Advancing Inclusivity: Exploring AI-Enhanced Digital Tools and Citizen Participation Processes for Marginalized Groups

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Preface

Dear Reader,

This report marks the completion of my Master's degree in Construction Management and Engineering (CME) and the conclusion of my entire academic journey at Eindhoven University of Technology. My time has been quite a journey. After spending one year studying Civil Engineering in Delft and deciding to change direction, I felt somewhat uncertain about starting a new program at a technical university, but I am glad I chose to continue my path at TU/e. As I reach this milestone, I would like to express my gratitude to those who have supported me not only during this thesis but throughout my academic path.

First and foremost, I want to thank my supervisors, Bige Tunçer, Gamze Dane, and Cem Ataman, for their valuable insights and guidance over the past six months. Bige and Gamze have been excellent mentors during our biweekly meetings and beyond. A special thanks to Cem, who always made time in his busy schedule to support me through additional meetings, Teams chats, and discussions. I have learned a lot from my supervisors, who helped me improve my thesis and engage with the subject. I am grateful to them for involving me in the EQUAL project. Through this project, I had the opportunity to share my findings with experts and connect my work to ongoing research.
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To you, the reader, thank you for your time and interest in this topic. I hope you find this thesis both enjoyable and insightful.

With much excitement and love,
Sannah Musters (Eindhoven, June 2025)

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Summary

Citizen participation has been discussed in the literature for several years, starting from the first democratic decision-making initiation in the 1970s. However, traditional participation methods often overlook hard-to-reach and underrepresented populations, so-called marginalized groups. Their needs and barriers are not sufficiently understood or addressed in the context of citizen participation. Although digital (AI-enhanced) tools hold potential for increased inclusivity, their potential remains underexplored in this context.

The objective of this study is to explore how current public participation strategies can be improved through inclusive processes and digital tools, particularly those enhanced by AI. Additionally, the study presents a multi-perspective approach to lay a foundation for inclusive participation, offering actionable recommendations and digital solutions aimed at empowering everyone in society.

For this reason, the research question follows accordingly: *"How can marginalized groups be integrated into public participation for decision-making of urban interventions through inclusive (AI-enhanced) digital tools and processes?* This research question is supported by eight sub-questions, addressing topics such as public participation and social inclusion, traditional methods, marginalized groups and their barriers, the potential of (AI-enhanced) digital tools, design requirements, expert opinions, and the implementation of citizen participation processes and (AI-enhanced) digital tools for usability and inclusivity.

This research applies the Design Science Research (DSR) methodology from Wieringa (2014), consisting of the following, iterative phases: 1) Problem Investigation, 2) Treatment Design, and 3) Treatment Validation . These phases led to four key components: Meta Needs (MNs), Design Needs (DNs), Design Principles (DPs), and Functional Requirements (FRs).

The literature study provides a theoretical foundation and offers insights into the history and goals of citizen participation, as well as the barriers faced by residents. These groups are identified as youth, immigrants, refugees, ethnic minorities, individuals with lower socio-economic status or levels of education, the elderly, women, people with disabilities, individuals with limited literacy skills, and those who are single, either never married or previously married. The review further highlights the potential of digital tools in lowering participation thresholds and engaging a broader public. Especially AI holds potential to significantly improve citizen participation by enhancing accessibility, inclusivity, and communication through tools like chatbots and features like speech recognition, simplification of text, and personalization (Lahdili et al., 2024 ; Eziamaka et al., 2024). Nevertheless, the review also identifies significant digital barriers, including unequal access, poor design, low digital literacy, and obstacles like fear, stress, and a lack of confidence.

Following the literature review, semi-structured interviews were conducted with 11 experts in various fields, including citizen participation, human-computer-interaction, co-design, communication, and social sciences. This qualitative method gathered insights into their experiences and perspectives. Thematic analysis of these interviews confirmed known participation barriers (practical, personal, motivational, and socio-economic) and identified additional ones, particularly in the motivational and socio-economic domains. These include:

different priorities, no social approach towards the usage of technology, cultural differences, discrimination, lack of empowerment, other definitions of citizenship, and a feeling of not being valuable/knowledgeable enough. While experts acknowledge the potential of AI-enhanced tools, they also emphasized concerns regarding data privacy, security, and transparency. They stressed that no common solution for marginalized groups exists, as they all have different needs, and that the solution to exclusion does not solely lie in technological innovation but also in (quality of) the participation process itself. Moreover, the often-used "design-first, adapt-later" strategy was critiqued as ineffective, as marginalized groups require tailored participatory approaches from the start. This marks the end of the problem investigation and results in Meta Needs and Design Needs.

Building on this, a workshop was held during the Treatment Validation phase, during which the Meta Needs and Design Needs were validated and assessed by a consortium of experts (20 participants). This workshop revealed that inclusive participation, ensuring user needs, and enhancing perceived relevance are valued the most within the Human & Social pillar. Regarding the political pillar, inclusive decision-making and ensuring trust & legitimacy are prioritized. Lastly, for the technological pillar, accessibility, usability, and transparency were ranked highest.

The Treatment Design phase integrated input from both interviews and the workshop, to come to six Design Principles, overarching guidelines: 1) Principle of inclusive outreach, 2) Principle of empowering engagement, 3) Principle of participatory co-design, 4) Principle of clarity and simplicity, 5) Principle of trustworthy transparency, and 6) Principle of adaptive accessibility and feature definition. These principles led to Functional Requirements, which specify precise, technical requirements for participation tools and processes. These requirements are not intended as a strict checklist but rather as guidance. After all, every participation process, its context, and stakeholders are different.

The final outcome of the study is the co-design empowerment cycle, a framework that ties all elements together in a cycle consisting of 3 phases, guiding the design of an inclusive tool and process in collaboration with marginalized groups. The phases - Establishing a trusted relationship, Facilitating experience, and Co-design tool with user - are inspired by the knowledge gained during this study and reflect the majority of the MNs, DNs, DPs, and FRs.

This study faced several limitations, including the absence of direct input from marginalized groups, the generalization of diverse groups into one category, the exclusion of newly identified Meta Needs in the ranking exercise, and the lack of validation for the co-design empowerment cycle due to time constraints. As a result, the proposed framework and findings should be seen as preliminary. Future research should prioritize direct engagement with specific marginalized communities, validate the proposed framework in real-world environments, involve a wider variety of experts, and explore the development and implementation of AI-enhanced participation tools.

In conclusion, this thesis provides valuable insights into the exploration of inclusive citizen participation and lays the groundwork for future research aimed at creating more equitable, participatory decision-making processes, supported by digital tools.

Samenvatting

Al jarenlang wordt het burgerparticipatie concept uitgebreid besproken in de literatuur, al vanaf de eerste initiatieven voor democratische besluitvorming in de jaren 70. Traditionele participatiemethoden laten echter vaak moeilijk bereikbare en ondervertegenwoordigde groepen buiten beschouwing: de minderheidsgroepen. Hun behoeften en barrières worden onvoldoende begrepen en aangepakt. Hoewel digitale (AI) tools potentie hebben om inclusiviteit te vergroten, is dit potentieel in deze context nog onderbelicht.

Het doel van dit onderzoek is de verkenning van hoe huidige strategieën voor participatie kunnen worden verbeterd door middel van inclusieve processen en digitale tools, in het bijzonder met behulp van AI. Daarnaast presenteert deze studie een multi-perspectieve benadering om een basis te leggen voor inclusieve participatie, met concrete aanbevelingen en digitale oplossingen die gericht zijn op het versterken van alle groepen in de samenleving.

Daarom luidt de centrale onderzoeksvraag: “Hoe kunnen minderheidsgroepen worden geïntegreerd in burgerparticipatie voor besluitvorming over stedelijke interventies, door middel van inclusieve (AI) digitale tools en processen?” Deze vraag wordt ondersteund door acht deelvragen, die onderwerpen behandelen zoals burgerparticipatie, sociale inclusie, traditionele methoden, minderheidsgroepen en hun barrières, het potentieel van (AI) digitale tools, ontwerpvereisten, meningen van experts, en de implementatie van participatieprocessen en digitale tools met het oog op bruikbaarheid en inclusiviteit.

In dit onderzoek is gebruikgemaakt van de Design Science Research (DSR)- methodologie van Wieringa (2014), bestaande uit de volgende iteratieve fasen: 1) Probleemonderzoek, 2) Ontwerp van een oplossing, 2) Validatie van de oplossing. Deze fasen hebben geleid tot vier kerncomponenten: Meta Needs (MNs), Design Needs (DNs), Design Principles (DPs) en Functionele Eisen (FRs).

De literatuurstudie biedt een theoretische basis en geeft inzichten in de geschiedenis en doelen van burgerparticipatie, evenals de barrières die inwoners ondervinden. Deze groepen zijn geïdentificeerd als jongeren, immigranten, vluchtelingen, etnische minderheden, mensen met een lage sociaaleconomisch status of opleidingsniveau, ouderen, vrouwen, mensen met een beperking, laaggeletterden, en alleenstaanden. De literatuur wijst ook op de potentie van digitale tools om de drempel tot participatie te verlagen en een breder public te betrekken. Met name AI kan de burgerparticipatie verbeteren door de toegankelijkheid, inclusiviteit en communicatie te bevorderen via bijvoorbeeld chatbots, spraak ondersteuning, vereenvoudiging van tekst en personalisatie. Tegelijkertijd worden ook digitale barrières belicht, zoals ongelijke toegang, slechte vormgeving, lage digitale vaardigheden en belemmeringen zoals angst, stress en gebrek aan zelfvertrouwen.

Na het literatuuronderzoek werden semigestructureerde interviews afgenomen met 11 experts op verschillende gebieden, waaronder burgerparticipatie, human-computer-interaction, co-design, communicatie en sociale wetenschappen. Door middel van deze kwalitatieve methode, werden ervaringen en perspectieven verzameld. Thematische analyse van deze interviews bevestigde bekende participatie barrières (praktisch, persoonlijk, motiverend en sociaaleconomisch) en identificeerde aanvullende barrières, met name op

motiverend en sociaaleconomisch gebied. Deze omvatten: verschillende prioriteiten, geen sociale benadering van het gebruik van technologie, culturele verschillen, discriminatie, gebrek aan empowerment, andere definities van burgerschap en het gevoel niet waardevol/kundig genoeg te zijn. Hoewel experts het potentieel van AI-ondersteunende tools erkennen, benadrukten ze ook hun bezorgdheid over privacy, veiligheid en transparantie van gegevens. Ze benadrukten dat er geen pasklare oplossing is voor minderheidsgroepen, omdat ze allemaal andere behoeften hebben, en dat de oplossing voor uitsluiting niet alleen ligt in technologische innovatie, maar ook in (de kwaliteit van) het participatieproces zelf. Bovendien werd de vaak gebruikte “design-first, adapt-later” strategie bekritiseerd als ineffectief, omdat minderheidsgroepen vanaf het begin een participatieve aanpak op maat nodig hebben. De markeert het einde van het probleemonderzoek en resulteert in Meta Needs en Design Needs. Vervolgens werd in de fase van Validatie van de oplossing een workshop georganiseerd waarin de Meta Needs en Design Needs werden gevalideerd door een consortium van ongeveer 20 experts. Deze workshop toonde aan dat inclusieve participatie, het waarborgen van gebruikersbehoeften en het vergroten van relevantie het belangrijkst worden gevonden binnen de menselijke en sociale pijlers. Voor de politieke pijler hebben inclusieve besluitvorming en het waarborgen van vertrouwen en legitimiteit de hoogste prioriteit. Binnen de technologische pijler worden toegankelijkheid, bruikbaarheid en transparantie als het belangrijkst beschouwd.

In de Ontwerpfase van de oplossing werd input uit zowel de interviews als de workshop verwerkt tot zes ontwerpprincipes, ofwel, overkoepelende richtlijnen: 1) Principe van inclusieve bereikbaarheid, 2) Principe van versterkende betrokkenheid, 3) Principe van participatief co-design, 4) Principe van helderheid en eenvoud, 5) Principe van betrouwbare transparantie, en 6) Principe van adaptieve toegankelijkheid en functionaliteit. Deze principes leidden tot Functionele Eisen, die concrete technische vereisten specificeren voor participatietools en – processen. Deze vereisten zijn niet bedoeld als een strikte checklist, maar als richtlijn. Elk participatieproces, zijn context en belanghebbenden zijn immers anders.
Het uiteindelijke resultaat van deze studie is de co-design empowerment cycle – een raamwerk dat alle elementen samenbrengt in een cyclus van drie fasen die het ontwerp van een inclusieve tool en proces in samenwerking met minderheidsgroepen begeleiden. De fasen – Een vertrouwensband opbouwen, ervaring faciliteren, en het co-designen van een tool met de gebruiker – zijn geïnspireerd op de kennis die tijdens dit onderzoek is opgedaan en weerspiegelen het merendeel van de MNs, DNs, DPs, en FRs.

Deze studie kende enkele beperkingen, waaronder het ontbreken van directe input van minderheidsgroepen zelf, de generalisatie van diverse groepen tot één categorie, het uitsluiten van nieuw geïdentificeerde Meta Needs bij de ranking-oefening, en het ontbreken van validatie van de Citizen Participatie Cycle door tijdgebrek. Daarom moeten het voorgestelde raamwerk en de bevindingen als voorlopig worden beschouwd. Toekomstig onderzoek moet zich richten op directe betrokkenheid van specifieke minderheidsgroepen, validatie van het voorgestelde raamwerk in de praktijk, bredere expertbetrokkenheid, en verdere ontwikkeling en implementatie van AI-versterkte participatietools.

Tot slot biedt deze thesis waardevolle inzichten in de verkenning van inclusieve burgerparticipatie en legt het een basis voor toekomstig onderzoek naar meer rechtvaardige, participatieve besluitvormingsprocessen ondersteund door digitale technologieën.

Abstract

While citizen participation has been extensively discussed in research since the 1970s, traditional methods often fail to engage underrepresented, marginalized groups. Citizens can face a range of barriers, including practical, personal, motivational, and socio-economic issues, which have not been sufficiently addressed in participatory strategies. Although digital tools (especially those enhanced with artificial intelligence (AI)) offer potential to increase inclusivity, their application and research remain underexplored.

This thesis investigates how participatory strategies can be improved through inclusive participation processes and (AI-enhanced) digital tools. The Design Science Research (DSR) methodology is used, including three iterative phases: Problem Investigation, Treatment Design, and Treatment Validation. These phases led to the development of Meta Needs (MNs), Design Needs (DNs), Design Principles (DPs), and Functional Requirements (FRs).

The literature review offered a theoretical foundation and identified marginalized groups and overall barriers that citizens face in citizen participation. This was followed by a semi-structured interview with 11 experts from various domains. Experts confirmed marginalized groups, including youth, immigrants, refugees, ethnic minorities, individuals with lower socio-economic status or levels of education, the elderly, people with disabilities, and individuals with limited literacy. Additional motivational and socio-economic challenges were also revealed, such as cultural differences and a lack of empowerment. While the potential of (AI) digital tools was acknowledged, they emphasized their concerns regarding data privacy, security, and transparency. Moreover, there is not a single approach that works for every situation, and meaningful participation requires human-centered processes, rather than technological innovation only.

Following a workshop with 20 experts from academia, practice, and the municipality, needs were prioritized, and input for the development of six core DPs was gathered. These principles were translated into FRs and define specific, technical requirements for inclusive participation processes and tools. These include usability features and transparent communication mechanisms.

The outcome of the study is the co-design empowerment cycle. This framework consists of three phases: 1) Establishing a trusted relationship, 2) Facilitating experience, and 3) Co-designing the tool with users. This framework integrates and is inspired by the MNs, DNs, DPs, and FRs.

While the results are promising, limitations include a lack of direct input from marginalized groups and generalization due to the explorative nature of the study. Future research should therefore validate the framework in a real-world setting, and AI-enhanced tools should be further developed.

Key words: Citizen participation; Marginalized groups; Social Inclusion; Digital tools; AI-enhanced tools

List of Abbreviations

DPP Digital Participation Platform
ICT Information and communication technologies
AI Artificial Intelligence
LLM Large Language Models
NLP Natural Language Processing
HCI Human-computer interaction
DSR Design Science Research
MNs Meta Needs
DNs Design Needs
DPs Design Principles
FRs Functional Requirements

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1. Introduction

1.1 Problem Context

Urban development is a continuous process through which cities transform to create livable, equitable, and health-enhancing environments, guided by temporal and spatial actions across urban and architectural scales (Ataman & Tuncer, 2022).

The unequal access to opportunities and benefits of urban interventions highlights the foundational social and spatial inequalities among residents (Salmistu & Kotval, 2023). Discrimination like this often prevents marginalized groups from participating in and benefiting from initiatives that aim to foster healthy living and well-being in the urban environment.

Marginalized groups are described by the WHO as communities that, because of circumstances outside their influence, face unequal access to the opportunities and resources that privileged groups typically have (World Health Organization, n.d.). Building on this, a more extensive version is given by Kalliomäki et al. (2024): “Marginalized communities refer to those excluded from mainstream social, economic, educational, and/or cultural life, including (but not limited to) groups excluded due to race, religion, gender identity, sexual orientation, age, physical ability, language, and/or immigration status” (Kalliomäki et al., 2024 ; Baah et al., 2019). In various contexts, these populations are also referred to as “excluded”, “hard-to-reach”, “underrepresented”, or “minority” groups (Roberts, 2004 ; Li & Marsh, 2008 ; Pandya, 2012 ; Pateman et al., 2021). Despite differences in terminology, several common characteristics are emphasized by all: social exclusion (either socially, politically, culturally, or economically), limited opportunities to participate, and structural barriers. In the remainder of this thesis, the term *marginalized groups* will be used as an umbrella term to refer to these populations.

To address these inequalities, empowerment strategies are required that ensure a fair distribution of the benefits of spatial planning across all communities, ultimately enhancing inclusivity (Mouratidis, 2021 ; Baba et al., 2017)

Inclusive participation is increasingly regarded as essential to democratic processes, with researchers emphasizing the importance of integrating marginalized groups into decision-making processes (Bryson et al., 2013 ; Clark, 2018) . Citizen participation involves incorporating community interests, needs, and values into the decisions made by government agencies and private entities (Creighton, 2005). There is a growing recognition in urban design and planning that the participation process must actively address issues of diversity, equity, and inclusivity. It is argued that meaningful participation can only occur when all groups, including the marginalized, are allowed to express their views (Ataman et al., 2024). This emphasis on inclusive decision-making supports global initiatives such as the United Nations Sustainable Development Goals, which focus on reducing inequalities. In promoting inclusive urban development, there is a strong emphasis on ensuring that all voices, particularly those of marginalized communities, are heard and represented in urban development processes (United Nations, 2018).

In the field of urban interventions, digital tools play a crucial role in engaging marginalized communities and ensuring that their voices are heard in shaping urban environments

(Townley & Koop, 2024). Although these tools are being used more frequently and hold great promise for enhancing citizen participation, their functionality has yet to be fully explored (Shin et al., 2024). Furthermore, while a broad range of literature on participation models and methods exists, such as Arnstein's Ladder and the IAP2 Framework, there is a noticeable gap in research at the intersection of digital tools and inclusivity for marginalized groups.

As digital technologies evolve, Artificial Intelligence (AI)- enhanced tools have emerged as a promising development. AI could particularly be helpful in enhancing inclusive participation as it offers personalized, adaptive, responsive user experiences. While the implementation of AI is still in the early stages, there is growing recognition of its potential to enhance citizen experiences, especially through the use of chatbots and automated systems designed to better meet diverse needs (GovLoop, 2018). Despite this growing potential, there is limited literature on the role of AI-enhanced digital tools in this context, despite emerging studies suggesting their potential to facilitate more inclusive and accessible participation (Lahdili et al., 2024 ; Clarinval et al., 2024).

Consequently, this study aims to explore how inclusive citizen participation can be fostered by combining supportive engagement processes for marginalized groups with the use of AI-enhanced digital tools. By addressing the specific barriers these groups face, the research seeks to offer critical insights and practical recommendations for designing participation processes and digital tools that create a more empowering and accessible experience for all users.

1.2 Problem Statement

Marginalized groups are frequently excluded from meaningful participation in decision-making, despite the incorporation of digital tools in participatory planning processes. The needs and barriers these communities experience are frequently not sufficiently and adequately addressed by current participation frameworks and digital tools. As a result, social and spatial disparities persist. Despite the potential for personalization and increased user engagement, the impact of AI-enhanced digital tools in promoting inclusive participation is still little understood. Additionally, the literature available on insights into designing inclusive citizen participation processes is limited and should be addressed. This disparity emphasizes the pressing need to look into how (AI-) technologies may be used to develop participatory procedures that are both accessible and empowering for underrepresented groups. Moreover, the current participation processes should be studied to see how these can be improved.

1.3 Research Objective

This research investigates how public participation processes and (AI-enhanced) digital tools can be designed and implemented to foster the inclusion of marginalized groups into decision-making for urban interventions in the Netherlands. More specifically, this study aims to (i) identify the barriers that marginalized groups face, (ii) retrieve principles of inclusive participation, and (iii) examine how emerging digital technologies, especially AI-enhanced features, can support and strengthen these participatory processes. Using a multi-perspective approach that draws on insights from several fields, this research offers a bird's-eye view of current citizen participation practices. The findings are then translated into actionable recommendations for participatory planning approaches and digital solutions that are accessible and empowering for all community members.

1.4 Research Questions

This study aims at answering the following research question: *"How can marginalized groups be integrated into public participation for decision-making of urban interventions through inclusive (AI-enhanced) digital tools and processes?*

The following, corresponding sub-questions address sub-themes of the central research question:
Q1: What is public participation and what does social inclusivity mean in this context?
Q2: What are traditional methods of citizen participation?
Q3: Which marginalized groups are underrepresented in public participation for decision-making of urban interventions?
Q4: What challenges and barriers do marginalized groups face in (digital) participation?
Q5: What are digital tools, their functions, and what is the role and potential of Artificial Intelligence (AI)?
Q6: What are the critical design elements and features that are necessary for a citizen participation process and digital tool to be inclusive and effective?
Q7: What do stakeholders think of the conceptual needs for an inclusive citizen participation process and tool?
Q8: How can citizen participation processes and (AI-enhanced) digital tools be implemented for usability and inclusivity among marginalized groups?

1.5 Research Design

The research design outlines the structure of the thesis. This thesis follows the Design Science Research (DSR) methodology, with a focus on the engineering cycle outlined by Wieringa (2014). This research aims to establish meta needs (MNs), design needs (DNs), design principles (DPs), and functional requirements (FRs) for an inclusive participation process and tool, and evaluate those aimed at enhancing inclusivity in public participation processes, particularly for marginalized groups. These findings assist municipalities/planners/authorities, et cetera, in improving their participation processes. By applying the engineering cycle, this study creates an artifact, in this case, a more inclusive citizen participation process (and digital tool) - and evaluate its potential to address the challenges faced by marginalized groups in public decision-making.

Figure 1 displays the Research design stages of this thesis. The research is divided into three main stages based on both Wieringa's (2014) engineering cycle and Van Aken & Romme's (2009) design cycle. While the engineering cycle provides the overarching framework for the research, Van Aken & Romme's cycle informs the systematic review and research synthesis of the problem investigation phase. The phases are as follows:

1. Problem Investigation
2. Treatment Design
3. Treatment Validation
4. Treatment Implementation *(excluded from this research)*

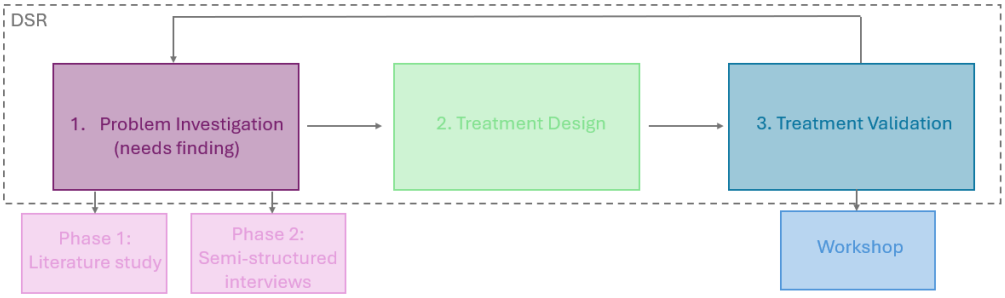

Figure 1: Research design stages (Author, 2025)

During the first phase (problem investigation), two parts are executed, namely, a literature study and the expert interviews. Key topics such as social inclusivity, AI and its potential and use, and the use of AI, and the role of digital tools in citizen participation processes are explored. The focus is also on understanding existing participation models, including Arnstein's Ladder and the IAP2 framework, and how AI-enhanced digital tools can potentially improve the inclusivity of citizen participation processes. This review aims to identify gaps in existing knowledge, clarify the definition of public participation and social inclusivity, define marginalized groups, and understand the barriers that they face when engaging (digitally) in citizen participation processes.

After the literature review, semi-structured interviews are conducted with a range of experts from various domains. These stakeholders include advisors on citizen and government participation, a district coordinator, academia in the field of social sciences, human-computer interaction, value co-creation, et cetera. The goal of these interviews is to confirm the key insights retrieved from literature and gain deeper insights regarding the practical challenges and barriers faced by marginalized groups in (digital) participation. The interviews address topics such as their experiences in (digital) citizen participation, the potential of AI-enhanced platforms, and the willingness of stakeholders to adopt such tools. Both the literature review and the interviews are used to retrieve preliminary Meta Needs and Design Needs.

Building on the insights from both the literature review and semi-structured interviews, the next phase, treatment design, focuses on the creation of Design Principles and Functional Requirements, both for an inclusive citizen participation process and a digital tool. These principles and requirements follow up on the needs identified during the problem investigation.

During the treatment validation phase, a workshop is organized to present the key insights retrieved from literature, the Meta Needs, and the Design Needs to a consortium of relevant stakeholders. These stakeholders include experts in the domains of information systems, architecture, urbanism, digital health, social geography, et cetera. The objective of the workshop is to gather feedback and validation directly from stakeholders on the proposed concepts.

The feedback gained during these workshops is used to refine needs and requirements, ensuring that they align with the needs and expectations of the stakeholders. This feedback allows adjustments to be made to the framework. Moreover, the experts provide additional input for the functional requirements. While the implementation phase is beyond the scope

of this research, the study systematically incorporates inputs from key stakeholders to validate and confirm the recommended features.

1.6 Relevance

1.6.1 Scientific Relevance

Public participation is a topic that has been extensively researched, yet critical gaps remain at the intersection of public participation, social inclusivity, and digital, emerging technologies, particularly artificial intelligence (AI). This thesis contributes to this emerging nexus by examining the perspective of both professional stakeholders and academia/researchers. It unites principles from participatory planning, socio-inclusion theory, and human-AI interaction to propose an integrated framework for AI-supported inclusive participation. Furthermore, the mixed-method approach adopted in this thesis provides fine-grained empirical evidence that is largely absent from current AI-participation literature. Finally, the research links concrete AI capabilities, such as adaptive language simplifications, sentiment-aware facilitation, and personalized feedback loops, to participation outcomes, delivering design principles that future studies can test and refine.

