion would be more likely to express their opinion, while participation interest becomes less dependent on location and time resource and requires less technical expertise. This group, too, stressed the obligation to involve citizens in public matters like construction projects as well as the strong public interest for this particular zoo. What they considered relevant for participation in the zoo was to emphasize the role of the zoo for species conservation. They further stresses the opportunity to offer the app to municipal politicians to represent their citizens more thoroughly in such construction projects, which are usually largely processed by the administration instead.

The two **IT experts**, who were part of the interviews, were appreciative of the effects that digital participation might have on transparency on the one side and efficiency on the other side. Together with the visualization, the planned app promises to lower the barriers to citizen participation. As a public institution, the zoo shall involve its visitors and can benefit from the citizens' perspective. However, above all participatory aspects, the experts' leaned towards citizen involvement in zoo design.

5.3.2 Technology Acceptance

Concerning the future relevance of AR and VR, the **zoo staff members** gave either equal assessment of both technologies or favored AR. One argument mentioned the lower access barrier of AR compared to VR. Regarding the use of technologies for e-Participation, the groups were concerned with the risk of manipulations in case of low security standards. One point of concern was also the risk of exclusion of older people with this shift to online-participation. The Zoo staff's experience with VR ranged from little to none, mostly through leisure activities, although the leadership did experience the use in professional sphere for project presentation. They expected a further development of VR technologies for both, the professional and the private sphere (leisure), although they saw an obstacle in the price of HMDs. The group's scarce experience with AR was

reflected in their different associations. However, this group associated AR with more technical aspects and professional use rather than entertainment. AR was considered very promising overall, specifically mentioned were the areas of public participation, constructions and advertisement (rather in the professional sphere), and its low usage barriers.

For the **zoo visitors**, neither AR nor VR was associated with public participation. Despite a slight tendency towards the future potential of AR, both technologies were expected to have different areas of application. The group expressed no concerns considering e-participation, except the possibility to enhance visualization to convince and manipulate the public. The group members had no experience with VR prior to the demonstration. Their associations revolved around film and gaming. Most participants assumed that VR would gain importance in the future, although they did not perceive it as overly present yet. Concerning AR in contrast to the older participants in the group, the younger visitors already had experience with the technology. The groups associations with AR related to QR-Codes and Pokemon Go.

The **charity organization's members** did not have prior experience with any of these technologies. Accordingly, they did not indulge in contemplations about their associations or the potentials of AR and VR. Through the introduction into the technologies, they considered VR as more realistic and more involving. Its level of visualization was considered beneficial for non-experts, as it can visualize how space can be used in everyday life. It was further suggested to be appealing for the youth. For AR in contrast, the group found it hard to associate the technology with public participation. Overall, the group's interest laid rather on the role of VR. This could be partly explained with the group's particular interest in the animation and the expected emotionalization effect of VR, as mentioned later in the interview with this group.

The **city council members and representatives** were very heterogeneous with regard to age distribution, and included one IT-expert, thus, the opinions on this topic turned out to be very diverse. One participant had no associations with any of the technologies. Overall, the interviewees acknowledged the benefits of both technologies for different purposes and specifically saw the potential to use them in different settings. Being overall very optimistic about the future relevance of VR and AR, the group did not show a specific leaning towards one of the technologies, even though single individuals did have slight tendencies toward either AR or VR. VR was, once again, associated with gaming, but also for visualization of construction and historic sites. Furthermore, VR was considered generally important for the future, although a barrier to use was seen in the price for HMDs. The participants could identify themselves more with AR than VR. One participant considered it to be "more an information tool and less of a participation tool"

(I13) in which AR helps to present information in a playful way. It was also stressed how AR "connects elements" (I13) and stays embedded into a real environment. Considering its future potentials most participants saw many options, while one scrutinized the future use of AR because of how the technology requires active use. This group also – outstandingly – presented several concerns regarding the use of such technologies for digital citizen participation: Data security in general, concerning user data (although less so for the research project Take Part) and the risk of manipulation, through visualizing a project in a more appealing manner. An important aspect concerned the quality of the discourse: here, one participant expressed the idea that lowering participation barriers could also lower the quality of the comments, as participation would require less commitment and therefore less profound involvement.

Indeed, the broadest span of associations with both technologies in the areas of leisure, professional life and everyday use, the group of **IT experts** has had. Similarly, to the group of local politicians, the two interviewed IT experts saw different potentials in the two technologies, but regarded both of them as promising. According to them, AR is quicker to explain and therefore more appealing for everyday use, while VR could help overcome the restrictions related to space: "as humans we are pretty place-bound" (I18). Mainly, alongside gaming, the interviewees discussed the ways in which VR could be used to visualize any type of space concept in advance. For the group, the focus of AR laid specifically on the transformation and enhancement of everyday tasks and commuting. Here, many new aspects were mentioned by the group that did not come up in other groups. Alongside their concerns about data security, they advocated for digital citizen participation to provide anonymity in order to allow "people to say things they would not say outside of the digital world" (I19). Furthermore, they argued for it to remain voluntary since obligatory use bears the risk of excluding certain people.

5.3.3 Degree of Participation

Since the construct degree of participation comprised more items in the interview guideline in comparison to other constructs, the content analysis on this topic will be specified in more detail.

5.3.3.1 If you were asked about your opinion on a construction project, would the use of digital technology like AR and VR make your participation more likely or not? (Why?)

The **zoo staff members** expected that it would especially increase the participation of the visitors to use the technologies. Construction experts themselves did not expect

such a strong influence given that they have fewer problems understanding construction projects anyway.

On the other hand, the **zoo visitors** expected that participation can become more enjoyable for some. They stressed the role of age, and proposed that an additional effect can come from one's social environment: those who used VR glasses could thereby raise interest for the technology, and thereby for participation, in their circle of friends.

The **charity organization** considered digital citizen participation with these technologies to be more convincing and therefore excite more people.

Using the technologies would make participation in construction projects more accessible, the **city council members and city representatives** thought. A concern raised repeatedly addresses technical skills – to get people who are less technically aspired involved, technical assistance (on the site) should be available.

The **IT experts** had somewhat divergent opinions. One participant claimed that their personal political interest decides whether they engage with topics or not, rather than technologies. However, another interviewee regarded the use of such technologies as more exciting and therefore said it would have a positive effect on participation.

5.3.3.2 Information that an app for digital citizen participation in construction projects should contain

There was an overall common understanding about some core aspects that the app should inform about: Duration, cost, project description, design, and relevance of the project. On top of that, there was some variation in preferences among the groups.

From the group of the **zoo staff members** one person preferred to have a desktop version instead of using the app, which they considered to be too small. They were also interested in up-to-date information in the app (rather than a single-instanced description) and, interestingly, a detailed view from different perspectives like animals needs' and visitor perspective.

The **zoo visitors** articulated no specific needs, except their wish for information about animals.

Answering the mentioned questions, the **charity organization** was interested in the opportunity to advertise the project and the option to donate in the app. Other needs, even regarding basic information, were expressed.

The **city council members and city representatives** had a very "project-management"-related perspective on the aspects that the app should cover on top of basic information.

Concerning the design, this group articulated, that the materials used should become clear. The visualization should shed light on the precise change throughout the construction. It should show the project's steps, as well as finished and open parts of the project, an up-to-date visualization and a timeline showing construction progress (also funding development). It should further offer clickable project details (to fade in/out). Similarly, to the zoo staff, the group wanted to see the benefits for the animals and to view the construction project from the animals' perspective. The animals' perspective also should emotionalize the viewer. Furthermore, the visualization shall be embedded in its surrounding respectively the landscape.

Articulated by the **IT experts** was the expectation that in addition to the basic facts, the scope of the participation process should be articulated. With regard to the zoo, they wanted to see how the initiators through the new project satisfy the animal needs. From the citizen perspective, they wanted to be informed about the project's "role […] as a possible visual and acoustical disturbing factor" (I19).

5.3.4 Attitude Towards Using an App for Public Participation

The **zoo staff** had had different experienced with previous participation, from none to involvement in some projects. They generally opposed setting incentives and claimed that participation should rise from the citizens' interest. While the app should clarify the scope of influence for citizens, there needs to be access to information and a possibility to inform oneself and express one's opinion. Acknowledgement of feedback was seen as an important source of motivation. Furthermore, the app should be simple and intuitive, quick in use and address different interest groups and present the urgency of the project. Also, the group wished for more lively visualizations and criticized that zoo animals in the demonstration were too static.

In the **zoo visitors** group the experience with participation also differed between the participants, ranging from work, to engagement in associations or schools, to having no experience whatsoever. The group agreed that monetary incentive setting was not necessary, since group members sought voluntary participation and regarded the latter as added value in itself. They, too, wished for transparent funding and a social media module. The app should be easy to use and free of charge. As for the visual design, a panorama of the animals' natural habitat was requested.

The **charity organization's** primary experience in participation was their involvement in the city zoo's charity organization, making them one of the more experienced interviewees when it comes to participation. They, too stressed the relevance of recognition of citizen feedback and also opposed, a binding character of participation due to the lack

of expertise in certain questions considering animals or construction. The app should be easy-to-use, and offer a good and lively animation. As a fundraiser, this group was particularly interested in the option to highlight the need for money for this project and offered suggestions on how to phrase the requests for donations.

More than any other group, the interviewed **city council members and city representatives** were very well-experienced in political participation through their profession. They wanted the app to allow the citizens to follow the decision-making process. The users' contributions should find recognition, they should receive feedback and/or, the initiators should present a result that summarizes the suggestions and presents the final decision. They, just like the other interviewed groups, viewed monetary incentives rather negatively, and were more willing to see genuine interest as a reason for citizens to participate. Similarly, binding decision-making by the citizens was problematized in face of uprising representation issues. Finally, with regard to online discussions, this group emphasized that the best way to work out concrete solutions is through direct exchange between the citizens, thereby pointing at a possible problem the app can face. They suggested their own vision of how app visualization could be used, namely as a resource in offline group discussions: a panorama view would allow people to engage with an identical perspective of 3D visualization, resulting in a collective immersive effect. People could even walk through the visualization together. With regard to app design, they, again, stressed that the app should be easy to use and also consider older people's needs. It should be open-source to offer transferability across communes and projects. For the sake of allowing users to easily follow project development, a newsletter should be included. Also, digital citizen participation projects in public construction should always stay in touch with the city administration.

One of the two **IT experts** was indeed rather politically engaged and participated in citizen surveys as a form of active participation, whilst the other interviewee was less experienced. Extra incentives were viewed negatively by this group as well, stressing the citizens' natural interest to get involved as an aspirational goal for digital citizen participation. The users should be allowed to submit their own suggestions, which in turn should be processed, for example to form a suggestion list. More generally, the app should be easy to use and to navigate, and have low entrance barriers. A problem to this can lay in the use of HMDs, that are rather pricey and not yet common.

5.4 Results of the Structured Content Analysis

As a result of our structured content analysis alongside our research dimensions, we could determine: (1) the general trends in attitudes towards the usage of digital technologies including AR and VR for public participation, and (2) the particular attitudes and expectations of the study's participants towards digital technologies including AR and VR for public participation, which will shape the development of the meta-requirements and design principles for our artifact and further help us to develop a nascent design theory.

With regard to the research dimension "relevance", our analysis demonstrated a very strong appreciation for the use of digital technologies for public participation. 86% of the study participants found that digital technologies present a helpful tool of public participation and mentioned that through digital media and technologies many people can obtain easier access to information considering public construction projects. The visualization was expected to make it easier to understand public projects, especially to people without the expertise required to deal with construction plans. Accordingly, 77% of the participants expressed their preference towards the use of 3D models, including AR and VR, over classical architectural models for the visualization of public construction projects. Furthermore, several participants expected digital technologies to reduce participation barriers (I14, I18). Some participants also mentioned the potential of reaching out to younger generations through the use of new technologies (I4).

The most striking observation from the research dimension "acceptance of technology" revealed the strong difference in the way VR and AR were perceived by the participants. As shown in Table 9, few participants could relate any of the two technologies to public participation. At the same time, AR was most frequently perceived as a source of information and was usually described as a tool that can offer additional information about existing places or objects, partly in context of construction projects. In contrast to that, some participants emphasized the opportunity to visualize new, non-existing spaces with the help of VR and three times as many participants related the latter to gaming and leisure than they did to AR.

Association	**AR**	**VR**
Information Tool	60%	20%
Gaming and Leisure	20%	80%
Further Associations	0%	25%
No Associations	15%	15%
Public Participation	20%	30%
Can't relate to Public Participation	20%	40%

Table 9. Categories of participants' associations with AR and VR and share of the interviews, that included those associations.

As demonstrated in Table 10, we further observed a slight preference towards AR vis-à-vis VR in the participants' estimation of the future relevance of the two technologies. In particular, eight out of 13 ideas about the fields in which VR might play a significant role in the future concerned either construction, urban planning or public participation, while two out of 11 ideas about the future applications of AR included the aforementioned categories. We assume that the frequent mentioning of public participation and construction projects to this open question is related to the interview context.

Estimation of Future Relevance	AR	VR
Relevant	90.0%	80.8%
Neutral/Ambivalent	10.0%	15.4%
Not Relevant	0.0%	3.8%

Estimation of future relevance of AR and VR in comparison	Number of responses
AR and VR are similarly promising	9
Ambivalent	6
AR is more promising	5
VR is more promising	1

Table 10. The left table shows the future relevance of AR and VR in percent of responses, while the right tables answers the question "Which of the technologies do you find more promising in regard to their future relevance?" associations with AR and VR divided into categories and the share of the interviews, that included those associations.

Further, half of the participants did not express any reservations considering the use of digital technologies including AR and VR for public participation (see Table 11). Yet, several participants expressed their fear about the protection of personal data on digital platforms. For example, one participant addressed the possibility of data misuse through the unpredictability algorithm-based analysis of the users' decisions (I19). Data security is also relevant if the users are expected to make online payments through the application (I18). The aspect of data security raises the need to consider the option of anonymity in an e-Participation application. While fear about the possible misuse of personal data might prevent some citizens from participating through the application, thereby impairing the representativity, few participants expected that anonymously designed e-Participation platforms would decrease accountability and thereby spur the number of less profound contributions (I13, I18).

	Number of responses	Percent of responses
Expressed no reservations	9	50.0%
Expressed some reservations	6	27.3%
Were unsure	5	22.7%

Table 11. The table shows the answers to the question "Do you have any reservations considering the use of digital technologies for public participation"?

Finally, 20 out of 27 participants responded that the use of AR and VR would increase the likelihood of their participation in a new construction project of the zoo. Interestingly, two-thirds of the interviewees responded that the use of digital technologies would not increase their willingness to participate because they would participate in a project regardless of the means of the visualization, either because they can easily interpret 2D construction plans (I2, I16) or due to their personal interest in the project (I13, I19).

We then analyzed the research dimension "degree of participation" and could observe that the participants were only ready to participate through an e-Participation application up to a certain degree (see Table 12). While most participants embraced the idea of informing themselves through the application, the readiness to get involved with the project sank in accordance with the increase in level of public participation.

Are you willing to use an application to _*_ a construction project?	**Level of Public Participation**	**Yes**	**No**	**Under certain circumstances**	**No response**
* inform yourself about	Inform	88.9%	3.7%	0%	7.4%
* comment on	Consult	85.2%	7.4%	3.7%	3.7%
* discuss		29.6%	40.7%	25.9%	3.7%
* vote on	Involve or Empower	74.1%	3.7%	18.51%	3.7%
* donate for	Collaborate	77.8%	11.1%	7.4%	3.7%
* participate in the budgeting of	Empower	55.6%	25.9%	11.1%	7.4%
* submit design suggestions	Collaborate	44.4%	33.3%	18.5%	3.7%

Table 12. The table demonstrates the attitudes of interviewees concerning their willingness to use an AR and VR application to participate in a construction project with reference to different participation levels.

Considering the participants' ideas about the information required in an e-Participation application, several participants pointed out that the main role of such an application would be to give a deep insight into the project and present the relevance or the possible urgency of the project (I4, I10, I20). In case of projects that present a change of an old construction project, the improvements of the new concept over the old one shall become clear (I16). Furthermore, many expressed the idea that such an app should serve as a means to keep the citizens updated about the changes throughout the construction project (I8, I9, I13, I14). Some participants, in particular from the zoo staff, stressed that the application should provide a detailed plan that allows to zoom into certain parts of the plan, thereby allowing to see information such as the material used for certain parts of the construction (I10, I14). According to one participant, only a detailed visualization would present a viable alternative to otherwise informative 2D plans (I16). A contrary stance was taken by public servants whom we have interviewed, since they assumed

that an overly detailed visualization can quickly become confusing for the citizens and should therefore only focus on the relevant information (I20).

On the whole, many participants felt that they lacked the competence to submit their own suggestions through the application, ranging from discussions through voting to design suggestions (I1, I6, I12, I14, I20). Many preferred live discussions over online discussions due to the danger of polarization of opinions considering the lack of moderation (I2, I7, I8, I14, I17). Several participants further described commenting through an e-Participation application as potentially too time-consuming (I2, I17, I18), while one of them specifically suggested offering a desktop version of this application, which would be more suitable for typing (I2). The staff of the zoo and the public servants we have interviewed further emphasized that the scope of participation in construction projects is necessarily limited by the technical and financial restrictions which only the initiators of a project can properly assess (I6, I7, I9, I13). Thus, in offering unlimited participation, the initiators run the risk of receiving many unrealizable suggestions that have to be evaluated and taken into consideration, resulting in lengthy procedures (I9, I17). As a solution to this, several participants emphasized the need for transparent communication of the scope of participation available to the users (I5, I8, I20).

While it would be possible to consider discussions and design suggestions as mere recommendations that reflect the public opinion, the question over the binding character of public participation was seen especially critical with regard to voting. Here, several interviewed zoo visitors, too, expressed their fear to participate, while members of the zoo staff and the municipality repeatedly stressed the lack of professional knowledge required for informed participation among the citizens (I2, I8).

Another problem arising with the use of voting for public participation is the representativeness. Several participants mentioned that an e-Participation application could exclude groups that are less receptive to new technologies, like people of older generations (I2, I6, I13, I14). Furthermore, one participant highlighted the lack of accountability of digital direct democracy (I19). Due to such effects, it would be problematic to use an e-Participation application as a binding instrument for political participation. Yet, the participants clearly recognized the potential of the application to offer citizens a platform to voice their wishes and for the initiators to get access to the public opinion.

While showing interest in donating for projects they support, the willingness of many participants to engage in a participatory budgeting process of a construction project was lower, again due to their perceived lack of competence in the field. One aspect determining their willingness to decide over budgeting could be the relatively widespread wish across the participants to have information about the spending related with public

construction projects – projects, frequently financed through taxes or, in our use case, additionally through the entrance fees. On the initiator's side, we observed the interest to motivate users to donate. Some expected that the visualization of public projects could raise the citizens' interest for the project and assumed that a dynamic, rather than a static, presentation would be required in order to emotionalize the citizens and get them more involved with the project (I6, I15). One of them also highlighted the potential of the application to involve young people specifically through aspects of gamification (I6). Such emotionalization, according to them, might increase the citizens' willingness to donate. The initiators further suggest showing the amount of money that is missing for the construction project and including the rough percentage of the money already collected, to demonstrate the need for additional funding to potential supporters of the project (I6, I8, I15). As for the payment methods, several participants stated that they preferred offline over online payments (I16, I17). However, younger participants pointed out the efficiency of online payments via platforms like PayPal as the reason why they prefer to pay directly with their smartphone (I4).

The analysis of the research dimension "incentive concepts" revealed several aspects relevant for the proliferation of an e-Participation application in the context of construction projects. One relevant aspect is undoubtedly the application's usability. Most participants want the application to be as barrier-free, easy to use and intuitive, as possible. This is especially relevant as a way to counteract the exclusiveness that can accompany the introduction of e-Participation tools. Thereby, increasing the representativity of the participation outcomes. If presented to citizens in situ, the demonstrators of the application should be willing to provide sufficient support to troubled users. Overall, the participants who described themselves as less responsive to technology, had pointed out that they would not use e-Participation tools by themselves, but showed themselves strongly willing to make use of those, if offered participation on the spot with the needed technical support (I13). Some participants stressed two challenges for the portability of the application. First, given the relatively high cost of HMDs required for the VR element of the application, it is problematic for the citizens to use the application at home (I17, I19). A possible solution could be a technology like Google Cardboard, which was said to offer a more affordable alternative to expensive HMDs (I19). Second, visualization based on AR always operates as addition to an existing, real-life objects, be it actual buildings or their pictures. This issue brings across the need for the users to see the construction project in situ. This, however, was also formulated as the strength of AR, since it allows citizens to get a better idea of a construction project in its actual surrounding and can thereby enhance real-life discussions about construction projects. (I20).

Another aspect of high importance to the users is the recognition of their participation. Although only few participants would expect their decision to become binding for the project initiators, most of them required some form of recognition and consideration of their participation. Many wanted to know that their contribution to the construction planning had an impact on the decision-making, while they mostly recognized the difficulty in finding a consensus on the ground of the many suggestions. One participant asked for proper communication of the results of such participation projects (I13). One suggested way of presenting the initiators' consideration of the citizens' participation would be to provide a comprehensive list of contributions made by the citizens (I18).

Finally, some participants advocated for the application to be open-source, which would make the application transferable between institutions and initiators and freely accessible to the citizens (I7, I14).

The results of the study will be used in the following chapters to develop meta-requirements and design principles for using immersive systems in citizen participation. The qualitative interviews are not only useful for this purpose but introduced the author of this dissertation through the conversations to the field of citizen participation and the challenges concerning the design of an app that uses the technologies AR and VR for the participation of citizens with digital means in urban planning.

Part III

Designing Immersive Digital Citizen Participation

6 Enriching e-Participation through Augmented Reality: First Results of a Qualitative Study[7]

6.1 Introduction

Public debates over significant public construction projects in Germany such as the Stuttgart train station, the Hamburg concert hall and the Berlin Monument to Freedom and Unity show that citizens are interested in construction projects within their urban environment and develop their own opinions about them. These examples show that when construction projects lack communication and, in turn, citizens feel overheard, disputes and protests can arise which might affect the overall trust in public administration and politics (Brettschneider, 2013; Thaa, 2013). One solution to this problem might be to involve citizens better in the initial project development. Following the idea of digital government (Falk et al., 2017), governing processes should be transformed to the digital age not only by replicating and digitizing established procedures, but rather through employing new digital opportunities. Some research has already shown the innovative opportunities that digital technologies can provide for e-Participation (Thiel et al., 2018), such as using wearables (Wilson et al., 2019) and public displays (Du et al., 2017) for e-Participation. In this short paper, we focus on AR technology, that has become increasingly accepted in consumer markets (Rese et al., 2017). Although several studies on the use of AR in the field of consumer decision-making exist, there does not seem to be sufficient research on the implementation of AR in the public sector. We will show preliminary results from an ongoing study about the implementation of AR in civic participation processes for public construction projects. Therefore, the paper is guided by the following research question (RQ): *Whether and to what extent does the use of AR technology in the planning and design of construction projects increase the citizen's participation in and acceptance of public projects?*

To answer this question, we conducted interviews with stakeholders involved in an AR-e-Participation project in the city of Karlsruhe. In the city's zoological garden, they are

[7] This chapter comprises an article that was published by Jonas Fegert, Jella Pfeiffer, Christian Peukert and Christof Weinhardt in the following outlet with the following title: WI 2020 Proceedings: Entwicklungen, Chancen und Herausforderungen der Digitalisierung. International Conference on Wirtschaftsinformatik 2020. Note: Tables and figures were renamed, reformatted, and newly referenced to fit the structure of the dissertation. Chapter and section numbering and respective cross-references were modified. Formatting and reference style was adapted and references were updated.

planning to build a new enclosure for ring-tailed lemurs, which should be built on an already existing island in one of the zoo's lakes. The lemurs will move freely on the island and the island itself will become accessible for the visitors via bridges. The island-enclosure is an architectural novelty for the zoo, which is why they would like to involve the visitors in its construction process. Although Karlsruhe operates the zoo, the construction will be financed through private donations. The e-Participation project aims at programming an AR application that enables citizens to participate in the development of the enclosure on the island and get a feeling for its accessibility. The app allows participants to see different versions of the enclosure as well as submit their feedback, comments and design suggestions. The app runs on smartphones or tablets and is controlled by lifting, lowering and turning the device. We chose this use case because both, the zoo and the city, are interested in testing new ways of participation in this construction project, while certain details of the enclosure are still up for discussion and modification. Public construction projects typically involve numerous stakeholders. It also applies for this use case, which is why it offers a high degree of generalizability. Following the Design Science Research Methodology (Peffers et al., 2007), we start with the initial activity "*problem identification and motivation"* and thereby derive meta-requirements for the AR e-Participation app. With these meta-requirements we contribute to research on the design of AR-based apps that enable e-Participation.

