

Foregrounding Values through Public Participation: Eliciting Values of Citizens in the Context of Mobility Data Donation

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ABSTRACT

Citizen science (CS) projects are conducted with interested volunteers and have already shown promise for large-scale scientific research. However, CS tends to cultivate the sharing of large amounts of data. Towards this, our research aims to understand better citizens' potential privacy concerns in such participation formats. We, therefore, investigate how meaningful public participation can be facilitated to foreground citizens' values regarding mobility data donation in CS. In this regard, we developed a two-step method: (1) a workshop concept for participatory value elicitation and (2) an analysis procedure to examine the empirical data collected systematically. Our findings based on three workshops provide new directions for improving data donation practices in CS.

CCS CONCEPTS

• Human-centered computing → HCI design and evaluation methods; Participatory design.

KEYWORDS

Participatory design; value sensitive design; values; mobility data; data donation; citizen science

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1 INTRODUCTION

Citizen science (CS) is a method for involving the general public in scientific research. In this regard, CS projects seek to understand better local concerns [23] and to foster challenges (e.g., regarding the project outcome and its quality) that researchers cannot address alone [45]. CS often involves many thousands of volunteers

through crowdsourcing activities (e.g., by using smartphones or wearables) [10], for example, in mobility [39], biodiversity [47], and healthcare [11]. CS aims to collect and connect data for society's greater good; however, research (e.g., [9]) argues that CS intensifies power imbalances of stakeholders such as corporations or government agencies that already have influence, bypassing citizens' concerns to protect their privacy. These imbalances should be mitigated, especially in contexts where the values and concerns of volunteers and other stakeholders are at odds [22].

We hypothesize that the responsible collection and use of data should be a primary concern of CS projects (e.g., public institutions and companies). For example, to develop technologies that support CS by considering people's concerns in local communities and technology infrastructures co-designed with communities [22]. Regarding this, our ongoing research is driven by the following question: *How can we facilitate meaningful public participation to derive design requirements for data donation practices reflecting citizens' values in the context of mobility in CS projects?* To foster this research question, we designed a two-step method: First, a workshop for participatory value elicitation consisting of four sequential phases, and second, an analysis procedure to examine the empirical data gathered for deriving design requirements for mobility data donation practices in CS. We considered two strains from the field of human-computer interaction (HCI), namely first, participatory design (PD), which serves as an epistemological framing to understand better what it takes to achieve active user involvement (e.g., [2, 42]). Second, value sensitive design (VSD) [15] to account for human values accompanied by related work on value-led PD (e.g., [24, 25]) for theoretical and methodological grounding. Our paper makes the following contributions: (1) we facilitated three workshops for participatory value elicitation regarding mobility data donation, and (2) we derived design requirements using our analysis procedure that reflect participants' values to inform data practices in CS.

In the following, we introduce the background and related work that informed our research in section 2. In section 3, we detail preliminary measures and participant recruitment and introduce our method, i.e., the workshop concept and analysis procedure. We then discuss our results, i.e., design requirements for data donation practices in the context of CS, in section 4. In section 5, we reflect on the limitations of our research and conclude with directions for future work.



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2 INQUIRING VALUES THROUGH PARTICIPATION

Research offers several definitions of values: For example, Almond and Wilson [1] describe values as persistent beliefs of people about what they perceive as desirable or undesirable. Rokeach [40] states that values are criteria that guide individuals' judgment, actions, and decisions. Fleischmann [13] describes values as "*bridges between the individual and the social*" held by individuals and the society as a whole. Friedman et al. [16] define human values as "*what is important to people in their lives, with a focus on ethics and morality.*" Regarding these definitions, the question remains about cultivating different stakeholder values through participation in technology design.