1.6.2 Social Relevance

This research benefits society by enhancing overall citizen participation and highlighting the importance of marginalized groups in society. It thereby strives to reduce inequality and enhance inclusivity. Moreover, local communities are empowered as the study promotes a more democratic approach to urban design and planning. By integrating marginalized groups, the decision-making process is enhanced, the needs of the community are addressed, and a more inclusive citizen participation process is achieved. This research's outcomes provide valuable insights into the understanding of effective engagement groups and how to involve them in (digital) citizen participation processes. Municipalities benefit from this as they gain insights into marginalized groups and how to increase their involvement in citizen participation.

1.6.3 Practical Relevance

Practically, this research offers an explorative analysis of the use of (AI-enhanced) digital tools in the citizen participation process. This addresses a gap in current literature and knowledge. The challenges and opportunities of AI tools are highlighted. By bridging the gap between theory and practice (insights from experts in various domains), this thesis offers valuable guidance for municipalities that want to enhance their citizen participation process (through digital tools). Moreover, the proposed prototype "Bestie", designed specifically for Best Municipality, demonstrates practical functionality and offers a concrete recommendation. Practical guidelines are included on designing inclusive participation processes and tools that foster more diverse participation.

1.7 Reading Guide

In Chapter 2, the theoretical framework is presented. This chapter includes the literature that serves as the foundation of this thesis. The context is drawn up through exploration of the history of citizen participation, its definition, traditional methods and their challenges, marginalized groups, the rise of digital participation, and AI-enhanced digital participation. Chapter 3 contains the Methodology, in which the methods used (literature, interviews,

workshop) are explained. The Problem Investigation follows in Chapter 4 under *"Understanding Meta and Design Needs for Inclusive Participation",* in which Meta Needs and Design Needs are created through the findings of the literature and refined through the interviews. Instead of presenting an individual Treatment Validation chapter, Chapter 4 also includes the validation of the MNs and DNs from the experts. This emphasizes that research is not a linear process and validation actually happens throughout the process. Chapter 5 presents the Treatment Design under *"Translating Needs into Design: Principles, Requirements, and System-Level Considerations)".* Chapter 6, *"Advancing Citizen Participation for Marginalized Groups"* is the pre-conclusion chapter in which various elements are tied together. The discussion and conclusion are presented in Chapter 7.

Figure 2 displays the Research Design based on these design stages.

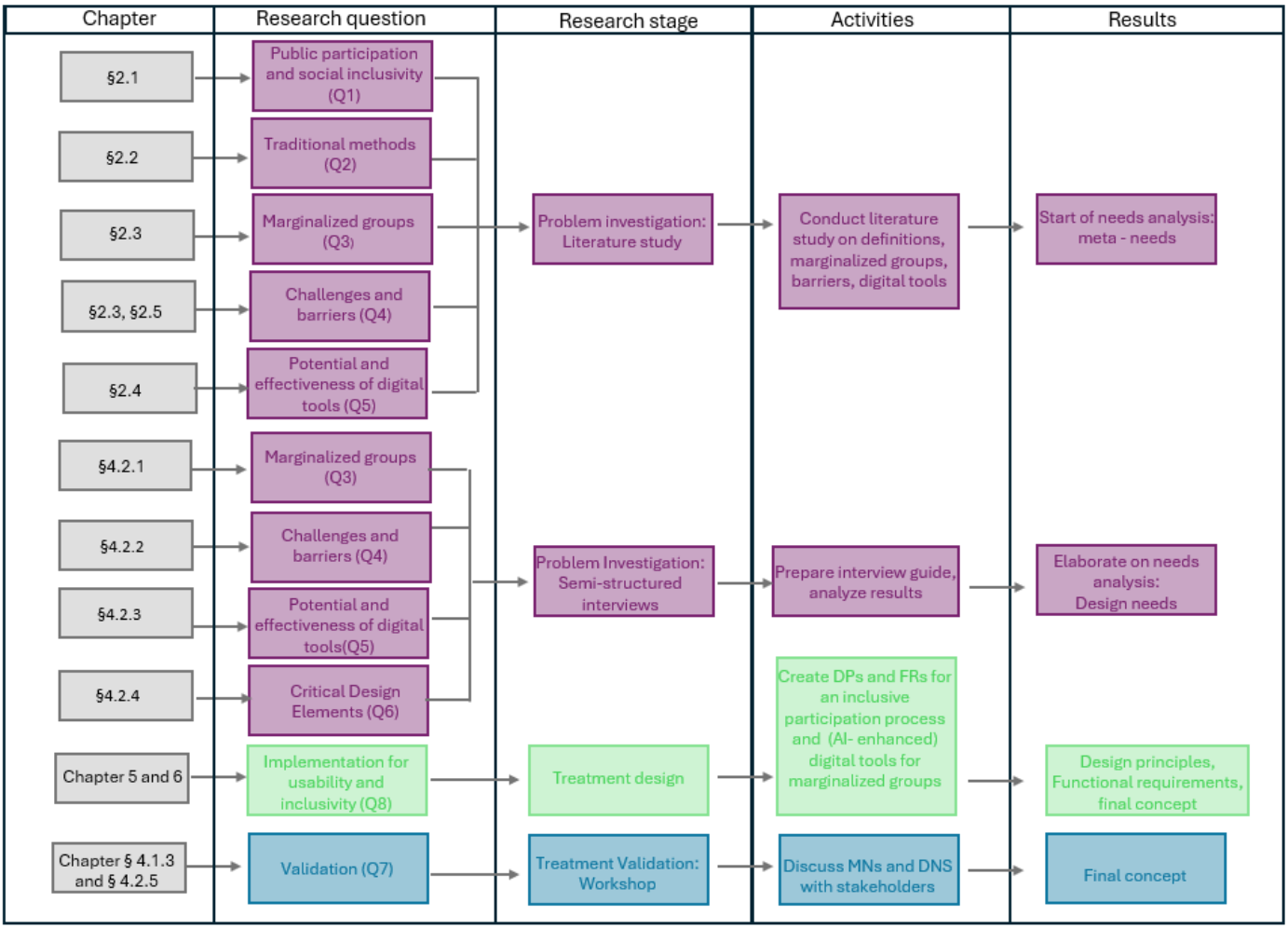

Figure 2: Research Design (Author, 2025)

2. Literature Review

This chapter includes a review of existing literature to serve as a foundation for developing an inclusive citizen participation process and tool. The examination of prior research provides an impression of the research done so far and identifies key concepts and gaps in the field. This literature review eventually guides the answering of the research (sub-) questions. Figure 3 displays the setup of the literature study, which is part 1 of the Problem Investigation.

2.1 Conceptual Foundation of Citizen Participation

This section discusses the definitions and frameworks of citizen participation, including Luyet et al.'s (2012) and Creighton's (2005) perspectives. It covers Arnstein's (1969) influential "ladder of participation" and Glass's (1979) core elements of participation to clarify involvement levels. The section also highlights the historical evolution towards a more inclusive and co-creative approach, both within the Dutch context and beyond.

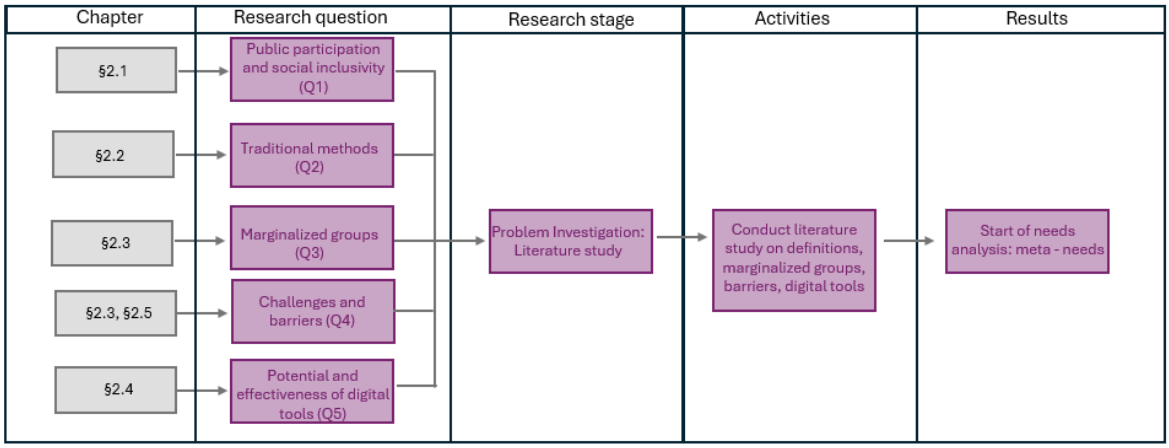

Figure 3: Problem investigation (needs finding) phase 1, Literature study (Author, 2025)

2.1.1 Definition of Citizen Participation and Theoretical Frameworks

Literature presents various definitions of participation. Luyet et al. define it as "A process through which stakeholders influence and share control over development initiatives and the decision and resources which affect them" (Luyet et al., 2012). Whereas Creighton defines participation as: "The process by which public concerns, needs, and values are incorporated into governmental and corporate decision-making" (Creighton, 2005, p. 7). The Dutch government describes it as "A method of policymaking in which residents, either individually or organized, directly or indirectly, are allowed to influence the preparation, implementation, or evaluation of policies" (Boogaard et al., 2024). These definitions highlight the public views in decision-making.

Arnstein's (1969) definition is highly influential, stating: "Citizen participation is a categorical term for citizen power. It is the redistribution of power that enables the have-not citizens, presently excluded from the political-economic processes, to be deliberately included in the future" (Arnstein, 1969, p.216). She emphasized active involvement, in which residents actively contribute from the start, not just after major decisions have been made (Arnstein, 1969).

Citizen participation gained attention in the 1960s and 70s (Reed, 2008). Activists like Jane Jacobs and Sherry Arnstein played key roles during this time. In her book (1961), Jacobs emphasizes the value of public participation in redevelopment projects by detailing a protest she took part in together with other citizens to oppose top-down urban planning (Jacobs, 1961 ; Verheul et al., 2021). She further stated that every individual has valuable knowledge about the community and, therefore, should be able to have a say in decisions that are taken about the urban environment (Jacobs, 1961).

Arnstein's "A Ladder of Citizen Participation" (1969) remains foundational (Verheul et al., 2021). She proposed to consider participation as a ladder, from non-participation (e.g. manipulation) to higher levels like partnership and citizen control, visualized in Figure 4. The lower steps represent tokenism. These levels give the impression of participation but fail to give citizens real power or influence over decisions (Arnstein, 1969). Similarly, the IAP2 Spectrum of Public Participation (IAP2, 2018) introduces five levels of engagement – inform, consult, involve, collaborate, and empower. These align with Arnstein's framework, with empowerment representing full citizen control and the highest degree of impact on the decision. Glass (1979) further supports this view by identifying five core elements of citizen participation: information exchange, education, support building, supplemental decision-making, and representational input (Glass, 1979). Together, these frameworks highlight the importance of empowering citizens to shape decisions that affect their lives.

While these frameworks highlight the potential for deeper citizen engagement, in practice, participation is usually initiated by the project proponent and typically involves three main stakeholders: the project initiator, local government, and residents (Verheul et al., 2021).

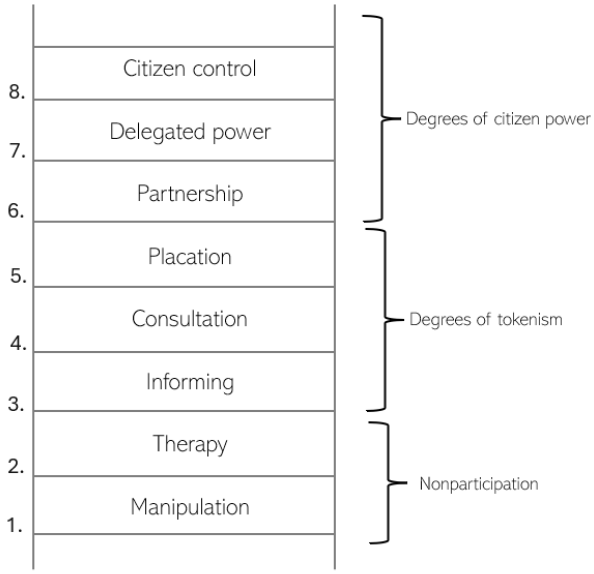

Figure 4: Eight levels on the Ladder of Citizen Participation (adapted from Arnstein, 1969)

2.1.2 Historical Overview and Evolution

In the Netherlands, democratic decision-making began in the 1970s, aligning with the principles articulated by Arnstein and Jacobs (Blom et al., 2010 ; Verheul et al., 2021; Chess & Purcell, 1999 ; Bosma, 2007 ; Denters & Klok, 2010). However, initial efforts to involve the public had already started during the 1960s, led predominantly by the "New Left" faction of

the Dutch Democrats, which aimed to actively promote citizen participation (Boonstra & Boelens, 2011).

Three generations of participation can be identified: 1) Consultation, 2) Interactive policy-making and co-production, and 3) Citizen initiative and facilitating government (Lenos et al., 2006 ; Boogaard et al., 2024). Table 1 displays these three generations.

Table 1: Three generations of participation (adapted from Lenos et al. (2006))

Generation	Type of participation	Period
1st generation	Consultation	1970-Present
2nd generation	Interactive policy-making and co-production	1990-Present
3rd generation	Bottom-up approach: Citizen take matters into their own hand	2000-Present

In the first generation, citizens' influence grew, leading to more outspoken participation (Lenos et al., 2006). In the 1970s, centralized planning was criticized for its top-down nature, and urban planners were seen as authoritative figures resisting input. As Verheul et al. (2021) explain, in response, participation became an integral part of urban planning through emerging democratic models. Drawing on the work of philosopher Habermas, the concept of "communicative action" is highlighted, stating decisions should be made through dialogue (Habermas, 1984). Despite these shifts, citizen participation remained limited to later stages, with most influence at lower levels of Arnstein's ladder (Denters & Klok, 2010).

In the second generation, while citizens participated earlier in policy-making via "interactive-policy" and co-production, final decisions were still made by the government. They were the ones deciding on the scope of the topics in which citizens may engage and through what level of influence they were permitted to have (Lenos et al., 2006 ; Hendriks & van de Wijdeven, 2013. The founding of IAP2 in 1990 and the Aarhus Convention in 1998 further emphasized citizen involvement, particularly in environmental matters (Buitelaar, 2023). During this time, participation was more and more seen as a norm (Reed, 2008).

The third generation is characterized by (informal) citizen initiatives (Blom et al., 2010 ; Hendriks & van de Wijdeven, 2013). This generation emphasized greater citizen involvement through co-creation (Verheul et al., 2021). Such interactive governance enabled citizens to participate and share their perspectives early on instead of at the end of the process (Denters & Klok, 2010 ; Edelenbos & Klijn, 2006). This shift places citizens in the lead, while the government steps back and participates as a partner rather than as an initiator. This model, known as "overheidsparticipatie" (government participation), shifted the control over shaping the content and guiding the process into the hands of the citizens (Berenschot & VNG, 2023 ; Hendriks & van de Wijdeven, 2013). In other words, this generation is characterized by inverted participation; citizens take charge (Hendriks & van de Wijdeven, 2013). Rather than relying on the government to take action, the community brings initiatives to life, fostering a more bottom-up, community-driven approach (Hendriks & van de Wijdeven, 2013).

The collaboration worked well and led to the foundation of the Environmental Planning Act in 2011, encouraging collaboration with residents and enabling initiators to come up with ideas

(Verheul et al., 2021 ; Buitelaar, 2023). Figure 5 displays a timeline of the history of citizen participation.

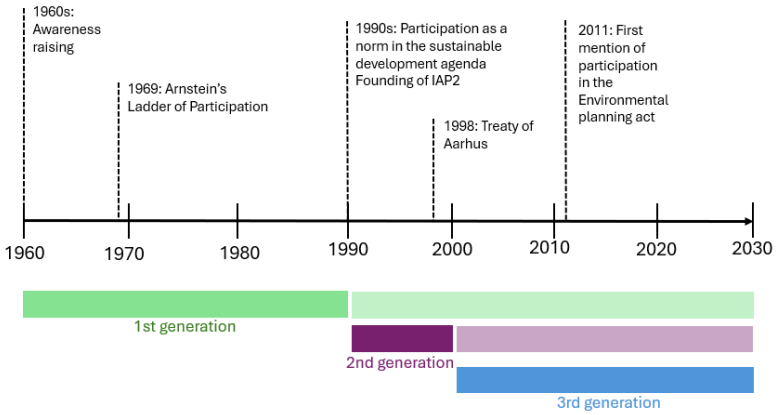

Figure 5: The history of citizen participation (Author, 2025)

Recently, public involvement in urban design and planning has become greater (Berenschot & VNG, 2023). This rise in citizen participation is driven by democratic principles, the need for transparent decision-making, and the recognition that unpopular policies can lead to protests and declining trust in authorities (Rowe & Frewer, 2013). This growing policy complexity and urban challenges require collaboration and behavioral change, making public involvement increasingly essential (Rowe & Frewer, 2013).

Building on this momentum, the concept of "do-it-yourself democracy" casts citizens as co-creators rather than passive participants. These self-organizing communities emphasize the responsibility of citizens in decision-making instead of relying solely on government actions (Verheul et al., 2021).

The digital age further facilitated the shift in public engagement by lowering barriers and streamlining participation processes (Majoor et al., 2017). In response, the Dutch government introduced the New Environmental and Planning Act (Omgevingswet) in January 2024. According to this act, active citizen participation is required in projects affecting their environment (Ministerie van Algemene Zaken, n.d.). The law obliges public participation and describes participation as "involving stakeholders early in the decision-making process for a project or activity" but allows flexibility in methods, tailored to each situation (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2021).

2.1.3 Benefits and Goals of Citizen Participation

Research by Beierle and Cayford (2002) revealed five goals of citizen participation. They reviewed 239 cases from the U.S. to assess how these goals impacted the quality of participation (Beierle & Cayford, 2002). Figure 6 shows the goals, with scores indicating whether the quality increased, decreased, or stayed the same. A high score suggests significant influence, a medium means limited impact, and a low means little to no impact. Table 2 presents a summary table of the goals of citizen participation as introduced by Beierle and Cayford (2002). Input for this table was also retrieved from Wabeke (2020).

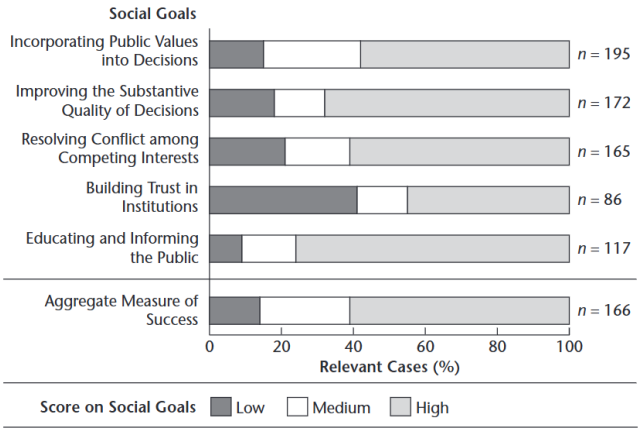

Figure 6: Social goals of citizen participation, in which n represents the number of cases. (Reprinted from Beierle & Cayford, 2002)

Table 2: Summary table of the goals of citizen participation (Author, 2025)

Goal	Description	Impact (High, Medium, Low)	Sources
Goal 1: Incorporation of Public Values into Decisions	Stakeholder participation helps incorporate diverse perspectives, well-supported data, a range of stakeholder interests, and local knowledge and experiences into decisions.	High: Significant influence on decisions	(Beierle & Cayford, 2002) (Luyet et al., 2012)
Goal 2: Improving the Substantive Quality of Decisions	Participation ensures decisions are cost-effective, accommodates diverse interests, and relies on strong information.	High: Improved decision quality	(Beierle & Cayford, 2002) (Creighton, 2005) (Wouters et al., 2011) (Luyet et al., 2012) (Reed, 2008)
Goal 3: Resolving Conflict among Competing Interests	Participation can help resolve conflicts by fostering trust, reducing tensions, and enhancing cooperation, although it may not solve all conflicts.	High: Conflict resolution	(Beierle & Cayford, 2002) (Creighton, 2005) (Reed, 2008)
Goal 4: Building Trust in Institutions	Participation fosters trust in public institutions by enhancing transparency and making sure opinions are heard	Medium: Minor improvement	(Beierle & Cayford, 2002) (Luyet et al., 2012) ; (Reed, 2008).
Goal 5: Educating and Informing the Public	Participation helps educate and inform the public, improving understanding and	High: Educating participants	(Beierle & Cayford, 2002) (Creighton, 2005) (Luyet et al., 2012) (Wouters et al., 2011)

	effectiveness in decision-making. Workshops and expert discussions also improve technical knowledge, credibility, and legitimacy		(Abas et al., 2023)

2.1.4 Definition of Social Inclusivity in the Context of Citizen Participation

Across various countries, individuals from different cultural, ethnic, and religious groups live together. However, such diversity can sometimes create tensions between groups, stemming from issues such as economic inequality, cultural differences, and social segregation. These challenges may contribute to the marginalization of certain groups, social exclusion (Nwachi, 2021). It is therefore important to involve citizens early on in the process. Encouraging citizen participation allows individuals and communities to voice their opinions and ensures socially inclusive projects.

The concept of social inclusion is described as: "The process of improving the terms on which individuals and groups take part in society – improving the ability, opportunity, and dignity of those disadvantaged based on their identity." (World Bank, 2013). In other words, it refers to ensuring that all citizens, particularly those from disadvantaged backgrounds, have the chance to fully engage in societal activities, including politics, culture, and the economy (Dugarova, 2015 ;Nwachi, 2021). This includes removing barriers to participation and making it easier for people to get involved. As highlighted by Bryson et al. (2013), one important design guideline for citizen participation is to use inclusive processes that engage diverse groups. By emphasizing inclusive participation, decision-making in urban design and planning can better support social inclusion and make sure everyone's voice is heard (Bryson et al., 2013).

This paragraph explored citizen participation, its definitions, and its evolutions through three generations – from consultation to citizen-led initiatives. Frameworks like Arnstein's ladder and the IAP2 Spectrum highlight varying levels of public influence. The goals of participation have been identified by Beierle & Cayford (2002). Growing urban challenges have increased the need for inclusive engagement, leading to policies like the Dutch Environmental and Planning Act (2024). Lastly, the section emphasized the role of participation in promoting social inclusivity and equitable decision-making.

2.2 Traditional Methods and their Challenges

This section discusses traditional methods based on their level of involvement, strengths, and limitations in fostering effective public participation.

2.2.1 Common Participation Methods

Various methods are designed to consult, involve, and inform citizens, giving them a voice in decisions that affect them. Methods like surveys and focus groups gather opinions, while others like citizens´ juries and consensus building involve citizens in decision-making (Rowe & Frewer, 2013 ; Shipley & Utz, 2012). These methods are categorized by the level of involvement, following Arnstein's Ladder (Luyet et al., 2012):

Information: Stakeholders are informed about the project.
Consultation: Feedback is collected, but the final decision may or may not incorporate it.
Collaboration: Feedback is considered in the final decision.
Co-decision: Stakeholders cooperate to reach an agreement.
Empowerment: Stakeholders have decision-making power.

Table 3 displays the degree of involvement per method, their key characteristics and considerations. This table is derived and adapted from Luyet et al (2012) and Petts and Leach (2000).

Petts and Leach (2000) introduce an additional categorization, the "levels of participation". These levels indicate the degree of innovation.

i)	Education and information provision	*Traditional*
ii)	Information and feedback	*Traditional*
iii)	Involvement and consultation	*Innovative consultative*
iv)	Extended involvement	*Innovative deliberative*

Another distinction is made between direct and indirect citizen involvement (Roberts, 2004). Direct involvement is when citizens engage personally, while indirect involvement is when they elect representatives.

Table 3: Selection of citizen participation methods and the type of involvement (Inspired by Luyet et al., 2012)

Methods	**Level of participation, direct or indirect**	**Information**	**Consultation**	**Collaboration**	**Co-decision**	**Empowerment**	**Key characteristics and considerations**	**Sources**
Public hearing/ meetings	Traditional, direct	X	X	X			- Open forum for feedback - No influence on the final decision - Potential for intimidation - Physical presence required	(Petts & Leach, 2000) (Rowe & Frewer, 2013) (Shipley & Utz, 2012) (Luyet et al., 2012)
Surveys	Traditional, direct	X	X	X			- Collect opinions via various formats - Can reach large, representative sample - Anonymous responses encourage honesty - Low response rates and changing opinions may hinder accuracy	(Petts & Leach, 2000) (Rowe & Frewer, 2013) (Luyet et al., 2012)

Citizen juries	Innovative deliberative, indirect		X	X	X	X	- Representative group discusses an issue with expert input - Informed decision-making - Chance to directly engage with experts - May lack diversity - Time-consuming process	(Petts & Leach, 2000) (Rowe & Frewer, 2013) (Shipley & Utz, 2012) (Luyet et al., 2012)
Consensus building	Innovative deliberative, indirect		X	X	X	X	- Participants represent different stakes and public perspectives - Discussions with experts - Time constraints - Exclusion of some interests	(Petts & Leach, 2000) (Rowe & Frewer, 2013) (Luyet et al., 2012)
Focus groups	Innovative consultative, direct			X	X	X	- Participants share perspectives on specific issues - Time-efficient - Limited in-depth exploration -May not represent the broader community	(Petts & Leach, 2000) (Rowe & Frewer, 2013) (Shipley & Utz, 2012) (Luyet et al., 2012)

2.2.2 Challenges and Limitations of Traditional Citizen Participation

Roberts (2004) outlines several issues of "direct" citizen participation (Roberts, 2004). Table 4 displays a summary of the key dilemmas related to citizen participation, which pose various challenges that hinder the effectiveness of participatory processes.

Table 4: Dilemmas identified in citizen participation

Dilemma	Description of the dilemma	Sources
The dilemma of size	Scaling direct democracy to larger populations, ensuring that everyone's voice is heard	(Roberts, 2004)
The dilemma of excluded or oppressed groups	Marginalized groups lack resources and face barriers to participation, leading to unequal representation and leading "usual suspects" (More outspoken individuals, available, and confident to give their opinion) (Bryson et al., 2013)	(Roberts, 2004) (Bryson et al., 2013) (Reed, 2008)
The dilemma of technology and expertise	Ordinary citizens feel overwhelmed by experts, leading to elite domination in participation processes and barriers.	(Roberts, 2004) (Petts & Leach, 2000) (Helleman et al., 2021)
The dilemma of time	Limited time for discussions causes fatigue and discourages participation.	(Roberts, 2004) (Petts & Leach, 2000) (Shipley & Utz, 2012) (Vroom, 2000)

		(Boonstra & Boelens, 2011)
The dilemma of trust	Lack of trust between citizens and the government undermines participation effectiveness.	(Walters et al., 2000) (Halvorsen, 2003) (Carreira et al., 2016) (Shipley & Utz, 2012) (Yu, 2023)
The dilemma of misunderstandings and frustrations	Differing expectations and frustrations among stakeholders can lead to disappointment and apathy.	(Fung, 2002)

The dilemma of size highlights the challenge of ensuring all voices are heard in large-scale direct democracy (Roberts, 2004). At the same time, marginalized groups, such as people from underrepresented ethnic backgrounds or lower-income groups frequently face challenges to participate due to a lack of time and resources (Roberts, 2004). The dilemma of technology and expertise arises from limited knowledge or experience, making ordinary citizens feel intimidated by experts and elites dominating (Roberts, 2004 ; Petts & Leach, 2000 ; Helleman et al., 2021). Additionally, participation takes a lot of time which can cause fatigue and disengagement, with many feeling it is not worth the effort (Roberts, 2004 ; Petts & Leach, 2000 ; Shipley & Utz, 2012 ; Vroom, 2000 ;Boonstra & Boelens, 2011). Moreover, there is a lack of trust between citizens and governments, which makes participation even more difficult. Adding to this, diverse expectations of stakeholders further enhance frustrations and apathy (Walters et al., 2000 ; Halvorsen, 2003 ; Carreira et al., 2016 ; Shipley & Utz, 2012 ; Yu, 2023). Addressing these dilemmas is key to creating inclusive and effective participatory processes.