6.2 Theoretical Foundation: e-Participation and AR

As a subdivision of digital government, e-Participation research focuses on the role of citizen engagement with the government. As defined by Macintosh (Macintosh, 2004), e-Participation gives citizens an opportunity to participate in and influence policy decisions using information and communication technologies (ICT). Sanford and Rose (Sanford and Rose, 2007) use Habermas' arguments on the importance of "effective communication and informed decision making" (Sanford and Rose, 2007) for democracies in their literature review about e-Participation. The spectrum of public participation suggests five steps of participation: informing, consulting, involving, collaborating and empowering the public (International Association for Public Participation, 2018; Nabatchi, 2012; Nelimarkka et al., 2014). In our study, we use these steps to deduce our meta-requirements.

The theoretical origin of AR goes back to the 1960s (Sutherland, 1965), while its practical application followed 30 years later (Azuma, 1997) and only entered the mass market in recent years. We follow Azumas definition, who defines AR as a real-time 3D visualization that combines real surroundings with virtual elements. Information like text objects or images can be displayed via different types of hardware (Kind et al., 2019). Using AR

for the visualization of construction projects in e-Participation contexts is an almost self-evident idea, since architects are already producing CAD models, which can be easily adapted. Those visualizations might give a better understanding of the construction at the site. Existing research emphasizes the potential of AR for participation processes, e.g. in landscape architecture (Goudarznia et al., 2017) or for its application in urban planning (Allen et al., 2011), but does not include forms of e-Participation. The scientific relevance of this study thus flows from the lack of comparable IS research. There is no research on the possible benefits of the use and design of an AR e-Participation app.

6.3 Research Design and Data Collection

Our research follows a Design Science (Peffers et al., 2007) approach. Within this approach, we use a mixed method design consisting of a qualitative research (QR) study focusing on problem and motivation identification (first activity) and a quantitative study that evaluates the prototype of the e-Participation artifact (fifth activity) (Peffers et al., 2007). Within this short paper, we only report first results of the QR study, which was conducted following Kaiser's (Kaiser, 2014) approach. The data collection took place in June 2019. For the interviews, which we recorded, our guideline was transparent in its structure to the interviewees. To assure a minimum level of common knowledge, the interviews began with an introduction into the technology, in which we informed the participants about AR and gave them the possibility to test it with a simple prototype: To illustrate AR, we presented the interviewees with a postcard with markers that activated an AR-visualization of a construction project. Further, a head-mounted display was used to demonstrate VR to the interviewees by showing them a panorama view of the construction project. Thereby, the interviewees could familiarize themselves with the technologies and the ways the latter can be used for the visualization of construction projects. We asked the interviewees about the relevance (Venkatesh and Davis, 2000), acceptance (Venkatesh and Davis, 2000), incentive concepts (Venkatesh and Davis, 2000) and their possible degree of participation (International Association for Public Participation, 2018; Nelimarkka et al., 2014) in an AR-based e-Participation app. We executed 20 face-to-face semi-structured interviews with 27 participants (some were conducted with groups of up to three people) representing the different stakeholders (zoo management and employees (37%), visitors (26%), friends of the zoo association (11%), city council members (15%), city employees (4%) and software engineers (7%)). The median age of the interviewees was 45 years (min. 18, max. 80) and among the interviewees were 51.85% female.

6.4 First Results and Meta-Requirements

The interviewees showed high interest in AR despite having had only little previous knowledge about the technology. We also observed interest in using AR for e-Participation and exploring new ways of visualizing construction projects. Participants tend to associate AR with fun and games (some specifically with PokemonGo). Different interviewees expressed their wish for the app to be open-source and as barrier-free as possible. The interview guideline used the mentioned spectrum of participation (International Association for Public Participation, 2018) to find out about the degree of participation and the willingness to use an app to participate in a construction project. We sub classified the answers in four response options (yes, no, maybe, no response). If it comes to voting (24% maybe, 4% no), participatory budgeting (11% maybe, 27% no) and submitting design suggestions (19% maybe, 33% no) some interviewees are questioning their own competence to participate. Furthermore, the interviewees showed skepticism towards online-discussions, and preferred non-virtual public debates instead. The participation levels of receiving information (89% yes), giving feedback (85% yes) and donating for a project (78% yes) were assessed positively. Our empirical results therefore suggest that users only seek information and participation through the app up to a certain level. Based on the study's results, we derive meta-requirements for an e-Participation app, which employs AR:

MR	Description
Motivation	*MR-1.1* Possibility to access the app easily and to navigate efficiently to the desired objective
	MR-1.2 Possibility to access the app as barrier-free as possible (e.g. via different end devices) and to guarantee that individuals with lower experience levels (e.g. higher age) do not feel excluded
	MR-1.3 Possibility to stay involved in the project through gamification
Information	*MR-2.1* Possibility to show visualizations with AR
	MR-2.2 Possibility to put the participation items in a broader context of content
Empowerment	*MR-3.1* Possibility to empower the users to feel able to participate esp. when it comes to voting, participatory budgeting and submitting design suggestions
Transparency	*MR-4.1* Possibility to learn about the initial motivation of the participation process
	MR-4.2 Possibility to stay informed and involved after the initial participation process
	MR-4.3 Possibility to have a fully transparent donation process
	MR-4.4 Possibility to learn about the data usage

Table 13. Meta-Requirements (MR) for an e-Participation application using AR.

6.5 Outlook

In this paper, we presented first results of our study, which helped us to identify problems and understand motivations in our DSRM-cycle. We will continue with defining objectives (activity two) and designing and developing the artifact (activity three) (Peffers et al., 2007). Moreover, we established meta-requirements for the development of an e-Participation app using AR, especially for construction projects in the public sector. In further research, we will continue the structured content analysis of the collected data by transcribing and coding the interviews entirely and will expand the analysis so as to include data about the usefulness of VR for e-Participation. We thereby hope to find out more about the expectations, possible challenges and the potential of these technologies for e-Participation.

7 Combining e-Participation with Augmented and Virtual Reality: Insights from a Design Science Research Project[8]

7.1 Introduction

Urbanization has led to an increase in urban population worldwide (United Nations 2019). In recent years, disputes about the design of urban space have emerged in city planning. Especially when it comes to construction projects, public debates and protests may arise, if construction plans remain unshared with the citizens they might affect. A few examples show that this kind of dissatisfaction can be seen globally: Following the reconstruction of the Stuttgart train station in Germany, the demonstrations against its rebuilding aroused not only local, but also international interest (Brettschneider, 2013; Thaa, 2013). Amazon's plan to build a headquarter in New York City, USA, too, gave rise to massive local protests forcing the company to cancel their plans (Goodman, 2019; Gupta, 2019). The transformation of Guangzhou, China, led to the displacement of many inhabitants and thereby changed their lives dramatically (He, 2012; Shin, 2016). Questions of ownership over and design of public space are therefore highly relevant and should be addressed by governments and public administration proactively. Involving citizens early in processes of transformation can secure or even strengthen trust in public institutions and prevent public resistance that leads to project delays and increased cost for project initiators.

To keep up with its citizens and their digital lifestyle, the public sector is trying to enrich old governing procedures by including new technological innovations (Falk et al., 2017). In case of urban planning, e-Participation offers new opportunities of involving citizens in public matters. In the past, public participation has been criticized for organizational cost and the time-consuming aspects of its procedures (Irvin and Stansbury, 2004) as well as its exclusive character resulting from a knowledge gap between the project planners and the citizens (Rockmann et al. 2015). By using information and communications

[8] This chapter comprises an article that was published by Jonas Fegert, Jella Pfeiffer, Christian Peukert, Anna Golubyeva and Christof Weinhardt in the following outlet with the following title: Combining e-Participation with Augmented and Virtual Reality: Insights from a Design Science Research Project. ICIS 2020 Proceedings, Note: Tables and figures were renamed, reformatted, and newly referenced to fit the structure of the dissertation. Chapter and section numbering and respective cross-references were modified. Formatting and reference style was adapted and references were updated.

technology, e-Participation is praised, in contrast, for its relative cost-effectiveness (Spirakis et al., 2010). Furthermore, e-Participation offers the opportunity to include technological innovations to public participation and thereby introduces new ways of citizen involvement. The COVID-19-Pandemic pushes governments and parliaments worldwide to use those new technologies to interact with their citizens and let them participate during times of crisis (United Nations 2020). Research shows a bandwidth of technological options for e-Participation (Thiel et al., 2018), like using wearables (Wilson et al., 2019) or public displays (Du et al., 2017). In this paper, we contribute to e-Participation research by presenting results of a qualitative and a quantitative study on the application of a technological innovation in e-Participation that is particular useful for our context of construction projects: augmented and virtual reality (AR and VR). AR and VR are promising candidates to address the mentioned knowledge gap by visualizing the construction project in an also for non-experts tangible format.

Experts and non-professionals have divergent levels of knowledge and abilities when it comes to understanding a construction project. Experts in the field have expertise on studying blueprints, while non-professionals have to rely on different modelling techniques provided by experts. This knowledge gap might lead to misunderstandings, especially in decision-making processes between both parties (Rockmann et al., 2015). Furthermore, public construction projects can become very complex and large, which makes it hard for non-professionals (and potentially experts as well) to mentally visualize the project, understand and process the information about it. We think that the combination of AR and VR might offer more inclusive forms of visualizing architectural designs and help creating a common understanding. AR is defined as a real-time 3D visualization in which physical surroundings are combined with virtual elements (Azuma, 1997). VR, in contrast, is defined as an immersive 3D environment (Suh and Lee, 2005; Wexelblat, 1995). Computer-aided design (CAD) models, used by architects to illustrate their plans, can be simply modified for usage in AR and VR (Lorenz et al., 2016; Whyte et al., 2000), which makes the technology deployment even more interesting. Therefore, this paper is guided by the following research question:

RQ: How should an AR- and VR-based e-Participation application be designed in order to increase the citizens' willingness to participate in a public construction project?

In our research, we use a Design Science Research approach (Hevner et al., 2004) following the methodology by Kuechler and Vaishnavi (2008) to accompany the creation of an e-Participation artifact, which uses both technologies. In this paper, we focus on two out of three cycles of the Design Science Research in Information Systems (DSRIS) framework. We use a mixed-method approach to complete our DSRIS cycle. The first cycle serves to gather 'soft context information' (Kuechler and Vaishnavi 2008) about

the needs of the stakeholders, thereby identifying possible problems and defining objectives for a solution through a qualitative study (Kuechler and Vaishnavi 2008). From the study's results, we derive meta-requirements for an e-Participation application using AR and VR technologies, which shall be refined in the second cycle with the help of a quantitative study. In addressing the research question and conducting the two studies mentioned above, we involved stakeholders from an e-Participation project in Germany, which presents our use case. In this case, the zoo of a larger city seeks to encourage citizens to engage in the zoo's construction project with the help of an AR and VR-based e-Participation application developed within our project.

Our contributions are manifold. Based on a set of meta-requirements, we present design principles for an AR- and VR- based e-Participation application that integrates the needs of construction project initiators and potential users. We evaluate these principles and thereby make them usable for scientists and professionals to develop other AR or VR e-Participation applications. Moreover, we show insights on the kind of participation procedures citizens are interested in when it comes to using an AR and VR e-Participation application. Thereby, we point out expectations, possible challenges and the potential of these technologies for e-Participation.

7.2 Foundations and Related Work

Digital government, also known as e-government, and the related participatory process, e-Participation, focuses on using ICTs to connect citizens to either governments or public administration (Wirtz et al., 2018). Research in this field has an almost interdisciplinary character, as it combines the theoretical background and methods of Information Systems (IS) with social science theories and methods.

7.2.1 Forms of Public Participation and E-Participation

There are different definitions of public participation: In Arnstein's (1969) "Ladder of Citizen Participation," which became the standard reference in the field, she argues, that participation processes consist of eight steps. The first five steps (e.g. "manipulation" or "consultation") are either non-participatory or token forms of participation, and only three steps on the ladder ("partnership," "delegated power" and "citizen control") are considered to be "degrees of citizen power" (Arnstein, 1969). In this definition, participation equals power and is built hierarchically (Collins and Ison, 2009). Arnstein's important contribution lies therefore in the critical perspective of showing how governmental narratives of participation can be misused to give the public only an impression of citizen power. Despite its benefits, her theory seems, from today's point of view, to

be influenced by the 1960s US-American discourse on governmental power. Another more recent contribution to defining forms of participation was developed by the International Association for Public Participation. Their Spectrum of Public Participation (SPP) focusses rather on different levels of participation with different impacts on decision-making. The levels are "inform," "consult," "involve," "collaborate," and "empower" (International Association for Public Participation, 2018). The SPP is as widespread as it is appealing and it is considered to be better measurable (Nabatchi, 2012; Nelimarkka et al., 2014), less judgmental and more suitable for participation processes with many stakeholders (Wirtz et al., 2018). Therefore, we use the SPP in our study to find out about desired levels of public participation and to deduce meta-requirements.

Macintosh (2004) defines e-democracy as "the use of ICT to engage citizens, support the democratic decision-making processes and strengthen representative democracy" (2004:2). *E-Participation* presents one form of e-democracy, which concerns citizen involvement in "democratic decision-making" (Macintosh 2004:2). Sanford and Rose (2007) note that "a well-used philosophical background to the eParticipation discussion is Habermas' conception of the public sphere" (2007:413), according to which an "effective communication" between civil society and politics alongside an informed public are essential for representative democratic decision-making (Habermas 1992). Accordingly, e-Participation research "tends to focus on liberal, collaborative forms of participation" (Sanford and Rose, 2007, p. 416) and is different from the other form of e-democracy – e-voting, which revolves around "addressing the electoral process" (Macintosh 2004). E-Participation should be further be distinguished from e-government, which concerns public service provision (Boughzala et al., 2015). The United Nations (2019) point out that "online tools can enhance access to information and public services, as well as promote better public policy decision-making" (2019:33) and thereby might help by lower the digital divide and by producing more accountability. Although e-Participation makes use of certain ICTs, there is no such thing as pure e-Participation technology (Sanford and Rose, 2007). Yet, some frameworks give orientation over the successful development of regular e-Participation projects (Scherer and Wimmer 2011; Wagenknecht et al. 2017). Our research thus focuses on e-Participation which involves citizens in collaborative decision-making with the use of ICTs, which may but do not have to produce binding decisions. With AR and VR, we would like to add to this research by focusing on recent technological trends and their potential benefit for e-Participation projects. This overview illustrates that points of references have to be chosen carefully from different disciplines.

7.2.2 Augmented and Virtual Reality

AR became popular in the mass markets only the last few years, however, its first practical application can be traced back to Azuma (1997) who defines AR as a 3D visualization in real-time that unites physical surroundings with virtual elements. Different types of hardware are used to show information like text objects or images as an extension to the perceptual reality (Kind et al., 2019). The application “Pokemon Go” promoted the mainstream use of AR and demonstrated the broad availability of the technology (Paavilainen et al., 2017). Studies on the use of AR in e-Participation demonstrated the technology’s potential to make construction information more graspable for non-experts site (Allen et al. 2011; Goudarznia et al. 2017; Rockmann et al. 2013). Thus, AR promises to facilitate the dialogue between initiators and citizens by offering an on-spot visualization embedded in an existing construction (Chapter 6).

VR is defined as a “computer-generated, interactive, 3D environment in which people become immersed” (Suh and Lee 2005, p. 675; Wexelblat 1995). Today, head-mounted displays (HMDs) are the most popular way to access VR. In addition to the high investments made by major tech companies in VR, falling prices by simultaneously increasing system quality supports the transformation of technology towards mass markets (Peukert et al., 2019a). VR is primarily used and researched in other contexts; nevertheless, some research findings are highly relevant for this e-Participation research project. Suh and Lee (2005) proved, for example, that VR interfaces enable higher product knowledge and interest. For museums, VR can help to involve visitors and enhance thereby their museum experience (Jung et al., 2016; Wojciechowski et al., 2004). In the construction and real estate sector, VR is used to create, with the help of immersive visualizations, interest in construction projects (Barnes, 2016; Whyte, 2003). Woksepp and Olofsson (2008) report wide acknowledgement of the capability to improve information handling by the construction workforce. According to Bilge et al. (2016), the visual quality of the presentation and the level of immersion play a decisive role in mobile participation applications. Therefore, using VR for the visualization of construction projects in the e-Participation context is an almost evident idea, which has been suggested by Macintosh (2008) and explored within participation in urban sound planning (Jiang et al., 2018). In the latter, a square in Italy was transferred into a participatory virtual sound environment and the related test showed that the sound effect supported the VR visualizations and helped to get a better understanding of the surrounding. While this research focused on the potential of sound design for VR, we see great potential to do further research about the effect of the spatial immersion in e-Participation that VR enables.

Both technologies bear certain implications: In VR environments, users may have troubles estimating the real dimensions of the visualizations (Rokhsaritalemi et al., 2020). In AR environments, this problem is solved as objects are embedded into the real world. The separate realities in AR, however, lead to lower levels of immersion for the user (Rokhsaritalemi et al., 2020). Thus, in combining both technologies for e-Participation, we would like to alleviate the weaknesses of the technologies mentioned above by offering a transparent transition from a 2D-view to an immersive 3D environment (VR) or eye-level visualization (AR). Finally, our approach allows off-site use as well, making it possible to participate outside the construction site. With technically advanced but at the same time affordable hardware and software entering the market, the prerequisite for remote participation in construction projects and urban planning is given (M. Wolf et al., 2020). We further take an approach by Nuernberger et al. (2016) who showed how small drawings can be placed precisely in 3D on a building on mobile devices and add a technology that enables not only to add drawings, but also other content like text fields, pictures, and audio comments. Thus, in following the SPP, we want to demonstrate on which levels of the spectrum AR and VR in e-Participation might have promising effects, since we see potential both for informing citizens on the “inform” level and enabling citizen exchange and decision-finding on the “consult,” “involve,” “collaborate” and “empower” levels.

7.3 Methodology and Use Case

7.3.1 Design Science

In our paper, we rely on the DSRIS framework by Kuechler and Vaishnavi (2008), which is based on Hevner et al. (2004) and follows the three-cycle-view offered by Hevner (2007). The DSRIS framework consists of five steps from gaining awareness of a problem through conducting research that helps to develop and further evaluate an artifact aiming at solving the initially outlined problem. Consequently, we use DSRIS to accompany the development of our e-Participation artifact (see Figure 16 for an overview of our activities).

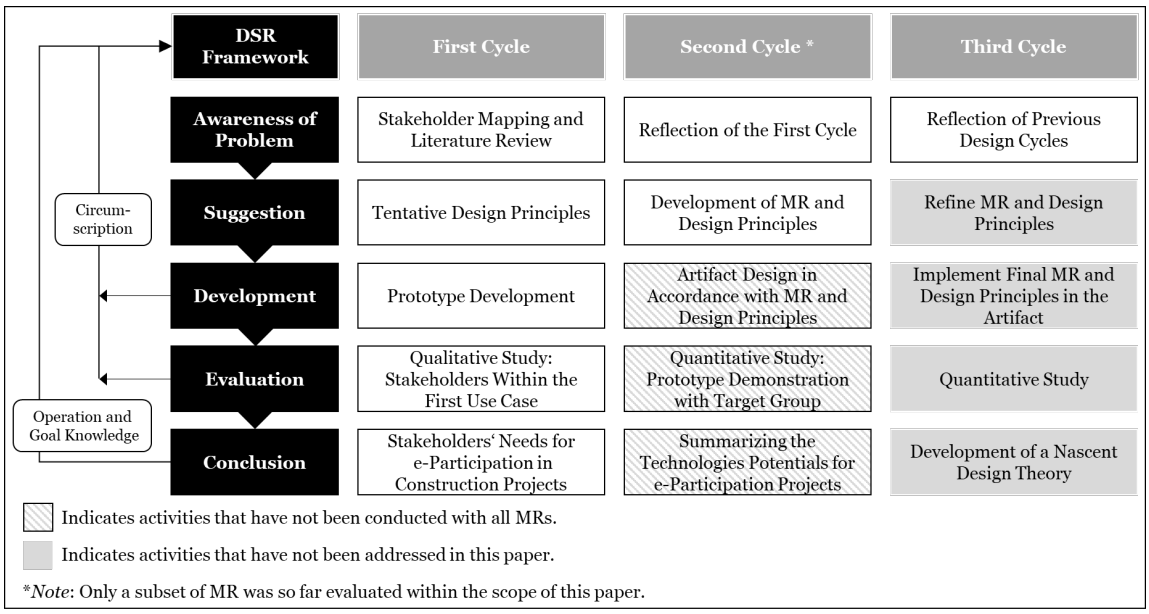

Figure 16. Overview of activities in the e-Participation Design Science Research Project (following Kuechler and Vaishnavi (2008) and Hevner (2007)).

7.3.2 Use Case & Procedure

In this e-participation project, the publicly owned zoological garden of the city of Karlsruhe plans to create a new enclosure for ring-tailed lemurs on a yet unused island in their park, which shall become a freely walkable enclosure, fully accessible for zoo visitors via bridges. Although the zoo is a public institution, financed and controlled by the city, the project is a public-private partnership, funded by private donations through a "Friends of" charity organization. The enclosure including the redesign of the island is an architectural novelty for the zoo, which is why their management wants to encourage visitors to participate in its development. Many aspects of the design of this enclosure are open for discussion, which is what makes this use case well suitable for our research purposes. Additionally, the strong relationship between the citizens of Karlsruhe and the zoo makes their participation more likely. Finally, due to the expectation to make constructions more tangible through visualizations, the institution became especially interested in testing the AR and VR e-Participation application for this construction project. The use case can offer many insights because the construction will be used by a very heterogeneous group of people, and its construction involves numerous stakeholders with a variety of interests, as large (public) constructions projects typically do (Li et al., 2013). Additionally, it is a construction project with a high local relevance, since it has already aroused public interest (Badisches Tagblatt 2019).

7.4 Designing an AR and VR based e-Participation Application

As shown in Figure 16, we followed a mixed method approach, where we evaluated the prototype qualitatively (first cycle) and developed meta-requirements. Some of these meta-requirements were then evaluated quantitatively in the field (second cycle). In the following, we present the activities of the two DSRIS cycles.

7.4.1 First Cycle

7.4.1.1 Awareness of the Problem and Suggestion

We started the first cycle by exploring the needs that initiators and potential users might have for an AR- and VR-based e-Participation application, and mapped the challenges that might arise during artifact design. Through conducting a literature review, we gained an overview over the aspects of civic and online participation. A brief overview of this literature review has been presented in the foundations and related work chapter. With a market analysis, we looked for existing applications of AR and VR in this field.

In a workshop with the initiators of the e-Participation project, we clarified the aim and scope of this particular use case. To find out about the stakeholders potentially involved in this e-Participation case, we conducted a stakeholder mapping. Axelsson et al. (2013) demonstrated how a stakeholder analysis can be used for the public sector. We used this method to outline the different perspectives and potential conflict lines between the stakeholders involved in our first use case. As a result of this analysis, we found a group of stakeholders on the initiators, the beneficiary and the supply side (s. Table 13). Based on our stakeholder mapping, we created detailed personas (Sinha, 2003) which we used to develop some of our design principles. We further relied on the theoretical foundation for design theorizing of Gregor and Jones (2007). The works of Wagenknecht et al. (2016) and Tavanapour et al. (2019) motivated us to develop meta-requirements and design principles in the field of e-Participation. The derived tentative design principles suggested certain attributes the application should offer concerning its usability, availability, flexibility and efficiency.

7.4.1.2 Development

Since the development of the application is a part of a greater research project in which two tech companies cooperate with scientists to develop the AR and VR e-Participation artifact, the application is only adapted for the previously described use case. It could enable citizens to participate in the construction project and help them to receive an impression of the island's accessibility. Furthermore, the application allows participants

to see the island from different perspectives and to see different versions of the enclosure. Moreover, it provides a platform for citizens to submit their feedback, comments and design suggestions. The application works on smartphones, tablets and HMDs. It is controlled by lifting, lowering and turning the mobile device and in the case of HMDs additionally navigate via controllers. The team of developers used the tentative design principles to develop the application, which could be evaluated by the named stakeholders.

7.4.1.3 Evaluation and Conclusion: Qualitative Study and its Results

We designed a qualitative study to explore the different kinds of motivations behind this IS research project. In IS, qualitative methods are widely used for data collection. Qualitative studies produce, if conducted carefully, empirically relevant research results. Furthermore, through their explorative approach, they can draw attention to new phenomena and increase practical relevance of research (Trauth 2001). We also chose qualitative methods because their participatory style appeared appropriate for our research topic. Axelsson et al. (2010) and Holgersson et al. (2018) demonstrated the importance of citizen participation in e-government projects, and we want to respond to this call by bringing citizens insights into this IS project.