PD calls for democratic practices in which designers and users contribute equally to sociotechnical design [5, 6, 34, 42]. In its tradition, PD aims to encounter values in a design process [5] and implies an intrinsic concern with values (e.g., general, self-evident, and stable) [24]; however, designers might influence a design process through their values [26]. Iversen et al. [24] assume that emphasizing values in PD requires rethinking how designers use and choose methods to work with values. Fraunberger et al. [14] highlight that designers should be more precise in considering and using values in design processes. One promising avenue to account for direct and indirect stakeholders' values and address potential value conflicts among them is VSD. As a theoretically founded approach, VSD offers the "tripartite methodology" consisting of *conceptual*, *empirical*, and *technical* investigations with accompanying methods that can be used iteratively (see [16]). However, Le Dantec et al. [29], for example, criticize that VSD methods should promote the discovery of values rather than just identifying them. This discovery would allow researchers to reflect on their and participants' values critically and refine them continually in the context of empirical inquiries. By taking a more value-led participatory approach, Grönvall et al. [21] assume that values should be negotiated continuously, enabling mutual learning processes for community-based PD. The author argues that these processes help to reshape possible conflicts between stakeholder values jointly in a continuous design process. Peer [37] conducted data literacy workshops to reveal participants' values regarding data justice. The author conducted activities for creating data story sketches (2D representations) and data sculptures (3D representations). The author concludes that such activities help develop more equitable data infrastructures. Hidalgo et al. [43] argue that CS should be more inclusive to enhance citizens' participation. The authors assume that CS projects should consider ways, for example, to communicate timelines and rules for participation or digital ways to discuss issues around policy. They conclude that such an approach can support citizens' decision-making and governance.

In summary, meaningful participation should consider individuals' values and concerns more closely. Methods for unfolding values need to be carefully composed by researchers to be responsive to participants' abilities enabling them to reveal their values. Furthermore, CS should readily take responsibility for anticipating citizens' values for more sustainable participation. In the following, we take up these implications and introduce our method.

3 METHOD

Informed by related work (see section 2), we detail our preliminary measures and participant recruitment, workshop concept, and analysis procedure in the following.

Preliminary measures and participant recruitment. In March and April 2023, two facilitators (this paper's first and third authors) conducted three workshops with 13 participants. We facilitated the workshops in German with a duration of 2 h (breaks excluded) in the facilities of our partner institution focusing on urban mobility. The number of participants is divided into a group of four in the first workshop, seven in the second, and two in the third. We chose not to consider participants' gender since we assumed that their identities did not affect our results in any way. Participants varied in their educational backgrounds and field of work (e.g., students in social science and urban planning, experts in digital policy, or voluntary workers). We recruited participants through an open call (e.g., in newsletters and social media). Participants were compensated with a 25 € voucher for a local bookstore. We decided to refrain from mentioning this incentive in our call to ensure participants partake out of their motivation. We developed internal research ethics to treat the empirical data gathered carefully since our university does not provide an ethical review board. Our research ethics are primarily about protecting participants, including, for example, legal measures of the GDPR approved by our university data protection officer.

Workshop concept. The workshop procedure consists of four sequential phases: In phase (1) *explore*, we instructed participants to explore values in the context of CS. After a short presentation to familiarize participants with our workshop purpose, objective, and context, we engaged participants to write their values down on yellow sticky notes (e.g., using descriptions or keywords) to arrive at an individual compilation of context-specific values [29]. We then introduced participants to the value questionnaire (see Appendix A). We asked participants to present their value questionnaire to achieve an initial discussion among participants. In phase (2) *contextualize*, participants systematized their values (from the first phase) on a value map to reveal relationships (e.g., commonalities or value conflicts) between stakeholders (see Appendix B). We define a value map as a medium illustrating a contextualized understanding of participants' values. A value map supports the identification of direct or indirect stakeholders [35] by unfolding stakeholders' relationships [33]. We specified the main stakeholders "citizens" but asked participants to add direct or indirect stakeholders they consider relevant to the context. We then asked participants to assign their values from the first phase to a stakeholder aligning with their values. Furthermore, we motivated participants to consider stakeholder relationships. These relationships were marked by tape and green sticky notes describing commonalities or value conflicts. In phase (3) *translate*, participants in subgroups (two or three participants) were prompted to create value scenarios (see [32]) materializing an idealized situation for mobility data donation in CS. We instructed the subgroups to choose at least three values from the value map they considered indispensable. Informed by characteristics of traditional scenarios (see [7]), value scenarios aim to consider direct and indirect stakeholders and their values [36]. In our view,

value scenarios can be materialized as 2D sketches (e.g., [17, 50]) or 3D representations (e.g., [37]) using prototyping materials such as Styrofoam or cardboard. We finished this phase by asking the subgroups to present their value scenarios. In phase (4) *reflect*, we aimed for participants' critical reflection and to understand why the value scenarios serve as an idealized solution for mobility data donation in CS and how it might resolve stakeholder value conflicts. We aimed to investigate whether participants reflected on their attitudes across the first three phases (see [44]).