In response to these challenges, there is an increasing need for innovative approaches that foster trust and mutual understanding among all stakeholders. These approaches can help overcome the limitations of traditional methods by promoting more effective, inclusive, and engaging participation processes (Ataman et al., 2024).

This section discusses various traditional methods of citizen participation, categorizing them by levels of involvement, from simply informing stakeholders to empowering them with decision-making power. However, traditional participation methods face several challenges, including issues of scale, exclusion of marginalized groups, expert dominance, time constraints, and lack of trust. Addressing these dilemmas is crucial to improving the effectiveness and inclusivity of participatory processes.

2.3 Marginalized Groups and (In) Equity in Citizen Participation

In order to design urban interventions that effectively address the needs of marginalized groups, it is crucial to understand them. By identifying these groups and their challenges, interventions can be better tailored for inclusivity and effectiveness. This section explores the concept of marginalized groups and their barriers.

2.3.1 Defining Marginalized Groups

The COVID-19 pandemic has intensified social and economic disparities by disproportionately affecting marginalized groups. This further highlights their vulnerability to social injustices and discrimination (United Nations, 2020 ; Pérez-Escolar & Canet, 2023). Because of a range of

factors – including culture, class, religion, and race – many citizens face challenges related to social and economic inequalities (Pérez-Escolar & Canet, 2023). The urgency of addressing this problem is underscored by Goal 10 of the United Nations Sustainable Development Goals (SDGs), highlighting how significant researching marginalized people is (United Nations, 2018). Such research is essential to eventually work towards a more equal society.

According to the WHO, marginalized people are those who "due to factors usually considered outside their control, do not have the same opportunities as other, more fortunate groups in society" (World Health Organization, n.d.). Building on this, a more extensive definition is given by Kalliomäki et al. (2024): "Marginalized communities refer to those excluded from mainstream social, economic, educational, and/or cultural life, including (but not limited to) groups excluded due to race, religion, gender identity, sexual orientation, age, physical ability, language, and/or immigration status" (Kalliomäki et al., 2024 ;Baah et al., 2019). This prevents them from fully participating and engaging in decisions regarding their living environments, as they are usually referred to as hard-to-reach groups for local participation events (Lightbody, 2017). The term hard-to-reach refers to population segments that are challenging to involve in research, often because of their life situations (e.g. drug use, mental problems, migrants), or through deliberately distancing themselves from mainstream society for any reason (Chamberlain & Hodgetts, 2018). These groups are underrepresented in literature research and often misunderstood (Bonevski et al., 2021). The groups are considered hard to reach due to several factors. These factors can include gender geographical location, their socio-economic status, race, age or experiences of discrimination (Lightbody, 2017) ; Pérez-Escolar & Canet, 2023) Such imbalances can worsen social and spatial inequalities in cities when these groups are continued to be overlooked.

Other studies also refer to these populations as "excluded", "oppressed", "non-participants", "underrepresented", or "minority" groups (Roberts, 2004 ;Li & Marsh, 2008 ;Pandya, 2012 ;Pateman et al., 2021). While the terminology varies, these concepts share key elements: social exclusion (either socially, politically, culturally, or economically), limited opportunities to participate, and structural barriers. In the remainder of this thesis, these populations will be referred to as *marginalized groups.*

Roberts (2004) already highlighted the challenge of excluded or oppressed groups in citizen participation. This concern has also gained increasing attention in the field of STI (Science, Technology, and Innovation) (Kalliomäki et al., 2024). According to Fung (2015), participatory governance mechanisms often lead to inequitable outcomes when certain groups exert disproportionate power to influence policies and decisions. These injustices often arise from the overrepresentation and influence of minority groups, such as wealthy elites (Fung, 2015).

Empowering marginalized groups to engage and participate in decision-making processes actively is essential for addressing systematic barriers. However, research highlights that involving vulnerable populations in co-design and decision-making remains challenging, especially when using face-to-face interactions and more traditional citizen engagement methods. Digitalization offers alternative ways to engage more citizens, providing a more inclusive process and online opportunities (Ataman & Tuncer, 2022).

2.3.2 Participant Types in Decision-making

As highlighted previously, the empowerment of marginalized groups to overcome participation barriers is essential for fostering a more inclusive decision-making process. These groups often face systematic challenges that hinder their engagement, making it crucial to identify who they are and understand the factors contributing to their exclusion.

Taking various categories of citizens into account, as well as their roles, is important. One way to categorize citizens is in the following three groups: active, standby (or monitor), and passive citizens (Carreira et al., 2016).

- *Active Citizens (engaged citizens)* are those who engage directly in their communities. Their active participation in decision-making helps to shape public policy.
- *Passive Citizens (disengaged citizens),* on the other hand, are disengaged from public life. They do not participate in decision-making processes and do not feel a connection to societal issues.
- *Standby* or *Monitor Citizens* will stay informed about what is going on in their society and are prepared to participate when necessary. Other than that, they are not actively involved.

In the broader context, the citizens consist of engaged (active) and disengaged (passive) citizens (Agger, 2012). However, this research emphasizes the *non-participants*, who are part of the disengaged citizens. They are typically the most marginalized groups (Li & Marsh, 2008). These individuals often face the highest barriers to engagement. These barriers will be touched upon later.

Engaged (active) citizens: Political activists, expert citizens, everyday makers, social entrepreneurs

Within the broader category of engaged citizens, there are various levels: political activists, expert citizens, and everyday makers (Li & Marsh, 2008 ; Bang, 2004). The sub-category of social entrepreneurs is added by other research (Agger, 2012 ; Thompson, 2002).

Political activists, as defined by Li and Marsh (2008), actively participate in political organizations or trade unions and are typically highly educated and part of the elite. Expert citizens, identified by both Bang (2004), Bang (2009), and Li and Marsh (2008), are familiar with politics and participate in full-time professional or societal organizations. With a strong belief in their abilities, they aim to use their political knowledge to influence other individuals (Bang, 2009). Everyday makers, in contrast, engage in local projects that align with their daily lives and are driven by personal development. They are not typically members of political organizations (Bang, 2004 ; Bang, 2009 ; Li & Marsh, 2008 ; Agger, 2012). Both everyday makers and expert citizens are concerned for society, want to make a difference, and reflect a shift in participation, namely away from the traditional framework (Bang, 2009). Social entrepreneurs, motivated by personal goals, focus on addressing community needs and creating networks for social projects. They are deeply committed to helping others and are primarily driven by personal reasons. As a result, they tend to associate with voluntary projects (Agger, 2012 ; Thompson, 2002).

Disengaged citizens

Besides the non-participants, Agger (2012) adds more levels to the disengaged (passive) groups of citizens: the monitorial citizens and the young citizens. These individuals are interested in politics and generally trust the political system in place. However, they do not engage in regular political activities due to time and energy constraints. Instead, they intervene only when they feel it is really necessary. On the other hand, the youth is not interested in so-called "conventional politics" and feels disconnected from traditional methods of politics (Agger, 2012). Other literature sources define youth as non-participants. For this reason, they are also mentioned in the next category.

Non-participants (marginalized groups)

Non-participants, as identified by Li and Marsh (2008), are those who do not participate at all. These individuals often belong to marginalized groups, which are considered to be disadvantaged and vulnerable (Barendregt et al., 2024). Referring back to the dilemma of excluded groups, these disadvantaged groups are systematically excluded from participation or just often dismissed (Roberts, 2004 ; Barendregt et al., 2024). Part of these marginalized groups are youth, immigrants, low socio-economic groups (low-income groups, the unemployed and working-class individuals), lower-educated individuals, women, non-married individuals, the elderly, people with disabilities, and people who have low basic skills.

Initially, immigrants were expected to work only, but their political representation has since gained importance, especially at the local level. Successful integration depends on their active participation, mobilization, and representation (Martiniello, 2006). Low socio-economic groups and low-income groups, including the unemployed and working-class individuals, prioritize providing for their families over engaging in the decision-making process (Irvin & Stansbury, 2004 ; Barendregt et al., 2024 ; Li & Marsh, 2008 ; Pandya, 2012; Evans et al., 2005). Similarly, lower-educated individuals are underrepresented, as education is intertwined with race, income, and gender (Bovens & Wille, 2010).

Other excluded groups include non-married individuals, the elderly, and people with disabilities, who face physical and confidence barriers (Lightbody, 2017 ; Townley & Koop, 2024). Poorly designed digital resources further hinder the participation of people with disabilities (Townley & Koop, 2024).

Lastly, people who have poor basic skills (reading and writing) or those who do not have enough confidence in this, also tend to be part of marginalized groups who struggle with digital skills, access, and motivation to engage in online participation (Townley & Koop, 2024 ; Smit et al., 2024). In the Netherlands, most low-literate individuals (65%) are native Dutch speakers, while others are immigrants (Huis voor Taal & Meedoen, n.d.).

Combining several papers, Table 5 displays the engaged (active) citizens and disengaged citizens and their characteristics. The first part of the table, the engaged (active) citizens has been retrieved and adjusted from Den Boer (2022).

Table 5: Types of engaged (active) citizens, and disengaged citizens and their characteristics. (First part of the table (engaged (active) citizens) adapted from Den Boer, 2022)

Engaged (active) citizens	**Characteristics**	**Sources**
Political activists	- Directly engage in political organizations or trade unions - Male - Tend to be part of the elite - Married, service class jobs, high education	(Li & Marsh, 2008)
Expert citizens	- Act as leaders - Want to influence others - Expertise in politics - Often involved in professional or societal organizations - Broad understanding of political participation - Full-time participant - Predominantly male, well-educated, and in service-related roles	(Li & Marsh, 2008) (Bang, 2004) (Bang, 2009) (Agger, 2012)
Everyday makers	- Not typically a member of political organizations - Community engaged - Think globally, but prefer engaging in local projects that fit their daily life - Driven by self-development - Strong, self-reliant, capable individual - Part-time participant - Participate when needed - Often female, not married, and younger than expert	(Li & Marsh, 2008) (Bang, 2004) (Bang, 2009) (Agger, 2012)
Social entrepreneurs	- Builds networks and identifies community needs - Driven by personal reasons - Actively engage in social projects - Builds networks and social capital - Motivates others - Strong listening ability - “Voice of the community” - Strong commitment to help others	(Agger, 2012) (Thompson, 2002)

	- From diverse ages and backgrounds - Associate with voluntary projects mostly	
Disengaged	**Characteristics**	**Sources**
Monitorial citizens	- Interested in politics - Trust the political system - Only participate when necessary - Limited time and energy available - Well-educated	(Agger, 2012) (Hustinx et al., 2012)
Young citizens	- 16-24 years old - Disinterested - Unattracted to traditional participation forms	(Agger, 2012)
	Groups	**Sources**
Non-participants (Marginalized groups	- Youth - Immigrants, refugees, ethnic minorities - Lower socio-economic status, e.g. people who are unemployed or belong to the working class - Lower level of education - Elderly	(Barendregt et al., 2024) (Li & Marsh, 2008) (Lightbody, 2017) (Checkoway et al., 2005) (Roberts, 2004) (Barendregt et al., 2024) (Li & Marsh, 2008) (Lightbody, 2017) (Martiniello, 2006) (Roberts, 2004) (Pateman et al., 2021) (Lightbody, 2017) (Irvin & Stansbury, 2004) (Townley & Koop, 2024) (Barendregt et al., 2024) (Roberts, 2004) (Li & Marsh, 2008) (Evans et al., 2005) (Pandya, 2012) (Li & Marsh, 2008) (Bovens & Wille, 2010) (Lightbody, 2017) (Roberts, 2004) (Townley & Koop, 2024) (Barendregt et al., 2024)

	- Women	(Li & Marsh, 2008) (Lightbody, 2017) (Pateman et al., 2021)
	- Once married or never married	(Li & Marsh, 2008)
	- People with disabilities	(Lightbody, 2017) (Townley & Koop, 2024)
	- People who have difficulties reading and/or writing	(Townley & Koop, 2024) (Smit et al., 2024)

This section explored the different groups in citizen participation, which can be defined as engaged (active) citizens and disengaged (passive) citizens. The first group consists of political activists, expert citizens, everyday makers, and social entrepreneurs. The disengaged citizens consist of monitorial citizens, youth, and non-participants. This last category has been discussed further as this group corresponds to the marginalized groups, the focus of this research. These groups face systemic barriers, including socio-economic status, education, ethnicity, disability, and digital accessibility, contributing to inequalities in health and engagement. Understanding the distinctions between the groups is crucial for developing inclusive strategies that empower marginalized groups, address systemic barriers, and promote equal participation.

2.4 Rise of Digital Participation

There has been a substantial shift towards digital technologies in recent years, deeply influencing their use and adoption across various fields, a transition further accelerated by the COVID-19 pandemic. As a result of the pandemic, the incorporation of technologies such as Artificial Intelligence (AI) and the Internet of Things (IoT), and other tools aiming to enhance digital lives has increased. The same holds for digital participation (Bricout et al., 2021). Digital participation involves the engagement of individuals, groups, and organizations in activities and interactions facilitated by digital technologies and online platforms.

To address the challenges and limitations of traditional citizen participation methods, new approaches have been explored to improve the ways urban practitioners and community members engage, communicate, and work together throughout the planning process (Kleinhans & Falco, 2022). In contrast to traditional methods, these new approaches emphasize equal involvement of citizens, thus promoting inclusivity (Kleinhans & Falco, 2022). Figure 7 displays the timeline shown earlier with additional components of digital developments.

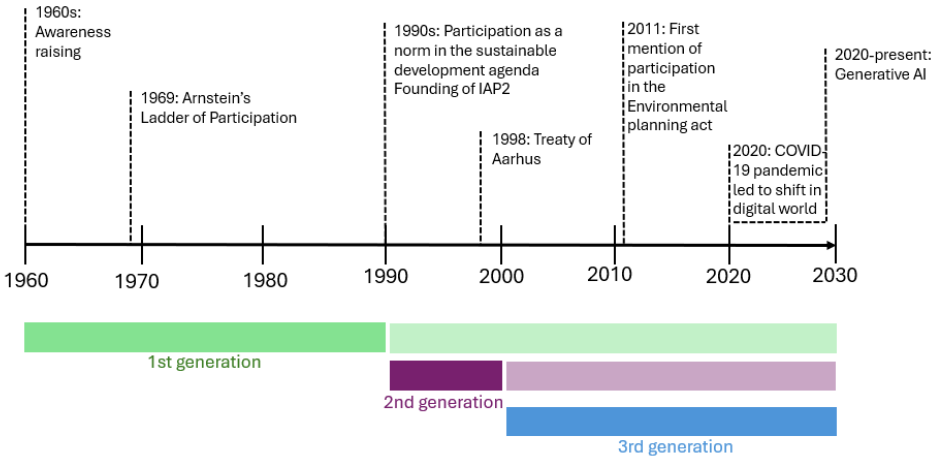

Figure 7: Addition of digital development to the timeline of citizen participation (Author, 2025)

2.4.1 Overview and Potential of Digital Participation

The Netherlands stands out as one of the EU leaders in digitalization (Digital Economy and Society Index, 2022 ; Smit et al., 2024). As digital tools become more common, they offer significant advantages in citizen participation. These tools, ranging from social media to specialized e-participation platforms, provide opportunities for authorities and communities to interact in a more efficient way. These include an efficient flow of information sharing, public consultations, collaborative decision-making, and problem-solving (Ataman & Tuncer, 2022 ; Linders, 2012 ; Falco, 2016). All these options enhance a more inclusive and dynamic way of collaboration between citizens and authorities (Linders, 2012). Moreover, through digital engagement, citizens are empowered, participation rates increase, and the feedback mechanism is improved (Falco, 2016).

One key advantage of digital participation is the reduction of barriers to participation. This reduction enhances greater inclusivity by simplifying citizens' involvement in the decision-making process (Townley & Koop, 2024). Digital tools also provide flexibility. Information can be presented in various formats that speak to the public. Interactive elements can be added as well, engaging participation even more (Townley & Koop, 2024). Regarding literacy, digital tools can incorporate alternative communication methods, such as emoticons or GIFS, which have the potential to simplify participation for individuals with lower literacy skills (Smit et al., 2024).

Moreover, digital participation removes physical and social barriers that often exist with traditional forms of participation (Bastien et al., 2020 ; Pflughoeft & Schneider, 2020). One significant advantage of online participation is the more private setting, reducing social pressure (Zheng & Schachter, 2017). In physical meetings, participants might hesitate to express their opinion due to fear of judgment. This is also relevant for individuals from marginalized groups. With this lower social pressure of an online environment, people might feel more comfortable taking part and expressing their views. This increases the overall participation (Zheng & Schachter, 2017). Zheng & Schachter (2017), further emphasize that engaging with the government through online participation can help strengthen citizen's trust in public institutions. Building on this, new methods of digital citizen participation lead to higher satisfaction among citizens, foster a stronger sense of social commitment, enhance

empowerment, and provide personal benefits (Zheng & Schachter, 2017 ; Millard et al., 2009 ; Ju et al., 2019).

In summary, the use of ICT for citizen empowerment provides opportunities for more active and inclusive participation. By lowering the threshold for involvement, digital tools help ensure a broader public with their views, ideas, and concerns (Falco, 2016).

2.4.2 Functions of Digital Tools

This thesis argues that digital tools have the potential to enhance the inclusion of marginalized groups in participatory processes. Shin introduces a "new generation" of digital participation, distinguishing three key categories: I) human-human interaction, II) human-machine interaction, and III) artificial intelligence (AI). Based on their literature research, Shin et al. (2024) identify 19 functions associated with these categories, which can be observed in Table 6.

The first category, human-human communication, forms the foundation of digital participation by enabling activities such as information sharing, communication, and supporting collaborative decision-making. Human-machine interaction, the second category within information and communication technology (ICT), is a growing field that facilitates communication between people and machines. This interaction expands how people can engage with digital platforms and technologies. Lastly, AI functions (the focus of this research) serve as a bridge to link both human-human and human-machine interactions (Shin et al., 2024).

Table 6: Functions of digital tools (adapted from Shin et al., 2024)

Function category		**Description**
i) Human-Human interactions	- Donation	A feature that enables users to donate real money to an organization
	- Gamification	The addition of game-like features to the tool to encourage users to engage.
	- Geographical Information System (GIS)	A system for storing, analyzing, and visualizing geographic data
	- “Like”-function	Function to comment likes and dislikes
	- Multi-criteria decision-making	Methods used to evaluate and choose between different options in decision-making
	- Open suggestions	Function that enables users to share written feedback, thoughts, or recommendations
	- Real-time communication	Software such as chat, video calls, file sharing, and screen sharing that allows people to communicate over long distances

	- Survey/Poll/questionnaires	A simple method to gather opinions from a group of people
	- Voting	Function to collect opinions
ii) Human-machine interaction	- 3D modelling	Creating 3D representations that can be used to simulate scenarios and compare them
	- Augmented reality (AR)	A technology that adds virtual elements to the real world in real-time
	- Virtual reality (VR)	A fully immersive technology that takes users into a completely virtual world
iii) Artificial intelligence	- Categorization	Sorting data into categories. This includes *classification*, where data is organized based on prior training, and *clustering*, where data is grouped by similarities without guidance.
	- Computer vision	The ability of computers to understand and interpret images or videos
	- Data mining	Branch of data analysis that focuses on extracting valuable insights from large datasets
	- Multi-language support	Automatic translation of text.
	- Natural language processing (NLP)	A field where machines are used to understand, interpret, and generate human language. NLP includes tasks like speech recognition, and generating text
	- Speech recognition	Transformation of spoken language into written text
	- Swarm intelligence	Helps tackle problems by using groups of agents. These agents follow basic rules and interact with each other

Previous research on the perspectives on digital tools revealed the features most people prefer according to a survey among 260 respondents. These essential features on platforms are: voting (23%), ranking options (16%), interacting on a map (16%), open-ended questions (15%), uploading pictures related to issues (10%), interact with 3D environment (8%), storytelling (6%), uploading videos (5%) and audio recordings (1%) (Gonçalves et al., 2024).

Examples of digital tools

Table 7 displays the digital tools identified in the literature (Shin et al., 2024 ; Stelzle & Noennig, 2019 ; Townley & Koop, 2024). Similar to the conventional methods, these digital tools are

categorized based on their extent of involvement according to Arnstein's ladder and defined by Luyet et al. (2012).

Table 7: Categorization according to Luyet et al. (2012) of digital tools (Author, 2025)

Methods	Information	Consultation	Collaboration	Co-decision	Empowerment
1. Online website	X				
2. Mail/Newsletter	X				
3. Blog	X	X			
4. Mobile Apps	X	X	X		
5. Social media	X	X	X		
6. Online focus group		X	X	X	
7. Online Forum		X	X		
8. Online consultation procedure		X	X		
9. Crowd-source mapping tools		X	X		
10. Interactive and place-based survey tools		X			
11. Consensus building or collaborative action tools		X	X	X	X
12. Analytical tools	X	X			
13. Co-funding tools				X	X
14. Decision-making tools			X	X	X

The first eight categories are relatively familiar, and their roles in facilitating participation are generally well-established. The remaining five categories represent types of digital tools based on clusters identified by Shin et al. (2024) based on their similar functions.

Shin and colleagues conducted a clustering analysis of 116 digital tools, identifying three main clusters that provide fresh insights into the digital participation landscape. The clusters are the following: problem and solution identification, drafting and decision-making, and specialized decision-making tools. These tools are categorized based on the specific ways they facilitate citizen engagement and decision-making (Shin et al., 2024).

These platforms fall under the broader term of Digital Participation Platforms (DPPs). DPPs provide the possibility to reach a large audience through an online environment. Such platforms specifically aim at facilitating participation, engagement, and collaboration. Research states 113 DPPs all over the world, which are categorized on various levels of citizen-government relationship (informing, consulting, interaction, co-production, and self-organization) (Falco & Kleinhans, 2018). Generally, one could summarize the levels in: informing (from government to citizens), dialogue (between government and citizens), and collaboration (Bono Rossello et al., 2025). This thesis focuses on collaboration and co-creation through digital decision-making platforms and tools. Such platforms enable citizens to express

their preferences and co-create solutions. Co-creative features can include rankings, conducting surveys, and offering interactive maps where citizens can contribute input by placing pins (Falco & Kleinhans, 2018).

2.4.3 Marginalized Groups in Digital Inclusion and Factors Behind Their Vulnerability

As previously mentioned, citizens in participation can be categorized into three groups: engaged (active), disengaged, and non-participants. The non-participating groups are often referred to as marginalized and vulnerable. While some of these groups are already recognized as marginalized in various contexts, research specifically focusing on digital inclusion highlights certain populations that are most at risk of exclusion in the digital context. A study analyzing 331 publications on digital inclusion (Pérez-Escolar & Canet, 2023) identifies the elderly (32,56%), individuals with disabilities (20%), and low-income groups (18,14%) as the most vulnerable and likely to face marginalization in the digital context.

The same research also highlights the factors responsible for the vulnerability of these groups in the digital context. They define five factors influencing the vulnerability. These factors include gender, geographical location, race, poverty, education, personal limitations, and age.

The first factor is gender, with women facing more barriers to digital engagement (Pérez-Escolar & Canet, 2023 ; Tyers-Chowdhury & Binder, 2021 ; Van Dijk, 2017).

The second factor contributing to digital exclusion involves geographical location and race, particularly affecting individuals living in rural areas or developing countries. These groups often face limited access to digital infrastructure and may lack the necessary skills to engage online. This makes them more likely to experience digital exclusion (Pérez-Escolar & Canet, 2023 ;Van Dijk, 2017).

The third factor is poverty and education. Low income is often tied to lower educational levels, which, in turn, contributes to multiple vulnerabilities (Van Dijk, 2017). These include challenges in engaging with ICTs (Pérez-Escolar & Canet, 2023).

The fourth factor relates to personal limitations, such as physical or cognitive impairments. These make digital engagement more difficult for individuals with disabilities (Pérez-Escolar & Canet, 2023; Townley & Koop, 2024 ; Van Dijk, 2017). Finally, age is another significant source of hindrance, especially for older adults (Pérez-Escolar & Canet, 2023)

This section reveals that digital participation has emerged as a valuable tool in enhancing citizen engagement. It highlights the benefits of digital participation, such as increased inclusivity, flexibility, and empowerment. This section, however, also includes issues related to socioeconomic status, education, disability, and digital accessibility. The need to focus on tools that empower these vulnerable populations is emphasized.

2.5 AI-enhanced Digital Participation

This section explores the potential of Artificial Intelligence (AI) and discusses the issues that need to be addressed for AI to be fully effective in fostering inclusive digital platforms.

2.5.1 Role of AI in Improving Inclusivity

A relatively recent development in digital participation is the potential inclusion of AI-related features. The use of AI in citizen participation is defined as "the application of AI techniques in governance systems, and communication between policy actors and stakeholders in the process of policymaking." (Lahdili et al., 2024). AI's role in citizen participation can be divided into two key areas: 1) AI-enhanced tools for enhancing digital participation and 2) AI-enhanced data analysis (post-participation). These improvements make it easier for marginalized groups to participate, improve communication between citizens and governments, and support better decision-making based on data.

AI-enhanced Tools for Enhancing Digital Participation

AI-enhanced tools play a crucial role in empowering marginalized groups as they can break down barriers and enhance accessibility. Advanced participation tools that include features like chatbots, voice assistants, and automated translation services, supported by machine learning algorithms for natural language processing and personalized assistance, provide several benefits for digital participation.

Firstly, they present human-centered benefits such as reduced accessibility barriers and personalization (Vasilakopoulos et al., 2024 ; Lahdili et al., 2024). By providing personalized support, such as AI-enhanced text-to-speech or speech-to-text features, accessibility is enhanced (Eziamaka et al., 2024). This is especially important for people with disabilities, who have conditions like visual or hearing impairments or a lack of basic skills (low literacy).

Moreover, through AI technologies and diverse applications like chatbots, participants can express their concerns, interests, and opinions (Lahdili et al., 2024). Such chatbots enhance communication between citizens and governments by facilitating a dialogue and direct consultation at any time. This helps acknowledge participants, increases their confidence, and reduces discomfort (Lahdili et al., 2024). Eventually, this will increase trust in the government as participants feel like they are valuable and being taken seriously.