Looking for a suitable method, we decided to follow Kaiser's (2014) qualitative research approach for the conduct of qualitative expert interviews in political science. The latter offer a valuable base for analyzing decision-making processes and mechanisms of power and is therefore useful for research on public participation. The qualitative interviews were guided along our proposed research question. Based on the findings in the literature indicating distinct challenges and opportunities of AR and VR we decided to separately ask about the technologies to further explore differences. In the beginning, we generally asked about previous experience with and interest in the area of AR and VR. Nevertheless, the crucial question in the interviews was about the possible degree of participation. Since participation is voluntary, involvement in public participation projects always depends on incentive concepts. Ultimately, however, the aim is to ensure broad participation, which is why it is important to ensure technology acceptance. This results in the following research dimensions: "experience and interest," "degree of participation," "incentive concepts," and "technology acceptance."

The questions reflecting the "experience and interest" asked about the interviewees' previous experience with public participation, citizen participation in the context of construction projects and e-Participation, as well as their previous experience with and interest in AR and VR. In doing so, we wanted to find out more about the participants backgrounds and attitudes towards the planned procedures and technologies. The "de-

gree of participation" research dimension asked the participants about the desired degrees of participation for an e-Participation application using AR and VR in accordance with the SPP. Since the application should be modular in the sense that different functionalities address different levels of participation, we asked about the different mentioned e-Participation techniques (e.g. informing, giving feedback, discussing, voting, etc.) for the context of participating in a construction project. We further examined the interviewees' "incentive concepts" in a more open and explorative manner. Thereby we wanted to find out what other elements or design details could make participating in a construction project via an AR and VR e-Participation application more likely for them. Furthermore, the set of questions about "technology acceptance" was used to explore the interviewees' acceptance of the general idea of the use of AR and VR for e-Participation to ensure that such an IS artifact would be used at all. The set of questions was based on Davis's (1989) and Venkatesh and Davis's (2000) technology acceptance models (TAM 1 and 2) and the adaption for Digital Government research by Pereira et al. (2017).

We decided to derive meta-requirements from interviews adjusted to this particular use case because the stakeholders are still unfamiliar with AR and VR. Exemplifying the interview around this use case makes it easier for the interviewees to imagine the application and making it less hypothetical. At the beginning of each interview, we created a common foundation, introduced to and familiarized the interviewees with the technology and used a postcard presenting the construction site, and a conventional smartphone with a preinstalled AR application that we implemented as prototype for this use case. Through the phone camera, the application identified markers printed on the postcard, and hence displayed the different versions of the construction site on the smartphone. The markers helped to determine the position of the virtual elements projected on the postcard. We introduced VR to the participants using an HMD showing a 3D model of a construction site. We gave the participants time to get to know the technologies at their pace. Before the interview began, a standardized guideline clarified the research project and made the interview structure transparent to the interviewees. The guideline contained 24 predefined questions, although the interview should be considered semi-structured due to the fact that the interviewer had the possibility to ask additional questions.

In June 2019, we conducted 20 face-to-face interviews, some of which included up to three people (see Table 14). We chose the interviewees carefully based on the stakeholder mapping and included representatives of all groups. The average age of the interviewees was 46 years (min. 18, max. 80, sd. 20.01) and among the interviewees were

51.85% female and 48.15% male. We recorded the interviews and protocolled the conversations (Kaiser 2014). We then transcribed the recordings manually using MAXQDA. With the help of the program, we coded the material and conducted a structured content analysis following Kaiser (2014). As a result of our structured content analysis alongside our research dimensions, we determined the general attitudes towards the planned artifact, and explored the challenges addressed by the stakeholders.

Stakeholder Group	Position/Role
Zoo staff members (10 interviewees)	Directorship, construction management, technical department, finance, public relations, zookeeping
"Friends of" charity organization (3 interviewees)	Fundraisers for the construction project
Zoo visitors (7 interviewees)	Target group for the application, potential donors
City council and representatives (5 interviewees)	City's Spokesperson, Members of the City Council (i.a. responsible for public construction projects)
Technical experts (2 interviewees)	Developers and experts on the usability of the project

Table 14. Groups of stakeholders interviewed and the stakeholders' role within the construction project.

Experience and interest: Overall, our analysis demonstrated a very strong appreciation for the use of digital technologies for public participation: 86% of the study participants found that digital technologies are a valuable addition to public participation and expected digital technologies to promote access to information about public construction projects. Accordingly, 77% of the participants preferred 3D visualization of construction projects over classic architectural plans. The applications' future design should build on this support through exploiting the potentials of VR- and AR-based visualizations to include non-experts into the planning of public construction projects.

Degree of participation: We could observe that the interviewees were only ready to participate through an e-Participation application up to a certain level of participation. While most participants embraced the idea of informing themselves through the application, the readiness to get involved with the project sank in accordance with the increase in the level of participation. Most participants were willing to inform themselves about the project through the application, many were less willing to engage in more interactive forms of participation like commenting or discussions. The latter, in many cases, was caused not only by the citizens' doubt in their own competence: project initiators, too, raised concerns in the former's ability to participate due to their lack of expertise. Besides, the question arose of how to achieve representivity and how to ensure a minimum quality of submissions and prevent polarization of opinions, which threatens to arise on loosely moderated digital platforms. While showing interest in as-

pects of crowdfunding (donating for projects they affirm), the willingness of many participants to participate in a participatory budgeting process of a construction project was weaker, again due to their perceived lack of competence in this field.

Incentive concepts: Interviewees from the initiator group stressed the need for transparent communication of the scope of participation available to the users. An aspect of high importance to the users was the recognition of their participation. The majority needed to know that their contribution to the project would have an impact on the decision-making, while most of them recognized the difficulty in finding a consensus on the ground of various suggestions.

Technology acceptance: We observed a difference in the way the interviewees perceived VR and AR. On the one hand, AR was most frequently perceived as a source of information and was sometimes related to construction projects. On the other hand, four times more interviewees related VR to gaming and leisure than AR, while some addressed its potential to visualize new, non-existing spaces. The use of the technologies would increase the likelihood to participate in a new construction project of 74% of the interviewees. While most of the participants did not express any reservations considering the use of digital technologies including AR and VR for public participation, several expressed their fear about the protection of personal data on digital platforms. With regard to the general aspects of application design, most participants pointed out the need for the application to have few barriers, be easy to use and intuitive. This was expected to counteract the exclusiveness due to the digital divide and thereby increase the representivity of the participation outcomes. Finally, some called for the application to be open source, which would make the application transferable between institutions and initiators and freely accessible to the citizens.

7.4.2 Second Cycle

7.4.2.1 Problem Awareness: Reflection of the First Cycle

Through conducting the stakeholder mapping and qualitative study, the first cycle helped us to get a clear picture of the concept of an AR and VR e-Participation application. The results of the qualitative study showed us that some assumptions based on the developed personas were true, while we had to revise others and were made aware of additional important observations. The different strengths and weaknesses found between AR and VR in the first cycle support our belief that combining both technologies for an e-Participation application is a promising new research field. It also encourages us to further explore these differences to be able to use AR and VR respectively in the appropriate use case.

While qualitative research offers advantages, presented in the corresponding activity, the limitation is the generalizability. Yet, we made an effort to follow Kaiser's suggestions of a theory-based approach that leads to traceability and some kind of standardization. Reflecting the first cycle, we had to acknowledge that we would need to derive testable meta-requirements based on the qualitative study and evaluate them quantitatively to address the problem of generalizability, weak spots we address in our second DSRIS cycle.

7.4.2.2 Meta-Requirements and Design Principles

The structured content analysis allowed us to map out the potentials and challenges to an AR and VR-based e-Participation application from the point of view of various stakeholders. Based on these results, we derived six meta-requirements for an AR and VR e-Participation application addressing the users' access to the application (MR-1), their needs for certain information (MR-2) and their motivation to use the application (MR-3). Additionally, the analysis showed the necessity of transparent communication of the project's intentions (MR-5) as well as data security (MR-6). The meta-requirements shall further determine six general design principles for the development of an AR and VR e-Participation application (Table 14).

Meta-Requirement	**Description**	**Design Principles**
Access (MR-1)	MR-1.1 Intuitive and efficient navigation throughout the application	DP-1 Reduce participation barriers through ensuring broad access and targeting groups with low participation or technical expertise
	MR-1.2 Application portability through access via various mobile devices that fulfill the respective AR and VR hardware requirements	
	MR-1.3 Connect to social media to address new users	
	MR-1.4 Offer crowdfunding through a donation process that offers online and offline payment methods	
	MR-1.5 Allow transferability between projects (through open source access and modular design)	
Information (MR-2)	MR-2.1 Use the strength of the visualization to inform: (1) in an interactive manner through AR and (2) in an entertaining manner through VR	DP-2 Highlight the project's relevance and exploit the visual and informative potentials of AR and VR to address the needs of different stakeholders
	MR-2.2 Offer information that addresses different stakeholders (e.g. citizens, experts), ranging from general overview to technical details	
	MR-2.3 Convey the urgency of the project's impact and the need to participate	
	MR-2.4 Empower the users to participate through increasing their competence	
Motivation (MR-3)	MR-3.1 Provide updates on the project's progress to keep the users informed and involved in the project after the initial participation process	DP-3 Motivate proactive involvement and interest through up-

	MR-3.2 Empower users to feel able to participate, esp. when it comes to voting, participatory budgeting and submitting design suggestions	to-date information and recognition
	MR-3.3 Encourage participation through the consideration and recognition of citizen feedback	
	MR-3.4 Incentivize donations by using the expected effect of visualization on the interest for a project	
	MR-3.5 Moderate discussions to ensure a respectful environment	
Transparency (MR-4)	MR-4.1 Outline the initial motivation of the participation process	DP-4 Make the aim and scope of the participation process transparent
	MR-4.2 Make the scope of influence transparent to the users	
	MR-4.3 Ensure communication of the results to the decisions-making bodies	
	MR-4.4 Ensure a fully transparent donation process	
Data Security (MR-5)	MR-5.1 Possibility to learn about and gain trust in the use of personal data	DP-5 Ensure and communicate data security measures
	MR-5.2 Ensure secure payment	

Table 15. Meta-requirements and design principles for an AR- and VR-based e-Participation application.

7.4.2.3 Development: Revised Artifact Design

In a workshop with the development team, we presented the results of our qualitative study and went through meta-requirements and design principles (Table 15). We focused on bringing the application development in accordance with the meta-requirements and design principles. Subsequently, we discussed with the developers how they could integrate them in the further development of the application. We assured that the application would be in a testable condition for the quantitative study. After another demonstrable prototype was developed, we consulted the initiators of the participation process to keep them involved and assure that the application meets their demands. Figure 17 presents the results of this DSRIS activity.

Figure 17. Illustration of an AR and VR e-Participation application: AR version of the construction site (left), visualization of the construction site in VR (right). Illustration by project partner (Raumtänzer GmbH).

7.4.2.4 Evaluation and Conclusion: Quantitative Study and its Results

The quantitative study that evaluated the prototype of the second cycle took place in the field over five days in October and November 2019 at a significant consumer fair (roughly 140.000 visitors each year) in Karlsruhe. The fair has strong ties to the local community and is frequented for various reasons – as an example local gastronomy, construction companies, city and state authorities present their work. At the zoo's booth, we presented our AR and VR e-Participation artifact and allowed the visitors passing by to participate.

The technology set up was similar to the qualitative study apart from the two tablets with preinstalled AR applications replacing the smartphone. To overcome the issue that the fair obviously did not take place at the zoo and therefore in-situ viewing was not possible yet, the AR application was again provided by means of markers on a poster (a common practice for advertising agencies to illustrate an AR application). Through the tablets' cameras, the application identified markers printed on a poster for locating the virtual content on the island's photo on the right position (see Figure 17 left). The poster showed the island without the construction project, which became visible only through the AR view on the tablet. The users had the possibility to move away and approach the virtual island from different angles, and thereby see more details of the construction site including moving ring tailed lemurs. For VR, we used an HMD (Oculus Quest) with a 3D model of the island (see Figure 17 right) including moving lemurs. The users had the possibility to walk over the island and see it from different perspectives using two controllers. The participants were assigned to either the AR or VR prototype. After the artifact demonstration, we asked the participants to fill out a questionnaire with 17 questions, out of which 12 tested the meta-requirements (measured on 7-point Likert scales ranging from strongly disagree", disagree, somewhat disagree, neither agree nor disagree, somewhat agree, agree to strongly agree, unless otherwise stated), and 5 asked about demographics and feedback. Overall, the study consists of 339 participants, of whom 57% were presented AR and 43% VR demonstrators. The average age of the participants was 40 years, (min. 9, max. 81, sd. 15.16). 63.8% of the study's participants were female and 36.2% male, however, a chi-squared test showed that no difference in the gender ratio between the use of the technologies (p= .648) could be found.

The quantitative study allowed us to evaluate the effectiveness of the implementation of a subset of the meta-requirements presented in Table 15. Using a human-centered design approach, we wanted to evaluate early on in the design process when not all requirements have already been implemented yet. Therefore, the evaluation is limited to certain meta-requirements. The first prototype focused primarily on innovative as-

pects of the application that make our work different from others, and therefore specialized on the AR and VR visualizations. For those meta-requirements we were able to test, we thus focused on aspects of accessibility, informing via visualizations and motivation, leaving a complete evaluation of all requirements for the repetition of the second cycle (Figure 16 shows activities that have not been conducted with all MR). E-Participation standard features like social media integrations (MR-1.3), feedback (MR-3.3) and discussion tools (MR-3.5) or aspects of transparency (MR-4) and data security (MR-5) will be evaluated later.

MR	Topic	Item	Question
MR-2.2; 2.4	Informativeness of the visualizations (IV) (self-developed)	IV1	Using the demonstrator helped me imagine how the new enclosure would fit into the zoological garden.
		IV2	What do you estimate: by how much is the new enclosure larger than the old one?
		IV3	With the support of the demonstrator, I could easily imagine the dimensions of the new enclosure.
		IV4	Compared to the demonstrator, I would have preferred a miniature model of the enclosure to inform myself about the construction project of the zoological garden.
MR-2.1	Perceived telepresence (PT) (Based on Kim and Biocca 1997; Klein 2003; Nah et al. 2011)	PT1	I forgot about my immediate surroundings when I was using the demonstrator.
		PT2	When using the demonstrator ended, I felt like I came back to the "real world" after a journey.
		PT3	During using demonstrator, I forgot that I was in the middle of a fair.
MR-3.2	Motivation to participate in the project (MP) (Based on Naranjo-Zolotov et al. 2019)	MP	The demonstrator would motivate me to become more involved with the construction project.
MR-3.4	Willingness to donate (WD) (self-developed)	WD	After using the demonstrator, I feel more willing to donate for the island for ring-tailed lemurs.
MR-1.5	Artifact's usefulness for further cases (AU) (Based on Naranjo-Zolotov et al. 2019)	AU1	Could you possibly imagine informing yourself about other construction projects in this manner?
		AU2	For which other areas or construction projects could you imagine using the technology?
Note: IV2, AU1 and AU2 were not measured on 7-point Likert scales.			

Table 16. Meta-requirements related to the respective questions in the quantitative study questionnaire.

We describe the study's results (Table 17) starting with the participant's feedback on the visualization. To evaluate MR-2.2 and 2.4, we asked various questions towards the informativeness of the visualizations and were surprised by the overwhelmingly positive feedback of the users. On average, participants rated the question whether the application helped them to imagine how the new enclosure would fit into the zoological garden (IV1) with 6.23, which is extremely high, given the maximum of 7 points on the Likert scale. Participants also largely agreed with the statement that the demonstrator helped them to get a clearer picture of the dimension of the construction project (IV3) with a mean of 5.61. For these two questions, VR was rated significantly larger than the AR application ($p<.001$).

To prove the understanding of the dimensions, we asked the participants to guess the size of the planned enclosure in comparison to the old one (IV2). Seven options ranging from the same, twice, five, ten, twenty, forty, to eighty times the size were given. The correct answer, "twenty times bigger," received the most answers (30.28%). When comparing right versus wrong answers, no significant difference between the two technologies can be shown ($p= 1$).

With a mean of 3.29 (be aware that low numbers are in favor of the demonstrator), the participants answered the question whether they would prefer a non-virtual 3D-model of the construction project to the demonstrated visualization (IV4) with a tendency towards the artifacts visualization. Although over half of the participants somehow showed their preferences towards the use of the technologies, one fifth of the participants neither agreed nor disagreed, showing also some hesitations towards using the technologies as an information tool for new construction projects. AR and VR were not rated differently ($p= .622$). We speculate that miniature models of construction projects are quite popular and providing an illustration of a construction project is important, whether it is a real, augmented or virtual 3D-model. Although the disadvantage of such a miniature model is that it often exists only once at a fixed location, which makes it difficult to access, whereas a VR visualization can be viewed from anywhere.

The interviewees of the qualitative study drew our attention to the different perceptions of the two technologies. We used the concept of perceived telepresence (Kim and Biocca, 1997; Klein, 2003; Nah et al., 2011) to test for the perceptions formulated in MR-2.1. Perceived telepresence (in the following considered as the mean of the items PT1-3, Cronbach's alpha = 0.86) is defined as "the feeling of being a part of the phenomenal environment created by a medium" (Kim and Biocca, 1997, p. 9). It is considered a unique characteristic of VR and therefore unsurprisingly, the respondents rated the feeling of perceived telepresence significantly higher ($p<.001$) using VR (mean of 5.37 when

compared to AR with a mean of 4.23). Therefore, we assume that the different technologies have indeed different strengths concerning MR-2.1. The high telepresence of VR demonstrates another kind of entertaining experience. Compared to AR, the visualization not only shows its interactive qualities but also can further distract from one's immediate surrounding.

MR-3.2 was tested by asking to what extent the application would motivate the participants to become more involved with the presented construction project (MP). MP is based on the e-Participation empowerment items developed by Naranjo-Zolotov et al. (2019). As they only experienced this limited version of the prototype focusing on the visualization functionality, we did not expect very high values. With an average of 4.75, we found moderate motivation to participate. In VR, we found significantly higher motivation than in AR ($p = .001$), but this might have been caused by the fact that the AR application was not tested in-situ.

In order to test if the visualization incentivizes donations (MR-3.4), we asked whether the demonstration increased the participants' willingness to donate for the project (WD). Although the moderate willingness of 4.32 does not immediately impress, almost half of the participants agreed to some extent that they felt more willing to donate after using the demonstrators, thereby showing that combining e-Participation for construction projects with crowdfunding has relevance to be further researched. There was no significant difference between the two technologies ($p = .157$).

Asking about the participants' estimation of the artifact's transferability to other projects (AU1) allowed us to test MR-1.5. AU1 is based on Naranjo-Zolotov et al. (2019) e-Participation intention to use items. When asked whether they could imagine informing themselves about a different project in a similar manner, 69.63% responded positively, while only 3.98% said "no", thereby demonstrating how the general idea of an AR and VR e-Participation artifact for construction projects resonates. Again, showing no differences in the ratings between AR and VR ($p = .395$). With a free text question, we asked for what kind of areas or other construction projects the participants could imagine using the demonstrated artifact (AU2). 76.66% of ideas related either to general construction planning (23.33%), construction projects in the zoo (23.33%), or the field of urban planning (30%), with the remaining 23.34% introducing further ideas around leisure and entertainment activities. This supports our conclusion that the idea of using AR and VR for e-Participation in urban planning is also promising.

Furthermore, we tested whether variables representing aspects of the attitude towards using (i.e., MP and AU1) were affected by participant's prior experience with the tech-

nology and age. We only observe a significant effect of age ($p < 0.05$) for MP when performing a linear regression with AR/VR as independent and MP as dependent variable (controlling for age and prior experience; the treatment effect was also significant $p < 0.01$).

Item/MR		Aggregated	AR	VR	p (AR vs. VR)
IV1 MR-2.2; 2.4	Mean	6.23	6.08	6.46	<.001[a]
	SD	1.08	1.08	0.96	
IV2 MR-2.2; 2.4	Twenty times the size	99 (30.28%)	56 (29.63%)	43 (30.94%)	1[b]
	False Replies	228 (69.72%)	133 (70.37%)	95 (69.06%)	
IV3 MR-2.2; 2.4	Mean	5.61	5.38	5.94	<.001[a]
	SD	1.25	1.24	1.14	
IV4 MR-2.2; 2.4	Mean	3.29	3.32	3.26	.622[a]
	SD	1.83	1.77	1.92	
PT (Mean of PT1-3) MR-2.1	Mean	4.71	4.23	5.37	<.001[a]
	SD	1.49	1.48	1.2	
MP MR-3.2	Mean	4.75	4.55	5.05	.001[a]
	SD	1.43	1.41	1.39	
WD MR-3.4	Mean	4.32	4.22	4.48	.157[a]
	SD	1.73	1.67	1.78	
AU1 MR-1.5	Yes	227 (69.63%)	126 (68.48%)	101 (71.13%)	.395[b]
	No	12 (3.98%)	5 (2.72%)	7 (4.93%)	
	Perhaps	87 (26,69%)	53 (28.80%)	34 (23.94%)	
Note: p-values based on: a = Mann-Whitney U test, b = chi-squared test					

Table 17. The questionnaires results.

7.5 Discussion, Limitations and Future Research

In the following, we would like to reflect on the previous design cycles, and thereby conclude this paper by starting the third DSRIS cycle (Figure 16). As shown in Figure 16, we conducted two cycles following the DSRIS framework by Kuechler and Vaishnavi (2008). In cycle 1 of our mixed-method approach to the DSRIS cycle, we conducted a large-scale qualitative study, interviewing 27 different stakeholders. The study showed that, although citizens do not generally associate AR or VR with public participation, they

tend to have a high interest in using these technologies for e-Participation and are convinced of the future relevance of these technologies. Furthermore, we used the method's exploratory approach to look beyond the expected and thereby learned firsthand about ideas and concerns regarding an AR and VR e-Participation application. For example, the willingness to get involved with the project sank with the increase in the level of public participation due to self-doubts about their own competence. Furthermore, the possibility to display the architecture in 3D was estimated by most participants to be of great help.

Entering cycle 2, the results of our qualitative study led us to formulate meta-requirements, namely access, information, motivation, transparency, data security, and design principles for the design of an e-Participation artifact that explores the potentials of AR and VR. Following a user-centered design approaches, we wanted to evaluate early and with a broad user group. Since the implementation of a prototype addressing all meta-requirements was not possible at such an early stage, due to, many technical challenges, we focused primarily on informing via visualizations, aspects of accessibility and motivation. We, again, observed an overwhelming interest in using AR and VR for e-Participation to better visualize construction planning. Also, the prototype helped the imagination of the construction project and this was more profound for the VR prototype. Furthermore, we could establish the positive impact of AR and VR on the willingness to engage with and donate for the construction project. This allows us to assume that the use of AR and VR as a means of visualization of construction projects has, indeed, potential to increase public participation in this field. We could further show the general willingness to engage with urban planning in a similar manner, which supports our intention to ensure the application's transferability beyond the use case.

Interestingly, our visualizations went beyond mere illustration in that they could make many users feel virtually transported from the study's environment to project site – an effect described as telepresence. The fact that VR was often rated higher than AR might result from this larger telepresence experienced in VR. Yet, comparison between AR and VR in this work are still limited possibly, because the AR prototype was not shown in-situ. Usually, users will be able to see the construction site in reality and then the added AR content above. This will further improve evaluation proportions in size and might make AR more attractive to the users. Therefore, our results concerning the differences between the technologies should be regarded with some caution. Nevertheless, we could extend existing research on the use of AR and VR for citizen participation (Allen et al., 2011; Goudarznia et al., 2017; Rockmann et al., 2015).

The presented e-Participation project is rather complex. Therefore, we started to evaluate the artifact and learn from the results early in our design cycles. Since there are

hardly any applications using AR and VR for e-Participation yet, we consider it important to inform the research community and practitioners about our suggestions, the meta-requirements and design principles early on. Through this, we want to help other projects that are at their early stages. Considering the study design, we acknowledge the limitations of the generalizability that arise from the DSRIS focus on a specific use case. Yet, in the evaluation, most participants stated the artifact's usefulness for further cases. However, we consider that trust in politics and public administration might vary not only from country to country, but also from municipality to municipality. Lee and Schachter (2019) suggest that trust in government has an impact on the willingness to participate in political settings. Therefore, we suggest including sociological findings in our future work so as to link e-Participation research more closely to social realities.

In the remaining DSRIS activities, we would like to strengthen our findings on the potentials of AR and VR for e-Participation by testing the AR application in-situ and introducing a control group that would allow us to draw comparisons between an AR and VR e-Participation tool and analogue forms of public participation. We will furthermore refine our existing design principles and evaluate the prototype by testing the remaining meta-requirements that we did not include in the quantitative study so far. A complete test of our meta-requirements, ranging from informative through participatory to technical aspects would have exceeded the scope of the second study. Based on our findings that showed interest to participate in construction projects through donations we would like to test the impact of AR and VR on the willingness to donate and further test features like social media integrations, feedback and discussion tools, or aspects of transparency and data security in the context of the researched technologies. Therefore, new features will be implemented in the artifact, which will be further developed based on the refined meta-requirements and design principles. We are looking forward to conclude the third DSRIS cycle by developing a nascent design theory for AR and VR e-Participation artifacts based on Gregor and Jones (2007).