Analysis procedure. The workshops were audio recorded (over 9 h) and transcribed verbatim using the MAXQDA software for qualitative data analysis. Previous research suggests a value source analysis to identify sources of values [16, p. 77]. This analysis differentiates the values of direct and indirect stakeholders. However, we perceive a gap in systematically analyzing and translating values into design requirements to inform a specific context. We, therefore, propose an analysis procedure tailored to our workshop procedure to answer our research question. We conducted a qualitative content analysis [30], i.e., an inductive coding strategy, to understand better how participants substantiated their values. For this, we used the value maps as a coding scheme. Apart from other value-oriented coding manuals (e.g., [18, 28]), we argue that a value map comprises participants' contextualized values of a specific context. First, we reviewed the meaning of each value using the value maps. We then generated an overview of values, i.e., codes (see Appendix C). Second, we analyzed the value scenarios as these incorporate subgroups' materialized values. We investigated the value scenarios for prevailing values (see Appendix D), pointing to implications for design requirements. We synthesized the design requirements by grouping comparable requirements and removing redundant or inconsistent requirements. Finally, we reflected on and sharpened the resulting design requirements by revising them with the first analysis step (e.g., whether these mirrored the contextualized participants' values).

4 REFLECTIONS ON DESIGN REQUIREMENTS FOR MOBILITY DATA DONATION

We facilitated three workshops in the context of mobility data donation and analyzed the empirical data gathered to answer our research question. We obtained six value scenarios (see Appendix D): Value scenarios (VS 01, 02, and 06) include interactive elements supporting subgroups' storytelling. Value scenarios (VS 03, 04, and 05) are reminiscent of process-like graphics or narrating a step-by-step approach. The value scenarios generally illustrated specific situations, i.e., imagining locals or local communities in certain urban settings. For example, VS 01 addressed residents in a neighborhood; similar to VS 02, which considered marginalized groups (such as minors or youth) in a town district. VS 06 more broadly takes citizens and governments into account. VS 03, 04, and 05 developed an overarching catalog of requirements for data protection in Germany (e.g., for user interfaces of apps). We discuss and reflect on the design requirements derived in the following.

Sustaining citizens' self-governance by focusing on local infrastructures. We found that subgroups were concerned about large-scale

data collection in CS that could diminish citizens' autonomy, reinforced by non-transparent data use (see Appendix D; VS 01 and 02). The subgroups indicated that data collection should exclusively concentrate on specific areas (e.g., neighborhoods) to support close communication among citizens. They pointed out that focusing on specific areas might increase the relevance of a mobility data donation for citizens.

This assumption is reflected by Taylor [48], highlighting that data justice should align with a local community's experiences. The author argues that appropriate data justice considers each individual equally, i.e., looking at personal capabilities and activities. Mendel and Toch [31] note that collective support from local community members (e.g., family members or volunteers) can increase individuals' personal information sharing. In this regard, Garrett et al. [19] encourage researchers and practitioners to be aware of their own and others' ethical sensibilities, which the authors believe are essential for designs contributing to a social and technology-driven world. We suggest that future research should continue addressing the challenge of designing community-oriented technologies without imposing a cross-society solution.

Enhancing citizens' reflection on data donation by foregrounding social interaction. We experienced subgroups being stimulated to design new opportunities for citizens when donating mobility data (see Appendix D; VS 03 and 04). The subgroups approached directions to visualize information comprehensively, helping citizens to reflect on data donations. Echoing this, Terpstra et al. [49] explain that managing privacy preferences remains contesting due to individuals' cognitive constraints as they tend to make automatic or intuitive decisions. However, reflection foregrounded in technology designs provides a promising direction allowing individuals to improve their privacy decision-making. Our results showed similar directions: One subgroup (VS 03) suggested delineating data donations into categories (e.g., location or personal data and data for particular research purposes). Each category would further include privacy ratings indicating how sensitive data are. Another subgroup (VS 04) suggested an archive to visualize data donations by placing time stamps on each data donation and which data (e.g., location data) was donated.