In addition to enhancing accessibility, AI-enhanced technologies promote diversity, openness, and engagement (Lahdili et al., 2024). AI-enhanced tools provide intelligent systems that adapt to the needs and preferences of citizens, such as different learning styles. This improves inclusivity in digital engagement (Vasilakopoulos et al., 2024). Furthermore, AI technologies enhance motivation by offering personalized recommendations and content that align with individual preferences (Vasilakopoulos et al., 2024).

Another key advantage of AI is its ability to facilitate multilingual and multicultural participation. AI-enhanced translation tools ensure that language barriers do not hinder the involvement of diverse populations. AI's ability to adapt to cultural contexts fosters more inclusive engagement. AI also democratizes expertise by simplifying complex technical or policy content, making it more accessible to a broader audience and enabling citizens without specialized knowledge to engage meaningfully in policymaking.

AI tools further support inclusivity in content creation by identifying and addressing gaps, ensuring that underrepresented voices are included and that the platform reflects a diverse range of perspectives (Vasilakopoulos et al., 2024). This makes the digital participation process

more open, equitable, and effective. This strengthens the communication between citizens and government institutions (Lahdili et al., 2024).

Through these capabilities, AI not only improves accessibility and inclusivity but also strengthens the overall engagement process, ensuring a more open, equitable, and effective digital participation experience.

AI-enhanced Data Analysis (Post-Participation)
In addition to enabling digital participation, AI improves policymaking by analyzing data in depth, allowing governments to process public feedback, identify trends, and make well-informed decisions in an effective way (Ataman et al., 2025).

AI systems can efficiently process participation data on a large scale, uncover patterns and emerging issues, and gain insights that are essential for policymaking. Automated analysis is indispensable for managing large-scale participation initiatives because manual examination of high-volume textual and numerical data is impractical (Bono Rossello et al., 2024).

Moreover, AI can predict trends and detect patterns, which could help policymakers understand the priorities of the public. This enables them to develop better-informed choices that align with the needs, hopes, and expectations of the public (Lahdili et al., 2024).

In addition to its role in decision-making enhancements, AI also plays a key role in reducing human bias and ensuring consistency in the analysis process (Lahdili et al., 2024 ; Vasilakopoulos et al., 2024). Algorithms apply the same criteria to every comment, preventing subjective weighting that can arise when different analysts interpret contributions differently. Because each processing rule is recorded, results are reproducible and open to audit, allowing policymakers to trace how conclusions were reached and to recalibrate models if new forms of bias are detected. This workflow is transparent and data-driven, supporting fairer policy development.

2.5.2 NLP, LLMs, and Computational Linguistics in Data Analysis

Computational linguistics is an interdisciplinary field that focuses on using computational methods to understand and process human language. It combines insights from cognitive science and computational linguistics (Apidianaki et al., 2024 ; Schubert, 2014). The field aims to create frameworks for analyzing grammar and meaning in languages and to develop efficient tools for tasks like speech recognition and machine learning (Schubert, 2014). Computational linguistics delves into the underlying structure and rules of language. Incorporating linguistic principles allows NLP systems to better capture and interpret the subtleties of human language.

Building on the potential of AI tools in digital participation, Natural Language Processing (NLP) plays a critical role in enhancing how these platforms analyze and interact with citizen input.
Natural Language Processing (NLP) is a subfield of artificial intelligence designed to process and summarize unstructured text (Bono Rossello et al., 2024). Research highlights its value in tasks such as data pre-processing, summarization, and clustering, particularly in citizen participation (Guridi et al., 2024). By pre-processing data, one can think of speech-to-text and

filtering duplicates. Summarizing data involves, for example, extracting key topics in comments placed by citizens, whereas with clustering, citizens with common attitudes can be grouped together (Guridi et al., 2024). Moreover, it includes speech recognition, key-phrase extraction, text-to-image generation, and argument mining (Shin et al., 2024). Machine learning (a subfield of NLP), can automatically translate text from one language to another based on the context and grammar of the text provided (Shin et al., 2024).

The emergence of large language models (LLMs) has significantly enhanced the effectiveness of NLP across a wide range of applications (Guridi et al., 2024). LLMs now constitute the foundation of many state-of-the-art methods.

These models, such as ChatGPT, are deep learning systems designed to process language data. Trained on vast amounts of text, they can predict the next word in a sequence with high accuracy (Apidianaki et al., 2024 ; Blank, 2023). LLMs excel at processing and generating natural language, producing grammatically correct and meaningful outputs. They are the first computational models to handle language effectively at scale, across large volumes of data and a wide range of linguistic tasks (Blank, 2023). However, despite their demonstrated effectiveness across a range of NLP tasks, LLMs remain the subject of ongoing debate regarding their capacity to approximate human language processing (Apidianaki et al., 2024 ; Blank, 2023). A fundamental distinction concerns the nature of learning mechanisms. LLMs are trained on extensive corpora of textual data, relying on statistical patterns to generate coherent output. In contrast, humans acquire language from relatively limited input, drawing on both linguistic exposure and embodied experiences. Human language acquisition is deeply embedded in social interaction and multimodal sensory input, which contribute to the development of meaning and understanding beyond textual co-occurrence (Apidianaki et al., 2024).

NLP techniques and LLMs are essential for analyzing large volumes of citizen feedback, including unstructured textual data such as survey responses, open-ended comments, and social media posts. Together, these tools can enhance the quality of citizen engagement and participation by facilitating more effective analysis and interpretation of public input. Moreover, they hold the potential to improve the accessibility and inclusivity of participatory processes.

2.5.3 Barriers in Traditional Participation and (AI-enhanced) Digital Participation

Both traditional and digital participation face several barriers, which primarily affect citizens. Challenges for the authorities such as costs of hardware and software (Falco, 2016) or policy-making, re-establishing routines and practices and expectation management (Kleinhans & Falco, 2022 ; Gonçalves et al., 2024) will not be touched upon.

Accordingly, this section first discusses general barriers and then focuses on those specific to digital participation. The end of the section concludes with specific challenges of AI in participatory processes.

General participation barriers

The general barriers citizens face can be divided into four categories: practical barriers, personal barriers, socio-economic barriers, and motivational barriers (Lightbody, 2017).

Practical barriers refer to limited access to resources to participate. These may include a lack of information about the process, difficulties with transportation, or other logistical challenges that hinder involvement (Pateman et al., 2021).

For *personal barriers*, people might lack the confidence to participate, or they do not speak the language. Such language barriers can, for example, hold for people who have English as a second language and are therefore unfamiliar with difficult terms and technical words. This makes it more difficult for individuals to effectively engage in participation. Moreover, to participate actively, a lack of knowledge among citizens can be challenging (Correia et al., 2023 ; Townley & Koop, 2024). Issues raised by authorities are often hard to understand for citizens due to their complexity and lengthy, difficult writing style. Due to this, citizens are less willing and capable of engaging in decision-making. Not all society members possess the same level of understanding or the ability to engage effectively in ways that meet the expectations of authorities (Townley & Koop, 2024).

Socio-economic barriers include a lack of time due to working multiple jobs to provide for their families or other causes of an unstable socio-economic position, such as for refugees is the case (Pateman et al., 2021 ; Evans et al., 2005 ; Pandya, 2012. Education level is another factor that fits this category, as individuals with a limited educational background are generally less engaged in public decision-making.

Lastly, *motivational barriers* include skepticism about participating and fear of whether they will be taken seriously or whether their input will be valued by the decision-makers (Lightbody, 2017 ; Kleinhans & Falco, 2022 ; Townley & Koop, 2024). This skepticism is tied to limited trust in the process. Some people are reluctant to engage in public participation as they have low trust in researchers and policymakers (Lightbody, 2017). A lack of previous experience in participation also adds to this (Evans et al., 2005), as well as interest in the topic (Pandya, 2012). User motivation is necessary for digital participation.

One main challenge in maintaining user motivation is how well the expectations of users align with actual outcomes (Gonçalves et al., 2024). When citizens participate via a digital platform, for example, this costs users time and effort. In return, they expect a positive payoff when engaging (Kleinhans & Falco, 2022). Townley & Koop recognize several reasons for the lack of motivation to engage in online participation. Some individuals face barriers to engaging online because they do not see the benefits of engaging digitally. Others lack the necessary devices or the support needed to use them effectively. Additionally, some people find the internet too complex to navigate, while for others, the costs associated with going online act as a significant obstacle (Townley & Koop, 2024). A range of drivers for the lack of motivation are mentioned: a lack of interest, (digital) priorities that vary, fear of difficulties, and fear of security. Socio-economic reasons (low level of education or low income), can enhance these drivers.

Digital participation barriers

Besides the general barriers that can arise, there are also more specific barriers to digital participation. Gonçalves et al. (2024) also researched encouraging and discouraging factors for digital citizen participation. Some of these factors are related to the barriers that are identified. Table 8 displays a summary of these factors.

Unequal access. The first challenge which is highlighted by researchers is the unequal access to digital resources Kleinhans & Falco, 2022 ; Townley & Koop, 2024 ; Bricout et al., 2021 ; Damodaran, 2021 ; Gonçalves et al., 2024 ; Dedding & Goedhart, 2023). This unequal access is a practical barriers and can be caused by financial reasons or by the digital divide, a lack of competence and skills (Lahdili et al., 2024).

In order to be able to participate digitally, one depends on tools like a laptop or smartphone, as well as a reliable internet connection. Some low-income or poor educated households lack these resources, making it hard for them to participate (Kleinhans & Falco, 2022 ; Zheng & Schachter, 2017). This can be linked to socio-economic barriers as well as practical barriers as the limited access to such devices, limits the practicality of engaging online. Specifically, research states that 94% of British citizens have access to the internet, while 6% are excluded from the internet. Some only have access to the internet via their smartphone, which can hinder some activities due to the limited functionality of smartphones (sometimes access requires a desktop) and the size of the screen. This hinders full participation and thus inclusive digital citizen engagement (Townley & Koop, 2024).

Poor design (Complicated Tool Interfaces). For many individuals, poor design of the digital environment is another barrier that they face (Damodaran, 2021 ; Gonçalves et al., 2024). Devices like smartphones, laptops, and tablets can be difficult to use when usability poses a problem. Common issues include confusing layouts, small fonts, unclear instructions, and inconsistent experiences across devices or browsers. People can experience difficulties with this, especially when they have a disability. One takeaway from this is that the design of a digital tool should be easy to customize to tailor to the needs of the user (Damodaran, 2021).

Poor digital literacy and skills. The digital divide also means the unequal distribution of advantages of digital tools across citizen groups due to the gaps that exist in access and digital skills (Bricout et al., 2021 ; Kleinhans & Falco, 2022 ; Townley & Koop, 2024 ; Zheng & Schachter, 2017 ; Gonçalves et al., 2024 ; Lahdili et al., 2024). Several factors, such as accessibility, usability, and affordability influence the divide. All of these factors create challenges for marginalized groups (Bricout et al., 2021).

Digital literacy plays a central role in digital participation, as it directly affects the accessibility, inclusiveness, and effectiveness of for example, digital platforms. Digital literacy includes the skill to find, comprehend, analyze critically, and effectively use digital tools and information (Li & Li, 2022 ; Yavuz, 2023). To participate, individuals need skills like language processing, navigation, and critical thinking. They also need to feel comfortable with digital devices to participate (Gonçalves et al., 2024). Moreover, people need to be familiar with English computer terms like “browser”, “caps-lock” and “swipe” (Dedding & Goedhart, 2023). When people feel uncomfortable or unable to participate online, feelings of frustration can lead to demotivation (Gonçalves et al., 2024).

However, a lot of people struggle with reading, writing, and interpreting text (Kleinhans & Falco, 2022). Moreover, language barriers (for non-native speakers) also occur (Gonçalves et al., 2024). Ensuring broad access to these skills is key to bridging the digital divide and promoting inclusive participation in policy-making (Yavuz, 2023). Without sufficient digital

literacy, individuals may struggle to navigate participation platforms, interpret data or discussions, and contribute meaningfully to the decision-making process. Research shows that people with higher literacy levels are more likely to share their views on a city's future direction (Correia et al., 2023). For this reason, the platforms should be developed to match people's capabilities and encourage broader participation (Li & Li, 2022 ; Yavuz, 2023). So even though COVID-19 has boosted the digital economy, marginalized groups still face obstacles. These issues include for example unequal access to digital skills and tools, and usability issues (Bricout et al., 2021). For these groups, the digital divide can lead to political exclusion, adding to the existing social inequalities.

The concept of the digital divide emphasizes that there is no need to entirely replace the traditional participation methods with digital alternatives. Instead, digital tools are best used as a supplement, enabling those who are comfortable and willing to engage through technology, while still including those who are not capable of participating digitally (Falco, 2016).

A lack of confidence with digital tools (and AI technologies) is also highlighted as a barrier to participating. Low confidence is often the result of a lack of skills or experience. For some citizens, this lack is tied to broader disadvantages like low income, poor health, and limited education. Others struggle because they are aware of their digital skills gap. Barriers that are mentioned for digital engagement include infrequent use, rapid explanations from helpers, being taught on unfamiliar devices or software, and the need for reassurance. A lack of confidence in AI technologies, specifically, is also mentioned in the literature (Lahdili et al., 2024). This creates a risk for the use of AI in citizen participation. Adding to this, a lack of confidence also intensifies factors like stress and fear. People have worries about, for example, privacy, online safety, and complex new technologies. These factors, together with using unfamiliar digital tools, cause low confidence in engaging digitally (Damodaran, 2021).

Finally, literature highlights ethical concerns related to AI, such as a lack of privacy protection, cybersecurity, and the protection of personal data (Lahdili et al., 2024). These challenges could hinder the effective use of AI in digital citizen participation. It is therefore crucial to understand that AI is not a one-size-fits-all solution. AI is still an evolving field that is developing at a fast pace (Lahdili et al., 2024).

Figure 8 displays an overview of the challenges identified in the literature, both general and digital. As can be observed, the socio-economic barriers are not linked to any specific digital barriers in specific. This is due to the fact that socio-economic barriers like education level or income can affect multiple digital barriers in an indirect way (such as unequal access or poor

literacy). Socio-economic barriers are therefore more generic and not linked to any digital barrier in specific.

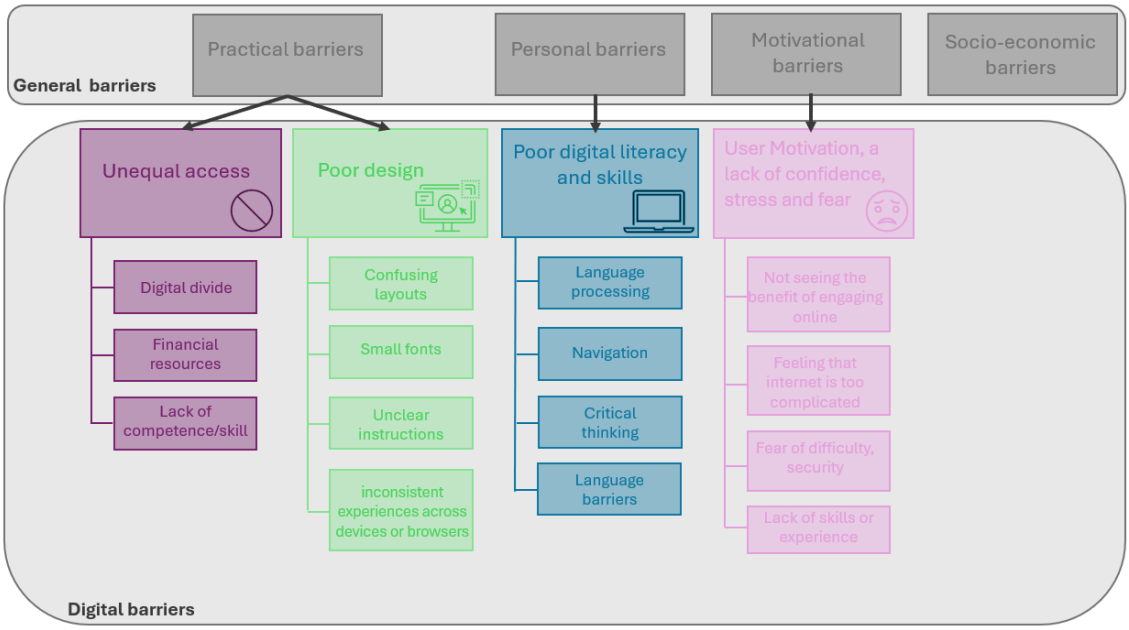

Figure 8: Barriers in citizen participation, general and digital (Author, 2025)

While digital tools hold great potential for the enhancement of citizen participation, they must be designed with existing challenges in mind to ensure they truly serve the public through a human-centered approach. In this context, research by Gonçalves et al. (2024) offers relevant insights by identifying key factors that influence citizens' engagement with digital participation tools. Although their survey included 260 respondents who do not specifically represent marginalized groups, the findings still highlight important considerations for inclusive design. These factors are presented in Table 8 (Gonçalves et al., 2024).

Table 8: Encouraging and discouraging factors for digital citizen participation according to a survey among 260 respondents (data from Gonçalves et al., 2024)

Encouraging factors		**Discouraging factors**	
Ease of use	27%	Time availability	23%
The possibility of finding information regarding the planning decisions being made	19%	Perception that their input would not be taken seriously by authorities	19%
The platform covering topics relevant to people's daily lives, concerns and needs	17%	Lack of interest from citizens	18%
Power to influence planning decisions	12%	**Language barriers**	12%
Gamification elements	4%	**Access to digital technologies**	10%
Monetary rewards	4%	**Digital literacy**	6%
Knowing 'who is who'	Negl.	**The issue with design and interfaces**	Negl.
		Inappropriate or irrelevant content	Negl.
		Lack of accountability and continuity	Negl.

AI challenges in participatory design

As AI becomes an integral part of government operations, meaningful citizen participation is crucial, but it faces several barriers, especially for marginalized communities. One key challenge lies in the lack of inclusivity in AI design, often leading to biased systems that fail to account for the needs of vulnerable groups. This exclusion is partly due to the absence of consultation with marginalized communities during development processes. Additionally, digital literacy regarding the comprehension of AI prevents communities from engaging in AI discussions. Without sufficient understanding, it is difficult for citizens to participate in shaping the systems that increasingly influence their lives.

In addition to these barriers, AI systems must meet key criteria such as transparency, accountability, reliability, and safety to earn public trust. When these tools are developed behind closed doors, it becomes difficult for citizens, especially those already marginalized, to understand how decisions affecting their lives are being made (Wong et al., 2022).

Consequently, this section concludes that AI has significant potential to enhance inclusivity in digital participation. This could be achieved by personalized support, improving accessibility, and fostering engagements across diverse populations. However, challenges such as unequal access (to digital resources), low digital literacy, and poor design must be addressed to ensure equal participation. By focusing on human-centered design, digital platforms can more effectively empower citizens.

2.6 Identifying the Research Gap

The literature reviews examined both traditional and digital approached to citizen participation. While traditional methods such as public hearings, surveys, citizen juries, community advisory groups, and focus groups will maintain their key role in citizen participation, these methods are constantly challenged by issues such as limited scalability, the exclusion of marginalized groups, technological and knowledge-related barriers, time constraints, lack of trust, and regular misunderstandings and frustrations.

The exclusion of marginalized groups has become particularly relevant in the aftermath of COVID-19. COVID-19 has strengthened already pre-existing inequalities, disproportionately affecting vulnerable populations and further hindering their full capacity to engag in participation processes. This situation stresses the urgent need for targeted research and policies that address structural and systematic inequalities. Active participation and meaningful inclusion of these marginalized populations are necessary to break down barriers and foster inclusive environments.

Literature consistently highlights the underrepresentation of numerous groups in participatory processes. These groups include, but are not limited to, youth, elderly, women, single individuals, working-class or unemployed, people with a lower level of education, immigrants, refugees, ethnic minorities, those with lower socio-economic status, people with disability, and those with difficulties reading/writing (Barendregt et al., 2024) (Li & Marsh, 2008 ; Lightbody, 2017 ; Checkoway et al., 2005 ; Martiniello, 2006 ; Irvin & Stansbury, 2004 ; Townley & Koop, 2024 ; Bovens & Wille, 2010 ; Smit et al., 2024). The barriers encountered by these groups range from practical, personal, socio-economic, to motivational factors.

Literature demonstrates potential in the use of digital participation tools to reduce some of these barriers by enabling broader engagement among marginalized groups. More specifically, the integration of AI into citizen participation processes is mentioned to potentially reduce inequalities in participatory planning processes. When such digital tools are applied in combination with traditional participatory methods, inclusivity can be enhanced. However, literature reveals critical gaps in this domain. There is insufficient empirical research available that focuses on tailoring communication methods to the needs of different target groups (Correia et al., 2023). Additionally, there is a notable lack of research focused on promoting social inclusion during the decision-making process (Nwachi, 2021). Marginalized communities—those most often excluded from participation—remain understudied and are frequently overlooked in both academic and practical contexts, as well as their improved representation (Agger, 2012 ; Bono Rossello et al., 2025). Furthermore, real-life barriers to participation faced by these groups require further exploration (Correia et al., 2023). Lastly, the full potential of AI usage on DPPs is underexplored (Bono Rossello et al., 2025).

In response to the gaps identified in the literature, this study focuses on marginalized groups who face structural and situational barriers in citizen participation processes, particularly individuals from lower socio-economic backgrounds, including those with limited formal education, low income, non-Dutch language proficiency, and physical disabilities. These groups have consistently been identified as particularly vulnerable to exclusion from participation in decision-making processes. The research aims to create inclusive strategies and guidelines for the development of digital tools that address their unique needs and contribute to a more equitable level of participation in urban planning and governance processes.

2.7 Summary

While citizen participation is defined by various scholars, Arnstein's definition is most influential. She emphasized citizen participation being a redistribution of power, which should enable citizens who are often otherwise excluded from political processes to engage in decision-making in an active manner (Arnstein, 1969). Through her "Ladder of Citizen Participation" (1969), she categorized participation levels from non-participation to full citizen control. She highlights that these higher levels offer real empowerment. The citizen participation concept gained popularity in the 1960s and 70s, with activists like Jane Jacobs and Sherry Arnstein pleading for a greater involvement of the public in urban planning. Over time, participation has evolved from consultation to citizen-initiated processes (Rowe & Frewer, 2013 ; Beierle & Cayford, 2002). Eventually, the Dutch Environmental and Planning Act (2024) came into force, further highlighting the importance of active public engagement.

One distinguishes between traditional and digital citizen participation methods. Traditionally, surveys, public hearings, and citizen juries are examples of methods used, depending on the level of involvement. However, such methods face challenges like the exclusion of marginalized groups, expert dominance, time constraints, and a lack of trust between citizens and governments (Roberts, 2004). Key to a more inclusive participation process and tool is overcoming these issues. The goals of these traditional methods were studied by Beierle and Cayford (2002) and include: improving decision quality, resolving conflict, and fostering trust in institutions. Additionally, citizen participation incorporates public values into decisions, and educates and informs the public.

Different types of citizens in decision-making processes can be distinguished: engaged (active) and disengaged (passive) citizens (Agger, 2012). Engaged citizens include political activists, expert citizens, everyday makers, and social entrepreneurs (Agger, 2012 ; Bang, 2004 ; Li & Marsh, 2008), while disengaged citizens are monitorial citizens, youth, and non-participants (Agger, 2012 ; Li & Marsh, 2008). This research focuses on marginalized groups, often falling into the non-participant category. These groups – such as youth, immigrants, low-income individuals, ethnic minorities, disabled people, and those with low education- face barriers that limit their participation in decision-making on urban interventions. These barriers strengthen inequalities, emphasizing the need for targeted interventions to empower these groups.

Digital citizen participation has gained ground due to improvements in digital technologies. AI plays a crucial role in these developments. AI offers the opportunity to improve accessibility, supporting personalized communication, and enabling enhanced data analysis for decision-making (Lahdili et al., 2024). Such features provide increased inclusivity, empowering marginalized groups, fostering greater engagement between citizens and governments, and have the potential to break down barriers to participation. However, both traditional and digital participation methods also face common challenges. These challenges include practical, personal, motivational, and socio-economic barriers (Lightbody, 2017). Specifically, digital participation faces additional challenges such as unequal access to digital resources, lower digital literacy, and poor design of digital environments. Survey results from Gonçalves et al. (2024) also highlight discouraging factors for digital participation, such as time constraints, skepticism regarding the impact of input, lack of interest, language barriers, and limited access to digital technologies. Addressing these issues requires a strong emphasis on improving digital skills, ensuring inclusive access, and designing user-friendly platforms that encourage meaningful citizen engagement.

3. Methodology

As proposed earlier in 1.5 *Research Design,* this study adopts the Design Science Research (DSR) methodology. In this chapter, the incorporation of Design Science methodology into this research is discussed along with the further methodological steps. This study specifically targets two key actor groups: municipal authorities and academic experts. The selection for these actors is based on the observation that previous literature often considers these stakeholders in isolation, rather than examining their perspectives in parallel (Gonçalves et al., 2024).

3.1 Design Science Research

For this research, Design Science methodology is used. The key element of Design Science is "the design and investigation of an artifact in context" (Wieringa, 2014). An artifact is something that humans create, having a specific purpose in mind. Such artifacts can, for instance, be frameworks and algorithms. Additionally, artifacts interact with their context, which can include people, social structures, organizations, values, and goals (Wieringa, 2014).

The problems investigated in Design Science are so-called "improvement problems" – issues that arise in a context where there is an urgent need for improvement. To effectively address such improvement problems, the context must be fully studied and understood.

In this research, the artifact is twofold: the citizen participation process and a citizen participation tool, both aimed at enhancing inclusive citizen participation. The context of citizen participation is really complex as it involves various stakeholders, including citizens, NGOs, and authorities. All these stakeholders bring different values, needs, and goals. The interaction between the context and the artifact enhances solving the problem. Wieringa (2014) emphasizes that the researcher should focus on the interaction between these components, rather than studying both individually (Wieringa, 2014).

Figure 9 illustrates the interaction.

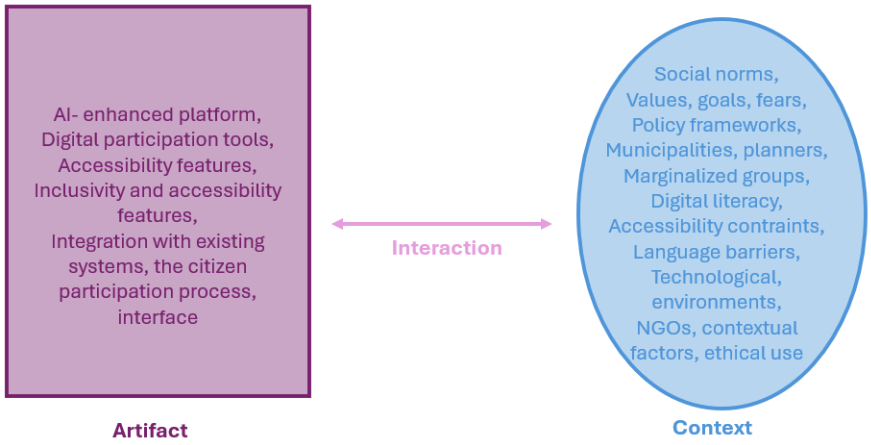

Figure 9: Interaction between the artifact and context (adapted from Wieringa, 2014)

In this case, there are two key aspects of the problem, namely a design problem and a knowledge question. A design problem seeks a practical solution. In this research, these are the MNs, DNs, DPs, and FRs aiming to enhance the citizen participation process with the support of a digital tool. In contrast, a knowledge question seeks an understanding of the

world and results in a proposition. This concept is also applicable to this research, as there is a significant knowledge gap: a lack of research and literature on involving marginalized groups in citizen participation (Wieringa, 2014).