In this paper, we put forward a set of meta-requirements and design principles for the development of an AR and VR e-Participation application. We believe that both technologies can be used productively: By using the informative and entertaining strengths of AR and VR, e-Participation can become an exceptional experience for the citizens and in that way help them overcome barriers to participate in construction project planning, thereby making engagement with public issues more gratifying for citizens and initiators.

8 Evaluating Differences Between Traditional and Immersive e-Participation

8.1 A Behavioral Economics Study During the Pandemic

To evaluate the Take Part prototype further under standardized laboratory conditions, the research project Take Part provided the opportunity to conduct a behavioral experiment at the Karlsruhe Decision and Design Lab (KD2Lab, founded by German Research Foundation). The KD2Lab would have provided 40 climatized and soundproofed booths, psychological measurement instruments and suitable immersive hardware.

Due to the COVID-19 pandemic, unfortunately, it seemed impossible to conduct in 2020 or 2021 the study in the lab as planned. It became a legitimate fear to expose the participants, through the hardware or personal interactions, to the virus, which was, in the beginning of the pandemic, an unforeseeable threat. Therefore, in autumn 2020 the decision has been made to conduct an online study instead. This online study still aimed at testing immersive e-Participation and compare it to traditional forms of e-Participation.

The new reality posed numerous challenges: First, it had to be ensured that a realistic participation process was simulated, even though the participants took part online. Challenging about it was obviously that an online study was in contradiction to the intended on-site participation. Secondly, and in this lay the real challenge of designing this experiment, the usability of the platform had to be simulated on devices which weren't mobile and made for immersive experiences. It became necessary to develop a browser-based alternative for desktop computers and notebooks. An alternative that allowed participants to perceive differences between two treatment groups, where one should simulate e-Participation with immersive systems. If a platform is made primarily for mobile devices and head-mounted displays (see Chapter 9 and 10), this poses a challenge. Although there are examples of studying immersive systems using browser-based simulations (Jiang et al., 2018; MacIntyre and Smith, 2018; Takac, 2020), this effort can only be understood as a fallback solution in a time full of new and unexpected occurrences.

In this chapter, initially the general design of the online study will be presented, reflecting on the above described challenge. In the second sub-chapter it will be shown that the study was full of ideas and approaches that should test the impact of immersive

systems for e-Participation in urban planning and furthermore touched on issues such as civic crowdfunding (Stiver et al., 2015). Since the later was not directly relevant for this dissertation, as it shifted away from the research questions and the focus on participatory urban planning, most of the evaluation of the online study will need to be addressed in forthcoming investigations. Nevertheless, the evaluation of the remaining meta-requirements, those which have not been evaluated comprehensively in Chapter 7, will be presented in the third and put in a broader context in the fourth sub-chapter. The testing of the remaining meta-requirement is intended to facilitate the completion of the Design Science Research Cycle and to provide first insights.

8.2 The Design and Conduction of the Online Study

8.2.1 Research Design

After extensive rescheduling and a complete redesign, the study was conducted with the assistance of the KD2Lab staff members[9]. It took place from September 20 to September 24, 2021. In the year prior to the realization, a research model (Figure 18) had been developed based on various hypotheses. Those hypotheses were primarily related to the influence of different factors on two effects under investigation: the willingness to donate and the intention to use (the artifact). Although only the intention to use is relevant in this context for the evaluation of the remaining meta-requirements, the entire research model of the study should be explained on the basis of the respective hypothesis and their theoretical foundations.

[9] This large-scale only study, similarly to the field experiment, could not have taken place without the exchange with and support of numerous colleagues. The design of the study was carried out in collaboration with Jella Pfeiffer, Christian Peukert and Anke Greif-Winzrieth. For the implementation of the development work, gratitude is to be given to the Take Part consortium and in particular to Nadine Pfeiffer-Leßmann and Lucy Thiele. For the input on the design, and the support in the controlled execution of the study itself, Gregor Pahlitzsch and Carolin Stein should be thanked for their extraordinary assistance.

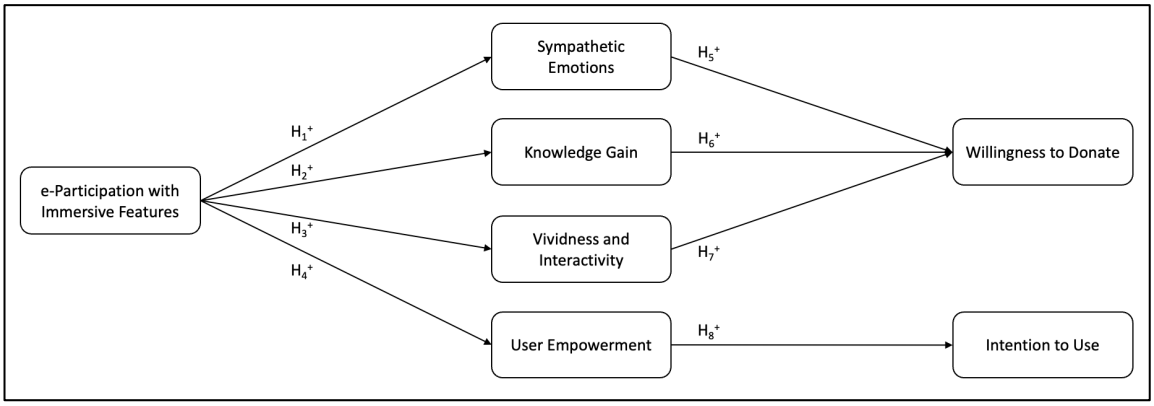

Figure 18. The research model of the online study comparing traditional with immersive e-Participation.

***H_1** : Immersive features in an e-Participation app will increase the users' (positive) emotions.*

Immersive systems are expected to excite the participation experience (see Chapter 3, 4 and 5). Furthermore, psychological research on emotional reactions in virtual environments showed more reactions in virtual environments (Felnhofer et al., 2015). Additionally, a systematic literature review on VR and emotions has shown the impact VR has on the emotional state of individuals (Marín-Morales et al., 2020). The authors proved this effect for several fields, such as e-Commerce, education and psychology. Moreover, immersive systems, respectively telepresence, will foster perceived enjoyment (Lombard and Ditton, 1997; Nah et al., 2011). The findings of Herrero et al. (2014) go in the same direction, by establishing that VR is fostering positive emotions among patients with chronic pain. Based on this research, it can be assumed that immersive features in an e-Participation app will increase the users' (positive) emotions.

***H_2** : Immersive features in an e-Participation app will increase the users' knowledge gain.*

The second hypotheses is based on the idea that product knowledge and decision quality are higher with 3-D products (Li et al., 2003). Another study found that participants show higher actual and perceived product knowledge using virtual environments (Suh and Lee, 2005). In addition, VR simulations seem to be promising for psychology education, since they can provide a knowledge and empathy gain (Formosa et al., 2018). Especially in the educational sector, the benefits of virtual environments are well researched (Bricken, 1991; Huang et al., 2010). Therefore, it was assumed that immersive features in an e-Participation app would increase the users' knowledge gain.

***H_3** : Immersive features in an e-Participation app will increase the vividness and interactivity.*

Marketing research showed, that virtual environments lead to a higher feeling of vividness and presence (Van Kerrebroeck et al., 2017). Furthermore, AR product presentations are generally better evaluated than traditional web-based product presentations due to their vividness and interactivity (Alves and Luís Reis, 2020; Yim et al., 2017). For those reasons, it can be expected that immersive features in an e-Participation app will increase the vividness and interactivity.

***H_4** : Immersive features in an e-Participation app will increase the users' (user) empowerment.*

Already in the 1990s, Lombard and Ditton (1997) found that telepresence and immersion leads to higher "participation" and a "sense of involvement" among users. Furthermore, it could be shown for the business context, that telepresence supports higher consumer brand engagement (Algharabat et al., 2018). The study presented in Chapter 7 shows, that the prototype has the ability to get citizens more involved with construction projects and urban planning. Therefore, it is assumed, that immersive features in an e-Participation app will increase the users' feeling of (user) empowerment.

***H_5** : Positive or sympathetic emotions will increase the users' willingness to donate.*

Additionally, the study researched how sympathetic emotions towards a charitable cause might strengthen the willingness to donate. The so called victim effect, which argues that people are more willing to donate, when they feel pity for individuals, is an important factor to consider, when it comes to motivations behind donations (Cryder et al., 2013; Dickert and Slovic, 2013; Small et al., 2007). Nevertheless, other research found that the feeling of being inspired also contributes to more donations. Particularly, the combination of feelings of emotional strength together with feeling pity can inspire people to donate. (Liang et al., 2016). Based on this research, it is expected that positive or sympathetic emotions will increase the users' willingness to donate.

***H_6** : A knowledge gain will increase the users' willingness to donate.*

The literature also reflects that individuals, who receive detailed information about a charity cause, donate significantly more than participants with less knowledge about the cause (Cryder et al., 2013). Duncan's (2004) research on impact philanthropism demonstrates that donors want to make a difference by contributing for a specific cause. Therefore, it can be assumed, that a knowledge gain based on given information, will increase the users' willingness to donate.

***H_7** : A strong feeling of vividness will increase the users' willingness to donate.*

As the feeling of vividness encourages individuals to donate for a cause (Cryder et al., 2013) and further leads to higher affective reactions and thereby fosters the willingness to help (Otanga, 2019), the seventh hypothesis assumed that vividness correlated with the users willingness to donate.

***H_8** : A strong feeling of user empowerment will increase the users' intention to use the application.*

The last hypothesis combined the feeling of user empowerment with the users' intention to use. As already discussed in Chapter 3, the intention to use is highly relevant for the e-Participation context. The psychological feeling of empowerment is strongly influencing the intention to use e-Participation (Naranjo-Zolotov et al., 2019). Cognitive factors, as participation, self-efficacy and outcome expectation (user empowerment), affects the personal intention of participants to use e-Participation (Khoirunnida et al., 2017). Additionally, attitude is a key factor in the intention to use an e-Participation system (Alarabiat et al., 2021; Gupta et al., 2016; Zolotov et al., 2018). Hence, it can be presumed that a strong feeling of user empowerment will increase the users' intention to use the application.

As already mentioned, these guidelines are intended to provide a general overview on the structure and design of the online study. In the further course of this chapter, primarily the meta-requirements will be evaluated. The meta-requirements were tested as follows: a) How successful is the fulfillment of the meta-requirement, b) How should the meta-requirement be fulfilled, c) Is the meta-requirement coherent.

8.2.2 Procedure of the Experiment

The study was carried out with 382 participants (191 participants in each treatment group). Based on Fritz and MacKinnon (2007), the calculation of the number of participants was based on a mediation with small to medium effects. Therefore, in the calculation it was argued that for a t-test (i.e., the treatment effect at low to medium effect size d=0.35) 356 participants were needed, and for a (simple) mediation 377 participants. In the recruitment of the participants, this number was again slightly increased in order to have enough fully completed questionnaires in cases of potential drop out.

First of all, participants, who did not know exact details of the study, were recruited by the KD2Lab. These probands were then randomly divided into two different treatment groups (test and control group). Subsequently, all of them received a personalized link to conduct the study on their own computers and notebooks via a website hosted by

the Take Part consortium member Neuland Medien. To access the website the participants received a personalized link and instructions via e-mail.

The study started with general information and instructions. Afterwards, the treatment group used a click dummy of the Take Part app with immersive features and performed various tasks, simulating participation levels, before answering a questionnaire. The immersive (VR/AR) technology was simulated by a click-through panorama tour. In contrast, the control group, had a very similar click dummy, which only varied through the fact that it used pictures instead of immersive visualizations. The participants performed the same tasks in both treatment groups and answered the same questionnaire. In general, the click dummy enabled independent navigation through the app. A participation process was simulated with fictitious discussion topics around the use case. The simulation of the participation scenario was built on the different participation levels of the Spectrum of Public Participation (Figure 4).

The experiment started with an introductory explanation about the use case. This included an explanation of the zoo's construction project and information on the lemurs itself. A four-minute introductory video explained the use case and tried to create a common knowledge basis. The AR/VR features of the app were only shown in the video for the test group. The actual structure of the study then reflected the five different levels of the spectrum of public participation (Figure 4) of the International Association for Public Participation (2018). Hereafter, examples of the technical implementation will be shown based on the spectrums levels.

In the simulation of the participation level *inform* and *consult*, the test group saw a wooden bridge leading through the enclosure in the immersive environment with the ability to explore the area in all directions. The control group, on the other hand, got the wooden bridge as a static image presented (Figure 19).

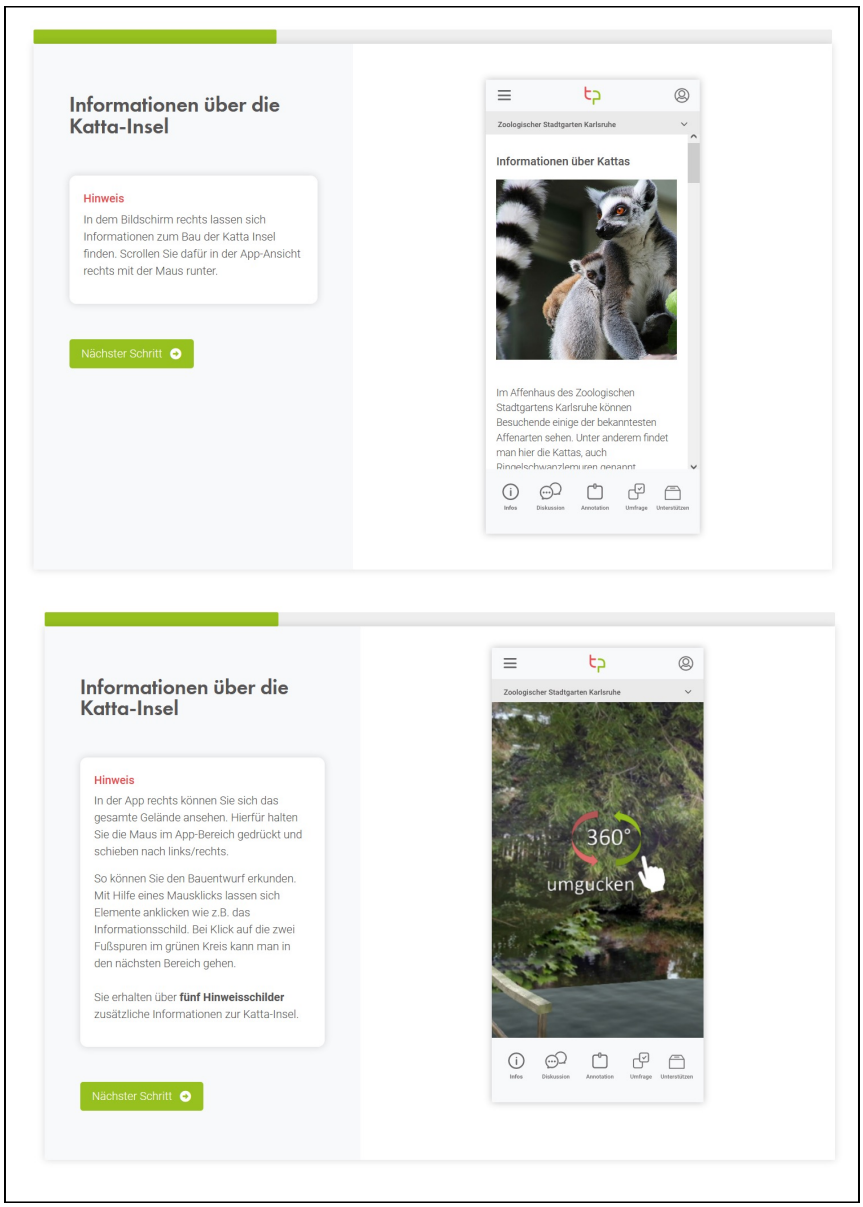

Figure 19. Upper illustration: representation in the control group (text with static image), lower illustration: representation in the test group (dynamic and interactive 360 degree environment).

The simulation for the level of participation *involve*, presented the test group users again the immersive panorama environment and enabled them to influence the discussion using up- and downvoting and entering own comments and remarks. The control group saw instead of the interactive environment an image, but participated in a similar discussion (Figure 20).

The participation level *collaborate* was about simulating the user's involvement for the design of the bridge. The test group was given the opportunity to directly and interactively choose between different materials in the immersive environment. In the control group, on the other hand, the different materials were displayed as simple static images.

Within the last participation level, *empower*, the participants were asked to make a binding decision on the design of the open space. In the test group and its VR panorama environment the corresponding objects were displayed directly in the virtual environment. In addition, the situation anchors contained small information texts about the respective objects. In the control group, pictures of the individual objects were displayed and were also provided with short informative texts.

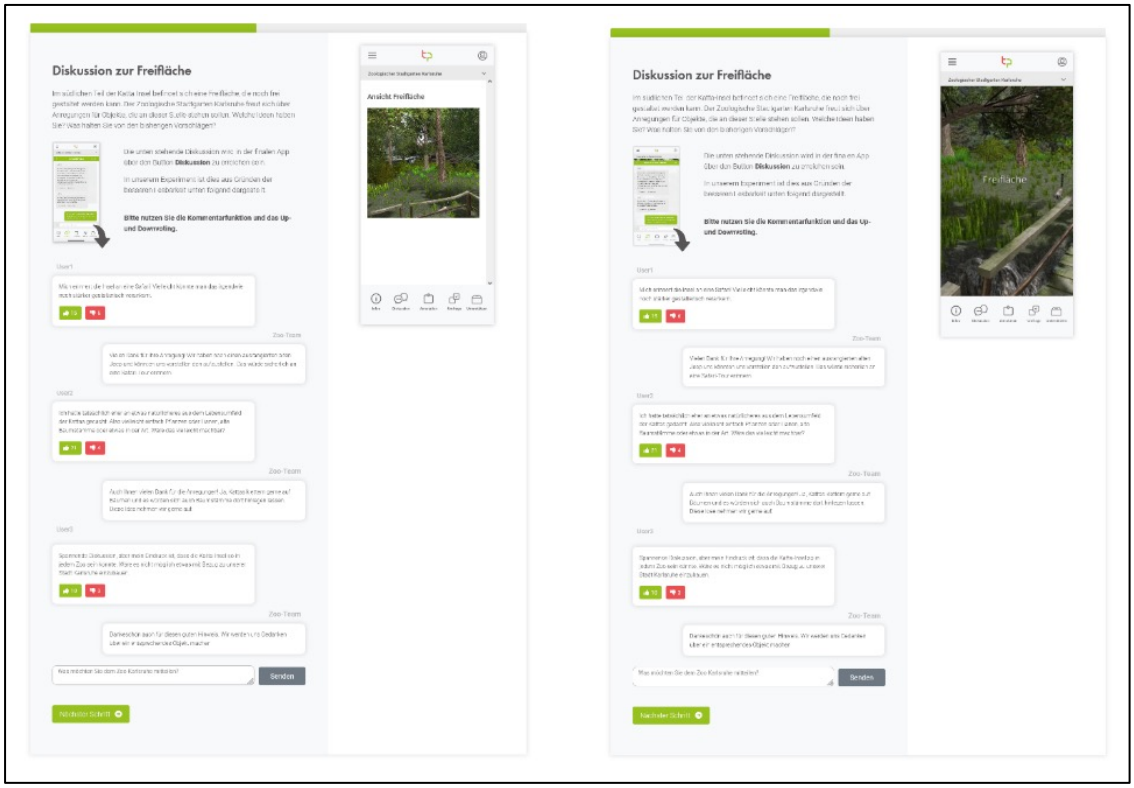

Figure 20. While the control group is shown a static image (left), the test group has an interactive immersive environment (right).

After participating in the different fictious participation levels, the participants were given a final questionnaire.

The description of the design and procedure of the online study showed that a complex study was designed and engineered in order to research diverse aspects on possible differences between non-immersive and immersive e-Participation. The complete evaluation of this online study exceeds the possible scope of this dissertation. The aspect of

researching the idea of donations to public construction projects (civic crowdfunding) is a separate emerging research topic and will therefore be used for further research. In order to maintain the coherence of the design science approach and cycle, the following analysis focuses mainly on the meta-requirements that have not yet been evaluated (Table 18).

Topic/Construct	Item	Measurement
MR-1.1 Intuitive navigation (Construct "perceived ease of use" by Venkatesh and Davis, 2000)	MR111 My interaction with the app was clear and understandable.	7-point Likert scale
	MR112 Interacting with the app did not require a lot of mental effort.	
	MR113 I found the app was easy to use.	
	MR114 I found it easy to get the app to do what I wanted.	
MR-1.2 Portability (self-developed)	MR121 On which devices would you like to use such an app?	*Multiple-answer multiple choice question* • Smartphone • Tablet • Notebook/ PC • VR-Headset • Smartphone VR (e.g. Google Cardboard) • Other (text box)
	MR122 Do you already own hardware that would be suitable for using such an app?	
MR-1.3 Social media connection (based on Lindner and Aichholzer, 2020)	MR131 I think that connecting such an app to social media (e.g. Facebook or Instagram) would be beneficial.	7-point Likert scale
MR-1.4 Crowdfunding (self-developed)	MR141 If you were to donate money during a participation process for a construction project, which payment method would you prefer?	*Multiple-answer multiple choice question (visualized with logos)* • SEPA direct debit, online bank transfer and credit cards such as MasterCard or Visa • Direct debit/ Giropay • PayPal • Apple Pay/ Android Pay • Paydirekt (name of the service) • Viacash (name of the service) • Manual transfer to a displayed account • Cash donation on site
MR-2.2 Information detail (self-developed)	MR221 I would prefer if the app offered more details about the construction project.	7-point Likert scale

MR-2.3 Information on the urgency of the project (self-developed)	MR23 Through my use of the app I became aware of the background of this participation process/ initiative.	7-point Likert scale
MR-3.1 Information through status updates (self-developed)	MR31 If you were interested in a similar construction project, how would you prefer to be kept informed about the progress?	*Multiple-answer multiple choice question* • Updates through push notifications from the app • Independently and as needed use an app to check for updates • Newsletter • Post • Other means (text box)
MR-3.3 Motivation through the consideration and recognition of citizen feedback (self-developed)	MR33 What would motivate you to participate via such an app?	*Multiple-answer multiple choice question* • Consideration of feedback • Personal interest • Openness of the initiators to share information • Reliability of the initiator • Monetary rewards • Other motivation (text box)
MR-3.4 Interest in the project as an incentive to donate (self-developed)	MR34 After using the app, I have a stronger interest in the construction project.	7-point Likert scale
MR-3.5 Moderation of discussions (Rosenberry, 2011)	MR351 It is important for me to know that a forum for discussions is moderated.	7-point Likert scale
	MR352 The possibility of anonymous participation on the internet is generally important to me.	
	MR353 It is important for me to see the name of other users instead of a username.	
MR-5.1 Personal data and trust (self-developed and based on Parycek et al., 2014)	MR511 It is important for me to check the privacy measures before using such an app.	7-point Likert scale
	MR513 Which measures and information on data protection are important to you?	*Multiple-answer multiple choice question* • Information page and FAQ • Encrypted connections (https) • Data protection seal of approval (e.g. EuroPriSe, TÜV SÜD, Trusted Shops)
	MR132 Which login options for platforms do you prefer?	*Multiple-answer multiple choice question* • Username and password • Identity card

		• Social network connection (Facebook, Connect, Google, Twitter etc.) • E-mail address • I prefer to use the platform without registration • Other (text box)
PT Perceived Telepresence (based on Kim and Biocca, 1997; Klein, 2001; Nah et al., 2011)	PT1 I forgot about my immediate surroundings when I was using the demonstrator.	7-point Likert scale
	PT2 During usage of the demonstrator, I forgot that I was sitting in front of my computer.	

Table 18. The topics and constructs tested in the online study, the used items and respective measurements.

8.3 The Evaluation of the Remaining Meta-Requirements

The online study was conducted with a total of 382 participants from which 137 were female, 243 male and 2 people did not identified as either male or female. The distribution of genders among test and control group was not significantly different. One third of the participants held a high school diploma as their highest degree, another third a bachelor degree, and the rest was distributed between master degrees and a few state exams as the highest degree. This high level of education is not surprising, as the KD2Lab participant pool is predominantly composed of students.

The study has been conducted in German language to simulate a participation setting as realistic as possible. The listed items (Table 18) are a translation into English, which aims to be as precise as possible. The results will be presented in the following in the order of the respective meta-requirement. Table 19 and 21 show the results of the items based on ordinal scales, measured on 7-point Likert scales, ranging from strongly disagree, disagree, somewhat disagree, neither agree nor disagree, somewhat agree, agree to strongly agree. Whereas table 20 presents nominal scaled data that evaluated the meta-requirements asked with multiple-answer multiple-choice questions.