These findings are reminiscent of Choe et al. [8], arguing that data visualization platforms allow users to gain rich insights into personal data to promote self-reflection. The authors emphasize that contextual information (e.g., semantic location data) should be recognized as essential to enhancing users' interpretation of their data. Ploderer et al. [38] highlight that collectively used technologies should be embedded in a community's environment to offer reflection through social interaction (e.g., community feedback). Although work in HCI (e.g., [4, 12]) provides concepts to design for reflection. We suggest that future research should investigate how technologies can continuously promote reflection on data donations embedded in social structures [38].

Increasing citizens' data sovereignty by disentangling data practices. Zygmuntowski et al. [52] assume that on a systemic level, the anthology of data must be reconceptualized, i.e., to recognize data as digital commons. The authors explain that public data communities can unravel data practices by considering individuals'

rights and values. Similarly, our findings show that subgroups generally were concerned about opaque data practices (e.g., how data are shared or processed by commercial and scientific institutions). They argued that, despite legal measures, citizens' privacy is lacking since third parties (e.g., service providers) readily find a way to induce data donation that is not in citizens' best interest. Also, we found that subgroups emphasized additional instances, namely networks or regulators, enabling data protection for citizens' welfare (see Appendix D; VS 05 and 06). VS 06 demonstrated that networks between citizens and data-collecting institutions can enforce protective standards by restraining third-party access to donated data. VS 05 indicated a regulator that requires institutions to report on data practices. This regulator also educates and informs citizens about how and by whom donated data are processed.

Reflecting on this, we realized subgroups proposed directions for supporting and mediating citizens' control and autonomy in data practices. In this regard, Barnett et al. [3] illustrate that mediating does not require additional skills or knowledge of individuals, i.e., data suppliers. They suggest that a data intermediary can control data on data suppliers' behalf. Janssen et al. [27] explain that a data intermediary can balance asymmetric power relations between data suppliers and data collectors (e.g., third parties) by centralizing data processing. They argue that a data intermediary includes measures for data governance to ensure that data are accessed and used only when appropriate. The goal is to provide confidence in data use and safeguard all stakeholders' concerns. For future work, we witness the particular utility of a data intermediary to strengthen citizens' values (e.g., enable control of data or realize comprehensible processes of data usage on data platforms [46, 51]), especially concerning digital participation and for the betterment of society.

In summary, our design requirements suggest CS projects moving in new directions. In particular, the design requirements foreground citizens' values, for example, by addressing local needs and concerns. We hope that our approach will encourage researchers, practitioners, and policymakers to incorporate the values of all stakeholders, realizing the potential of privacy-preserving utilization of urban mobility data in the design of socially responsible technologies (e.g., user interfaces for data donation).

5 LIMITATIONS AND FUTURE WORK

In our ongoing research, we aimed to realize a community-based PD approach [21] to unfold and negotiate citizens' values. We reflect on our method, i.e., a workshop concept and analysis procedure, and discuss the limitations of our research in the following.

In phase (1) *explore*, the value questionnaire supported participants to express their values through writing. We iterated the questions carefully; however, participants struggled to define their values. We assume participants might be hindered from being precise when answering the value questionnaire as they were never supposed to concretize their values. Future research should extend the value questionnaire with examples of values and their descriptions that do not affect the workshop context but support participants in expressing their values without influencing their answers. In phase (2) *contextualize*, the value map supported participants assigning their values to unfold stakeholders' commonalities

and value conflicts. We were careful not to guide participants; however, our comments during this activity might have influenced participants' viewpoints and actions. Future work should consider a self-guided realization of the value map by detailing a step-by-step activity beforehand for identifying stakeholders, assigning values, and disclosing commonalities or value conflicts without facilitator support. In phase (3) *translate*, participants' materialized new ideas for an idealized mobility data donation in CS. We argue that the value scenarios supported participants' critical reflection on values informing a specific context. We provided prototyping materials to unleash participants' creativity. However, we found that subgroups of the same workshop adapted their ideas from one another. Future research should consider a spatial separation of the subgroups to exclude homogeneous value scenarios and prevent mutual influence affecting subgroups' creativity.