Wieringa (2014) proposes the engineering cycle as a part of the DSR methodology. This approach provides a structured way of solving design problems. To create an effective design (a treatment), one should fully understand the (problem) context. This problem context will later also be discussed as the "understanding-phase" (Interviewee 9, 2025).

The research combines both the engineering cycle by Wieringa (2014) and the DSR cycle by van Aken and Romme (2009). The engineering and design cycle includes of the following phases: 1) problem investigation, 2) treatment design, 3) treatment validation, 4) treatment implementation, and 5) implementation evaluation (Wieringa, 2014). This engineering cycle is displayed in Figure 10. This cycle is useful in creating effective designs by first understanding the problem at hand. DSR is well-suited for this study because it focuses on creating (and testing) practical solutions to real-world problems (Wieringa, 2014).

The cycle by van Aken and Romme consists of: 1) Selection of the field problem to be addressed, 2) systematic review, 3) research synthesis, 4) design propositions, and 5) testing to enable further development (Van Aken & Romme, 2009). This proposed cycle starts with an interest in a certain problem, after which a review of already existing academic literature and knowledge is conducted. In the third step, solution concepts are brought up, followed by the development of different design propositions. In the last step, the design propositions are tested and developed further (Van Aken & Romme, 2009).

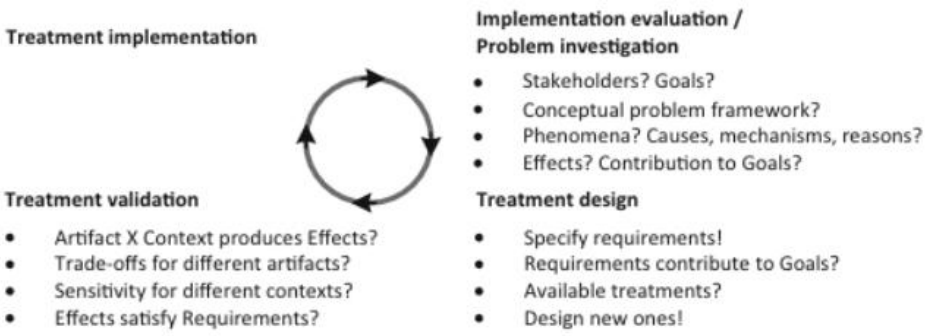

Figure 10: The engineering cycle according to the Design Science Methodology (reprinted from Wieringa, 2014)

While both cycles share similarities, the cycle by van Aken and Romme (2009) puts more emphasis on problem investigation and lacks an implementation phase (Van Den Berg, 2020). The focus on the problem investigation (the understanding phase) is particularly important in this study, as there is limited research on marginalized groups and inclusive citizen participation. The sensitivity of the topic also requires a deep understanding of the problem and context before designing a solution.

This research primarily focuses on Wieringa's (2014) design cycle, with an exclusion of the implementation phase. However, the systematic research phase proposed by van Aken and Romme (2009) is also incorporated.

The first phase, the needs finding (part of DSR) is executed using a literature study and interviews. The literature study aims to get overall insights into the research topic and to retrieve supportive design principles (meta-requirements) (Bono Rossello et al., 2025). In this research, these are renamed Meta Needs (MNs) to reflect their conceptual function in framing the design process.

After the initial MNs are defined, the Design Needs (DNs) subsequently follow through refinement of the MNs through the knowledge gained from semi-structured interviews. By first deriving the MNs through the literature review and then refining them, the process ensures both contextual relevance and alignment with practical concerns.

In the Treatment Validation phase, a workshop is held in which the MNs and DNs are validated by a consortium of experts. This phase also informs the identification and refinement of the upcoming elements. The next step is the Treatment Design, the translation from the DNs to Design Principles (DPs), for which the inputs are also gained from the semi-structured interviews. These DPs are more general and overarching guidelines. Lastly, the Functional Requirements (FRs) are the precise, technical features or behaviors the system or process should have. Table 9 displays the definitions of these various concepts.

Table 9: Concepts of the design methodology and their definitions (Author, 2025)

Concept	Level	Definition	Question to ask
Meta Needs (MNs)	Abstract	High-level, abstract needs that reflect the goals, values, or challenges of stakeholders.	What are the main goals, challenges, or desires that stakeholders have?
Design Needs (DNs)	Concrete	More concrete and actionable expression of the MNs. The DNs guide the creation of a solution, but still do not describe specific implementations.	What must the system support or achieve to address these stakeholder needs and values?
Design Principles (DPs)	Guideline	Principles that suggest the best approach to achieve a particular goal; how to fulfill the DNs (Gregor et al., 2020)	What overarching principle should guide the design?
Functional Requirements (FRs)	Technical	Exact, more technical specifications or features that must be implemented. They are derived from the DPs.	What specific functionality or feature must be implemented to realize this principle in the system?

Overall, this approach ensures a clear line of reasoning by connecting each component in a systematic way and building every design element on the previous one. All components can thus be traced back to their basis, the MNs, ensuring consistency throughout the process.

This is an iterative process in which the Treatment Design and Problem Investigation phases continuously inform one another. The refinement of MNs is not solely based on the initial literature review but is also shaped by insights gained from the interviews, creating a feedback

loop between empirical findings and conceptual development. A similar iteration occurs during the formulation of the DPs, as these principles are developed, certain requirements are revisited and further refined to ensure alignment with both stakeholder input and design objectives.

The actual implementation and evaluation of the results fall beyond the scope of this study. Still, the research lays a strong foundation for future development and deployment. Accordingly, the study concentrates on the problem investigation in specific, providing critical insights and actionable functional requirements to guide future implementation efforts.

Figure 11 displays the phases of the research based on the DSR phases of Wieringa (2014). This figure also includes the results of every phase.

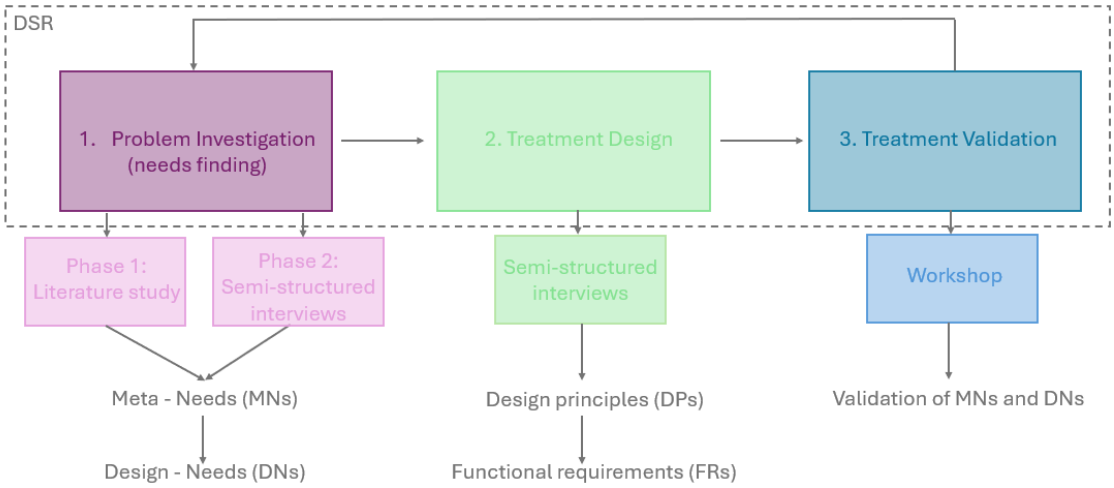

Figure 11: Design Methodology (Author, 2025)

The research questions are addressed throughout the chapters. Figure 12 displays the detailed Design Research process and how the research questions are addressed to reach the intended results. Throughout the methodology, this figure is used to indicate the various phases.

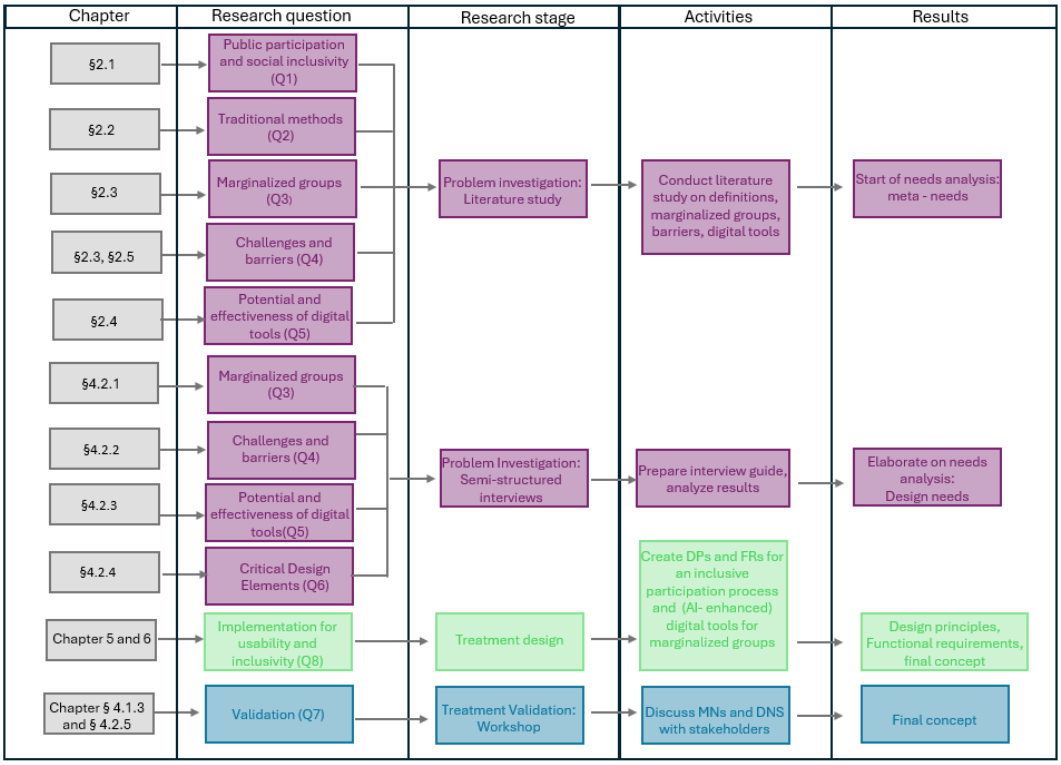

Figure 12: Research Design (Author, 2025)

3.2 Data Collection Methods

Figure 13 displays the design methodology in detail, inspired by (Vaishnavi & Kuechler, 2007).

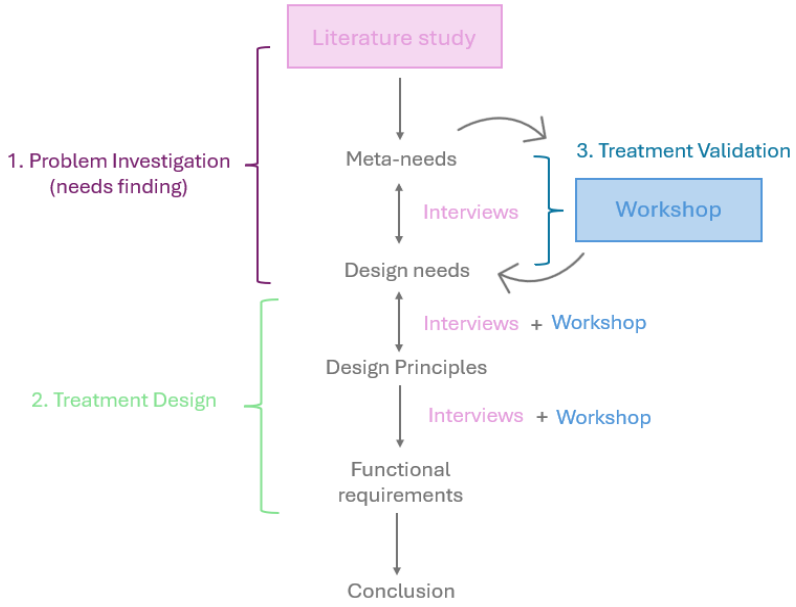

Figure 13: Design Methodology in detail (adapted from Vaishnavi & Kuechler, 2007)

3.2.1 Problem Investigation Phase 1: Literature Review

The problem investigation is the first part of the research and aims to gain a better understanding of the problem, identify gaps and barriers, and gather insights for appropriate solutions. This problem investigation consists of both a literature review and interviews. Figure 14 displays this part of the research design.

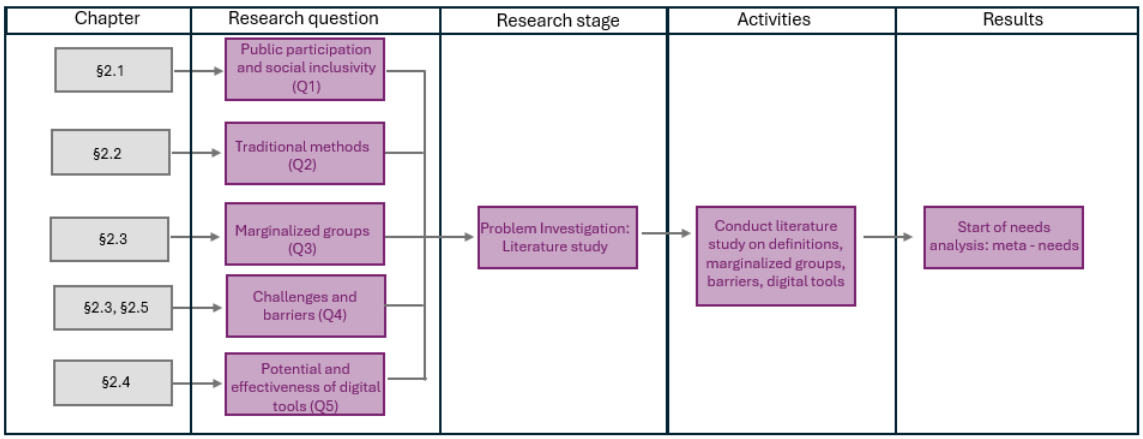

Figure 14: Problem Investigation Phase 1- Literature review (Author, 2025)

The literature review begins by researching the definitions of public participation and inclusivity, focusing on how marginalized groups are defined, particularly in the context of urban living. Key challenges and barriers faced by marginalized groups in participating in decision-making are also explored. This review aims to define the research problem, identify research gaps, and understand the context of inclusive participation, particularly through digital tools. Relevant literature is gathered through scientific databases such as Scopus and Google Scholar. Relevant search queries are used to find academic articles, books, and reports. For the research on general, traditional citizen participation, no specific queries are used. To explore the topic of digital citizen participation, the following queries are used.

("Citizen participation" OR "e-participation" OR "digital participation) AND ("marginalized groups")

Moreover, a snowballing technique is used to expand the review process further. This technique revolves around finding key sources from the reference lists of relevant articles, resulting in the discovery of additional studies not initially found using the search queries. This is an iterative process and helps to ensure that the review is comprehensive and captures significant work in the area of interest. Furthermore, relevant master's theses from previous years are accessed through the Master Thesis Database of the study association *Ofcourse* (focused on the Construction Management and Engineering program). In addition, the EQUAL project alliance's database is utilized to retrieve supporting sources, curated and added by researchers within the alliance. This multi-pronged approach helps to extend the range of materials included in the research further.

3.2.2 Problem Investigation Phase 2: Semi-structured Interviews

After finalizing the literature review, the second phase of the problem investigation involves conducting semi-structured interviews with various experts. The targeted stakeholders include both experts in the field and academia. The primary goal of these interviews is to validate the findings from the literature review and address specific sub-questions so that the MNs can be refined and DNs set up. By gathering participants' opinions, experiences, and feedback on topics such as barriers to digital participation, openness to AI-enhanced platforms, and suggestions for more inclusive tool design, the interviews aim to obtain a better understanding of key issues related to the research. Figure 15 displays this part of the Research Design.

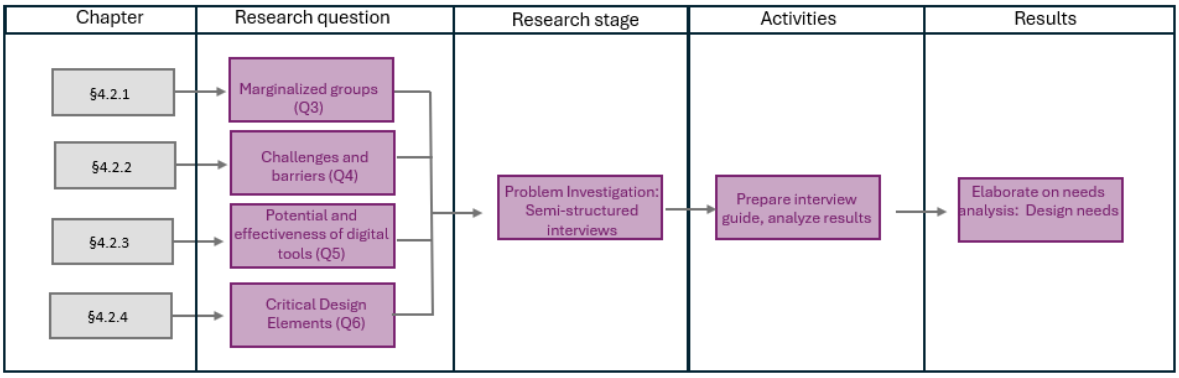

Figure 15: Problem Investigation Phase 2 - Semi-structured Interviews (Author, 2025)

Semi-structured interviews are selected as they are useful for exploring personal experiences and perspectives (Horton et al., 2007). Additionally, challenges and experiences can be identified in a qualitative way (Ataman et al., 2025). Moreover, this method is used in previous studies in the same area of research (Gonçalves et al., 2024 ; Ataman et al., 2024 ; Ataman et al., 2025 ; Simonofski et al., 2017 ; Smit et al., 2024) due to their capability to effectively capture people's perspectives and challenges.

The interview guides are developed to address gaps and insights revealed through the literature review, ensuring all questions are relevant. Moreover, the structure of the interview guide is based on an existing framework related to empowerment through Human-Computer Interaction (HCI) (Schneider et al., 2018).

The interviews are conducted and automatically transcribed using Microsoft Teams. These texts are carefully reviewed and checked for accuracy, after which thematic analysis is used to extract key themes and main topics discussed.

Type of interview: semi-structured

When conducting interviews, one must choose between several approaches. These approaches are mainly based on whether the research is qualitative or quantitative. In this case, the interviews are qualitative, as the aim is to gather insights into the experiences and opinions of participants. Qualitative interviews come in different forms, including focus groups, semi-structured interviews, and unstructured interviews (Dingemanse, 2015).

For semi-structured interviews, an organized list of questions is prepared in advance. In general, the order of these questions is followed. However, there is flexibility to adapt the order based on the conversation, without altering the overall focus of the interview

(Dingemanse, 2015). By using semi-structured interviews, a conversation is started in which interviewees can bring up topics that the interviewer can anticipate. Face-to-face interviews are preferred, as this format is considered the most effective for encouraging a natural conversation. However, when in-person meetings were not possible, alternatives like online interviews were used. The interviews are recorded and transcribed using Microsoft Teams, after the interviewee has given his/her consent through the informed consent form. This form also includes additional necessary information about the interview and the data that is collected. This informed consent form is included in Appendix I. This informed consent form is the template of the TU/e, retrieved from the Intranet of the TU/e. By recording the interview, the interviewer could fully focus on the interview itself and set a natural, ongoing conversation.

Interview set-up
The interview questions are developed based on the sub-questions outlined in the research design and insights derived from the existing literature. The primary focus of these questions is to explore personal experiences with (digital) citizen participation and opinions and insights regarding the potential of AI. In the beginning of the interviews, the interviewee is introduced to the research and the structure of the interview.

The interview for both groups consists of four parts:
Section 1: Barriers to Digital Participation
Section 2: AI-enhanced platforms and Digital Empowerment
Section 3: Design and Inclusivity in Digital Tools
Section 4: Final Thoughts

These four sections are guided by various categories introduced in the paper *"Empowerment in HCI - A Survey and Framework"* (Schneider et al., 2018). This paper focuses on the concept of empowerment within Human-Computer Interaction (HCI), specifically how technology can empower individuals. The authors propose several categories to structure the interview questions, which are based on previous research on the concepts of power and empowerment, as well as in HCI.

Additionally, the interview questions are directly aligned with the sub-questions of this research, with a particular focus on Q4, Q5, Q6, and Q8. While Q4 and Q5 have been explored in existing literature, the semi-structured interviews aim to capture real-life experiences and practical insights in these areas. Q1, Q2, and Q3 have already been addressed through the literature review.

Table 10 displays the categories and their "manifestations" according to the research (Schneider et al., 2018). The table also presents examples of interview questions per category and to which sub-questions these are related. Appendix II displays the full interview guide.

Table 10: The categories, their "manifestations", and examples of interview questions (adapted from Schneider et al., 2018)

Categories	Manifestation	Definition	Example interview question	Related to sub-question
Concept of power	Power-over	Power is a relationship	*"In your experience, who are the most*	Q3

		where one actor is capable of influencing or controlling another actor.	*marginalized in terms of (digital) participation?"*	
	Power-to	Power is seen as something that enables or allows someone to do something.	*"Have you ever conducted or been involved in a participation campaign? If so, what challenges and barriers did marginalized groups face in their participation?"*	Q4
Psychological component	Feeling	Empowerment is understood as having a sense of control, confidence in one's abilities, feeling capable, and being motivated.	*"How do you think marginalized groups feel about participating in public decision-making?"*	Q4
	Knowing	Empowerment includes recognizing available opportunities to take action and building the skills needed to solve problems effectively.	*"What specific skills or knowledge do marginalized groups often lack that may hinder their effective engagement with digital participation tools, and how can these gaps be addressed?"*	Q4
	Doing	Empowerment is realized when individuals take action and use their power.	*"What factors would influence your decision to use or avoid using AI in a digital platform for public participation?"* *"How can AI-based digital tools be implemented for useability and inclusivity among marginalized groups?"*	Q5 Q8
Persistence of empowerment	Transient	Empowerment occurs exclusively and instantly	*n.a.*	

		during the use of the system		
	Persistent	Empowerment extends beyond system use and continues even after the system is no longer being used	*n.a.*	
Design mindset	Participatory	Technology is empowering when it is designed from the perspective of the person being empowered.	*"How important is it for designers to involve/collaborate with marginalized communities in the development of digital platforms?"*	Additional
	Expert	Empowerment needs to be analyzed from a third-party researcher perspective.	*"From an expert's perspective, what critical design elements are necessary for a digital tool (AI-enhanced or otherwise) to be inclusive and effective for marginalized groups?"*	Q6

For the interviews, the category of *persistence of empowerment* is not applied, as it would be difficult for the interviewees to answer such questions accurately. This concept, which focuses on whether empowerment lasts beyond the use of a system, requires a level of understanding and reflection that may not be feasible for all participants.

As not all interviewees are familiar with AI, the interviewer provides an explanation of this concept and ensures sufficient time for any additional clarification. This helps create a comfortable environment where interviewees can express their insights clearly and effectively. Additionally, some interview questions are rephrased or adjusted depending on the expertise of the academic.

The interviewees from the expert group are selected based on their function within the Municipality of Best. People with different functions were interviewed to get different perspectives and experiences with citizen participation and the inclusivity of marginalized groups. Table 11 displays the experts and their functions. The academic group is selected based on their diverse fields of expertise and is primarily recruited through the EQUAL alliance.

Table 11: Experts interviewees and their function

Experts	Function	Company/ organization
Expert #1	District Coordinator/resident contact officer	Municipality of Best
Expert #2	Policy officer: Basic skills and participation	Municipality of Best
Expert #3	Advisor on citizen and government participation	Municipality of Best
Expert #4	Online communication officer	Municipality of Best
Expert #5	Advisor on citizen and government participation	Municipality of Best
Academia/ researcher		
Expert #6	Entrepreneur and Design researcher – Co-creation and participation in the spatial and social domain	Cocosmos
Expert #7	Digital Products Innovation Designer and Researcher	Eindhoven Engine and TU/e
Expert #8	Prof. Information systems - Digital platforms, value co-creation	TU/e
Expert #9	Prof. of Technology and Development	Erasmus University, International Institute of Social Studies
Expert #10	Human-computer interaction, Industrial Design - co-design, participation, marginalized groups	University of Twente
Expert #11	Prof. Human computer interaction - Design of Empowering Systems, User experience evaluation, games and behavior change	TU/e

Thematic analysis of the interviews

Thematic analysis is widely used in qualitative research to search for patterns in texts. The transcripts of the interviews are processed and color-coded to reveal core topics, ideas, and concepts that are frequently discussed by the interviewees (Gibbs, 2007). These identified themes and the corresponding codes (sub-themes) are displayed in Figure 16. The themes identified are: Municipality-neighborhood collaboration, functional scope & feature definition, stakeholder understanding & information access, clarity & communication gaps. These main themes are used to structure the Design Needs. Appendix III includes an elaborated table including the color coding system. Ultimately, this iterative approach led to meaningful insights that could be used to complement the MNs and DNs.

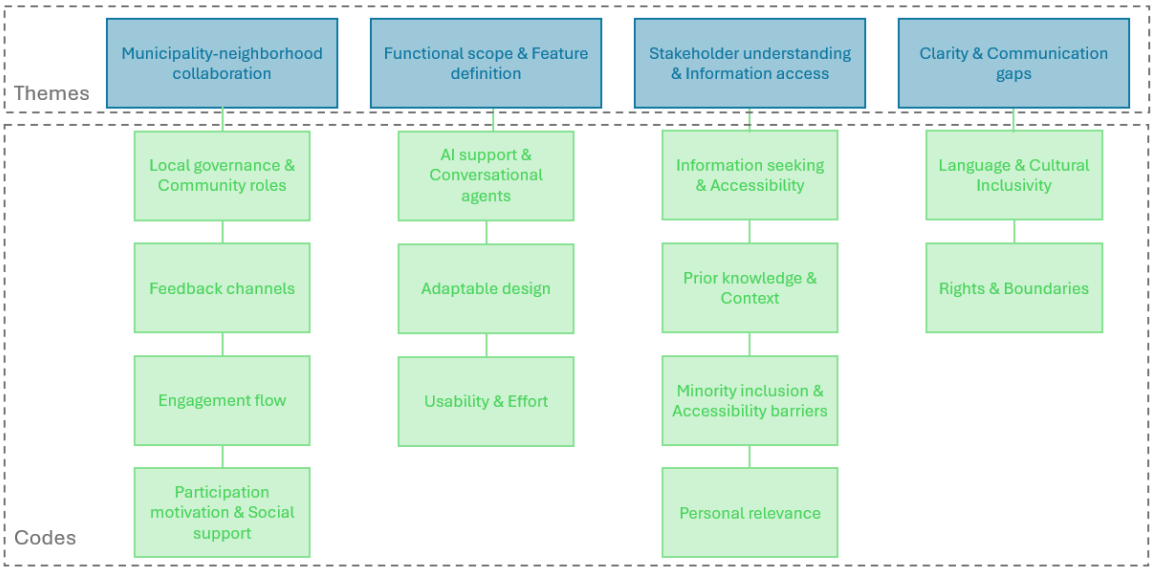

Figure 16: Summary of the most frequently mentioned themes during interviews (Author, 2025)

3.2.3 Treatment Design Phase

From the problem investigation phase, the treatment design phase is initiated, as displayed in Figure 17.