Meta-Requirement	**Item**		**Test Group**	**Control Group**	**p-value test vs. control group (t-test)**
MR-1.1 Intuitive navigation (Cronbach's alpha: 0.6)	MR111	Mean	5.66	6.10	<.001
		SD	1.42	1.14	
	MR112	Mean	5.38	5.65	.063
		SD	1.44	1.42	
	MR113	Mean	5.62	6.30	<.001
		SD	1.46	0.99	

	MR114	Mean	5.32	5.27	.737
		SD	1.47	1.35	
MR-1.3 Social media connection	MR131	Mean	5.55	5.39	.338
		SD	1.51	1.58	
MR-2.2 Information detail	MR221	Mean	5.52	5.33	.152
		SD	1.26	1.34	
MR-2.3 Information on the urgency of the project	MR23	Mean	6.02	5.96	.624
		SD	1.13	1.16	
MR-3.4 Interest in the project as an incentive to donate	MR34	Mean	5.24	5.30	.649
		SD	1.54	1.37	
MR-3.5 Moderation of discussions	MR351	Mean	5.21	5.48	.081
		SD	1.48	1.56	
	MR352	Mean	5.39	5.42	.815
		SD	1.54	1.53	
	MR353	Mean	2.83	3.03	.279
		SD	1.75	1.83	
MR-5.1 Personal data and trust	MR511	Mean	5.52	5.67	.196
		SD	1.22	1.07	
Note: p-values are based on two sided t-test.					

Table 19. The results of the tested meta-requirements (7-point Likert scale measurement) in the online study.

The Access (MR-1) to e-Participation was the first tested meta-requirement. MR-1.1 focus is on an intuitive and efficient navigation throughout the app. For its testing the construct perceived ease of use by Venkatesh and Davis (2000) was applied. It consisted of the four items MR111, MR112, MR113, and MR114, which were tested on a Likert scale. With a Cronbach's alpha of 0.6, the internal consistency is questionable. Therefore, the items results should be explained one by one. For MR111 the mean value is 5.66 for the test group and 6.10 for the control group. The MR113 mean value is 5.62 in the test group and 6.30 in the control group. For those two items we can see a significant difference between the test and control group, meaning that the control group perceived the design and navigation as more intuitive. Given that a value of 7 stands for strongly agree, that the system follows a very intuitive design. MR112 (test 5.38; control 5.65) and MR112 (test 5.32; control 5.27) no significant differences between the two treatment groups could be found. With these values we can see that the navigation of the immersive environment required partly more effort, but the prototype succeeded generally to provide an intuitive navigation.

For evaluating the meta-requirement on portability (1.2), the participants were asked on which devices they would like to use such an e-Participation app (MR 121). In a second question, the current status was determined by asking which hardware, suitable for

such an e-Participation app, is already owned by the participants (MR122). Both multiple-answer multiple-choice questions were self-developed. In the test group 98% of the participants wished to use such an e-Participation app to be available on a smartphone, and 91% in the control group. Substantial differences became visible when it comes to the request to use such an app on a tablet or VR headset. While in the test group 86% of the participants wished to use such an app on a tablet, only 49% asked for the same in the control group. While 50% in the test group asked to use such an app on a notebook or PC, 58% wished for the same in the control group. Another noticeable difference exists between the desire to use VR headsets. In particular 28% in the test group, and only 5% in the control group wished to use such a VR device, while 11% of the test group and 2% in the control group see themselves using smartphone based VR extensions like Google Cardboard when using an e-Participation app. These results show that the test group participants, which used immersive panoramic tours in contrast to the control group, seem to prefer the use of hardware suitable for immersive content (smartphones, tablets, VR headsets and smartphone VR). It also shows overwhelming support for the idea of making e-Participation available for mobile devices, which has not yet become the standard. When asked which hardware the participants already have, that would be suitable for such an app, in both groups more than 96% of the participants had a smartphone to their availability. Almost 90% of the participants in both groups have access to a PC or Notebook and could see themselves using this device for this purpose. Around 50% have access to a tablet and would use this device for their participation. 2% in both groups own VR headsets, while 5% (test group) and 2% (control group) own smartphone based VR extensions like Google Cardboard and would be interested in using it for such an e-Participation app.

The meta-requirement 1.3 focused on possible social media connections. The used items were based on Lindner and Aichholzer's (2020) description of recent e-Democracy trends and social media integrations. The first item (MR131) let the participants rate a statement on the benefit of connecting social media apps like Facebook or Instagram to e-Participation. With a mean of 5.55 (test group) and 5.39 (control group), both groups rated the statement relatively high. Thereby, the result underlines the participants' willingness to continue their e-Participation involvement through social media, independent of the use of immersive system (the treatment groups did not show differences).

The self-developed MR-1.4 item on crowdfunding (MR141) asked about the preferred payment method for donating money during participation processes for construction projects. Multiple-answer multiple-choice questions asked, visualized with logos, very concrete about the preferences in payment methods. The service PayPal is the most favoured payment method with 72% (test group) and 79% (control group). SEPA direct

debit, online bank transfers and credit cards such as MasterCard or Visa are the second favourite option with 46% of the test group and 44% of the control group. In descending order: the less preferred payment methods are on site cash donations (30% test group; 29% control group), manual bank transfers to a displayed account (25% test group; 21% control group), Apple Pay/ Android Pay (17% test group; 15% control group), viacash (6% test group; 7% control group), Giropay (5% test group; 7% control group), and Klarna (0% in both treatment groups). These results show how mainstream digital payment methods became for crowdfunding and that their implementation is in general beneficial for e-Participation.

Meta-Requirement	Item	Answers	Test Group	Control Group
MR-1.2 Portability	MR121 On which devices would you like to use such an app?	Smartphone	190 (98%)	188 (91%)
		Tablet	165 (86%)	101 (49%)
		Notebook/ PC	97 (50%)	120 (58%)
		VR-Headset	54 (28%)	10 (5%)
		Smartphone VR (e.g. Google Cardboard)	21 (11%)	4 (2%)
		Other	0 (0%)	0 (0%)
	MR122 Do you already own hardware that would be suitable for using such an app?	Smartphone	188 (97%)	202 (96%)
		Tablet	91 (47%)	116 (56%)
		Notebook/ PC	169 (88%)	185 (89%)
		VR-Headset	3 (2%)	5 (2%)
		Smartphone VR (e.g. Google Cardboard)	9 (5%)	5 (2%)
		Other	0 (0%)	0 (0%)
MR-1.4 Crowdfunding	MR141 If you were to donate money during a participation process for a construction project, which payment method would you prefer?	SEPA Direct Debit, Online Bank Transfer and Credit Cards such as MasterCard or Visa	89 (46%)	91 (44%)
		Direct debit/Giropay	19 (10%)	25 (12%)
		PayPal	139 (72%)	163 (79%)
		Apple Pay / Android Pay	32 (17%)	31 (15%)
		Paydirekt (name of the service)	9 (5%)	14 (7%)
		viacash (name of the service)	12 (6%)	15 (7%)
		Klarna (name of the service)	0 (0%)	1 (0%)
		Manual transfer to a displayed account	49 (25%)	44 (21%)
		Cash donation on site	57 (30%)	59 (29%)
MR-3.1 Information through status updates	MR31 If you were interested in a similar construction project, how would you prefer to be kept informed about the progress?	Updates through push notifications from the app	88 (45%)	81 (39%)
		Independently and as needed use an app to check for updates	136 (70%)	118 (57%)

		Newsletter	60 (31%)	66 (32%)
		Post	10 (5%)	5 (2%)
		Other means	1 (0%)	0 (0%)
MR-3.3 Motivation through the consideration and recognition of citizen feedback	MR33 What would motivate you to participate via such an app?	Consideration of feedback	109 (56%)	135 (65%)
		Personal interest	144 (74%)	168 (81%)
		Openness of the initiators to share information	70 (36%)	96 (46%)
		Reliability of the initiator	42 (22%)	50 (24%)
		Monetary rewards	92 (47%)	98 (47%)
		Other motivation	3 (2%)	0 (0%)
MR-5.1 Personal data and trust	MR513 Which measures and information on data protection are important to you?	Information page and FAQ	144 (75%)	172 (83%)
		Encrypted connections (https)	136 (71%)	149 (72%)
		Data protection seal of approval (e.g. EuroPriSe, TÜV SÜD, Trusted Shops)	90 (47%)	110 (53%)
	MR 534 Which login options for platforms do you prefer?	Username and password	123 (64%)	149 (72%)
		Identity card	11 (6%)	22 (11%)
		Social network connection (Facebook, Connect, Google, Twitter etc.)	52 (3%)	62 (30%)
		E-mail address	108 (56%)	138 (67%)
		I prefer to use the platform without registration.	86 (45%)	55 (27%)
		Other	0 (0%)	0 (0%)

Table 20. The results of the tested meta-requirements (multiple-answer multiple choice questions) in the online study.

The second meta-requirement (MR-2) targets the distribution of information in (immersive) e-Participation apps. In this regard the focus of 2.2 aims at offering information that addresses different stakeholders (e.g. citizens, experts), ranging from general overview to technical details. With the self-developed item MR221 the statement, if the participants would prefer an app offering more details about the construction project, was rated. The results showed no significant differences between the treatment groups with a mean of 5.52 (test group) and 5.33 (control group). That statement is interesting since it shows that e-Participation platforms do not have to be kept as simple as possible. Nevertheless, when interpreting this result, one should also take the educational level of the participants and the artificial setting of the online study into account, since the participants might be used to quickly processing new information. Furthermore, since

the participants received a payment for their participation, they did not have the temporal constraints to include their participation into their everyday life.

The meta-requirement 2.3 aims at conveying the urgency of the project's impact and the need to participate. The self-developed Likert scale item stated "through my use of the app I became aware of the background of this participation process/ initiative" (MR23). The treatment group showed no differences with a mean of 6.36 (test group) and 6.02 (control group). Nevertheless, the results are noteworthy, since they show that the Take Part prototype produced in general an impressive result when it comes to giving background information on the participation process.

The third meta-requirement motivation (MR-3) deals with the motivational factors that make citizens use and keep interacting with e-Participation. Therefore, MR-3.1 is about the provision of updates on the project's progress to keep the users, after the initial participation process, informed and involved in the project. The self-developed item MR31 asked, with a multiple-answer multiple-choice question, concretely about the means in which the participants would like to be kept informed about a similar construction project. The majority of the participants prefer to have a certain autonomy when it comes to being kept up to date (inform themselves independently and as needed use an app to check for updates); 70% of the test group and 57% of the control group would like to check for updates by themselves to stay informed. Surprisingly, a noteworthy proportion of the participants showed interest in getting updates from the app via push notifications (45% in the test group; 39% in the control group). 31% in the test group and 39% in the control group would like to stay informed through newsletters. Classical means such as the use of postal mailings, were not favoured by the participants (5% in the test group; 2% in the control group). Again, this might be explained by the demographic of the participants, who were students. The latter is a rather interesting finding, showing that the means, that are normally used to update citizens on participation processes in urban planning, should be critically reflected.

The meta-requirement 3.3 draws attention to the encouragement of participation through the consideration and recognition of citizen feedback. Therefore, in the online study the self-developed multiple-answer multiple choice question item MR33 asked what motivates the participants to participate via such an app in urban planning. The personal interest in the matter of subject is the most important motivational reason for participation in both treatment groups (74% test group; 81% control group). For 56% (test group) and 65% (control group) the consideration of their feedback is an important motivational factor. In both treatment groups 47% of the participants think that monetary incentives would motivate them to participate. The transparency of the participation project initiator (sharing information) was relevant to 36% in the test group, and

46% in the control group. The initiator's reliability in implementation is only important to 22% of the test group and 24% control group. The results show how much the motivation to get involved in e-Participation remains a personal matter to the participants.

In addition, meta-requirement 3.4 puts a focus on incentives for donating in e-Participation. The self-developed Likert-scale item MR34 stated "after using the app, I have a stronger interest in the construction project." With a mean of 5.24 for the test group and 5.30 for the control group, the Take Part prototype motivated the participants to get interested and involved into the matter of the participation project. Nevertheless, the treatment groups showed, no differences regarding their average rankings.

Since the qualitative interview study (Chapter 5-7) revealed concerns about the hostility of online debates, the online study included three Likert scale questions on the moderation of online discussions based on Rosenberry (2011). Meta-requirement 3.5 specified that a moderation of discussions should aim to ensure a respectful environment. The first item (MR351) stated "it is important for me to know that a forum for discussions is moderated." The results showed, with a mean of 5.21 for the test group and 5.48 for the control group, a positive tendency towards the moderation of debates. The second item (MR352) proposed the statement "the possibility of anonymous participation on the internet is generally important to me." The participants of the study evaluated this item similarly. With 5.39 for the test group and 5.42 for the control group, the mean values indicate a need for users to participate anonymously. This finding is supported through the results of the third item (MR353), which presented the statement "it is important for me to see the name of other users instead of a username." The relatively low mean values of 2.83 in the test group and 3.03 in the control group indicate that the participants are in agreement with a pseudo- or anonymized participation process. All of the three items showed no significant differences between the two treatment groups.

The fifth meta-requirement focuses on data security. While MR-5.1 highlights the possibility to learn about and gain trust in the use of personal data, MR-5.2 focusses on ensuring secure payment options for citizens. The requirements were researched in the online study using a statement measured with a Likert scale (M511) and two multiple-answer multiple choice questions (MR513 and MR534). The users rated the statement "it is important for me to check the privacy measures before using such an app" with mean values of 5.52 (test group) and 5.67 (control group). These values, that do not show any significant difference between the treatment groups, indicate a rather high demand for data privacy education before the app usage. MR513 explicitly asked with a multiple-answer multiple-choice question about the importance of data protection measures and information. In both treatment groups, an information page and FAQ section is the most important measure with a mention frequency of 75% in the test group

and 83% in the control group. Encrypted connections (https) are important to over 70% of the participants in both groups. Data privacy certifications such as EuroPrise, TÜV Süd, and Trusted Shops are key to 47% of the test group participants and 53% of the control group attendees. Moreover, the item MR534 asked which login options the participants would prefer when registering for an e-Participation project. The item was based on research by Parycek et al. (2014), who argue that the desire for privacy is a possible explanatory variable for non-registration. In the online study, the participants have answered that a combination of self-chosen username and password is the most favoured login mechanism with 64% in the test group and 78% in the control group. 57% of the participants in the test group and 72% in the control group preferred an e-mail based login. 36% (test group) and 29% (control group) attendees wish to use the e-Participation app without registration. Where by contrast 27% in the test group and 32% in the control group prefer single sign-on social logins (based on platforms such as Facebook, Twitter and Google) as a mean for their login into the e-Participation platform. 6% of the test group and 12% of the control group would like to use a login based on their national identity card. When it comes to registration in e-Participation, the online study shows that many users are willing to create new accounts for the respective platform.

Lastly, the results of the construct telepresence, which was introduced in Chapter 7, demonstrate that the online study did achieve the goal to compare a more immersive version of the e-Participation app prototype to a less immersive version of the same app (Table 21). Nevertheless, the mean values itself are in their aggregated form with a mean of 3.60 in the test group and 3.33 in the control group quite low and also considerably lower than the values of the AR and VR artifact tested in Chapter 7 (Table 17). Despite the significant difference, the difference between the mean values of the two treatment groups are not as strong as it would be expected when comparing an immersive to a non-immersive artifact. The result shows that, unfortunately, it was not possible to create an immersive experience of a comparable quality to that which we experienced in the field study. This issue will be explained and interpreted in the following sub-chapter.

Construct Perceived Telepresence	**Item**		**Test Group**	**Control Group**	**p-value test vs. control group (t-test)**
	PT1	Mean	4.42	3.99	.004
		SD	1.61	1.53	
	PT2	Mean	2.78	2.66	.488
		SD	1.72	1.67	
(Cronbach's alpha: 0.76)	Aggregated values PT1 and PT2	Mean	3.60	3.33	.024
		SD	1.80	1.79	

Table 21. The results of the construct telepresence in the online study.

8.4 Discussion of the Results and Limitations

The analysis in the last sub-chapter clearly draws an ambivalent picture of the online study's results. Certain effects that were expected based on the qualitative and quantitative field study did not occur. For a majority of the presented items there are no significant differences between the treatment groups. Although it succeeded to create a more immersive e-Participation artifact, the low results of the perceived telepresence show that the artifact in its presented form did not succeed to create, via a panoramic tour, a high feeling of immersion. Not surprisingly, in the test group, the participants were more open to the idea of using the same app in the future with technologies and hardware that are suitable for immersion. Smartphones, Tablets, VR-Headsets and smartphone-based VR were more relevant for the participants in the test group, which used the panoramic tour. Therefore, it has to be clarified that the online study cannot give a general impression of a fully immersive e-Participation. Nevertheless, the evaluation of the artifact itself, the many more general evidence on e-Participation and the studied differentiation between browser-based immersion via panoramic tours and classical versions of e-Participation are relevant and useful.

First of all, also within this evaluation, the artifact showed in both treatment groups an intuitive navigation and enabled the users to understand the meaning and impact of the participation process. This confirms, at a later point of the artifact evaluation the success of the user centered platform development based on the Design Science Research framework. Nevertheless, the significant differences between two of the items that evaluated MR-1.1 (MR111 and MR 113) show that the browser-based immersion did not contribute to an easier and better understandable handling of the app. This result show, combined with the results of the field experiment, that immersive elements in e-Participation only develop their full potential if they are used on suitable devices. Otherwise, more classic forms of e-participation are the better choice. In fact, this result also helps to critically question the navigation of the immersive panoramic tour. Are there perhaps better possibilities for controlling and navigating those tours in the future? In any case, users seem to have already become accustomed to devices that allow a higher degree of immersion, such as tablets and smartphones. Even the idea of using VR headsets seems, especially after using the browser-based immersion, quite feasible for more than a quarter of the participants.

Moreover, the online study provides insights on various possibilities for further consideration of e-Participation. The assumption that registration should be as simple as possible, in the form of a single sign-on, could not be confirmed. The online study showed that users are willing to create new accounts for e-Participation platforms. Nevertheless, the users are ready to and interested in connecting e-Participation platforms to their

social media. When it comes to connecting e-Participation platforms with crowdfunding mechanism, an idea very relevant for further research on civic crowdfunding, users tend to modern forms of money transfer. This result contrasts with the rather timid evaluation of participants in the first and second studies toward the use of online payment services. The fact that PayPal appears to be the most obvious option for donations in participation processes for about two-thirds of the participants shows the market power of individual companies in this sector. If donation options are offered in e-Participation, these services should be integrated due to their widespread use and acceptance. Only in doing so it can be ensured, that participants who are receptive to donating do not refrain from it due to a complicated donation procedure.

Another interesting finding can be seen in the results on status updates on the participation project. In addition to the finding that users generally want to keep track of the participation process on their own – and thus also match their own needs, such as the intervals between updates – there are two other important outcomes. More than one third of the respondents are interested in staying informed about a participation process by means of push notifications. This result provides for the first time, for e-Participation as a research field, concrete evidence that further investigation into mechanisms of involvement via push notifications are valuable.

The results on motivational factors are in accordance with other research on e-Participation. Rottinghaus and Escher (2020) already described the importance of personal interest for e-Participation involvement. The result, that almost half of the participants would be interested in getting monetary rewards to participate, prompts reflection on how citizens, whose capacities are limited, can be incentivized to participate. In this study, the item specifically asked for monetary compensation, nevertheless what might be appropriate incentive mechanisms for e-Participation should be addressed in further research.

Lastly, when it comes to developing trust in e-Participation, factors such as moderated forums and providing data security seem crucial to the users. Besides the need for FAQ pages, users demand encrypted connections and reassurance of the data security through badges of approval (like TÜV SÜD or other certificates).

A limitation of this study remains the lack of representativity. Although providing great possibilities for user-centered behavioral experiments, the KD2Lab pool has the limitation that it consists of students. This group is not representative of society as a whole in terms of its demographic characteristics (e.g. age) and the socioeconomic milieu it represents. The age group might have had an effect on the ability and willingness to use

digital technologies. Although this study consisted of a large number of participants, it cannot be claimed that its results are representative of the population as a whole.

The compensation of the participants makes it possible for them to take their time to participate in the study, but at the same time this financial incentive leads to a simulation of participation procedures that is not particularly close to the real world. Normally, in public participation processes, time is an important factor that determines participation or non-participation. The online study, as it simulates participation procedures, is relatively artificial. Although such a type of study, as described, became necessary in times of pandemic, it seems appropriate to complement it with other types of investigations (qualitative interview studies, field experiments, etc.), as it is done in this dissertation. Nevertheless, it should be self-critically noted that other forms of types of experiments should be preferred when testing immersive forms of e-Participation.

This chapter tried to show transparently the challenges of researching (immersive) e-Participation in the midst of a pandemic. Although, it was achieved to simulate a realistic participation scenario, the results did not show the expected high immersion within the test group. As a result, it was hardly possible to identify significant differences between the treatment groups. Thereby, the online study showed that the perceived telepresence is the determining factor, for the success of immersive e-Participation. Through the online study's results, it became clear, that browser-based virtual environments remain a challenge in implementing and are currently no alternative to hardware options that play out the full potential of extended realities like smartphones, tablets or VR headsets. Those insights are, in combination with the other, more general findings on modern e-Participation forms and mechanisms, the major results of this online study. It will be interesting to see how researchers in the e-Participation field will use these results to further expand our research field.

Part IV

Towards Immersive Digital Citizen Participation Artifacts

9 Take Part Prototype: Creating New Ways of Participation Through Augmented and Virtual Reality[10]

9.1 Introduction

As Plans and ideas of construction projects of public and private institutions often remain unshared with the citizens or employees whom they affect. This might create conflict potential, which can manifest itself in dissatisfaction. The latter can lead to protests like the ones experienced in Stuttgart, where demonstrations against the rebuilding of a local train station aroused international interest (Brettschneider, 2013; Thaa, 2013) or in New York City where local protests forced Amazon to cancel their plans to open a second headquarter in Queens (Goodman, 2019; Gupta, 2019). Therefore, citizen dissatisfaction can lead to project delays and increased costs for initiators like municipalities and property developers. Thus, informing the affected individuals and receiving feedback from them at an early stage could not only increase their approval of the project in question, but also avoid mistakes by learning from the citizens‘ perspectives and expertise, while strengthening trust in public administration and politics (Brettschneider, 2013) and making urban development more sustainable.

The aim of our artifact “Take Part” is to provide a technology that is easily understandable and efficient in usage for initiators and citizens and, foremost, encourages citizens to participate in urban planning. As a result, our prototype is meant to identify and prevent conflict potentials of construction projects at an early stage. In order to achieve this, we want to provide an easily configurable implementation of the participation concepts on motivating, informing, discussing, making design suggestions and voting (International Association for Public Participation, 2018) based on augmented and virtual reality (AR, VR). Take Part allows users to see different versions of a construction project as well as submit their feedback and design suggestions. The application (app) runs on smartphones, tablets and head-mounted displays, and is controlled by lifting, lowering and turning the device.

[10] This chapter comprises an article that was published by Jonas Fegert, Jella Pfeiffer, Anna Golubyeva, Nadine Pfeiffer-Leßmann, Anuja Hariharan, Patrick Renner, Thies Pfeiffer, Mark Hefke, Tim Straub and Christof Weinhardt in the following outlet with the following title: Take Part Prototype: Creating New Ways of Participation Through Augmented and Virtual Reality. 29th Workshop an Information Technologies and Systems. 2019. Note: Tables and figures were renamed, reformatted, and newly referenced to fit the structure of the dissertation. Chapter and section numbering and respective cross-references were modified. Formatting and reference style was adapted and references were updated.

AR is defined as an interactive experience of a real-world environment in which certain elements are displayed with perceptual information generated by computers, e.g. smart glasses or tablets. VR, on the other hand, is defined as an immersive, interactive, computer-generated experience, situated in a simulated environment, in which auditory, visual, haptic, and other types of sensory feedback are incorporated (Kind et al., 2019). We decided to involve AR and VR technologies in the prototype because of the potential that they offer for the visualization of complex contents in an interesting, innovative and inspiring manner. This research is thus guided by the question: How can augmented and virtual reality technologies help to inform citizens about construction projects and encourage them to contribute to decision-making efficiently and at an early stage so as to avoid later conflicts?

Take Part will be shown and evaluated using several use cases, in which we will test the different technological elements with different partners such as a city hospital, a public college and a zoological garden. The zoological garden is our first use case, which the prototype presented in this manuscript was specifically designed for. Within this use case, we cooperate with the municipality of a large German city, which runs the zoo and plans the construction of a new enclosure for ring-tailed lemurs that shall become freely walkable for the zoo visitors. We chose this use case because both, the zoo and the city, would like to test new ways of participation in this construction project, while certain details of the enclosure are still up for discussion and modification. The rather large number of stakeholders (e.g. zoo visitors, friend of the zoo association, members of the zoo staff as well as municipal employees) and the diversity among the end users (zoo visitors ranging from digital natives to elderly visitors) make it an interesting use case for our artifact. We therefore expect that our experience with this first prototype allow for a high level of generalizability.