Regarding our empirical data gathered, we doubt that we have reached theoretical saturation (see [41]). Furthermore, we faced the challenge of achieving an evenly distributed number of participants across the three workshops. Despite our efforts, we had to postpone workshops due to cancellations. Regarding the third workshop, we nevertheless decided to include the two participants in our study to acknowledge their valuable insights and time. We suggest that future research should consider workshop formats allowing participants in different life situations (e.g., single parents, full-time workers, or students with tight semester schedules) to participate. Another approach would be to externalize the individual value exploration (phase (1) *explore*) of the workshop into daily life by adapting, for example, Gaver et al. [20]. Despite these limitations, we hope our approach will enrich future research efforts.

6 CONCLUSION

In this paper, we introduce a two-step method and findings of three participatory workshops for value elicitation in the context of mobility data donation in CS projects. Our method consists of (1) a workshop concept for participatory value elicitation and (2) an analysis procedure to systematically examine the empirical data gathered to derive design requirements informing data practices in CS. Based on our design requirements, we provide directions for mobility data donation practices as part of a larger guideline to enhance citizens' privacy. Our method used in this research is intended to act as an example for identifying citizens' values regarding data collection within CS projects, which fairly involves all stakeholders affected. We hope to improve mobility data collection practices, maximize the reach of CS projects, and thus the validity of their outcomes for demand-driven refinements in urban mobility.

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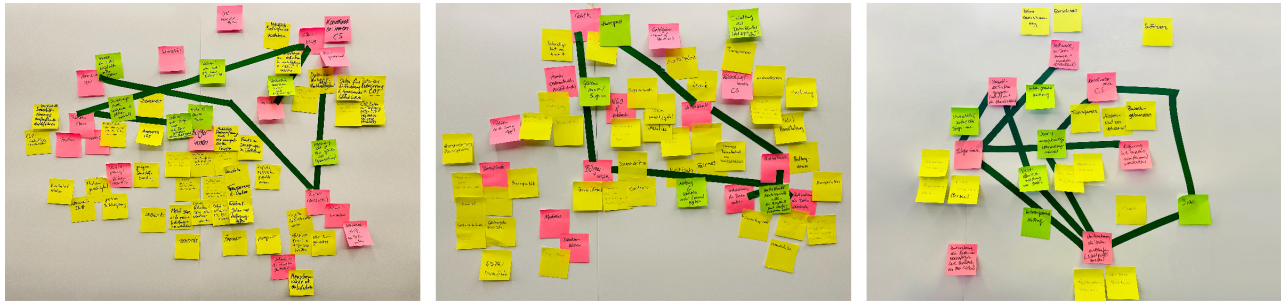
A VALUE QUESTIONNAIRE

Based on an iterative process within our research group, we developed the value questionnaire supporting participants to be more precise in defining values:

Given your chosen value, think about the following questions. You have about one minute for each question. Write down everything that comes to mind. You can formulate the answers in complete sentences or keywords.

- (1) *Why is this value important to you?*
- (2) *How do you define this value?*
- (3) *Describe a situation in which this value is considered.*
- (4) *Describe a situation where this value is not considered.*
- (5) *How does this value affect data donation in the mobility domain?*