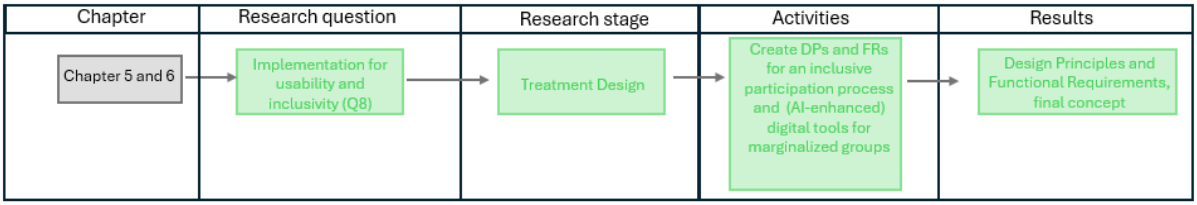

Figure 17: Treatment Design Phase (Author, 2025)

The goal of this phase in DSR is to develop design solutions that address identified problems. In this phase, from the knowledge, MNs and DNs gained from the literature study and interviews (problem investigation phase), Design Principles (DPs) and Functional Requirements (FRs) can be designed to improve the current citizen participation process and the development of a digital tool aimed at enhancing citizens' participation for marginalized groups in decision-making processes.

3.2.4 Treatment Validation Phase: Workshop

The next phase of the research is the treatment validation phase. The objective of the treatment validation phase in this DSR is to assess and improve the proposed MNs and DNs. This validation phase provides robustness to the elements that will follow, such as the design principles and the functional requirements.

During this phase, a workshop is organized to which a consortium of relevant stakeholders is invited. The target stakeholders are experts from various fields of research, including spatial planning, geosciences, social sciences, information systems, artificial intelligence, landscape architecture, and human-centered design. Fifteen experts participated on the first day, while seventeen attended the second day.

This workshop takes place at the TU in Eindhoven, the Netherlands, and is in collaboration with the EQUAL project partners. During this two-day workshop, research findings are presented, and MNs and DNs are proposed. Stakeholders' opinions and feedback are gathered in order to refine these concepts.

Although the initial versions of the Design Principles and Functional Requirements have already been developed, the focus of the workshop is intentionally placed on the MNs and DNs. This decision is made as the MNs and DNs lay the foundation for the design logic, displaying the main directions the system should take. By first validating this through the input of experts, the design elements that follow – the DPs and FRs – would better align with real-world contexts. Involving the development of FRs is considered too early, as these are more technical and require a strong understanding of the underlying needs.

Figure 18 displays the elements of the treatment validation phase according to the Research Design.

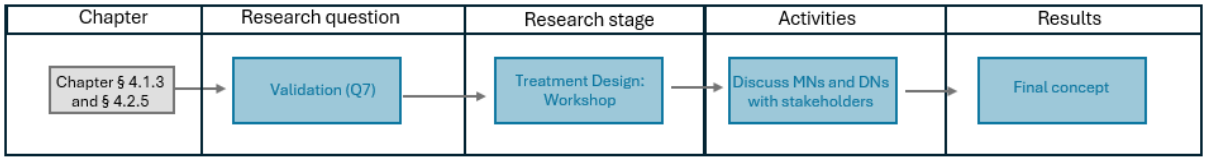

Figure 18: Treatment Validation Phase (Author, 2025)

Workshop day 1

The first day of the workshop included presentations on active lifestyle interventions in the built environment, digital participation tools for the built environment, and the design of engaging tools for different population groups. Other presentations focus on stakeholders' perspectives on digital participation tools, marginalized groups, and their preferences for emerging participation tools. A demo on text-to-3D and VR concludes the short presentations. These presentations are given by members of the EQUAL project group. The aim is to provide workshop participants with the necessary background and knowledge required for the discussions that are planned for the following workshop sessions.

After the presentations, the content of this thesis is discussed in more detail. The main findings, namely, the barriers faced by marginalized identified in the literature, are presented alongside the three thematic pillars: Human & Social, Political, and Technological. These literature-based barriers are then compared with those emerging from the semi-structured interviews to examine overlaps and differences.

Other key findings from the interviews are shared, including the conceptual framework consisting of MNs, DNs, DPs, and FRs. An initial set op MNs is presented for review. Participants are then divided into three groups, each corresponding to one of the three pillars. Within these groups, participants are asked to link each MN to the category of barriers it addresses, namely, practical, personal, motivational, or socio-economic barriers, as defined in the literature. A template, presented in Appendix IV is used for this.

Each group begins with a focus on their assigned pillar but is encouraged to explore and connect MNs from other pillars if time permitted. The purpose of this activity is to validate

whether the identified MNs adequately addressed the known barriers and to uncover any potential gaps. In addition, participants are invited to provide feedback on the MNs and suggest improvements or additional needs are relevant.

After this collaborative activity, participants are asked to individually rank the MNs within their pillar, from least to most important. This individual ranking approach is selected to collect personal expert perspectives without the influence of the group. This ranking allows for a clear understanding of which needs are considered most critical by the experts. The decision to rank the MNs, and not the DNs was deliberate. MNs serve a higher level of abstraction and reflect fundamental values and challenges of stakeholders. By ranking these overarching needs, this exercise clarifies which goals should guide the development of subsequent design decisions. So, firstly, underlying priorities are validated, providing robustness to everything that follows.

After the ranking of the MNs, the conversation moves into an open discussion focusing on the DNs. The participants are invited to reflect on the initial set of DNs that had been derived from the MNs and the interviews. These preliminary DNs are presented on a slide and a template, presented in Appendix V. Experts are asked to annotate and comment on the DNs. Additionally, they are asked to suggest new DNs that have been overlooked. The goal of this approach is to keep the DNs relevant and grounded in real-world experiences. Moreover, through this exercise, the DNs are enriched with practical insights. Insights gathered from this discussion are used to improve the DNs and to inform the development of DPs and FRs, ensuring that the design decisions match the needs and expectations of the experts.

Workshop day 2

During the second workshop day, a case study (context) is introduced to ground the discussion in a real-world scenario. This case focuses on a municipal engagement project in the Netherlands involving the development of a pump track – a paved course with bumps and curves designed for bikes, skateboards, scooters, et cetera. This facility aims to engage in physical activity, social interaction, and recreational play. This facility is targeted at all ages, but especially youth of 4-14 years old. The overall target groups are presented as: immigrants, the elderly, youth, individuals with low income, individuals with low education, and individuals with health issues.

The experts are asked to propose a concept for developing a digital participation process and tool aimed at marginalized groups and their use in citizen engagement processes. The proposal is expected to address the target groups, specific needs, engagement phases, stakeholders, possible interfaces, the tool's key capabilities, et cetera. The workshop is structured around three main components: context, mechanism, and interface. For each component, the groups are instructed to discuss barriers, catalyzers (enabling factors), needs, and conditions. To guide the discussion, the groups are chaired by mentors of the EQUAL project. At the end, each group presents its proposed concept to all participants.

Table 12 indicates the definitions of the barriers, catalyzers, needs and conditions of the three parts of the workshop.

Table 12: Definitions of barriers, catalyzers, needs and conditions in the three different parts of the workshop: Context, Mechanism, and Interface

Context	
Barriers	Obstacles that prevent or limit participation by marginalized groups.
Catalyzers	Factors that support or enhance participation.
Needs and conditions	Specific requirements or contextual factors that must be addressed to enable meaningful participation.
Mechanism	
Barriers	Capture limitations or challenges related to tools, technology, and user engagement.
Catalyzers	Highlight strategies, tools, or features that promote effective participation.
Needs and conditions	Reflect requirements or design principles that must be considered to ensure inclusivity and long-term impact.
Interface	
Barriers	Obstacles that hinder inclusivity, adoption, or ethical use of digital interfaces.
Catalyzers	Features, technologies, or practices that promote inclusive, transparent, and effective participation.
Needs and conditions	Essential interface requirements and contextual factors that enable meaningful participation.

The final phase would involve treatment implementation, but this is not part of this thesis.

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4. Understanding Meta and Design Needs for Inclusive Participation

This chapter discusses the results of the problem investigation and presents the final list of MNs and DNs. These MNs and DNs are identified through both the literature review and the interviews, and reviewed and validated by a consortium of experts during the workshop.

4.1 Identifying Meta Needs

A summary of the findings of the literature is given in *2.7 Summary*. Besides this summary, MNs were retrieved from this first phase of the problem investigation. These MNs arise from the barriers marginalized groups face in participation processes, as indicated in the literature. The interviews are used to further expand and refine the list of MNs, after which the workshop validated the list.

Even though this research focuses on digital AI-enhanced tools, it became clear during the literature review that there are also a lot of social aspects of citizen participation for marginalized groups to consider when shaping the decision-making process. Therefore, the MNs are structured according to three pillars: Human and Social, Political, and Technological in order to ensure key aspects in all three context are considered, based on a similar approach applied by Bono Rosello et al., (2025). The needs are based on a **participation process** on one hand (Human and Social, and Political pillars) and a **participation tool** on the other hand (Technological pillar). Figure 19 displays the pillars and their categories.

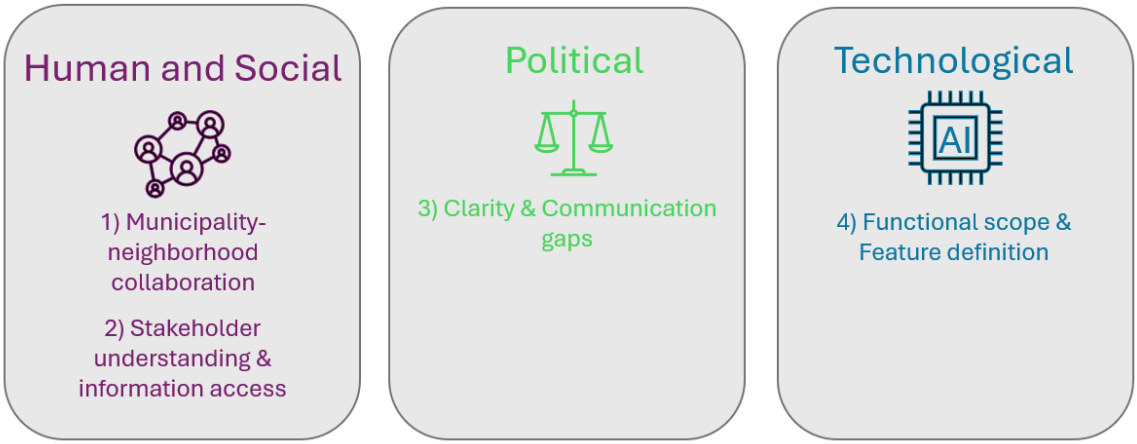

Figure 19: Pillars of the methodology and their corresponding categories (Author, 2025)

4.1.1 Insights from the Literature into Pillars

From the literature, four categories of barriers that marginalized groups face are distinguished: practical, personal, motivational, and socio-economic. The barriers addressed in the literature include low accessibility, a lack of knowledge, (digital) illiteracy, poor design, and language barriers (Gonçalves et al., 2024 ; Townley & Koop, 2024). Additionally, AI-driven tools must be transparent, accountable, reliable, safe, trustworthy, and unbiased (Wong et al., 2022). They should be designed in consultation with communities to prevent difficulties. Moreover, support should be established to comprehend the topic of AI, as people might lack sufficient technical knowledge and the ability to grasp the topic. Additionally, the tool should be made

adaptable to diverse preferences to suit a broad range of people (personalization) (Vasilakopoulos et al., 2024), and communication can be improved (Lahdili et al., 2024).

As suggested earlier, the MNs are based on three pillars. The human and social pillar emphasized an overall inclusive environment, awareness, and human-centered design. Research also highlights the importance of multichannel outreach, clear communication, and alignment with existing social behaviors to encourage participation (Lightbody, 2017; Falco, 2016).

The Political pillar focuses on establishing a trusted relationship between citizens and authorities using (AI-enhanced) technologies through digital rights and protection. On the other hand, an equal relationship between political figures (e.g. municipalities, authorities, etc), should be strived for.

Unlike the first two pillars, the technological pillar focuses more on the actual design of a digital participation tool. Research shows complex interfaces and a lack of personalization to be a barrier to participation (Damodaran, 2021 ; Lahdili et al., 2024). Thus, digital tools in general hold they should be accessible and user-friendly. When using AI features, transparency about the use of AI should be further safeguarded. Ensuring usability, transparency, and accessibility is crucial to fostering engagement and trust in digital platforms.

4.1.2 Insights from the Interviews into Citizen Participation Barriers

While the interviews were mainly used to identify the DNs, they also provided valuable insights into the refinement of the MNs. A more detailed and comprehensive section on the interview results will follow in section *4.2 Identifying Design Needs.* However, this section highlights the key insights that were key in adjusting the list of MNs.

Following the interviews, additional focuses became clear. During the majority of the interviews, interviewees highlighted that the problem of limited engagement of marginalized groups in citizen participation is not a technological problem (caused by practical barriers), but rather a social problem (caused by motivational barriers). They highlighted that marginalized individuals often feel that their input is not valued or important enough. They often lack confidence in their knowledge, believing that expertise is required to provide meaningful contributions. This is further worsened by a limited understanding of what citizen participation is.

Another recurring theme was the lack of clarity around the relevance of participation to people's personal lives. This lack of understanding of how urban interventions affect their neighborhood results in a need for scenario exploration (making changes in the neighborhood visible).

Finally, interviewees emphasized the need for flexibility in participation as marginalized groups often have different priorities. This not only holds for both online and offline possibilities for participation, but also accommodates flexibility in time availability.

4.1.3 Expert Validation of the Meta Needs

The focus during the workshop was on the refinement of the MNs and DNs. By testing these needs with experts, this conceptual framework is grounded in real-world expertise. Moreover, it presents that the needs are not just speculative and stemming from literature and interview insights only, but are “validated” and refined by experts from various domains. The feedback from the experts confirmed the relevance of the needs for marginalized groups in citizen participation. This provides robustness to everything that follows, namely the design principles and the functional requirements.

During the linking exercise in the workshop, the experts were asked to connect the identified MNs to the four barrier categories (practical, personal, motivational, and socio-economic). In addition to making these connections, the experts also provided feedback on the existing MNs and proposed additional MNs to complete the list (see Table 17). This linking exercise served as a valuable step in strengthening the conceptual framework. It contributes to refining and clarifying the formulation of the MNs, while also ensuring that they align with the real-world concerns and needs expressed by experts. By merging overlapping needs and identifying unaddressed ones, the process enables the development of a more coherent and complete list of MNs, grounded in a thorough understanding of the barriers to citizen participation.

The motivational barriers emerged as the most frequently addressed category, with fourteen out of nineteen MNs linked to it. This finding supports the insights emphasized during the interviews that the core challenges lie primarily in the social, rather than the technological field. Human-centered and behavioral obstacles appear to be the main bottlenecks. Since many MNs from the list target this barrier from different angles, their integration into participation processes and tools is likely to enhance the overall effectiveness in overcoming these obstacles.

The Human & Social pillar remained largely unchanged, as the experts agreed with the MNs that were stated. However, “Enable scenario exploration” is moved into the Human & Social pillar as the experts considered it to be more aligned with user understanding and interaction than with technological capacity. Additionally, the meaning of the term “human-centred design” was not sufficiently clear. In response, its meaning is clarified in the revised explanations of the MNs to ensure shared understanding.

Regarding the political pillar, three additional MNs, MN13 *(Ensure commitment from political authorities),* MN14 *(Ensure time, and capacity to support participation by local authorities),* and MN15 *(Ensure ownership of participation tools),* were suggested by the experts (see Table 17). MN13 emphasizes the importance of ensuring ongoing commitment from political authorities. Experts noted that while many digital participation tools already exist, they are often used only once and without follow-up. This, as they argued, reflects a broader absence of public and political commitment to inclusive urban environments.

MN14 highlights the internal challenges within municipalities, especially the lack of time, staff, and institutional capacity to adopt and maintain new participatory tools and processes over time. These limitations hinder the long-term integration of inclusive approaches into routine practice.

Lastly, MN15 addresses the need for clear ownership and responsibility in managing digital participation tools. At the moment, these tools often become the product of a researcher or developer, with a lack of responsibility taken by authorities. Experts linked this issue in part to limited technological literacy among staff, making it difficult to assume long-term responsibility for these tools and integrate them effectively into public-sector workflows.

For the technological pillar, the MNs "provide an explanatory and understandable system" and "ensure transparency" were merged, as the expert felt these two were very closely interlinked and addressed similar barriers. Moreover, while they agreed on the importance of offering explanations about how AI tools function, they emphasized that such information should be presented in a non-intrusive manner. Most citizens may not comprehend the technical details or are simply not interested in this, as this knowledge is not necessary to effectively participate.

To address this, the experts suggested a minimal and optional approach to transparency, such as a Hoover function labeled "powered by AI", which citizens can click on for more information if desired. This ensures that transparency is available without overwhelming or deterring users.

Based on the outcomes of the workshop, a total of 19 MNs are identified in three pillars, as seen in Table 13. The type of barrier that is addressed per MN is defined and elaborated upon as well. Appendix VI displays the list of MNs with an extended need description. The MNs indicated by * are retrieved from research by Bono Rossello et al. (2025).

Table 13: Final list of MNs for an improved citizen participation process and participation tool for marginalized groups (Author, 2025)

Pillar	Meta Needs	Barrier addressed from literature/interviews	Practical	Personal	Motivational	Socio-economic
Human and Social	Ensure inclusive participation (**MN1**)	Lack of inclusion of marginalized groups in citizen participation	X	X	X	X
	Increase flexibility in participation formats (**MN2**)	Feeling that the internet is too complicated, and unequal access to participation (resources)	X	X		
	Ensure effective Communication and Awareness (**MN3**)	Lack of confidence, stress, and fear		X	X	
	Consider existing social interactions (**MN4**) *	Lack of human-centered design (design processes often overlook existing social relationships/structures, routines, and contexts), lack of interest, lack of time		X	X	X
	Enhance sustained Engagement (**MN5**)	Lack of interest, lack of time, lack of positive payoff when engaging		X	X	X
	Ensure user needs (human-centered design) (**MN6**) *	Lack of human-centered design, no one-size-fits-all solution	X			
	Foster participatory literacy (**MN7**)	Lack of understanding about the citizen participation process	X	X		X

	Enhance perceived relevance (**MN8**)	Feeling that their opinion is not valid and uncertainty about the impact on their personal lives			X	
	Enable scenario exploration (**MN9**)	Lack of understanding of how the urban interventions will affect their neighborhood				X
Political	Enhance trust & Legitimacy (**MN10**)	Lack of trust between citizens and government, skepticism			X	X
	Ensure digital rights and protection (**MN11**)	Privacy concerns, security risks, protection of personal data	X	X	X	
	Ensure inclusive decision-making and address perceptions of power imbalance (**MN12**)	Feeling that input is not taken seriously (reciprocity of trust), limited influence over decisions, feeling the decision-making is biased, skepticism			X	
	Ensure commitment from political authorities (**MN13**)	Lack of institutional follow-through or shifting political priorities can undermine participation efforts and reduced trust			X	X
	Ensure time, and capacity to support participation by local authorities (**MN14**)	Overloaded or under-resourced authorities may be unable to facilitate meaningful participation	X		X	
	Ensure ownership of participation tools (**MN15**)	Lack of taking responsibility by political figures, and technological literacy among authorities personnel	X		X	
Technological	Allow personalization (**MN16**)*	Low digital literacy, discomfort with digital tools, and lack of confidence		X	X	
	Ensure Transparency (**MN17**) *	Lack of trust and Transparency in (AI) decision-making, lack of technical knowledge and AI comprehension	X	X	X	
	Enhanced usability (**MN18**)	Poor design, usability challenges, digital literacy/divide	X	X	X	
	Enhanced accessibility (**MN19**)	Unequal access, digital literacy/divide, language barriers	X			X

4.2 Identifying Design Needs

As noted previously, the interviews primarily aimed to validate the outcomes of the literature review. Moreover, specific sub-questions were addressed so the MNs could be refined and the DNs set up. This section, therefore addresses the insights from the interviews and how this relates to the literature findings. These findings are structured according to the sub-questions that are aimed to be answered: Defining marginalized groups, challenges and barriers, potential and effectiveness of digital tools, and critical design elements (referring back to the research design in Figure 2. Moreover, the results include the DNs resulting from the MNs, the input from the interviews, and the validation from experts.

4.2.1 Who are Marginalized Groups?

During the interviews, several groups were identified as marginalized, listed in order of frequency: immigrants (or individuals with a non-Dutch background), youth, parents, people with disabilities, individuals with low literacy, those with limited digital literacy (often

mentioned concerning older people), individuals with lower levels of education, and those with a low income. While these findings align with the literature discussed, some groups identified in the literature – specifically women and individuals who were once married or never married – are not mentioned during the interviews (Barendregt et al., 2024 ; Li & Marsh, 2008 ; Lightbody, 2017).

4.2.2 Participation Challenges and Barriers

As discussed in the literature review in section 2.5.3, the barriers that marginalized groups commonly face are divided into four categories: practical, personal, motivational, and socio-economic barriers. Insights from the literature are consistent with the barriers, with interviewees mentioning elements that closely correspond to the discouraging factors for digital citizen participation as summarized in Table 8. The interviewees mainly focused on barriers that hold for traditional participation, but also digital participation barriers.

Practical barriers primarily involve a lack of time, particularly among individuals with young children. Interviewees noted that citizen participation activities are often scheduled during working hours, making it difficult for people to engage. One interviewee stated:

> *"You need to have the time to join and most likely we conduct the studies during working hours. So that is also a downside like of course either you are working or you gave up on you working hours or you get some leave to participate." (Interviewee 10)*

While some interviewees also mentioned limited access to digital tools, such as laptops or computers, others argued that this has become less of a barrier over time. One interviewee observed that it is increasingly rare to find individuals who are entirely excluded from digital access:

> *"People have shared usage, people have a public access usage of Wi-Fi, getting into libraries. Actually at this point of time, it would be hard to put together, you know, let's say an FGD (focus group discussion) of somebody who cannot access technology." (Interviewee 9)*

Personal barriers identified in the literature include low self-confidence, language difficulties, and a lack of knowledge, all of which are confirmed by several interviewees. In addition, some interviewees highlighted that many citizens are unaware of what citizen participation entails or how it relates to their circumstances, further limiting their engagement.

The issue of digital skills, especially among older adults, was also discussed. Some interviewees pointed out that limited digital literacy can hinder participation. However, others disagreed, noting that many elderly individuals are familiar with basic technologies and platforms, such as Facebook.

Motivational barriers were strongly emphasized during the interviews. The literature highlights issues such as trust, skepticism, and doubts about the value of their input. These concerns were confirmed by many interviewees. Several note that marginalized groups often feel uncomfortable participating, largely due to a perceived lack of knowledge. Distrust toward

governments, municipalities, and NGOs was frequently mentioned as well, along with a sense that their opinions will not be taken seriously. This contributes to low expectations and limited engagement. One interviewee also pointed out that some individuals hold a different understanding of citizenship compared to the dominant Dutch cultural perspective. This leads to them feeling that citizen participation efforts are simply *"this is not really targeted at me"* (Interviewee 9).

Although *socio-economic barriers* are not explored in depth in the literature review, the interviews reveal that these barriers are highly relevant and complex. Interviewees noted that individuals from different backgrounds often face issues, such as poverty, migration, and political instability, which have priority over citizen participation (Interviewee 11):

> *"But then these people, will be connected to lots of ongoing developments and things from micro to macro scale. Then think about big movements or big issues, like for example, refugees migration, poverty, instability, and things like that. They definitely have other priorities. So they (marginalized groups) may not be feeling themselves as part of a whole." (Interviewee 11).*

Additionally, some groups have experienced discrimination through digital tools, which reinforces skepticism and prevents them from seeing a source of discrimination as a solution (e.g. for citizen participation). One interviewee further noted that many marginalized individuals have never felt sufficiently empowered to actively participate in society.

Overall, the barriers and challenges to (digital) citizen participation identified in the interviews generally align with those discussed in the literature. However, motivational barriers were significantly more emphasized, and socio-economic factors were explored in more depth during the interviews.

Furthermore, the discouraging factors outlined in Table 8 largely are in line with the main insights from the interviews. These included time constraints, the perception that their input will not be taken seriously by authorities, a general lack of interest, language barriers, access to digital technologies, digital literacy, and issues related to design and interface (Gonçalves et al., 2024). Among these, only the issue of design and interface was not explicitly mentioned in the interviews. Additionally, perspectives on digital access and literacy were divided. Table 14 displays the barriers and challenges mentioned during the interviews and arranged from most frequently mentioned to least frequently mentioned.

Table 14: Barriers and challenges for (digital) citizen participation mentioned during the interviews. The barriers indicated in grey indicate that these were not mentioned in the literature review

Practical	Personal	Motivational	Socio-economic	Most frequently mentioned
Lack of time	Language barriers	Feeling uncomfortable, feeling that they are not knowledgeable enough	Different priorities	
Lack of digital skills	Little understanding of citizen participation	Trust in authority/government/research	No community of social approach towards the usage of technology	↕
Digital divide/unequal access	Lack of knowledge	Lack of interest	Lack of education	
	Low literacy	Feeling of not being taken seriously	Cultural differences	
		Feeling of not being important/valuable enough	Discrimination	
		Other definition of citizenship	Lack of empowerment	Least frequently mentioned

4.2.3 Potential and Effectiveness of Digital Tools

The challenges associated with AI, as discussed in the literature, generally align with concerns raised in the interviews, although these issues are not exclusive to marginalized groups. One interviewee highlighted algorithmic bias in large language models, particularly in features like image generation. Additionally, when websites ask users to identify characteristics like age or gender and adapt their interfaces accordingly (e.g., using larger fonts for people over 60), it remains uncertain whether users will feel truly represented, as AI often relies on stereotypes (Interviewee 10).

Data privacy and security are also frequently mentioned by interviewees as areas of concern, though not specific to marginalized communities. Transparency in AI use is another key issue, with interviewees emphasizing the importance of knowing when and how AI is being applied in digital engagement. AI is also described by several interviewees as a current "hype", with its long-term role and impact still unclear, as noted by one interviewee:

> *"My opinion is that anything that anybody says to you, let alone me, and I think this certainly applies to me, is that anything anybody's saying about AI right now is completely speculative." (Interviewee 9).*

Due to this, most interviewees (n=8) expressed hesitance about the use of AI for engaging marginalized groups in citizen participation. While they are neither for nor against it, many acknowledged AI's potential to support accessibility and usability in citizen participation platforms.