9.2 Take Part's Pillars of Innovation

In order to fulfill the aforementioned purpose, we developed the following four pillars of innovation during the conceptualization phase of Take Part:

Immersive information: In construction projects, experts and non-professionals have different levels of knowledge or rely on different presentation concepts, which often leads to misunderstandings (Rockmann et al., 2015). By employing a combination of AR and VR technologies, we aim at creating more inclusive forms of visualization that would allow citizens to see possible construction designs in situ. For this purpose, CAD models, already employed by architects, could be easily adapted for use in AR and VR. However,

our research demonstrated that in contrast to CAD models and blueprints, AR and VR visualizations offer better support for non-professionals.

Despite the evidence about the numerous advantages of AR for enabling communication about and the opportunities to participate in project development (Allen et al., 2011; Goudarznia et al., 2017; Rockmann et al., 2015), real implementations of these technologies are still missing. Yet, the continuously changing character of a construction site poses a crucial challenge for the implementation of AR technologies for visualization.

Motivational Participation: Often, citizens only become aware of an upcoming construction project when the construction has already started and the decision-makers may not be able to include the citizens' concerns anymore. This unsustainable behavior may lead to frustration while creative potential and knowledge of citizens as a "crowd" remain unused. Positive effects of participation processes on motivation, satisfaction and the performance of employees, especially in industry contexts, are proven (Wegge et al., 2010) and should be transferred to this context. With Take Part, we would like to encourage co-creation and contribution. For this, we considered the idea of placing annotations precisely on 3D-visualization of buildings on a mobile device (Nuernberger et al., 2016) and extended this idea by allowing to attach drawings or other contents such as texts, photos and voice notes directly to an object. With this feature, citizens using Take Part can bring in their design suggestions on very concrete aspects into the construction process (e.g. placement of handrails or doors).

In Situ Discussion: Another challenge in designing public participation processes is to develop a user-friendly procedure that reduces the complexity of information. The spectrum of public participation includes following aspects: information, consultation, involvement, collaboration and empowerment (International Association for Public Participation, 2018). Until now, many tools only focused on single aspects of the range of public participation (Nelimarkka et al., 2014), whereas Take Part tries to combine and simplify several ones of them. Users will also obtain the opportunity to cooperate by editing and changing proposals, and simplified voting procedures can be introduced by merging those propositions that obtained a good rating (shown in Figure 22). With the use of presented technologies, Take Part empowers a more precise and direct means of participation.

Easy Involvement: To assure that initiators can adjust participation processes within Take Part efficiently to their needs, we are trying to include technologies used for product configurators. These knowledge-intensive, complex software systems support the users during the configuration of a specific service and are considered key technology

for mass customization (Felfernig et al., 2014; Piller et al., 2017). The creation and marketing of target-group-specific applications remains a primarily technical, organizational and economic challenge: Such solutions require cooperation of technology experts, software and content providers with tools for cooperative development and operation of AR and VR technologies. Furthermore, the effort of integrating such technologies into existing standard applications is high. In Take Part we are developing a proper ecosystem which would include the mentioned expert groups.

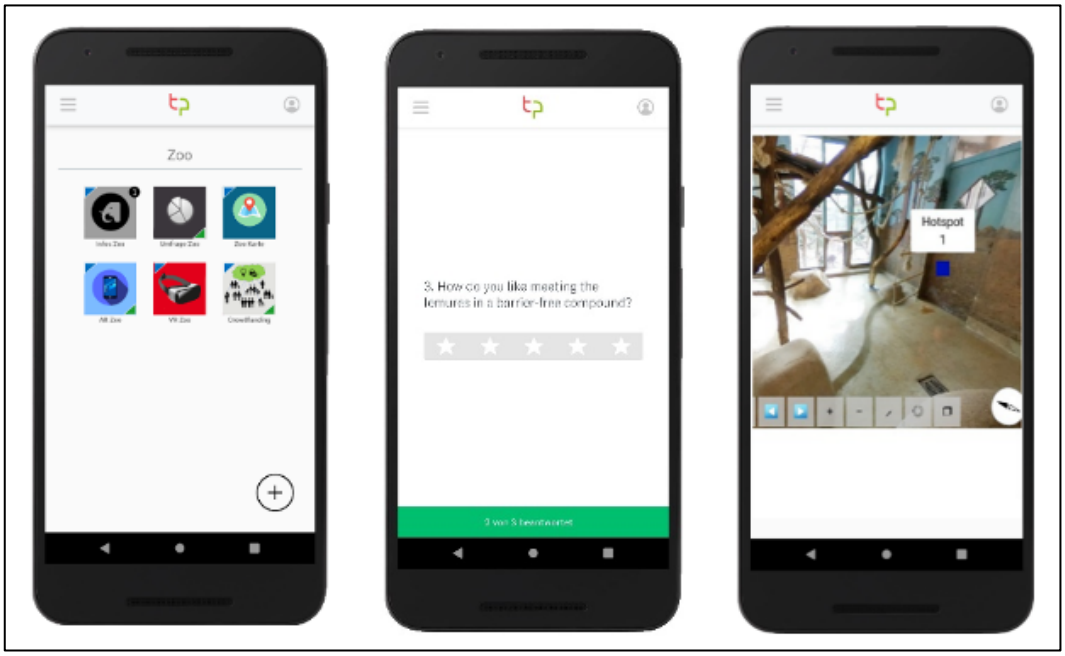

Figure 21. Overview of modules covering different information about the zoo construction project (left), survey module covering a survey about interaction aspects in the zoo (middle) VR module with interaction function, displaying a panorama picture of the previous (right).

9.3 Research Approach

Following a user-centered design (Karlekar et al., 2010), next to our own considerations regarding the main four innovations of Take Part we conducted qualitative semi-structured interviews with potential users following Kaiser's (Kaiser, 2014) approach to collect data about the potential of using Take Part for a construction project in the zoological garden Karlsruhe. The 20 face-to-face interviews with 27 participants (some were conducted in groups of up to three people) took place in June 2019. The interviewees represented different stakeholders (zoo management, employees, visitors, friends of the zoo association, city council members, the cities press spokesperson and technology experts). Before starting the interviews, we familiarized the participants with AR and VR, using a smartphone and a head-mounted display and showed them prototypes similar

to the ones shown in Figure 21. Using MAXQDA, we were able to execute a structured content analysis, and used the analysis results to derive the following meta-requirements that guide the consortium through the process of the prototype development. The **meta-requirement motivation** showed us that Take Part should offer easy, barrier-free access and efficient navigation throughout the application and should guarantee that individuals with lower experience levels (e.g. higher age) will not feel excluded. We also added aspects of gamification as a requirement for the platform to guarantee high involvement throughout the participation process. The **meta-requirement information** includes the option of showing visualizations with AR and VR to put the items of participation in a broader context of content. With the **meta-requirement empowerment**, we suggest that Take Part has to offer the possibility to recognize their ability to participate in decision-making over public projects. The **meta-requirement transparency** represents the possibilities to learn about the initial motivation of such participation projects, to stay informed after the initialization of this process, to have a fully transparent option to donate for the construction project and to learn about the usage of user data. The meta-requirements were useful to specify the pillars of innovation in Take Part and to develop the prototype concept.

9.4 Prototype Concept and App Ecosystem

Moving from the concept of mobile apps, app ecosystems have been emerging on the market that enable apps to be offered as modules, serving different content and purposes for different stakeholders (Pousttchi et al., 2002; Sigala and Christou, 2006).

Our modular and configurable App ecosystem “TakePart SmartWe” (see Figure 22) is an app-based CRM Cloud solution. As depicted in Figure 22, the Initiator starts customizing the Take Part app by specifying which modules are relevant for their particular use case, followed by a detailed specification of each module's content.

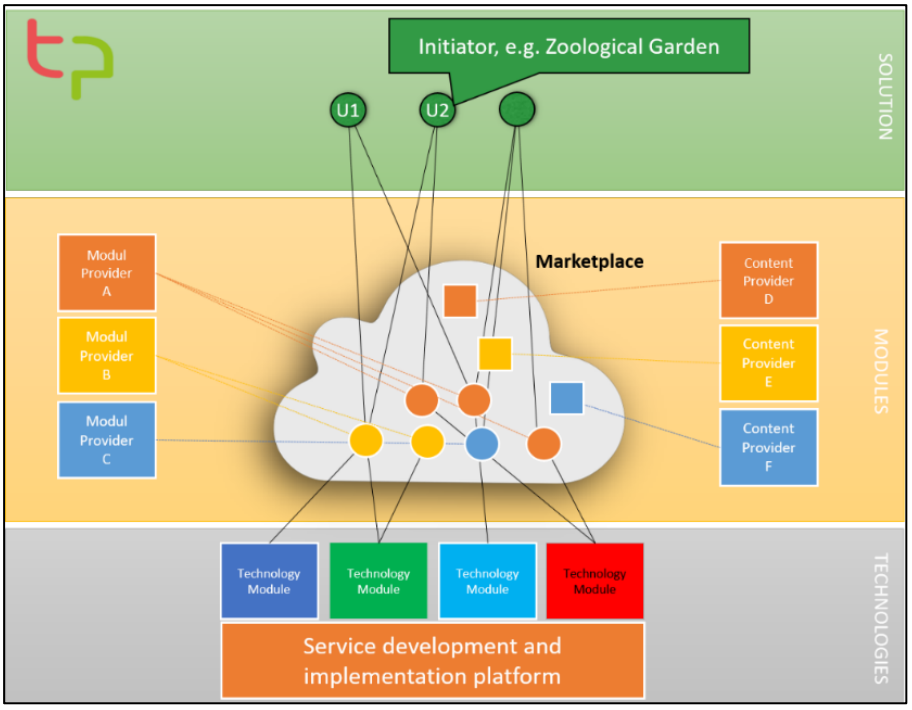

Figure 22. The Take Part ecosystem and its structure around a central market place.

Modules can also be loaded as off-the shelf solutions made available in the app store environment, where different content providers (AR, crowdfunding apps, etc.) have the possibility to place their app solutions on the SmartWe app ecosystem. Based on the specified inputs from the configurator, a final Take Part view can be prepared on SmartWe, which can then again be customized using the native app webframe of SmartWe or web apps.

These apps are then synchronized on the standalone Take Part app for the citizens, using REST synchronization calls, as well as direct Web Frame integration with secure and authorized SmartWe URLs for each module on a Xamarin dramework that integrates native apps (e.g. augmented reality tracking Apps). The integrated solution based on SmartWe focuses on the project initiator's point of view, but also can be used as a collaborative tool to create content for citizens for a given use case, together with the building engineers and content providers for AR and VR.

9.5 Augmented and Virtual Reality Concepts

For the use case, we wanted to inform citizens in an inclusive manner. Information about the start and end of the construction process, costs, missing funding, and initiators of the new enclosure can be displayed in an information module. Additionally, panorama pictures of the previous enclosure were taken with a 360° panorama camera (Figure 21,

right). We used a drone to take pictures of the island, where the enclosure will be built upon and created a 3D model of the building.

Regarding the acceptance of the construction project, citizens may be concerned whether the new building would fit in the surrounding landscape. Thus, the concept of the Take Part App includes an AR view helping to visualize a 3D model of the new building in the real surrounding. By scanning a marker, the app is able to calculate the correct position in the real world and display the new building with realistic dimensions at the exact position it will be built on. In future, we will put effort in localization aspects of Take Part so that no explicit marker will be necessary. Outdoor tracking poses several challenges as a construction project itself may change during the construction process. Within Take Part, solutions will be developed which make seasonal and sequential changes of the surroundings visible by extending the spatial reference points to include seasonal aspects. In addition to the tracking technology of ARCore (Google) and ARKit (Apple), a multisensory localisation algorithm will be extended to include an image-based fusion of local and global coordinate systems (GIS), e.g. horizontal and vertical gravity aligned edges (Karlekar et al., 2010; Takacs et al., 2011; Williams et al., 2013). By this means, the registration of 3D models in urban environments will be improved in particular.

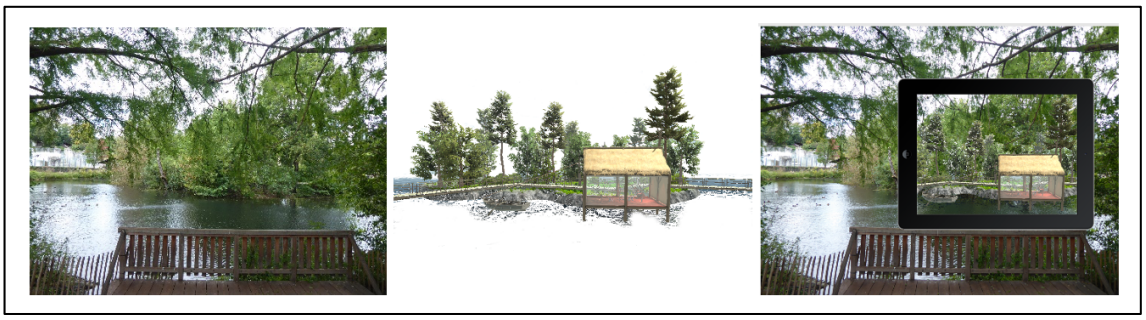

Figure 23. The island and surrounding (left), the) 3D model of new enclosure (middle) prototype of AR visualization (right).

We further want to give citizens the opportunity to take a closer look at the planned building. Because of the dangerous aspects entering a construction site might have, non-professionals might have to keep distance to construction sites. In our use case, the fact that the enclosure is built on an island keeps the zoo visitors from accessing the site. To empower citizens to take a closer look at the planned construction project anyhow, Take Part offers virtual reality visualization as a solution. The user can use their mobile device or head mounted display to enter virtual reality and explore a 3D model of the planned enclosure. The 3D model is embedded into a Skysphere that is based on images taken by the drone out of bird's eye view. The visualization gives a clear image of the construction and the surrounding.

Figure 24. Bird's eye perspective of 3D Model (left) and exploring the first person view in VR (right).

The users may not only want to get an impression of the new enclosure, but also be able to compare the new enclosure to the previous one to get a better understanding of the benefits of a reconstruction. Therefore, Take Part offers a module covering a panorama tour, where the user may enter the previous enclosure and get an immersive experience (Figure 23). In addition to the immersive experience sparked off by the VR and AR visualization, the Take Part app offers an AR module which imposes the 3D model of the new enclosure. By this means, the 3D model is situated in the landscape, can be accessed, and experienced using the Take Part app. It can be used as a miniature for discussions between several users as it provides the possibility to serve as a reference one can point to.

Figure 25. AR miniature model of the new enclosure.

9.6 Conclusion

We presented Take Part, the ideas behind it and the prototype that we designed specifically for the first use case. Currently, we are at the stage of incorporating the meta-requirements and developing an ecosystem that would allow to easily adapt the application for other use cases, which will focus on further details of construction projects

like the interior design. With the mentioned pillars of innovations, we showed how we would like to combine different technologies and ideas into a new app for participation processes. In the coming month, we will try to incorporate the Ecosystem Concept and the AR Concept into Take Part. We will evaluate Take Part's progress testing the prototype in field and lab experiments and are looking forward to measuring possible effects of its innovative approach.

10 On the Potential of Augmented and Virtual Reality for the Digital Participation of Citizens in Construction Projects and Urban Planning[11]

10.1 Introduction

In times of urbanization, when people around the world are increasingly moving to cities (United Nations et al., 2019), the use of public space is widely debated. If not all stakeholders involved in construction projects are not included in the construction process, conflicts can arise that can drive social division. For example, the effect on the public financing that can result from rising construction costs can be a serious challenge. The consequences of exclusive construction planning have been evident in various conflicts around the world in recent years. In 2019, the debate over a new Amazon corporate headquarters occurred in New York City, where protests against the risk of gentrification of the neighborhood led to the cancellation of the construction project. In Germany, the conflict over the redesign of Stuttgart's main train station was particularly crucial for a more in-depth examination of citizen participation and the question of contemporary visualizations of construction projects. Stuttgart 21 can be described as "one of the most controversial infrastructure projects in Germany" (Brettschneider, 2013). The redesign of the train station began in 2010, primarily through a partial demolition of the building, which led to numerous protests, that were observed by a broad public beyond the city of Stuttgart itself. The conflict could only get resolved through an arbitration and a referendum, and, as a consequence, researchers increasingly investigated what exactly had gone wrong in Stuttgart and how such mistakes could be avoided in future (Schuster, 2013). One reason that repeatedly came up in research was poor communication (e.g.,

[11] This chapter comprises an article that was published by Jonas Fegert, Jella Pfeiffer, Pauline Reitzer, Tobias Götz, Anuja Hariharn, Nadine Pfeiffer-Leßmann, Patrick Renner, Thies Pfeiffer and Christof Weinhardt in the following outlet with the following title: Ich sehe was, was du auch siehst – Über die Möglichkeiten von Augmented und Virtual Reality für die digitale Beteiligung von Bürger:innen in der Bau- und Stadtplanung. HMD Praxis der Wirtschaftsinformatik. Note: This article was originally published in German and translated for this dissertation. Tables and figures were renamed, reformatted, and newly referenced to fit the structure of the dissertation. Chapter and section numbering and respective cross-references were modified. Formatting and reference style was adapted and references were updated.

construction plans were not available for citizens to see on site) of the initiators, who made the construction appear as if it was set in stone (Thaa, 2013). The lack of involvement of citizens and non-transparent communication by the initiators can have a lasting impact on trust in politics and administration. This local conflict was important for the development of the research project described in the following. The Take Part project, funded by the German Federal Ministry of Education and Research, follows the idea of improving the interaction between initiators and citizens with the help of modern visualization techniques for construction projects. With the help of AR and VR, citizens are encouraged to participate in construction and urban planning. AR and VR technologies can make spaces immersive through appropriate hardware. As a result, the app should be able to help identify the initators and prevent potential conflicts in construction projects at an early stage. The research question accompanying the project is therefore:

> *How can citizens be informed about construction projects at an early stage and in a low-threshold manner with the help of AR and VR technologies, and can this create an incentive for citizen participation in order to contribute to decisions that avoid conflicts later on?*

With the aim of investigating this research question, an interdisciplinary consortium consisting of research institutions (FZI Research Center for Information Technology, Justus Liebig University Giessen, Karlsruhe Institute of Technology) and companies (Raumtänzer GmbH, Neuland Medien GmbH & Co KG and CAS Software AG) came together in 2018. Between 2018 and 2021, they had worked on the development and accompanying research of the app Take Part, which will be comprehensively presented as a prototype for the first time in this article. In the first part of the article, the theoretical foundations regarding e-Participation and AR and VR are highlighted, thus creating a starting point for answering the research question. The following chapter brings the two topics together and elaborates on which opportunities AR and VR technologies open up with regard to citizen participation. Subsequently, the Take Part app (final prototype) and the participation ecosystem will be presented and it will be described how the challenges described previously were met.

10.2 Theoretical Foundation

10.2.1 e-Participation

E-democracy describes the broad concept of using information and communication technology to promote and strengthen democratic participation and processes (Macintosh, 2004). According to Macintosh e-Participation can be understood as the

part of e-democracy through which citizens are directly involved in democratic decision-making. E-Participation itself is not a technology, and it is less concerned with the use of technology within political electoral processes (the subject of e-voting), but rather a form of citizen participation that, through its collaborative nature, can go beyond annual voting (Sanford and Rose, 2007).

The International Association for Public Participation provides a comprehensive model for categorizing civic participation using different levels (International Association for Public Participation, 2018). In their Spectrum of Public Participation, each level of participation ("inform," "consult," "involve," "collaborate," and "empower") has different implications for decision making. This model, laid out for traditional citizen participation, can also be applied to e-Participation (Nabatchi, 2012; Nelimarkka et al., 2014; Wirtz et al., 2018). The general positive effect of participation processes on, for example, employee motivation, performance, and satisfaction (Wegge et al., 2010) needs to be exploited and transferred to urban planning. Wolf et al. (2020) address precisely this demand and present already developed approaches of the elements of e-Participation for urban and construction planning. As a basis for argumentation for the necessity of intensified research in the field, the participation paradox is listed, which describes the conflict between an increased interest in participation and the simultaneous decrease of options for participation for those affected parallel to the progress of a planning process. In the context of urban and construction planning, this conflict is reflected in the fact that at an early stage of planning, the willingness of stakeholders to participate is usually low, but this is not due to a lack of interest in the construction projects, but rather a challengingly high level of abstraction (Wolf et al., 2020) . In order to counteract the participation paradox and its consequences, the authors point to the opportunity of e-Participation and advocate testing the theoretical considerations with evidence-based methods.

10.2.2 Augmented and Virtual Reality

In the practical application of AR, the immediate physical environment is supplemented with virtual elements (Azuma, 1997). In addition, AR enables an extension of the perceptible reality with further information such as text objects or images (Kind et al., 2019). VR, on the other hand, places users into an interactive 3D environment (immersion) and a virtual world (Wexelblat 1995; Suh and Lee 2005). This is often achieved with the help of head-mounted displays (HMDs), which use a display to place the virtual environment in front of the user's field of view (Meißner et al., 2020; Chapter 7). Suh and Lee (Suh and Lee, 2005) demonstrated that a VR interface can promote interest and knowledge about a product, and Peukert et al. (2019b) showed that immersion can lead

to more enjoyment when using an application. VR is also used in the construction and real estate industries to generate interest in construction projects (Whyte 2003; Barnes 2016). Wolf et al. (2020) articulate the opportunities of using AR and VR applications especially in the early stages of urban and construction planning. According to the authors, AR and VR technologies could be used as a complement to participation formats to promote intelligibility, comprehensibility, collaboration, and stakeholder interaction in planning processes. They formulate the need for future research regarding AR and VR use for concrete application scenarios and the requirements of different levels of participation, to which this article and the Take Part project make a first contribution.

10.3 Points of Contact and Challenges

E-Participation offers opportunities to rethink participation processes and to open up new possibilities for participation through those technologies. What is interesting here is the function that concrete technological developments (including outdoor AR tracking and spatially anchored discussions), as well as the participation ecosystem (service development and execution platform), can assume in e-Participation processes in order to make them more accessible, interesting and motivating. For example, an approach by Nuernberger et al. (2016) on how annotations enable adding drawings, text fields, images, and audio comments within the visualization on for example buildings.

In order to develop an IT artifact that is designed close to the needs of the user, a design science approach by Pfeffers et al. (2007) was initially used. To address the increasing complexity, this approach was replaced during the research process by the approach of Kuechler and Vaishnavi (2008a). The three-cycle view for Design Science Research allows the development of the prototype to be kept transparent and structured. To define the problem, a qualitative study with involved stakeholders was conducted and later the artifact was evaluated (Chapter 7). Thus, the development of Take Part followed a user-centered approach.

From the citizen perspective, not only can technologies such as AR and VR promote more inclusive and low-threshold participation, but also increase motivation to participate and support imagination (Chapter 7). Citizen participation requires all stakeholders to have a similar idea of the concepts in question. However, especially in terms of knowledge level and expertise, it is predictable that knowledge is unevenly distributed between stakeholders, and individual interpretation of presented concepts can easily diverge (Rockmann et al., 2015). If this process is not intercepted by clear communication, misunderstandings can hardly be avoided, which in turn stands in the way of successful participation. Studies show that technologies such as AR and VR can support this

process by limiting the scope of interpretation of the participants (Goudarznia et al., 2017). Macintosh referred to visualizations, including 3D environments and VR, as a key e-Participation research activity as early as 2008. The idea of using the technologies began with their use as a participatory element in urban and building planning (Allen et al., 2011; Goudarznia et al., 2017; Rockmann et al., 2015; Mario Wolf et al., 2020). Take Part builds on this research.

Unlike the aforementioned research (and already established e-Participation tools), Take Part seeks to enable participation using AR and VR at all levels of the participation spectrum ("information," "consultation," "involvement," "collaboration," and "empowerment"). To make this complex endeavor manageable for citizens, a user-friendly design is essential.

While the immersive participatory environment is designed to be used by the citizens, it should not be overlooked that the **initiator participation** should also be offered as extensively as possible. Construction projects have the characteristic of only attracting attention after they already have entered the implementation phase. At this stage, it is often difficult or even impossible to include the needs and suggestions of the affected citizens, and thus the opportunity to serve the suggestions of the population (*Wisdom of the Crowd*) is missed. Creative input and expert knowledge remain unused in this context. AR and VR can counteract this problem by virtually shifting the construction process to other time stages, where certain arguments become clearer in the local and temporal context. This can capture otherwise belated feedback at an appropriate point in time and enable co-creation (Imottesjo and Kain, 2018; Jutraž and Moine, 2016). Also relevant for initiators is the fact that computer-aided design (CAD) is already used by architects in construction planning. Therefore, a technical foundation exists that makes adaptation for AR and VR use in the context of digital participation (Lorenz et al., 2016).