B VALUE MAPS: ACTIVITY OUTCOME



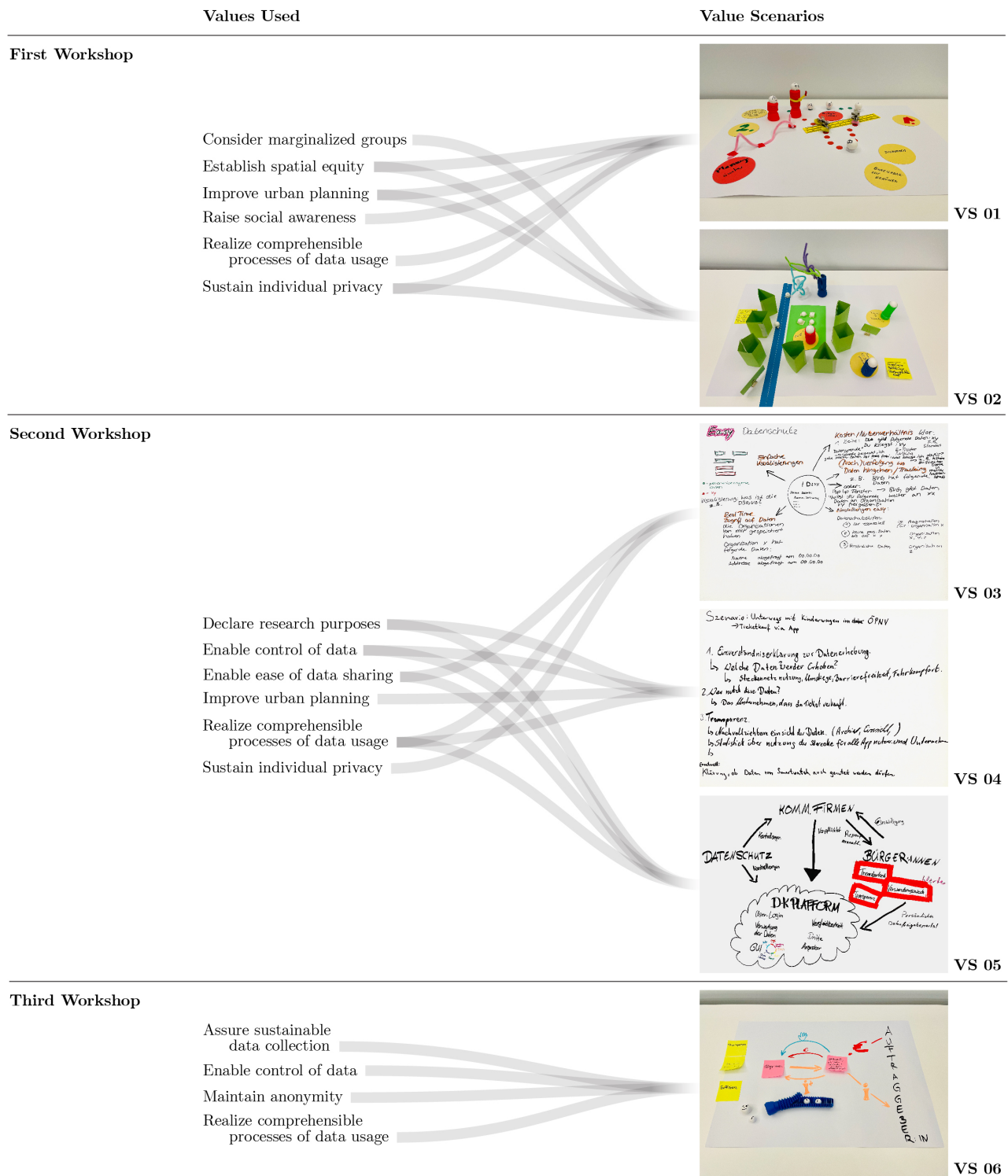
Overview of the value maps created in the first workshop (left), the second (middle), and the third (right).

C OVERALL VALUES BASED ON THE VALUE MAPS

	Enable individuals' reflection on data sharing purposes	Consider marginalized groups	Allow deidentification	Enable ease of data sharing	Enhance control of data	Ensure data sovereignty	Establish (legal) certainty	Improve participation	Induce spatial equity	Induce urban planning	Make data (public) available	Prevent data breach and manipulation	Realize comprehensive governance	Assure sustainable processes of data usage	Uphold individual privacy	Sustain social awareness	Uphold human dignity	
First Workshop		X		X		X		X		X	X	X	X	X	X	X	X	X
Second Workshop	X		X	X	X	X	X	X	X		X		X	X	X	X	X	X
Third Workshop			X		X	X								X	X		X	X

Summary of the prevailing values (in alphabetical order) based on the value maps of the three workshops.

D VALUE SCENARIOS: ACTIVITY OUTCOME



Overview of values used to materialize the value scenarios of the six subgroups.