Beyond AI, interviews see value in digital tools in a broad sense. Digital participation can provide individuals with flexible options for engagement (online or offline), and technologies like VR are mentioned as tools that might help people better empathize with different situations. Literature supports this perspective, suggesting that digital platforms may remove certain physical and social barriers associated with traditional forms of participation.

However, interviewees expressed doubt that digital tools alone are sufficient to address the obstacles faced by marginalized groups. Many (n=8) stress that these challenges are deeply rooted in societal structures and can not be resolved purely through technological solutions. According to several interviewees, real progress begins with understanding them and *"empathizing with their lived experiences"* (Interviewee 5). Only when trust is established and people feel genuinely empowered can digital tools serve as effective instruments for fostering engagement. Until then, the barriers to participation remain fundamentally social, not just digital.

4.2.4 Critical Design Elements

The goal of this fourth sub-question is to identify critical design features for a future digital tool aimed at engaging marginalized groups. However, the interviews primarily yielded insights about the design of the citizen participation process rather than specific tool functionalities, besides some accessibility and usability features.

Many interviewees (n=9) emphasized that meaningful engagement must begin with a deeper understanding of marginalized groups. They criticized current development practices, noting that tools are often designed first, expecting citizens to adapt to them, rather than involving users from the start through co-design and needs assessments. Several interviewees (n=3) argued that reverse-engineering a tool after its creation is rarely effective. Moreover, they stressed that no single digital tool could solve the complex challenge of engaging marginalized communities. These groups are very diverse, with varying needs, making a one-size-fits-all approach unrealistic.

Nevertheless, when asked about design features that could improve accessibility and usability, interviewees identified several promising elements, such as multi-language support and simplified texts. Some (n=7) also expressed interest in conversational agents (e.g., chatbots), as long as these tools could be made more human-like in their interactions. Additional features such as text-to-speech functionality and built-in summaries were seen as potentially valuable in reducing accessibility barriers. Finally, several interviewees showed enthusiasm for the use of generative AI and 3D visualizations to help citizens better understand how interventions could impact their neighborhoods.

4.2.5 Expert Validation of the Design Needs

During the second part of the workshop, the DNs were presented to the experts, after which they were asked to discuss and provide feedback.

During the discussions, it became clear that especially the municipality's needs were missing. Municipalities often do not have the time, resources, and capacity to provide effective and inclusive citizen participation. For this reason, *DN3 (integrate participation into existing municipal workflow)*, *DN4 (provide institutional onboarding and training modules),* and *DN5 (support interdepartmental collaboration)* were added. These three DNs provide more concrete, and actionable expressions regarding the position of the municipality. These new DNs are also closely related to the MNs that were previously added, as suggested by the experts: *MN13 (ensure commitment from political authorities), MN14 (ensure time, capacity, and resources to support participation by authorities),* and *MN15 (ensure ownership of participation tools).*

Additionally, experts suggested *DN9 (Communicate project context & timeline clearly),* ensuring that the citizens feel informed throughout the process and have free access to the status of the project.

Based on these insights, together with the findings from the interviews and their relation to the literature, Table 15 presents the final list of 16 DNs. These DNs are structured according to the themes identified in the thematic analysis, as described in *3.2.2 Problem Investigation Phase 2: Semi-structured interviews.* The DNs indicated by * are retrieved from research by Bono Rosello et al, (2025). The mapping of the MNs and DNs is displayed in Figure 20. This figure presents how the DNs relate to the MNs and to which pillar and category they correspond.

Table 15: List of refined DNs for the improvement of the citizen participation process and participation tool for marginalized groups according to the feedback from experts (Author, 2025)

Themes	Design Needs	Description	Meta Needs link
1) Municipality-neighborhood collaboration	Support diverse participation pathways (**DN1**)	Provide citizens with diverse ways for engaging in shaping urban interventions (online, offline, mobile, in Dutch, in English, at various times, etc.), ensuring marginalized groups are included. Use a combination of platforms (social media, SMS, email, community events) to reach diverse demographics.	MN1, MN2, MN6, MN19
	Engage community ambassadors (**DN2**)	The citizen participation process should engage local ambassadors to encourage and guide citizen participation in decision-making for urban interventions, ensuring marginalized groups feel welcomed and represented.	MN1, MN4, MN7, MN8, MN10, MN12, MN13
	Integrate participation into	The design should support municipalities by aligning participation tools and processes	MN13, MN14, MN15

	existing municipal workflow (**DN3**)	with existing planning routines. This aims at making participation feasible despite limited time and capacity.	
	Provide institutional onboarding and training modules (**DN4**)	Guidance for municipal staff should be provided to support adoption, limit friction, and build internal capacity.	MN3, MN6, MN14, MN15
	Support interdepartmental collaboration (**DN5**)	The system should enable coordination between departments (e.g. urban planning, IT) to integrate participation holistically	MN13, MN14, MN15
2) Stakeholder understanding & information access	Provide a clear feedback mechanism (**DN6**)	The process should ensure that participants receive clear, transparent feedback on how their input has influenced spatial planning decisions, fostering legitimacy and sustained involvement. This strengthens trust and long-term participation.	MN3, MN5, MN7, MN10, MN12
	Foster user confidence (**DN7**)	The process should provide guidance, and support to increase users' confidence in citizen participation for decision-making for urban interventions.	MN3, MN5, MN8, MN10, MN12, MN19
	Enable co-design with citizens, consider their needs (**DN8**)	The design should actively involve citizens — especially marginalized groups — and other key actors (e.g. planners) in shaping tools and processes for citizen participation in their physical environment to ensure relevance, inclusivity, and improved usability for diverse users.	MN1, MN4, MN5, MN6, MN9, MN18
	Communicate project context & timeline clearly (**DN9**)	Citizens should be clearly informed about the status of the project (broader timeline, phases, how their input contributes to each stage).	MN3, MN5, MN8
3) Clarity & communication gaps	Ensure Data Security and Privacy (**DN10**)	When collecting participation input for urban planning, ensure strong data protections and clear communication on data usage to foster trust.	MN10, MN11

	Explain AI use and influence clearly (**DN11**)	The design should communicate how AI systems work and impact urban development decisions, using accessible, non-technical language.	MN3, MN17
	Implement transparent Consent Processes (**DN12**)	The design should allow users to understand, manage, and withdraw consent easily, with clear forms and settings.	MN3, MN10, MN11, MN17
4) Functional scope & Feature definition	Design for intuitive interaction (**DN13**)	The interface should be simple, familiar, and easy to navigate, minimizing barriers for users with diverse digital skills	MN5, MN6, MN16, MN18, MN19
	Allow personalization of AI by the user (**DN14**) *	The design should allow users to adjust features (e.g., layout, contrast, language) to suit their needs and preferences and thus not be uniform.	MN1, MN16, MN18, MN19
	Support digital literacy, comprehension, and language support (**DN15**)	The design should include tools and aids (e.g., tutorials, chatbots, speech-to-text) to support users with limited digital experience. This supports a “learn-as-you-go” concept.	MN1, MN3, MN18, MN19
	Enable 3D visualization (**DN16**)	The design should allow users to see the changes of the urban intervention to the neighborhood in 3D	MN7, MN8, MN9

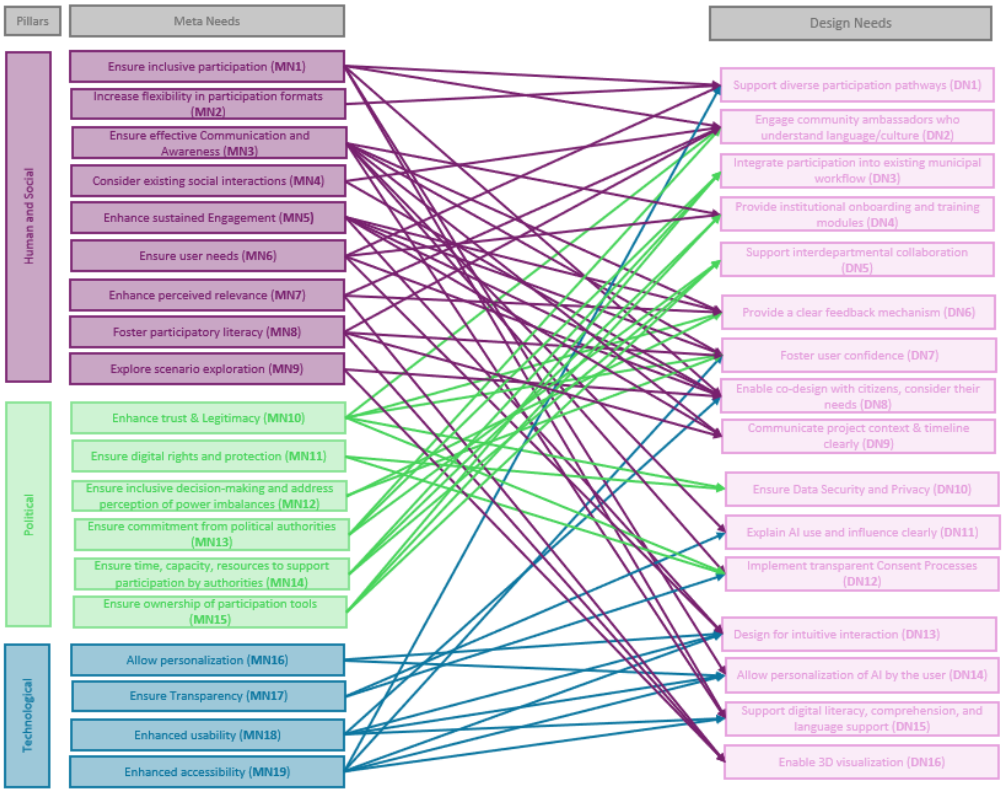

Figure 20: Mapping of the final MNs and DNS (Author, 2025)

4.3 Inclusive Citizen Participation: Overcoming Motivational, Personal, Practical, Socio-economic Barriers

This chapter highlighted the complex, multi-dimensional nature of enabling inclusive citizen participation. The findings, retrieved from both literature and interviews, underscore that addressing participation barriers for marginalized groups not only includes the development of a digital tool but also a human-centered process (understanding, awareness). This human-centered process is emphasized and seen as most important. There are already multiple citizen participation tools on the market (as previously mentioned in the literature study), but marginalized citizens will not use them when they lack trust, confidence, et cetera. The problem thus does not seem to be a technological one, but a social one. As interviewee 11 stated, *"The motivational part is the biggest hurdle and biggest barrier."* Interviewees discussed broader issues such as social structure, time constraints, and competing life priorities, all of which shape participation behavior. These insights suggest that the core design challenge is not technological, but social. As such, developing a digital tool alone is insufficient; prioritizing human engagement, trust-building, and context-sensitive design is essential for meaningful participation. For this reason, during the majority of the interviews, the focus was on the "understanding-phase" of the marginalized groups, as formulated by Interviewee 9:

> *"Try to understand them first and then we can go in and start thinking about tools to deal with it." (Interviewee 9)*

Moreover, stronger connections are needed between municipal employees, organizations (NGO's), and the citizens. Collaboration across these groups and the integration of their networks can significantly contribute to the shared goal of reaching a broader and more

diverse range of communities. Together, these stakeholders must actively promote the message that everyone belongs, and that the municipality serves its citizens, not itself. One interview stated this as:

> *"' We from the municipality'. No: 'We from society'" (Interviewee 5)*

Additionally, several interviewees (n=9) emphasized the fact that they do not think a digital tool would solve the minimal engagement of marginalized groups. *"There is no solution, one solution for all of course" (Interviewee 8)* and *"I don't think digital is going to solve every problem" (Interviewee 9).* These statements reflect a broader skepticism regarding purely technological fixes for structural participation issues.

Therefore, by structuring the MNs and DNs across the Human and Social, Political, and Technological pillars, the research presents how both the process and the digital tool need to enhance inclusive citizen participation. On one hand, building trust, engaging with citizens, and understanding their lived realities are fundamental to reaching and involving marginalized groups. On the other hand, any digital tool that supports this process must be accessible, user-friendly, and adaptable to diverse needs. The integration of these two dimensions, relational processes and inclusive technologies, ensures that both the way people participate and the tools they use are aligned to support equitable engagement. Eventually, this dual approach leads to more fair, meaningful, and sustained involvement in urban decision-making processes.

5. Translating Needs into Design: Principles, Requirements, and System-level Considerations

This chapter outlines a set of design principles aimed at fostering a more inclusive citizen participation process and a digital (AI-enhanced) participation tool. These principles are derived by grouping the DNs that share common goals or can be addressed through a similar approach. Each DP applies to multiple DNs, offering clear guidance without defining specific features. The principles are directly linked to the MNs and DNs proposed in the previous chapter.

5.1 Design Principles

The design principles are set up using the insights from the Problem Investigation Phase, quotes that were given during the interviews, and the thematic analysis. From the thematic analysis, the following themes emerged: municipality-neighborhood collaboration, stakeholder understanding & information access, clarity & communication gaps, and functional scope & feature definition. The final DPs are as follows: the principle of inclusive outreach (DP1), the principle of empowering engagement (DP2), the principle of participatory co-design (DP3), the principle of clarity and simplicity (DP4), the principle of trustworthy transparency (DP5), and the principle of adaptive accessibility & feature definition (DP6).

The themes that emerged from the thematic analysis express general topics that are frequently mentioned during the interviews. The DPs, on the other hand, are formulated as overarching, actionable guidelines intended to inform practice. However, since the themes alone are too broad to sufficiently address the actions needed to develop the DPs, the sub-themes (codes) are included in the analysis. This inclusion ensures that the principles go beyond the broader theme and address practical issues that were identified during the interviews.

Although some of the DPs are directly informed by the identified themes, for example, *inclusive outreach (DP1)* and *clarity and simplicity (DP4)* directly link to the themes of *municipality neighborhood collaboration* and *clarity & communication gaps,* the final set of principles was critically defined to extend the thematic labeling. This approach ensures that the DPs offer actionable and context-sensitive guidelines rather than functioning merely as general thematic summaries of recurring topics.

Figure 21 presents the themes and codes that emerged according to the thematic analysis, and the DPs that subsequently followed.

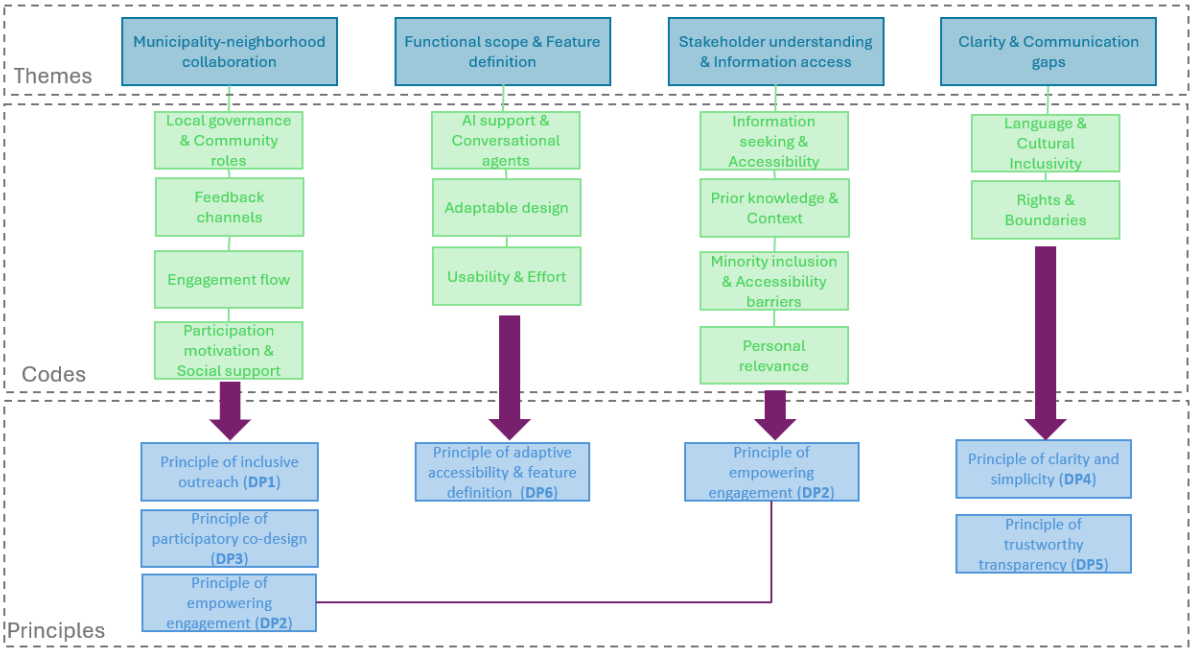

Figure 21: Overview of how the DPs were developed from the thematic analysis of interview data (Author, 2025)

Table 16 displays the list of DPs and the linked DNs.

Table 16: List of overarching DPs created from the DNs

Design Principle	Design Needs link
Principle of inclusive outreach (DP1)	DN1, DN2
Principle of empowering engagement (DP2)	DN3, DN4, DN5, DN6, DN7
Principle of participatory co-design (DP3)	DN8, DN13
Principle of clarity and simplicity (DP4)	DN9, DN13, DN15
Principle of trustworthy transparency (DP5)	DN10, DN11, DN12
Principle of adaptive accessibility & feature definition (DP6)	DN13, DN14, DN15, DN16

5.1.1 Principle of Inclusive Outreach (DP1)

This first principle highlights the need to reach marginalized communities in different ways. Multiple interviewees highlighted the concept of awareness and that they feel like this is the first step in effective and inclusive citizen participation. Awareness is the first phase in overcoming the barriers that marginalized groups face. As interviewee 7 stated:

> *"I think, one way could be awareness. About the content, but also awareness about the importance of your opinion and that you can participate; How can you participate? Where can you go?"*

Besides the importance of raising awareness, interviewees highlighted the fact that participation must be offered through both digital and physical channels in different forms to prevent excluding marginalized groups. Recognizing the diversity of individual needs, they stressed that inclusive engagement requires adapting participation formats accordingly. If the goal is to involve people meaningfully, the process must be flexible enough to meet them where they are. Two interviewees specifically highlighted the importance of multi-channel participation:

> *“We really do it consciously both, so that you give as many people as possible the chance to do it in their own way." (Interviewee 6)*

> *“I would say strategy in a multi-pronged strategy where you do community events, you do traditional media, you do digital media” (Interviewee 9)*

Moreover, interviewees emphasized the importance of creating a bond with the citizens:

> *“I think the first step in participation is just getting to know each other” (Interviewee 5)*

Besides the twofold online and offline participation, awareness and engagement could be improved by going to the people instead of expecting them to come. Making a direct connection with people can help to reach and engage them. *“I think that you really need to approach those people personally” (Interviewee 3).* Another interviewee formulated this as trying to be present where the target group is.

5.1.2 Principle of Empowering Engagement (DP2)

As discussed earlier, the most significant barriers marginalized groups seem to face are the motivational ones. The majority of the interviewees (n=7) noted that people do not feel important, knowledgeable, or included enough. This lack of empowerment leads to self-exclusion from participatory processes.

> *“But they were never told that they have something meaningful to contribute on a topic they weren't educated in, right? So you also have that—people who exclude themselves because they think, "My opinion doesn’t matter anyway." (Interviewee 6)*

Moreover, some individuals simply feel like participation processes are not meant for them. Interviewee 9 stated:

> *“The assumption in this that everybody who’s partaking of that neighborhood, sees themselves equally as citizens. 40% of the country was not born in the Netherlands, so the minute we frame a topic as digital participation for citizens, you are going to have a lot of people who are like: ‘this is not really targeted at me’”.*

This insight points to the concept of systemic exclusion issues, where individuals are not empowered or they do not have a sort of community or social approach towards citizen participation and its usage of technologies. As interviewee 9 again stated:

> *"So I would say that the issues are now not so much about access and affordability and therefore providing tools and training, I think it's more about dealing with sort of systemic issues that people are not empowered. Or they don't have a sort of community or social approach towards usage of these technologies. And therefore, they find it very difficult to engage with the programs that are being developed." (Interviewee 9)*

Therefore, these individuals find it very difficult to engage with programs that are being developed. Moreover, they lack the feeling that their opinion is valued and feel like nothing will be done with their input. This is evident from multiple interviews (n=6).

> *"I believe participation starts with connection and mutual trust—listening to one another, engaging in conversation, and feeling that you are being taken seriously" (Interviewee 5)*

Another important point raised was that people can be empowered by incentives, whether tangible (e.g. food) or symbolic (e.g. meaningful follow-up). These individuals would prefer to receive a serious reaction, not to be explicit, to get what they want. One interviewee mentions that this is where a problem is created:

> *"When we involve participants, most of the time we ask participants to share their lived experience, share their knowledge, but they do not get anything in return. And for example, in the case of some marginalized communities, a lot of people reach out to them, bring a lot of research, but they do not give anything back and that is where the burden comes in" (Interviewee 10)*

5.1.3 Principle of Participatory Co-design (DP3)

The next principle revolves around first understanding the target group and the social structures they live in before designing a tool that would help them engage in citizen participation. Interviewee 5 highlighted this "understanding phase" to be of great importance, as stakeholders can not reverse-engineer a tool for marginalized groups. *"I think you (stakeholders: municipality employees, participation experts) really need to empathize with the world those people live in to truly involve them" (Interviewee 5).* Understanding also starts with understanding their needs and focusing on human-centered design.

However, marginalized groups struggle to express their needs before they have had a chance to engage with a design firsthand (Interviewee 11). To address this, the concept of designing a tool can be framed in three interconnected phases. First, establish a genuine connection with marginalized citizens by exploring their perspectives and understanding why they may choose to participate – or not – in decision-making processes. Next, develop a digital tool that enables them to experience how the system functions in practice. By interacting with the tool, the concept of participation becomes easier to grasp. Finally, use this shared experience as a basis

for co-designing the tool with them, as they will now be in a better position to voice their needs and requirements.

It is also crucial to see what their current engagement in technology and digital tools is. This can be part of the first phase. As an interviewee stated:

> *"I think this is part of the issue, is to not jump straight for the solution and design a platform or a tool or a solution, but to first see where people are and what is their current engagement for a marginalized society" (Interviewee 9)*

Another interviewee noted:

> *"It is not about the type of AI, but it is about the understanding which type of technologies are already used and how you can elaborate on that. So you have a good entry point" (Interviewee 8).*

Besides understanding the marginalized groups, the subsequent step should involve shaping solutions with them, working together as a team: *"But I think the most important thing is to create with them as well."* (Interviewee 7). Several interviewees (n=4) emphasized that co-designing with marginalized groups is not only beneficial but "vital" and "extremely important" to the development of inclusive participation tools and processes. As Interviewee 10 explained:

> *"This is something that needs to be used by other people. And if I was to make decisions for you without asking you what you want, you will be really frustrated and that's unfair. And in that sense, participation is something that allows you to have a saying in that and people are happy to have a saying in that because they do have an opinion because they have the lived experience. So they have the knowledge on what is needed" (Interviewee 10).*

This statement underscores the essential value of lived experience in shaping relevant and effective design outcomes. However, despite widespread recognition of the importance of co-design, *"it rarely occurs in a meaningful manner"*, as interviewee 9 noted.

5.1.4 Principle of Clarity and Simplicity (DP4)

The fourth principle is about the clarity and simplicity of a digital tool. In the design of a participation tool, the layout and interface should be a simple as possible. Moreover, the communication and explanations should be straightforward:

> *"Try to explain as you are explaining to a five year old child. So it's very simple, it's very direct and there is no room for complexity" (Interviewee 7).*

This directly ties to marginalized groups who, for example have difficulties with reading and writing. Providing clear, short texts can help them understand the concept better. Pictures and less text could work better, as well as using icons.

> *"If I can say only one word, it would be simplicity" (Interviewee 7)*

5.1.5 Principle of Trustworthy Transparency (DP5)

This principle of trustworthy transparency highlights the lack of trust in the government and the need for privacy, data security, and a transparent citizen participation process. Trust in the government has been mentioned in literature and during the interviews as a barrier that marginalized groups face in citizen participation. Interviewees noted that there is a significant group that does not have any trust in the government, municipality, or authority. Fostering trust is therefore of great importance.

> *"If there is no trust and you are distrusted from the outset, that's a very different starting point than if they know you" (Interviewee 1)*

Moreover, concerns for AI, such as privacy and data security, were expressed during the interviews. The government should have transparent communication about these topics to secure a safe feeling with citizens. Interviewee 10 noted on this communication: *"informing the participants about those data in a way that they understand what they're doing." (Interviewee 10).* So, people should be informed about their data protection, but also about their rights in a way that they can comprehend.

5.1.6 Principle of Adaptive Accessibility & Feature Definition (DP6)

This last principle relates to the different needs marginalized groups have. There will be no one-size-fits-all digital tool that could help engage marginalized groups. Touching upon the barriers the marginalized groups face, however, some barriers can be lowered by implementing technological features. These barriers have been mentioned earlier and are poor design, poor digital literacy and skills, and unequal access. Even though interviews note that such a digital tool would not solve the problem, overall, they do see potential to make digital tools more accessible, usable, and inclusive for all.

Figure 22 displays an extended version of the mapping of MNs, DNs, and DPs.