As the Spectrum of Participation already suggests, the possibilities for involving citizens in construction planning through (digital) participation are diverse. Depending on the type of construction project, its geographical location and social position, and also the interests of the initiators, the participation formats differ in their requirements. The configuration of e-Participation systems is therefore knowledge-intensive. For this reason, making them possible also requires specific technical, organizational and economic expertise, which varies with the selected participation format. Initiators are thus not only faced with the challenge of assigning the appropriate participation format to the corresponding project, but also with the problem of a lack of expert infrastructure for the technical implementation. This is where the idea of a participation ecosystem comes in.

In the Take Part project, the Karlsruhe Zoological Garden serves as a use case. The zoo is a municipal institution of the city of Karlsruhe, but it plans to convert an island in their park-like property to use it as a free enclosure for lemurs, with donations from the zoo's sponsoring organization.

10.4 Solutions and Their Effectiveness

Within the Take Part project, a prototype was developed that attempts to best address the opportunities of AR and VR in citizen participation described above. This prototype will be presented and at the same time the challenges associated with it will be addressed. The Take Part app helps to bring initiators and citizens together. It offers a common platform for exchange and creation of a common context. The initiating person or institution configures the project and thus the modules in the app in such a way that it corresponds with their wishes in terms of participation opportunities. The structure of the Take Part app reflects this approach and adapts dynamically. The following chapter describes the specific technological developments and elaborates on how they meet the abovementioned requirements.

Initiators design the top area of the app, for example, by setting the contents of the main background window as situation anchors (Figure 26). Here, in order to create a common knowledge base, images can be uploaded, panoramic tours can be linked, and AR or VR models can be posted. Citizens can immerse into planned models and participate by means of discussions, annotations and surveys. In addition, the initiators can give the project a structure by specifying topics.

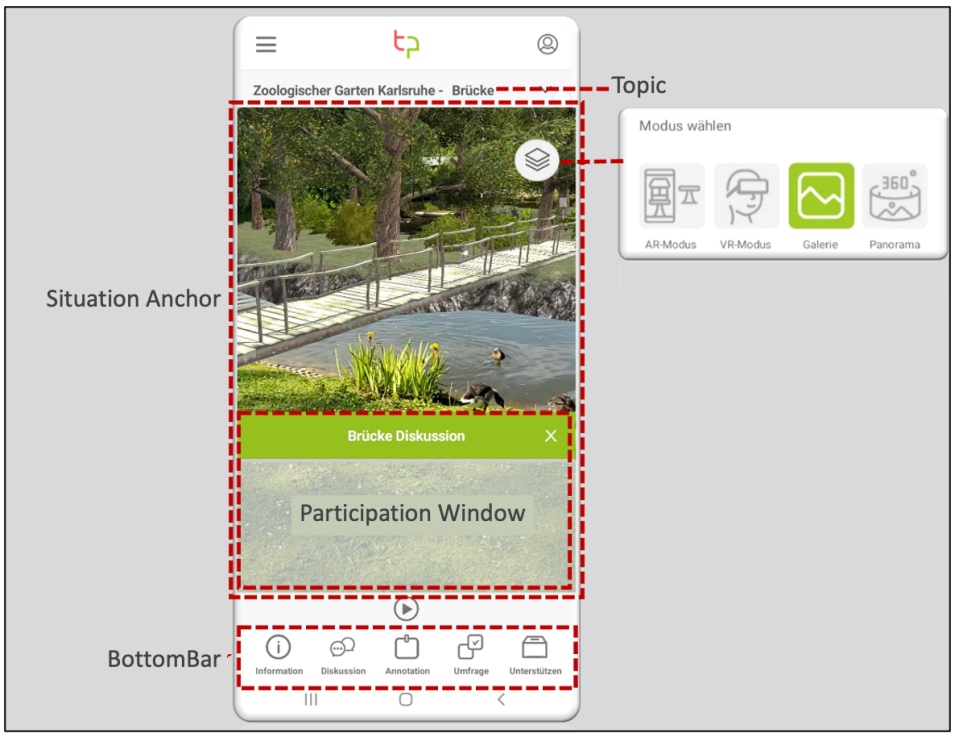

Figure 26. The structure of the Take Part app.

The *BottomBar* of the app spans the different levels of participation (see Section 10.4.1) of the citizens (Figure 26). As an approach to user-centered design, situational anchors were developed that integrate participation modules such as information, discussion, annotation, survey, and support in the immersive environment. The selected participation module overlays the background context as a transparent window (see Participation Window in Figure 26), allowing citizens to interact in the desired situation anchor. The basic design requirements of the Take Part app follow the maxims: creating orientation, situatedness, familiarity, multi-perspective (all information and concepts directly in parallel, easy access), topicality (information about news since last call), rights management (target group-specific access) and clear separation between information from initiators and citizens. By implementing these requirements, the user-friendliness for citizens and initiators is ensured.

10.4.1 Implementation of Immersive Participation

A particular challenge in construction planning projects is the transition from 2D plans to a 3D vision of situations from a user perspective. To make this possible, the Take Part app offers AR and VR visualizations. If citizens are standing in front of a planned construction area, they can use AR to directly display the planned object in the real world by scanning a marker, such as a sign. Thereby, the user can more accurately estimate

the dimensions and how the construction object will fit into the environment. Figure 27 (left) shows the real sign for scanning a virtual information sign, and an overlaid AR-based model of the planned bridge. For areas on the island that are not accessible, users can switch to the VR model and thus teleport directly to the island in the model. In the VR version, the citizen can move around and look anywhere. Information signs provide topic-related information and serve as participation sites (Figure 27, left). The app provides the user with a participatory experience which not only makes information realistically imaginable, but can also motivate creativity and participation through interactivity.

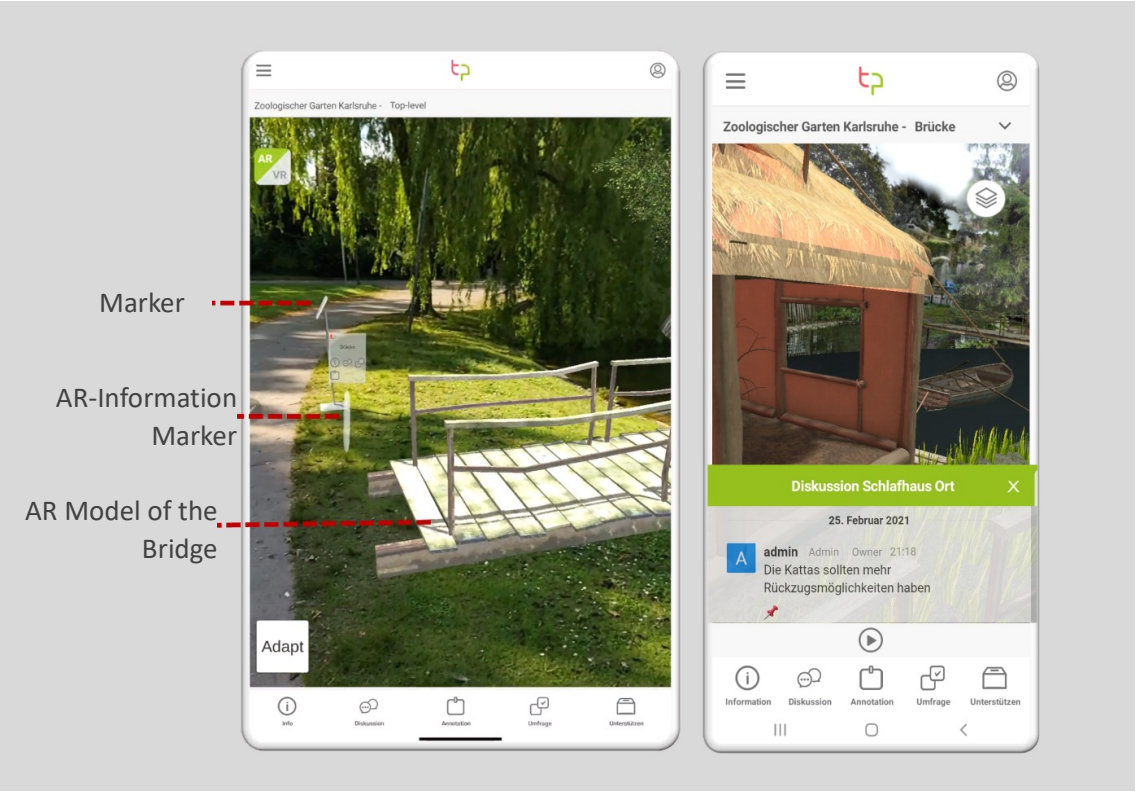

Figure 27. The Take Part app with the AR view (left) and the VR view (right).

Discussions often are accompanied by the issue that participants lack a common level of knowledge or a common understanding of the project at hand. Moreover, discussions in a forum usually take place asynchronously, which exacerbates this problem. For this reason, the Take Part app offers the concept of 'situation anchors' that link contributions to a specific context. For example, if a citizen is looking at a new model of a lemur roost and wants to comment that the lemurs do not have enough places to retreat, they can add a link to the comments indicating where in the enclosure this thought occurred to them. Other citizens can access the link, represented by the pin in Figure 27 (right), and

are thus placed directly in the context of the comment. By discreetly placing the situation anchor, the discussion flow does not become disrupted, while the traceability of comments improves. The Take Part app integrates Rocket.Chat as a tool for discussions, but supplements it with JavaScript extensions to enable these specific additional functionalities.

If citizens would like to make an annotation independent of a discussion, they can anchor annotations (e.g. audio comments as well as supplementary images or comments) directly in one place in the AR/VR world. Another functionality that the Take Part app supports is variant visualization. Initiators can set up configurator signs that allow citizens to directly experience the construction projects visually without having to perform a complicated transfer from technical drawings. Based on the presentation of design options, the initiator can also lead users to a survey in order to obtain an opinion or to conduct a voting. The citizens can comment on the options, up- or downvote them, as well as attach their own suggestions with concrete picture examples and thus also suggest alternatives. The situation anchors thus concretize the contributions of the citizens by assigning them to the objects in question (e.g. the sleeping house of the lemurs). Thus, they provide a knowledge base and counteract the knowledge gap between initiators and citizens. Misunderstandings about construction plans can thereby be prevented with the help of this function.

Figure 28. Voting mechanism in the Take Part app; decision on different versions of the visualization.

Due to the different technologies, one challenge in implementing AR and VR content in mobile apps is to simultaneously ensure an optimal user experience when using the app as well as optimal performance and quality of the immersive visualizations. The Take Part app solves this problem by combining two technological approaches. The basic app was implemented natively using the Xamarin framework. Thereby, a coherent user experience can be guaranteed. The immersive content, on the other hand, was developed using the Unity game engine. This allowed flexible and high-performance implementation of 3D applications, also for AR and VR: The AR foundational framework combines the native AR libraries ARCore (Android) and ARKit (iOS) and ensures stable tracking. The content created in Unity was loaded as a plugin fully integrated in the Xamarin-based app.

10.4.2 Implementation of the Participation Ecosystem

In the Take Part app, initiators are given the opportunity to configure a participation environment with the help of a so-called participation ecosystem, which can be imagined as a digital marketplace. The participation ecosystem brings together technology providers, industry software specialists and content operators and enables initiators to form partnerships and integrate the necessary expertise according to project-specific needs. Through reusable technology modules, innovative solutions can be developed and deployed for different target industries. From the perspective of the initiators, this participation ecosystem enables an exchange with the citizens to be initialized, flexibly configured, conducted and continuously evaluated. In addition to the creative input of the citizens, which can thus be tapped by the initiators, the participation ecosystem enables a simplified technical implementation of the participation formats (e.g., by transferring CAD models of architects into the AR/VR environment). Furthermore, experts can be involved and consulted here, for example for the creation of 3D models, in order to support the implementation of the participation process. By providing this infrastructure, it is thus possible to respond to a wide range of requirements for participation formats.

In order to meet the requirements in terms of adaptability, expandability and flexibility, which are necessitated by the initiators multi-layered projects, a modular system concept was chosen. The Take Part participation ecosystem, based on the SmartWe software from CAS Software AG, provides individual functional components, so-called modules (Figure 29: Information, Map, Visualization). In addition, external services (Figure 29: Voting using LamaPoll), as well as internal, independent services (Figure 29: Discussion module, based on Rocket.Chat) can be integrated as modules.

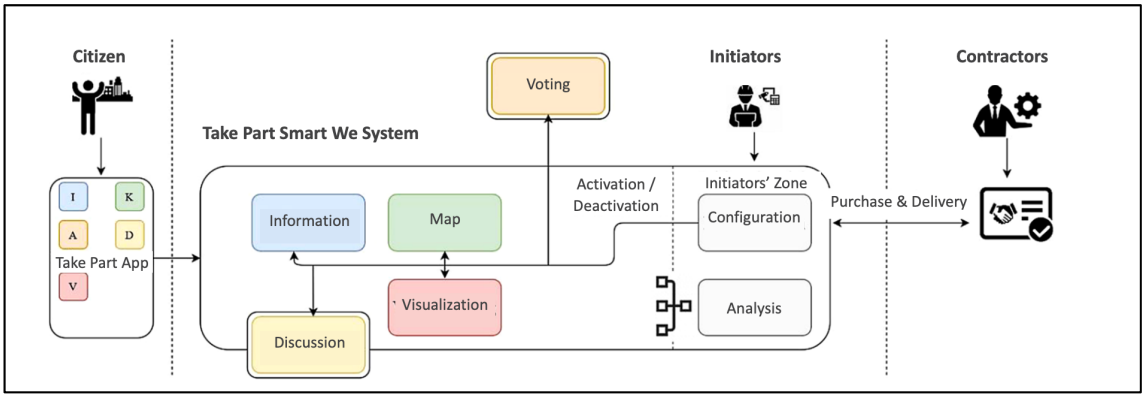

Figure 29. The Take Part participation ecosystem.

Initiators begin the creation of their projects with a configuration dialog that recommends a module combination based on the desired participation levels. After selecting the desired combination (Figure 29), the required competencies for the content and operation of all modules are presented. From this point on, the initiators have the option to manage the required content or administrative tasks themselves or to involve an external service provider via the Take Part system. If contracting with external service providers occurs, then the instruction, delivery and integration will be handled by the Take Part participation ecosystem. Searches are conducted based on location and required competencies. Through the SmartWe appstore, the initiator can also enhance the app with existing additional CRM apps - for example, project planning tools or visitor reports. The entire configuration steps for the project presence can be called up again by the initiators at any time to make structural changes.

The data from the use of the modules is made available to the initiators to a limited extent as data aggregation in a dashboard. This not only supports the assessment of the app configuration within the project at hand, but also provides important insights into the project through survey results and open discussion. For initiators, the Take Part app thus represents a clear, homogeneous entry into the participation ecosystem. In addition, there is no need to authenticate users when changing modules or contexts internally, thus enabling fast, unhindered interaction with the content.

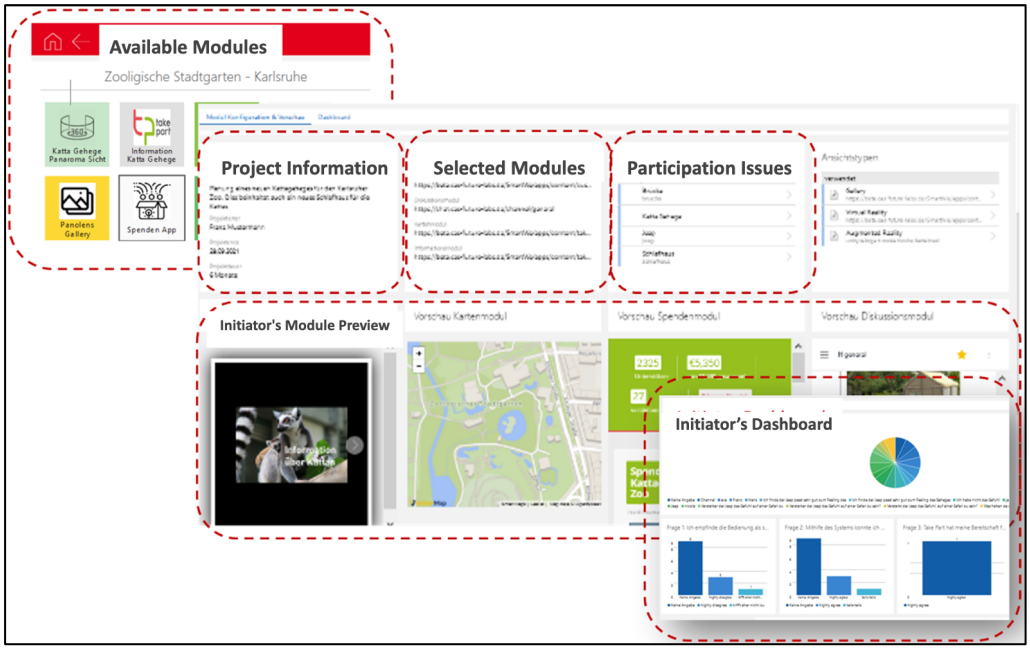

Figure 30. Visualization of the system for initiators of participation processes (selection of available modules, management of the project data, modul preview and participation dashboard).

10.5 Conclusion

The aim of the Take Part project is to research methods to involve citizens in public construction participation projects at an early stage and in a low-barrier manner with the help of AR and VR technologies. As a solution to the research question, this article presents two technological developments: the Take Part app and the participation ecosystem. Specifically, this article addresses the concrete requirements that arise from a use of AR and VR technologies in citizen participation and how the developed prototype attempts to respond to them. A prior analysis of the possibilities and challenges is absolutely necessary in order to align the development and design of the prototype accordingly.

This article presents how the Take Part app creates immersive participation with AR and VR visualizations and features such as the situational anchor. Further studies resulting from the research project (Chapter 7) also confirmed that the visualization of construction projects using AR and VR in our app motivated the users to participate and supported their imagination. The visualizations succeed in creating a similar knowledge base for the participants - true to the motto 'I see what you see'. Interestingly, the Take Part visualizations went beyond mere illustration in that they could give the users a feeling of being virtually transported from the study environment to the project site (Chap-

ter 7) which is referred to as the feeling of telepresence. In this way, the often dry participation processes around construction projects can achieve a playful dimension that encourages low-threshold participation.

Furthermore, by integrating high-quality AR and VR visualizations into a tested foundational framework, a flexible but also reliable basis for the Take Part participation ecosystem could be achieved. The tested configuration options open a range of opportunities that previously were not directly available to citizens and initiators. Participation formats, for example, can thus be adapted to the various requirements of projects without the need for complex technical expertise. This configuration of the platform makes it possible to develop a construction project as a collaborative product and thus offers previously unavailable accessibility for citizens and initiators.

Technically, there is still a need to achieve a compromise between sufficient identification of the citizens involved and digital self-determination. Implementing AR and VR capabilities as a native, local extension of the Take Part app proved necessary because the required web standards for these novel technologies do not yet meet the existing requirements.

The COVID-19 pandemic highlighted problems and challenges of societies, as if under a burning glass. The digitization of public infrastructure enabled states to respond quickly to the pandemic while interacting with their citizens. Here, we see great opportunities for an app like Take Part to enable participation and interpersonal agreement processes that simply translate complex knowledge. With the innovative form of visualization that only requires, in the case of AR, a smartphone, a solid knowledge base can be created. Therefore, we see an opportunity for our solution approach in the increased demand for e-Participation in times of crisis (United Nations, 2020b).

Finally, it must be self-critically reflected that while the Take Part participation ecosystem seems suitable for private construction projects, the regulatory framework for public construction projects makes citizen participation difficult. German construction law does not yet provide for digital participation options, especially when it comes to the concrete design of construction projects. Moreover, the actors involved often do not want to have their competencies disputed, which is also a lesson learned from our research project. Therefore, we were able to show that digital solutions are available and can be used, but when it comes to the concrete implementation, the will of the initiators is crucial. However, the establishment of technologies such as AR and VR on the mass market will also increase the pressure on public institutions to use them innovatively. It

stands to reason that citizens will want to use technologies that they increasingly demand and appreciate in their private lives to help shape their environment, the public space, for which we outlined a solution.

Part V

Conclusion

11 Conclusion and Outlook

11.1 Contributions

The contribution of this dissertation lies in exploring the use of immersive systems for public participation in urban planning. With the concept of Digital Citizen Participation, this dissertation maps out a framework for researching innovative and interdisciplinary forms of e-Participation. Nevertheless, the main contribution lies in developing meta-requirements and design principles using Design Science Research for an e-Participation platform that incorporates AR and VR for the involvement of citizens in urban planning. Those requirements and design principles were developed on the basis of a qualitative interview study and later tested in two quantitative studies. All three studies reflected critically the benefits and challenges of using immersive systems for this context. In the following, concise answers to the research questions will be presented.

RQ0 (*How should an immersive, AR and VR-based digital citizen participation app for urban and construction planning be designed to strengthen the citizens' willingness to participate?)* is answered with the formulation of meta-requirements and design principles (Chapter 7, Table 15) based on the qualitative interview study. It shows that platform development for immersive e-Participation in urban planning should focus on platform accessibility (MR-1, DP1) and information distribution (MR-2, DP1) as a powerful means to get the public involved. Furthermore, it should consider motivational factors (MR-3, DP3) that might nudge the public in staying involved. Transparency is always a key factor for successful public participation, therefore a transparent digital participation process (MR-4, DP4) was suggested that guarantees honesty and reliability to the public. Equally important for gaining and sustaining the public's trust is to ensure data security and sovereignty (MR-5, DP5) to the involved citizens.

RQ1 (*What are the general challenges and interests concerning the use of digital technologies for citizen participation?)* is addressed within the third and fifth chapter. Chapter 3 analyzes a current e-Participation platform in the context of mission statement development. Using the UTAUT model, the study evaluated the platform design and acceptance and showed for an existing e-Participation platform that there is room for improvement. The design affected the intention to use and the intention to recommend the e-Participation platform. The qualitative evaluation in Chapter 3 concretizes this potential for improvement by naming, from a user perspective, design elements for participation platforms (e.g. gamification, AI based clustering and mobile app development).

Chapter 5 demonstrated, through the use of qualitative interviews, the attitudes of relevant stakeholders towards using digital technologies for participatory urban planning. Several research dimensions (relevance of immersive systems for e-Participation, technology acceptance and attitudes towards the use of an app for citizen participation) were developed for the qualitative interviews to learn about the experiences, expectations, challenges and concerns of the respective stakeholders. It was shown that there is a high interest in using the technologies for public participation in urban planning, despite the relatively low concrete pre-experience with AR and VR. Furthermore, the interviews draw the attention to the phenomena that the public doubts in some cases their own or collective competence when it comes to decision-making in urban planning. Another finding dealt with hostility in online debates. Many interviewees described this digital hostility as almost overwhelming and therefore argued that it can lead to a reluctant attitude towards engaging in online debates and forums. This finding pointed out that the public might find an immersive e-Participation platform especially appealing for certain levels of participation (e.g. receiving information, giving feedback and donating for a project), but prefers real life discussions or hybrid formats over the anonymity of online forums. The wish for transparent communication of the participation scope by the initiator was of high importance for the asked stakeholders, as it was that their contribution would be recognized.

Additionally, the interviews partly answered **RQ2** (*What are – from a user perspective – the strengths and weaknesses of the use of AR and VR for public participation in urban planning?)*. First of all, the interviewees clearly presented that the technologies are evaluated differently. This finding could be shown through the qualitative interview study (Chapter 5 and 6) and the quantitative field experiment evaluation (Chapter 7). AR was mostly perceived as a source of information and sometimes associated with construction projects, while VR was associated with gaming and leisure and only in some cases its potential for visualizing new, non-existent spaces, was recognized. The interviews found that the use of these technologies would make 74% of the respondents more likely to engage in a new construction project. When it comes to the weaknesses of using the technologies for public participation, concerns about data protection were addressed as well as the exclusivity of the technologies in terms of hardware accessibility. To counter those concerns, study participants suggested that assistance should be offered to enable the participation of demographic groups with little prior technological expertise. Although, the interviewees raised the concern that older demographics might be especially hard to target when using immersive systems in e-Participation, our quantitative field experiment (Chapter 7) proved that the interest itself is age-independent. This interest in using AR and VR for e-Participation for a better visualization of construction planning was tremendous (6.08 AR, 6.46 VR, maximum of 7 points on the Likert

scale). The interest was found to correlate with the feeling of telepresence. Interestingly, Chapter 8 showed that the telepresence of the hardware might be the determining factor if immersive systems succeed in the context of public participation. The quantitative online study could not prove noteworthy differences between traditional e-Participation in urban planning and immersive environments concerning the meta-requirements, if both were accessed through a browser on a computer. This realization is thought-provoking. In the future, it will be important to determine the strengths and weaknesses of different forms of immersive systems. In this regard, it will be especially interesting to see how the mainstream acceptance of immersive systems – and new hardware concepts – will support the effects presented within the different studies.

RQ3 (*To what extent can the combination of immersive systems with e-Participation increase the citizen's participation in and acceptance of public construction projects?*) was answered within Chapter 7. There it was demonstrated that immersive systems, especially VR, are a profound help to support the individuals imagination, when it comes to construction sites and urban planning and thereby are beneficial for participation processes. A key take away of this study is, that immersive systems in e-Participation can concretize and enhance spatial understanding. The technologies help, in comparison to traditional forms of visualization (pictures or 3D models) to concretize the imagination. AR and VR can foster the motivation to be involved with urban planning and also provided a clearer understanding of the dimensions and details in the researched case. Therefore, they have the ability to lower the participation threshold by enabling citizens to get a clearer picture of the construction plan itself. Nevertheless, they do not have the ability to change the acceptance of a construction project, if the project shown does not convince the public. The quantitative field study also revealed that there is a positive effect of immersive systems on the willingness to engage with and donate for construction projects and thereby proved their relevance for participation forms in urban planning such as civic crowdfunding and public budgeting.

RQ4 (*How can citizens be informed about construction projects at an early stage and in a low-threshold manner with the help of immersive systems, and can this create an incentive for citizen participation in order to contribute to decisions that avoid conflicts later on?)* was answered in Chapter 9 and 10. The research question focused on the concrete development and design of the application from an app development perspective. Chapter 9 presented an early prototype and formulated four pillars for the design of an immersive e-Participation app. Based on those pillars, the app was later on developed together with software developers. The following pillars were formulated for their coding practice: immersive information (creating a common understanding through a

visualization which is graspable for many stakeholders), motivational participation (including technological innovations like placing annotations), in situ discussions (allowing spot-on participation at the construction site) and easy involvement (target-group-specific applications for a coherent participation ecosystem). While Chapter 9 rather theoretically focused on the upcoming development of the app, Chapter 10 presented, on the other hand, the fully developed app in its complete functional scope. In the latter, the Take Part ecosystem could be demonstrated and shown in concrete visualizations, which included components like the configurator, the voting mechanisms and concrete app elements like the central bottom bar. The promising results of the filed study (Chapter 7) revealed that the design and development of the Take Part app was successful in many of the researched categories like its usability and motivational aspects. Thereby, it could be demonstrated that a strong exchange between research and development is beneficial for creating a convincing artifact. The Design Science Research Framework thus proved its quality in designing a "solution to a real-world problem" (Kuechler and Vaishnavi, 2008a, p. 492) – as the authors and originators of the theory intended.

This dissertation furthermore aimed at methodically contributing to the Information Systems community, by presenting how qualitative interview methods can be integrated into Design Science Research. Using Kaiser's (2007) qualitative interview framework for the Chapters 4 and 5, the significance of integrating the user in the design process early on could be shown. Furthermore, it was presented how social science methods like interview techniques can support Design Science Research, especially the first two steps which are known for the problem description and motivation of an IT artifact. With this methodical section, an interdisciplinary approach to artifact design was demonstrated and successfully incorporated.

When it comes to interdisciplinarity, the Subchapter 2.3 on Digital Citizen Participation, aimed at proving a framework that argues for the necessity of interdisciplinary research approaches for the successful design of digital public participation formats. It maps out a framework which includes a variety of academic disciplines (philosophy, history, political science, sociology, media design, computer science, information systems and behavioral economics, as well as urban planning and architecture). Furthermore, the Digital Citizen Participation framework pleads for the incorporation of technological innovations (like immersive systems) and guaranteeing interoperability. Finally, since e-Participation flourishes even in authoritarian regimes (Åström et al., 2012), Digital Citizen Participation makes a strong case for incorporating an inclusive democratic approach in the platform design itself. Thus, with Digital Citizen Participation, this dissertation made the argument to adapt the idea of e-Participation in favor of a modern understanding of digital participation platforms. It takes up this call with the research

presented in this dissertation. Thus, this dissertation itself is an attempt to go in the suggested direction of Digital Citizen Participation by using a mixed-method approach (including methods from social science, information systems, informatics and behavioral economics) to research the potential of immersive systems for urban planning. In conclusion, introducing the concept of Digital Citizen Participation, was the attempt to put the manifold findings on the use of immersive systems for public participation in urban planning in a larger context and give first propositions for future research.

11.2 Limitations and Discussion

Like every research endeavor, this work also has clear limitations. Although the studies attempted to be internally consistent, the object of research, public participation, has distinctive features that make generalizations difficult. Lee and Schachter (2019) suggest that trust in government has an impact on the willingness to participate in political settings. Following this thought, some limitations arise from the specific and local research context. With the Design Science Research approach, there is a strong focus on one use case which took place in an economically strong region in southern Germany. Although this use case had widespread characteristics, such as the fact that it was a public construction project, which affected a wide range of the urban society, generalization and extending the results to other – also international – contexts seems difficult. Trust in government varies and the willingness to participate through the researched platform might have been especially promising in this case due to the fact that the city of our use case has, compared to other German and for sure other international cities, a well-functioning public administration. Therefore, a limitation of the shown research is related to missing comparability.

Especially when it comes to the exclusivity of the technologies, the presented research has some limitations. Although gender aspects were included, it would have been beneficial to embrace in the studies a more thorough consideration of the gender, social background, experienced migration and special needs of individuals. While the qualitative study and the field experiment attempted to reflect social diversity and reality through their participant recruitment, the sample of participants in the online study was relatively homogeneous, as it is the sampling procedure of a majority of current online-studies.

This dissertation already used a mixed-method research approach and participatory methods. It seems relevant to consider whether the methodological application of Citizen Science seems a suitable next step to develop e-Participation platforms in a participatory manner. In the presented research, it was still up to the conducting scientist to

decide on participatory elements of involvement. Certainly, it has to be questioned whether even more participatory research is possible, since the already used participatory methods, stakeholder mappings, qualitative interviews and a field experiment, used in this dissertation, supported the development of a coherent platform design.

In this regard, another restriction of this dissertation is an insufficient acknowledgement of sustainability in urban planning. The studies in this dissertation focused on new construction projects, while many experts agree that in countries like Germany or the US, the question would rather be how to transform existing building structures into new concepts of use (e.g. parking garages in residential complexes). This is because the demolition of old and construction of new buildings always releases more CO_2 than a well thought-out redesign or improvement. For visualizing the transformation of old buildings into new concepts of use, immersive systems like AR and VR could be of tremendous support. Another use case in the context of sustainability would be the visualization of photovoltaic systems (e.g. solar arrays on rooftops) or wind power plants. Both are in many societies highly polarized topics, but somehow representative for the major transformation processes some regions are facing. Due to the limitations of a dissertation the focus was set on construction in urban planning, nevertheless, it can be acknowledged that other interesting use cases could have been selected.

Conducting and carrying out a study during the COVID-19 pandemic also resulted in some limitations. The final prototype could not be tested in the KD2Lab research environment with the intended hardware (VR headsets and tablets) as planned due to access limitations according to the pandemics hygiene regulations. Nevertheless, the results also proved an important point by showing that immersive technologies in e-Participation require appropriate hardware.

11.3 Propositions for Future Research

The limitations of this research endeavor present, at the same time, research gaps where further research may be directed.

The dissertation demonstrated the potential of using immersive systems for public participation, but their deployment and diffusion will continue to depend strongly on the local context. When it comes to the comparability of the results, researching e-participation in cross-country comparisons can provide further insights and would in any case be worthwhile for future research. What the United Nations are publishing with their biennial e-Government surveys (United Nations, 2020a, 2018) and researchers like Lee-Geiller (2020) did for influencing conditions of e-Participation and Zheng (2016) for the

impact of e-Participation on corruption, can and should be further expanded to immersive systems and e-Participation.

At this point, a more global perspective on urban planning might be useful. Who is in many cases in charge of planning cities? Unfortunately, we can see two extremes which both deliberately prevent the involvement of citizens. First of all, there are powerful states like China and Saudi Arabia which respond to the ongoing and partly forced urbanization with complete transformation of cities or even the creation of new ones (Alqahtany and Aravindakshan, 2021; He, 2012). Their urban planning – just like their general form of government – cannot be considered democratic. In Europe and especially the US we can witness a different phenomenon: tech companies, especially Big Tech, are transforming with their investments cities like San Francisco or Seattle, leading to a massive increase in housing prices and thereby forcing population groups to experience homelessness (Hartenstein, 2019, 2017). How can platform design in such cases demand the democratic co-design of cities? With the introduction of the Digital Citizen Participation framework incorporating a democratic approach in platform design was already suggested. This approach can be called 'Democratic by Design' – a term regularly used in certain progressive design scenes (Metcalf, 2015) but not yet defined for platform design. A term that might not only be useful for the development of democratic e-Participation platforms, but also for the evaluation of other platforms. The idea of how platform design itself can promote democratic action should be pursued and evaluated in further research. This research would be – on a global scale – of high relevance. Nevertheless, researching small examples of successful democratic participation, like it was undertaken in this dissertation, is also of importance. Those examples can be used as role models and thus serve as a basis for argumentation for those that demand participation in the respective local contexts that lack democracy.

When it comes to local differences, it is of importance to put in further research a focus on hardware distribution and use. Although lacking democracy or goodwill towards participatory approaches might not be the problem when it comes to urban planning in countries of the global South (Novy and Leubolt, 2005; Rodrigues Mororó, 2014), hardware distribution might differ from the context researched in this dissertation. After all, financial conditions certainly change the circumstances and the possibilities when it comes to technology distribution. Shahab et al. (2021) and Sari et al. (Sari et al., 2018) already demonstrated barriers to the deployment of e-Participation technologies in developing countries. Based on this research, it would be worth exploring how participatory urban planning with immersive systems could be undertaken in countries of the global South. The findings from this research project might be interesting for further research in this direction and could be picked up by researchers or in cooperation with

scientist in the respective countries. For example, the exploration of a modular e-Participation system, as presented in Chapter 10, could facilitate a standardized setting that could be locally adapted. Furthermore, the differentiation between different hardware settings (AR, VR and web based immersion, in Chapter 5, 6 and 7) in the studies might be useful for researchers to explore the effect of one technology or another in their context. To name an example, for countries with a widespread smartphone use, where it remains foreseeable that the distribution of virtual reality headsets (such as head-mounted displays) will remain a long-term issue, the results on using AR for participatory urban planning might be especially valuable. For all of the above-mentioned reasons, to increase the external validity of the results, it should be argued to include cross-country comparisons in further research.

This dissertation focused on the use of immersive systems for digital participation in urban planning. As already pointed out by Thiel et al. (2018), there are other promising technological innovations (e.g. smart watches and public displays), which could further be researched and explored for the context of public participation. The latter is currently investigated in a research project on Digital Citizen Science at the Karlsruhe Institute of Technology, where researchers also experiment with chatbots for citizen involvement (Greif-Winzrieth and Gau, 2021). The results of this project might be interesting for e-Participation and Digital Government researchers and may be worth considering in future investigations.

Nevertheless, immersive systems have not yet been fully researched. The research project VIRTUS, initiated by the FZI Research Center for Information Technology and also funded by the Federal Ministry of Education and Research, will pursue from 2021-2024 the research efforts of Take Part (Federal Ministry of Education and Research, 2021). With a focus on Extended Reality, it follows the direction of current hardware trends towards devices, which will easily change between different realities. The COVID-19 pandemic resulted in an increasing demand for digital participation formats (United Nations, 2020b). However, participation from different locations remains a challenge. Therefore, this project will rather focus on researching how to enable inclusivity through asynchronous participation e.g. participation from different devices, on the spot and from home.

Especially in the field of human-computer interaction, the attention to inclusivity needs to be a cornerstone of information systems research. Hevner et al. (2004) argued that "[t]he goal of behavioral science research is truth. The goal of design science research is utility" (Hevner et al., 2004, p. 80). If utility is the aspiration of this popular Information Systems research method, a focus on the inclusiveness of digital participation platforms and processes has to become a major part of further Design Science Research, especially in the field of Digital Government.

Aelbrecht and Stevens (2019) show that social cohesion seems to be, especially in cities, at risk and that the question of how public space are designed plays a major role in securing this cohesion. For this reason, it seems important to expand research in the field of Digital Government to include even more research questions of how digital platforms can contribute to enable and empower social participation and thereby guaranteeing social cohesion. Rottinghaus and Escher (2020) and Vázquez and Vincente (2019) already presented that important motivating factors for public participation with digital means are the previous political involvement, the personal interest or concern of the involved citizens. Kim and Lee (2019) explored gender differences in the use of e-Participation. Their findings should be taken up in further studies on immersive e-Participation and thereby, above all, investigated how these differences can be specifically countered.

Also to counter those biases methodologically, a Citizen Science project on e-Participation platform development might provide interesting insights on which research questions and hypothesis matter to the affected citizens (Weinhardt et al., 2020). Citizen Science might bring the effort of catering the needs of the demos, as potential users, to another level. Integrating citizens into the research of immersive e-Participation platforms for urban planning could be beneficial as it might include the people who are later affected by the platform design and the urban planning itself. As a first step, it could be worth discussing with urban planning, Citizen Science and Digital Government experts how the perspectives, accesses and resources of citizens could be used to develop appropriate Citizen Science research projects on digital participation.

With the introduction of the Digital Citizen Participation (Chapter 2.2., Figure 11) framework, this dissertation also shows how further interdisciplinary research endeavors for the successful implementation of public participation on digital platforms might look like. This dissertation should give rise to the hope and aspiration to address, through interdisciplinary collaborations, the pressing issues of this time. Those can also address some of the United Nations Sustainability Goals (United Nations, 2015) including urbanization and social inequality in cities. New digital participation formats can be used to guide and inform the public, as mentioned in the limitations, also for research on achieving a more sustainable world. Research has shown that immersive systems can be of use, when addressing the United Nation Sustainability Goals (Pfeiffer et al., 2021). Moreover, immersive technologies are able to evoke emotions (Greif-Winzrieth et al., 2020) and could thus make citizens question the status quo and look for new solutions. The calls for action by Watson et al. (2010) and Gholami et al. (2016) to make sustainability a priority in information systems research, should be taken up so that the discipline plays its part in facing the climate crisis and tackling the dependency on fossil fuels. Digital participation using immersive systems therefore has to be extended to the sustainability

context next. Now is the time to act and the scientific community in each and every discipline should do its part to end or at least slow down the climate crisis.

11.4 Concluding Remarks

Most of this research process and writing on this dissertation took place during the COVID-19 pandemic. The pandemic not only affected the lives of many individuals around the world, it changed the perception of using digital technologies for personal interactions (Russell et al., 2021; Vaishya et al., 2020). With doing so, it also affected the demand for e-Participation (United Nations, 2020b) and changed the perception of immersive systems.

In Winter 2021 the platform operator Facebook launched its rebranding into Meta Platforms and announced the "Metaverse" as their core product (Isaac, 2021). At the point of the presentation, it was unclear if Meta and its founder, Mark Zuckerberg, used the product presentation to deflect from the negative press his platforms were getting prior to the presentation. The former employee and whistleblower, Frances Haugen, leaked just before the announcement papers on platform mechanisms that knowingly caused harm to children and adolescents (Frenkel, 2021). Furthermore, Facebook was under critic for their role in spreading disinformation in India, that might have had deadly consequences (Frenkel and Alba, 2021). Thus, the public's and media's reaction to the announced emphasis on immersive systems was divided when it came to the question if this effort could be taken seriously. Although Meta Platforms might have used the launch of their Metaverse to distract from the platforms structural problems, other technology companies like Microsoft, Google and Apple also invest heavily in immersive systems (Chen, 2022; Metz, 2021). Thereby, Big Tech tries to assure that if the Metaverse becomes a relevant version of future digital interactions, they already provide the appropriate products to the market or are ready to launch those products.

What Meta Platforms presented became part of a polarized debate on the future of the digital world (Barbaro et al., 2022; Tengtrakool, 2021; Verdi, 2022). If the Metaverse becomes the next big thing, who will assure that it will be a democratic and deliberative space? Those questions seem like reminiscences of the expectations towards the internet at the beginning of the 2000s (Gimmler, 2001). Again, especially corporate businesses seem interested in the Metaverse as a means to reach more clients and use immersion to do e-Commerce even more successfully.

This dissertation intends to be a step towards a deliberative future use of those technologies. A practice of immersive systems that empowers citizens and uses their potential

for a more inclusive participation in urban planning. With the general worldwide tendency towards urbanization and growing demand for (affordable) housing in cities, with the transformation towards renewable energies and the effect it has on entire landscapes, the necessity of participatory urban planning seems obvious. The tools for the participation of citizens should therefore be state of the art and as attractive to use as possible. If the Metaverse becomes the dominant reality for internet users, it is necessary that there is space for democratic practice and participation in it. Therefore, exploring platform design and ways to use immersive systems for digital participation could help to develop deliberative tools that are keeping up with the times. Hopefully, this research is of help to prepare for something that might become in the next decade an even more mainstream reality.

With the ongoing worldwide urbanization, it seems relevant to present prospects of how citizens can meaningfully contribute to urban planning using digital means. The presented research might be useful for governments, public administration and other construction project initiators. Findings can give practical advice on involving citizens in the planning of cities, how to consult them consciously, and how they can and want to participate in decision-making. The research also shows that the technological solutions that would promote this kind of immersive participation is, given the sums invested in construction projects, financially affordable. The modularity of the presented platform modules might contribute to easier implementation and thereby lower costs in further development. In this regard, the hope is that the presented research will serve as a practical inspiration.

While writing the concluding remarks of this dissertation, there is a war going on in Europe. In the beginning of 2022, Russia's president Vladimir Putin expanded the ongoing attacks on Ukraine into a war, which led to people fleeing their home country in masses. Not only through Ukraine's proximity to the place of writing, it puts the presented research once again into a larger political context.

As described in Chapter 2 on the Theoretical Background of this dissertation, democracy itself is at stake. Sometimes form the inside of states, with populists coming to power, sometimes through attacks from the outside. Those attacks nowadays happen digitally through disinformation campaigns or hacker attacks that target the sovereignty of a state – or manifest itself in the old way through war.

In his book „Democracy: A Fragile Way of Life" (2019), the historian van Rahden argues to study rather what keeps democracies alive, then to fixate on democratic failures. In this regard he argues for creating and sustaining "democratic experiential spaces" (Rahden, 2019, p. 139). That includes, as one argument, shifting away from focusing on

voting as the main form of democratic practice to broader forms of participation. Rahden argues to involve democracy in everyday life and thereby integrating it in various occasions and settings.

Living and practicing democracy in everyday life is what this dissertation is about: To study and show cases of the incorporation of democratic practice and how modern technologies might contribute to or even foster those practices. Since urban planning manifests the world that surrounds us quite literally, it was the use case of choice for this dissertation.

In any case, the euphoria of the 1990s and 2000s, which predicted continuous progress toward democracy after the end of the Cold War, seems to be over. And still, democracy is alive around the world. Not always as a form of government, but often as an aspiration or something that is practiced and lived on a small scale. (Digital) democracy is something that can and should be nurtured, nourished and evolved.

The approach of Taylor et al. (2020), presented in Chapter 2 of this dissertation, has to be taken up. Democracy must be cultivated and lived at the local level in order to function on a larger scale. As researchers, we have the possibility to contribute to this call by studying and evaluating innovations in digital participation. Digital democracy must be tested in practice, since it only has the possibility to advance when it is applied and validated on a concrete local level. Here, as shown, the use of Design Science Research can be of great support. Besides providing a structure for the development of the artifact, it also puts a focus on the users, in this case primarily the citizens, their motivation, expectations and needs. As presented, this perspective is crucial when it comes to designing platforms that are intuitive and user-friendly. Additionally, for answering the question of suitable hardware (e.g. the benefit of mobile devices for e-Participation), independent research is needed to verify how well certain technologies work and how they can best unfold their potential.

The German Federal Ministry of Education declared participation to be the subject of the so called Science Year 2022. Under the title "Participate!" the Science Year aims to "strengthen the participation of citizens in scientific and political development processes" (Federal Ministry of Education and Research, 2022). The aspiration to involve citizens has thus arrived in (German) federal politics. It is to be hoped that this effort will not stop at national borders, moreover, that research will take into account how (digital) citizen participation and democratization can have an impact and where this knowledge on user-friendly participation platforms is needed.

Now it is on us in academia to follow up on this initiative and provide for its critical accompaniment. This dissertation is intended to make a contribution in this regard by investigating, on a local level, the practical application of Digital Citizen Participation through immersive systems. It will be highly interesting to see which innovations and challenges will arise from the continuous digitalization and how further research can help to shape, democratize and diversify e-Participation technologies.

Appendix

Supplementary Material & Bibliography

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List of Abbreviations

AR	Augmented Reality
CAD	Computer-aided design
DP	Design Principle
DSR	Design Science Research
DSRIS	Design Science Research in Information Systems
HCI	Human-Computer Interaction
HMD	Head-Mounted Display
ICT	Information and Communication Technology
IS	Information Systems
MR	Meta-requirement
OECD	Organization for Economic Co-operation and Development
SPP	Spectrum of Public Participation
UK	United Kingdom
UN	United Nations
USA/US	United States of America
VR	Virtual Reality

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Qualitative Interviews

Instructions for the Interview Transcripts

The following interview transcripts do not present the "gapless" content of the interviews. For the most part, interview recordings allowed to understand the interviewees perfectly. In few cases though, the interviewees were not perfectly intelligible. In these cases, their statements could still be understood in the given context, but would not have made sense as a transcription; for these cases, their ideas were summarized. Additionally, in some cases, when the interviewees repeated their ideas closely to what had been said before, their ideas, too, were summarized and boiled down to specific statements. In both cases, summarizations of the interviewees' ideas were put in simple brackets '( )'. Sometimes, summarizations nonetheless included quotes that were very specific for the speakers opinion; such quotes were placed in double quotes, " ". Whenever the interviewees interrupted themselves to start the sentence over, a single dash '/' was placed. Longer pauses were indicated by (…). Whenever one speaker interrupted another one, double dashes were placed '//'. The aim of symbol use in interview transcription was, first, to allow a more efficient transcription, as the transcription served as a basis for important steps in app-development. Secondly, through precise noting of the structure of the speakers speech and interaction with the interview or other interviewees, a reader who has not conducted or listened to the interview recording, should receive a more authentic impression of the interview situation.

Legend

Numbers [1,2,3] on the left	Original line count from the transcription program
I	The interviewer
B (1/2/3)	The interviewee; numbers indicate persons in group interviews
(*text*)	Summarized statement or emotion (e.g. laughing).
(…)	Pause in speaking
/	Interruption in a speaker's sentence
//	Interruption between speakers (especially in overalpping speaking during group interviews)

The interview transcriptions were available to the PhD committee in the version submitted on April 21, 2022. For reasons of data protection, they are not to be published. Transcripts are available upon request.

Interview 1 (Zoo Employee)

Interview 2 (Zoo Employee)

Interview 3 (Zoo Employee)

Interview 4 (Group Interview with Three Zoo Visitors)

Interview 5 (Zoo Employee)

Interview 6 (Group Interview with Three Members of the Zoo's Charity Organization)

Interview 7 (Zoo Visitor)

Interview 8 (Zoo Employee)

Interview 9 (Zoo Employee)

Interview 10 (Zoo Employee)

Interview 11 (Zoo Visitor)

Interview 12 (Group Interview with Two Zoo Visitors)

Interview 13 (City Council Representative)

Interview 14 (Group Interview with Two City Council Representatives)

Interview 15 (Zoo Employee)

Interview 16 (Zoo Employee)

Interview 17 (Zoo Employee)

Interview 18 (Technical Expert)

Interview 19 (Technical Expert)

Interview 20 (Group Interview with Two City Council Representatives)

Eidesstattliche Versicherung

gemäß § 13 Abs. 2 Ziff. 3 der Promotionsordnung des Karlsruher Instituts für Technologie für die KIT-Fakultät für Wirtschaftswissenschaften

1. Bei der eingereichten Dissertation zu dem Thema *Digital Citizen Participation – Involving Citizens Through Immersive Systems in Urban Planning* handelt es sich um meine eigenständig erbrachte Leistung.

2. Ich habe nur die angegebenen Quellen und Hilfsmittel benutzt und mich keiner unzulässigen Hilfe Dritter bedient. Insbesondere habe ich wörtlich oder sinngemäß aus anderen Werken übernommene Inhalte als solche kenntlich gemacht.

3. Die Arbeit oder Teile davon habe ich bislang nicht an einer Hochschule des In- oder Auslands als Bestandteil einer Prüfungs- oder Qualifikationsleistung vorgelegt.

4. Die Richtigkeit der vorstehenden Erklärungen bestätige ich.

5. Die Bedeutung der eidesstattlichen Versicherung und die strafrechtlichen Folgen einer unrichtigen oder unvollständigen eidesstattlichen Versicherung sind mir bekannt. Ich versichere an Eides statt, dass ich nach bestem Wissen die reine Wahrheit erklärt und nichts verschwiegen habe.

Berlin, den 11.04.2022

Jonas Fegert