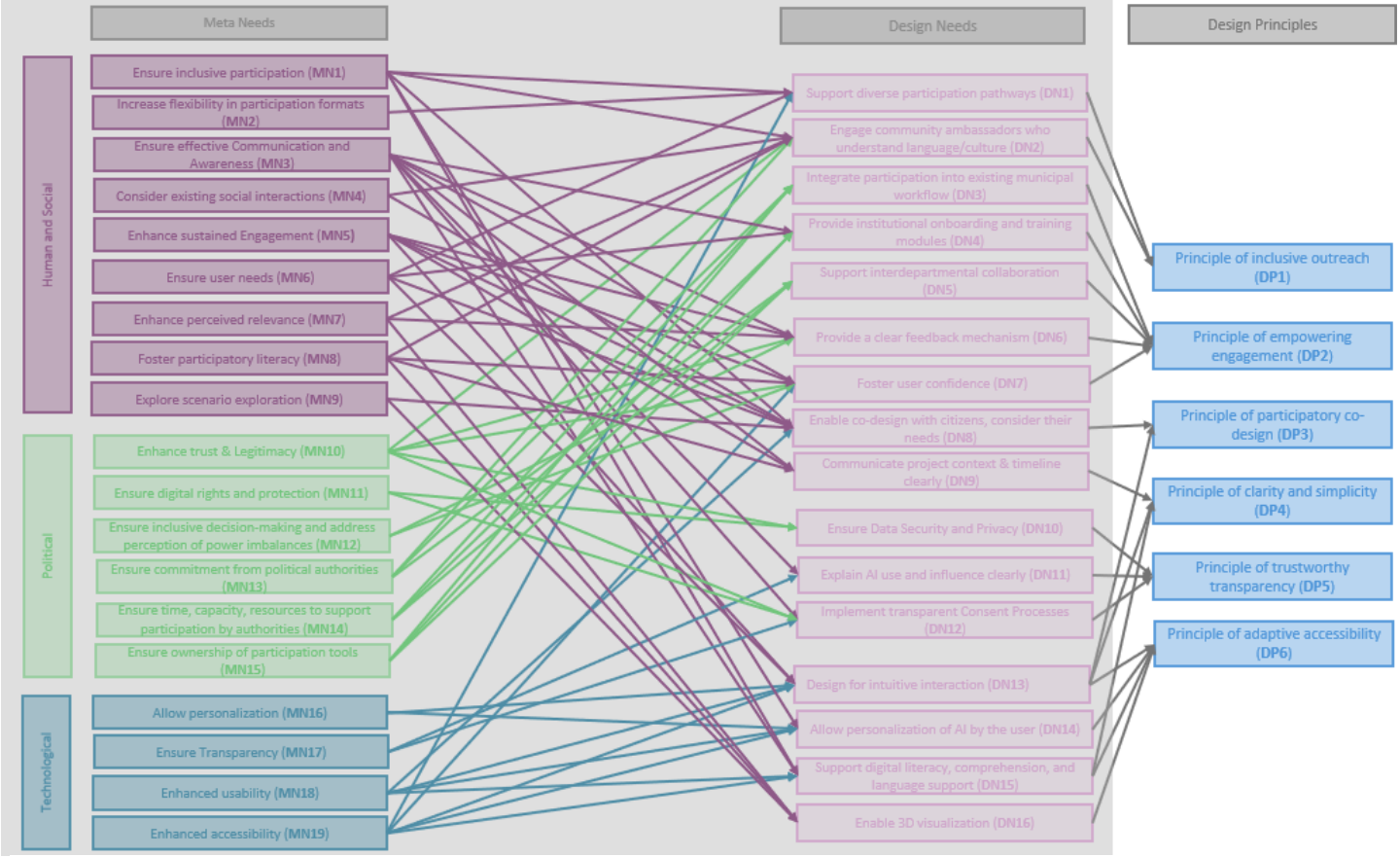

Figure 22: Final mapping of the MNs, DNs, and DPs (Author, 2025)

5.2 Functional Requirements

This section presents the Functional Requirements (FRs) derived from the previously discussed Design Principles (DPs). These requirements are informed by a combination of insights gathered through interviews, input from the workshop, and personal reflection and domain expertise. The FRs are organized according to the DPs, ensuring a clear connection between the principles and their practical implementation.

The FRs address both the processes of citizen participation and the design of digital tools that support these processes. It is important to emphasize that the FRs should not be viewed as a rigid checklist. Instead, they serve as a flexible, practice-oriented guide to support the development of inclusive participation strategies and technologies. Given the diversity of local contexts and participation goals, some requirements are more applicable than others. Therefore, the intention is to offer a broad and adaptable toolkit that can assist in designing and facilitating inclusive citizen participation across different settings.

5.2.1 Functional Requirements for the Principle of Inclusive Outreach (DP1)

The first set of FRs under the principle of Inclusive outreach (DP1) aims to engage marginalized communities through diverse and culturally appropriate methods. This principle is linked to DN1 *(support diverse participation pathways),* and DN2 *(Engage community ambassadors who understand language/culture).*

The central focus is building trust through community ambassadors (FR1.2, inclusive participation phase 1) who speak the language, understand their culture, know how to chat with them, and maintain personal connections. These ambassadors can be supported by an inclusive outreach tool (FR1.4). This personal approach helps ensure marginalized individuals feel welcomed and seen.

The different priorities, schedules, and needs of marginalized groups are emphasized repeatedly. Dual participation channels (online and offline) (FR1.1) must be available, preferably offering options not during working hours. Participants should also be asked to set participation preferences (FR1.3), helping tailor future outreach.
The promotion of a community event should be inclusive, using both online (email, websites) and offline (posters, SMS) methods (FR1.5).

Lastly, one of the suggestions from the workshop was to set up a physical stand (or mobile cart) (FR1.6), to provide accessible, face-to-face contact with municipality employees. These stands serve as a bridge between physical and digital participation by displaying QR codes linking to digital content, enabling those who prefer online interaction to access relevant information easily.

To further promote accessibility and inclusivity, the stands can include visual indicators of language support, such as national flags (e.g. Dutch and English), to signal which languages are spoken by the staff present. This simple gesture encourages interaction by making citizens feel more welcome and supported.

In addition, such stands offer an opportunity to present and demonstrate digital tools in a hands-on setting. Citizens can experience platforms – such as augmented reality (AR), virtual reality (VR), or other digital tools – while being guided by experts. This not only enhances understanding but also builds trust and confidence in using new technologies.

Together, these FRs translate the inclusive outreach principle into concrete actions that foster accessibility, trust, and engagement. Table 17 displays the FRs of this first principle and their link with the DNs.

*Table 17: FRs of the Principle of inclusive outreach (DP1). The FRs indicated with * were explicitly stated by experts during interviews or the workshop.*

Principle of inclusive outreach (DP1)				
Functional requirement	**Description**	**Process**	**Tool**	**Design needs link**
Provide dual participation channels (**FR1.1**) *	Citizens must be able to participate either online or offline and at various times, ensuring both are fully valid and accessible. This respects differing access, skills, and preferences. This should not be a hybrid	X	X	DN1

	version, but either online or offline.			
Build a trusted relationship with marginalized individuals (Inclusive participation phase 1) (**FR1.2**) *	Start by talking to marginalized individuals and asking why they are not participating. Build a relationship with them.	X		DN1, DN2
Ensure participation preference setting (**FR1.3**) *	When signing up or joining a process, users must indicate their preferred way of participating (online or offline). This ensures future engagement respects accessibility preferences.	X	X	DN1
Provide a local outreach toolkit (**FR1.4**)	Provide district coordinators with inclusive outreach materials (visuals, multilingual flyers, simple language posters, event materials) tailored for use in community spaces (markets, mosques, libraries, etc.).	X		DN2
Use a community event scheduling system (**FR1.5**)	Enable organizers to plan and publicize events accessible to marginalized groups (SMS invitations, physical posters, RSVP by phone/SMS for non-digital users).	X	X	DN1, DN2
Use a physical stand (**FR1.6**) *	Make sure to establish a physical stand on site for people to visit and experience the area.	X		DN1

5.2.2 Functional Requirements for the Principle of Empowering Engagement (DP2)

The FRs for the principle of empowering engagement (DP2), link to DN3 *(Integrate participation into existing municipal workflow),* DN4 *(Provide institutional onboarding and training modules),* DN5 *(Support interdepartmental collaboration*), DN6 *(Provide a clear feedback mechanism),* and DN7 *(Foster user confidence).* These FRs aim to address the motivational barriers many marginalized individuals face in citizen participation. These barriers often stem from feelings of exclusion, a lack of confidence, or a feeling of not being valuable enough or not being taken seriously.

During the interviews and the workshop, recognition and providing feedback are emphasized. Multiple FRs, FR2.4 *(Provide tangible appreciation for participation), FR2*.5 *(Ensure feedback visibility),* and FR2.6 *(Interactive feedback & progress tracker)* directly focus on this. Tangible appreciation helps participants feel like their time, input, and effort are appreciated and respected. This is the least researchers and authorities can do to show their gratitude. Besides

tangible appreciation, visible and transparent feedback mechanisms (including life trackers and updates) can strengthen the feeling of participants that they are being heard and taken seriously. Even when their input is not effectively used, participants appreciate feedback on why this is the case and how the project will continue. This feedback should be provided through accessible forms, FR2.8 *(Easy-to-understand feedback forms).* This ensures users feel informed and capable. These forms can be published digitally, but also presented physically.

Further building digital confidence and reducing entry barriers, FR2.7 *(Digital confidence support through onboarding walkthrough),* provides supportive experiences. These onboarding serve as a way of getting acquainted with a digital platform (or other digital tool) in the simplest way. This onboarding can also be supported during a physical session in which residents can walk through the onboarding under the supervision of municipal experts. Tied to this digital confidence is a knowledge base (FR2.2). This knowledge base can be accessed through the digital tool when users have questions about the functioning of the digital tool.

Reminders (FR2.9) and accessible communication help sustain engagement over time. Additionally, to empower participation, internal collaboration (FR2.3) and staff access (FR2.1), ensure that municipal departments can work effectively behind the scenes. Besides having access to the system, all municipal employees should share a common understanding and approach to citizen participation. This shared mindset must be embedded in the organization's culture. This ensures that communication with residents is consistent and inclusive.

Together, these FRs translate the empowering engagement principle into features that foster inclusion and confidence, as presented in Table 18.

*Table 18: FRs of the principle of empowering engagement (DP2). The FRs indicated with * were explicitly stated by experts during interviews or the workshop.*

Principle of empowering engagement (DP2)				
Functional requirement	**Description**	**Process**	**Tool**	**Design needs link**
Enable Single Sign on (SSO) (**FR2.1**)	The municipal staff must sign in using their municipal account		X	DN3
Provide a knowledge base (**FR2.2**)	The system must include FAQ and help options.		X	DN4, DN5
Allow shared project management (**FR2.3**)	Multiple departments should be able to collaborate and co-manage participation project in the same space.	X	X	DN5
Provide tangible appreciation for participation (**FR2.4)** *	Physical sessions must include a form of reciprocal value for participants, such as meals, snacks, vouchers, or local products, as recognition of their time and contribution. These should be culturally appropriate and communicated in advance to	X		DN7

	encourage participation and foster confidence in the process.			
Ensure feedback visibility (**FR2.5**) *	Make sure feedback provided by citizens is made visible to other citizens. This could be through email, newsletter, or the digital platform.	X	X	DN6, DN7
Provide an interactive feedback & progress tracker (**FR2.6**) *	Ensure that participants receive clear, transparent feedback on how their contributions are being used in the design process. Provide a live tracker that shows participants how their input has influenced different stages of the design process. For example, a visual timeline or checklist could demonstrate where their feedback has been implemented.		X	DN6
Ensure digital confidence support through onboarding walkthrough (**FR2.7**)	Provide a simple, optional guided walkthrough (e.g., chatbot or animated tutorial) that introduces core features of the platform for first-time users.		X	DN4, DN7
Apply easy-to-understand feedback forms (**FR2.8**)	Design feedback forms that are straightforward and easy to complete, providing users with guidance on how their input will be used and ensuring that they can see the outcomes of their feedback.	X	X	DN6
Use reminders to participate (**FR2.9**) *	Provide reminders (either digitally or physically) to remind people to participate	X	X	DN6

5.2.3 Functional Requirements for the Principle of Participatory Co-design (DP3)

The FRs related to the principle of Participatory Co-design (DP3) are DN8 *(Enable co-design with citizens, consider their needs)* and DN13 *(Design for intuitive interaction),* and are aimed at a human-centered approach: enabling experiential design, and finally facilitating co-design. FR3.1 *(Facilitate experience through a digital tool (Inclusive participation phase 2)),* emphasizes the importance of first letting marginalized individuals experience a (digital) tool before asking for their needs or feedback, as suggested during interviews. Often, people can not identify their needs simply because they do not know. Experiential design allows users to first become familiar with the concepts of the participation tool. After having experienced the tool, they can meaningfully contribute ideas on features, language, and layout.

FR3.3 *(low-tech prototyping kit)* ensures accessibility and supports inclusivity through workshops for all residents (including those with limited digital literacy). Letting them physically explore ideas can help them contribute visually.

The last requirement, FR3.4 *(anonymous idea submission),* encourages honesty and increases input from those residents who otherwise are not open to engaging. This feedback can revolve around the participation process, or digital tools, or a current participation project, all input is welcome.

These FRs support co-creation, taking into account user empowerment. Table 19 displays the FRs of the principle of participatory co-design.

*Table 19: FRs of the principle of participatory co-design (DP3). The FRs indicated with * were explicitly stated by experts during interviews or the workshop.*

Principle of participatory co-design (DP3)				
Functional requirement	**Description**	**Process**	**Tool**	**Design needs link**
Facilitate experience through a digital tool (Inclusive participation phase 2) (**FR3.1**) *	Develop a digital tool that enables citizens to experience how the system functions in practice. By interacting with the tool, the concept of participation becomes easier to grasp.	X	X	DN8
Facilitate a community co-design session (Inclusive participation phase 3) (**FR3.2**) *	Facilitate co-design workshops with marginalized groups. This process is focused on gathering input on tool features, layouts, and language according to the experiences they gathered in the co-design step 2.	X	X	DN8
Provide an inclusive prototyping kit (**FR3.3**)	Offer low-tech and visual prototyping tools (e.g., card sorting, paper mockups, icon stickers) for in-person co-design with users who have low digital literacy. Also, let participants “try out” ideas.	X	X	DN8, DN13
Provide anonymous idea submission (**FR3.4**)	Allow users to anonymously contribute ideas and suggestions via both digital and offline channels (e.g., SMS, physical boxes at events), lowering barriers and encouraging honest input.	X	X	DN8

5.2.4 Functional Requirements for the Principle of Clarity and Simplicity (DP4)

The FRs under the principle of clarity and simplicity are linked to DN13 *(Design for intuitive interaction),* and DN15 *(Support digital literacy, comprehension, and language support*). These

FRs aim to ensure the communication surrounding the participation process and tool is as clear and straightforward as possible.

Given that well-established guidelines already exist for creating clear interfaces and accessible communication, the FRs linked to these principles are limited to FR4.1 *(Simple communication),* and FR4.2 *(Intuitive interface structure).* These FRs are primarily included for completeness.

Table 20 displays the FRs corresponding to the principle of clarity and simplicity.

*Table 20: FRs of the principle of clarity and simplicity (DP4). The FRs indicated with * were explicitly stated by experts during interviews or the workshop.*

Principle of clarity and simplicity (DP4)				
Functional requirement	**Description**	**Process**	**Tool**	**Design needs link**
Use simple communication (**FR4.1**) *	Ensure all text content, instructions, oral communication, and feedback use plain, non-technical language. Avoid jargon and long sentences. Use short paragraphs and bullet points.	X	X	DN15
Apply an intuitive interface structure (**FR4.2**) *	Design the platform with a clear, consistent layout using familiar UI patterns (e.g., navigation menus, back buttons, icons). Also make sure the importance/impact on participants daily life ("what's in it for me") is clearly visible.		X	DN13

5.2.5 Functional Requirements for the Principle of Trustworthy Transparency (DP5)

The FRs under the principle of trustworthy transparency are linked to DN10 *(Ensure Data Security and Privacy),* DN11 *(Explain AI use and influence clearly),* and DN12 *(Implement transparent Consent Processes).* The main objective of these FRs is to address the lack of trust citizens feel toward authorities (and their use of technology). As such, they prioritize clarity, control, and privacy as key components of trust-building.

FR5.1 *(Clear AI explanation module)* aims at building an understanding of the use of AI in digital tools. It should be made clear how AI is used, using simple language. Additionally, an AI-label should be included for features in digital tools that are powered by AI. This level of transparency helps build confidence in the system and fosters trust between authorities and citizens.

FR5.2 *(Consent control panel)* ensures users have direct control over the use of their data. By allowing individuals to actively manage their consents, this requirement reinforces a sense of autonomy and trust.

Lastly, FR5.3 *(Privacy by default)* provides a guarantee that data protection is given prioritization from the start. It includes a user-friendly privacy settings panel that gives individuals full control over their data, aligning with data minimization principles and legal standards. Even though building trust takes time, the FRs presented in Table 21 provide a foundation to create secure experiences that respect user rights.

*Table 21: FRs of the principle of trustworthy transparency (DP5). The FRs indicated with * were explicitly stated by experts during interviews or the workshop.*

Principle of trustworthy transparency (DP5)				
Functional requirement	**Description**	**Process**	**Tool**	**Design needs link**
Provide a clear AI explanation module and AI-label (**FR5.1**) *	Include a section explaining how AI systems are used in the decision-making process—what data is considered, what AI does, and what it does not do. Use visual aids and plain language. Also, ensure periodic updates on AI use and outcomes to keep citizens informed as AI capabilities evolve. Additionally, include "Powered-by-AI" labels for functions that are using AI. Add a hover feature for users to understand the specific role of AI in each labeled function.		X	DN11
Provide a consent control panel (**FR5.2**) *	Let users access a control panel where they can easily view, manage, or revoke their consents for data usage. Provide checkboxes for specific data types and purposes. Use simple language for this.		X	DN12
Set privacy by default (**FR5.3**)	Ensure that all privacy settings default to the most secure options (e.g., anonymous participation, no data sharing), with users explicitly opting in if they want to share more. Provide a "Privacy Dashboard" to allow users to track data sharing and review historical consent choices.		X	DN10

5.2.6 Functional Requirements for the Principle of Adaptive Accessibility & Feature Definition (DP6)

The FRs corresponding to this last principle, the principle of adaptive accessibility & feature definition, are DN13 *(Design for intuitive interaction),* DN14 *(Allow personalization of AI by the user), DN15 (Support digital literacy, comprehension, and language support),* and DN16 *(Enable 3D visualization).*

These FRs are focused on an actual digital tool and helpful (AI-) features that could be included. While such a digital tool will not solve the problem of limited inclusive citizen participation, interviewees and consortium members do express potential. Most features included in the list of FRs were mentioned during interviews as well as during the workshop. Table 22 displays the list of FRs.

*Table 22: FRs of the principle of adaptive accessibility & feature definition (DP6). The FRs indicated with * were explicitly stated by experts during interviews or the workshop.*

Principle of adaptive accessibility & feature definition (DP6)				
Functional requirement	**Description**	**Process**	**Tool**	**Design needs link**
Apply multi-language interface (**FR6.1**) *	Provide full platform functionality in multiple languages		X	DN14, DN15
Apply accessibility controls (**FR6.2**) *	Allow users to adjust visual settings such as font size, contrast, and color themes to improve legibility and comfort.		X	DN14
Apply text-to-speech functionality (**FR6.3**) *	Enable text-to-speech for all written content (e.g., instructions, feedback summaries), aiding users with visual impairments or low literacy.		X	DN15
Apply speech-to-text functionality (**FR6.4**)	Enable speech-to-text for commenting sections.		X	DN15
Apply a simplified language option (**FR6.5**) *	Provide a feature where people can select a “simpler”, easy-to-understand language for people with low literacy.		X	DN14, DN14
Apply a summarizing option (**FR6.6**) *	Include a summarization function that condenses long or complex information into key points for users with lower literacy		X	DN14, DN15

Ensure mobile and desktop compatibility (**FR6.7**) *	Ensure the platform is fully usable across devices (phones, tablets, computers), adapting layout and functionality to different screen sizes.		X	DN13, DN14
Ensure adaptive content complexity (**FR6.8**) *	Allow users to switch between simplified and more detailed versions of content (e.g., basic vs. advanced views of information)		X	DN14, DN15
Apply a conversational agent (**FR6.9**) *	Provide a conversational agent (chatbot) to which people can voice their opinion and which feels “human-like”.		X	DN13, DN14
Apply interactive 3D models (**FR6.10**) *	Provide interactive 3D models which can be accessed by citizens to see how the urban intervention affects their living environment		X	DN16

Figure 23 present a summary of all requirements, structured by principle.

Figure 23: Summary of the FRs, presented per principle (Author, 2025)

5.3 Beyond Digital Tools: Integration of Technology and Processes

Throughout the analysis of interviews, the workshop, and the development of Design Principles and Functional Requirements, it became increasingly evident that effective citizen participation requires more than the deployment of digital tools. There is a call for the thoughtful integration of technology with inclusive processes that reflect a range of perspectives and needs. The DPs and FRs that have been proposed reflect this dual focus and emphasize how the effectiveness and success of digital participation tools depend closely on the way participation is approached and facilitated. The exploration of multiple perspectives (through the interviews and a consortium of experts) has uncovered various angles, resulting in a diverse understanding that addresses both the practical side of tool design and the broader social dynamics of inclusive citizen engagement.

In response to these findings, Chapter 6 introduces a Co-Design Empowerment cycle composed of three consecutive phases. This cycle outlines essential elements needed to support effective participation processes in the implementation of digital tools. It ensures that tools are not only introduced but are also grounded in inclusive practices that value diverse perspectives.

The proposed phases reflect the dual focus identified in the research: on one hand, the practical and technical requirements for digital tool development, and on the other, the social and relational conditions necessary for meaningful and equitable participation. Figure 24 presents this relationship as a Venn diagram, showing the interconnectivity between participation tools and participation processes, and how their intersection leads to truly inclusive participation.

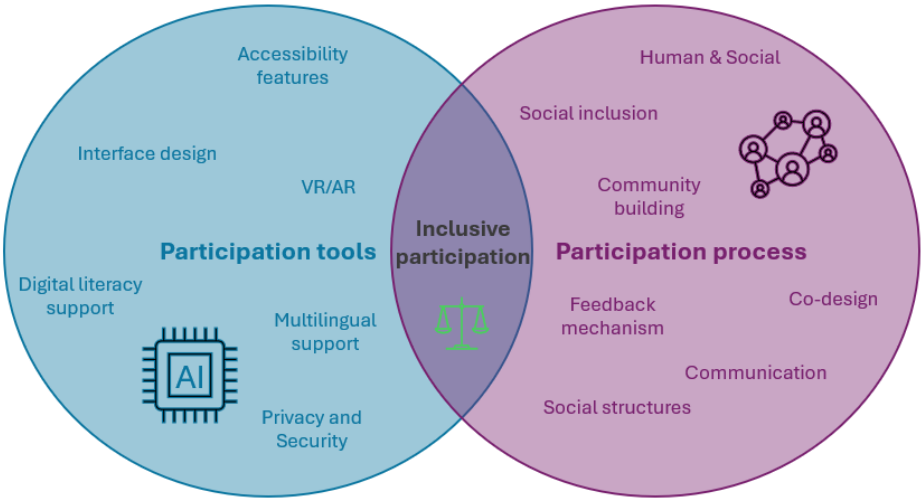

Figure 24: Venn diagram on the interplay of participation tools and participation processes (Author, 2025)

6. Advancing Citizen Participation for Marginalized Groups

Building on the design principles and functional requirements, this chapter discusses how these can be prioritized and implemented in real-world contexts to improve participation for marginalized groups via digital tools. This chapter first presents the final rankings of the Meta Needs, followed by the proposal of a comprehensive co-design empowerment cycle.

6.1 What are the Participation Priorities?

During the workshop, experts were asked to rank the MNs within the pillars. Ranking the MNs within each pillar, from least to most important, helps identify which needs are considered most critical by experts. Specifically, under the Human & Social pillar, eight MNs were ranked; under the Political pillar, four MNs; and under the Technological pillar, six MNs. Experts used a ranking template where they assigned a rank number to each MNs within its pillar. This template is included in Appendix VII. After the workshop, the completed template were collected and analyzed. Using an Excel sheet, the average rankings for each MNs were calculated, eventually resulting in the final ranking.

This is valuable for the guidance of future development, implementation, and management of participation tools, processes, and interventions. Moreover, ranking offers insights into the bottlenecks within each pillar. When needs are consistently ranked most important, it suggests consensus on where improvements are most urgent. Because the ranking was done individually, it also allows for cross-disciplinary insights. The rankings of different fields can be compared to reveal disciplinary alignment. Lastly, ranking strengthens the depth of the analysis by not only stating needs that exist but also how they compare in importance.

6.1.1 Average Rankings

The final ranking of the MNs is based on their average rankings. Please note that this ranking was conducted before any changes were made to the original needs or the additional needs suggested by experts. For this reason, the ranking includes the original needs and numbering, not fully matching the final MNs presented in 4.1 *Identifying Meta Needs.*

Table 23 displays the final ranking of the MNs of the Human & Social pillar according to the experts. *Inclusive participation (MN1)* was rated most important, emphasizing the idea that participation should first and foremost accommodate marginalized voices and overcome social exclusion. Needs like *human-centered design (MN6)* and *personal relevance (MN8)* were also ranked high, suggesting a strong emphasis on tailoring participation to individual expectations and contexts. On the other hand, *participatory literacy (MN7)* was ranked lowest. This suggests that citizens' understanding of the participation process is seen as less urgent than ensuring fair and relevant participation.

Table 23: Final ranking of MNs of the Human & Social pillar according to experts, based on average rank

Rank	MN	Need	Average Rank
1	MN1	Ensure inclusive participation	2,21
2	MN6	Ensure user needs (human-centred design)	3,57
3	MN8	Enhance perceived relevance	3,93

4	MN3	Ensure effective communication and awareness	4,29
5	MN4	Consider existing social interactions	4,36
6	MN2	Increase flexibility in participation formats	4,43
7	MN5	Enhance sustained engagement	4,71
8	MN7	Foster participatory literacy	5,64

Table 24 presents the final ranking of the MNs corresponding to the political pillar. From this pillar, one can conclude that experts prioritize inclusive and legitimate decision-making processes. *Addressing perceptions of power imbalances (MN12)* and *digital rights and protection (MN10)* are rates as slightly less important. This suggests that experts perceived inclusivity and trust as essential for the effectiveness of participatory governance.

Table 24: Final ranking of MNs of the Political pillar according to experts, based on average rank

Rank	MN	Need	Average Rank
1	MN11	Ensure inclusive decision-making	1,58
2	MN9	Enhance trust & legitimacy	1,88
3	MN10	Ensure digital rights and protection	2,15
4	MN12	Address perceptions of power imbalances	2,42

Table 25 displays the ranking of the Technological MNs. Within this pillar, experts show prioritization of *accessibility (MN16)* and *usability (MN15)*. This indicates that the ease of access and user-friendliness of digital participation tools are key. Ensuring transparent *(MN14)* and understandable tools *(MN17)* follow. *Personalization (MN13)* and explanatory features are seen as secondary to accessibility and usability. *Scenario exploration (MN18)* is ranked lowest.

Table 25: Final ranking of MNs of the Technological pillar according to experts, based on average rank

Rank	MN	Need	Average Rank
1	MN16	Enhance accessibility	2,15
2	MN15	Enhance usability	2,31
3	MN14	Ensure transparency	3,00
4	MN13	Allow personalization	3,46
5	MN17	Provide explanatory and understandable system	3,46
6	MN18	Enable scenario exploration	3,69

6.1.2 Cross-disciplinary ranking key insights

The experts present during the workshop varied in their expertise. These fields of domain can be divided into several categories:

1. Design, architecture, and urban planning (DAU)
- Landscape architecture
- Urbanism
- Architecture
- Architecture/computational design
- Social geography and planning
2. Governance and policy (G&P)

- Governance
3. Digital technologies and systems (DTS)
- Information systems
- Design science
- Digital health
- Architecture/computational design
- Urban planning & information systems

When comparing the different fields to each other, some striking patterns emerge.

Regarding the Human & Social pillar, across all disciplines, *ensuring inclusive participation (MN1)* is consistently ranked #1. Regardless of their disciplinary background, experts agree on the importance of open and inclusive participation. However, differences exist as well. DAU experts emphasized human-centered design, social interaction, and communication. G&P, on the other hand, prioritizes participatory literacy and awareness. This underscores the importance of informed citizen involvement. For DTS experts, perceived relevance and sustained engagement were mainly valued, with a stronger focus on user experience.

For the Political pillar, DAU experts ranked *inclusive decision-making (MN11)* highest, whereas G&P prioritized *ensuring trust & legitimacy (MN9)*. This highlights the importance of credible authority and the foundational role it plays in enabling citizen engagement. DTS experts ranked *digital rights and protection (MN10)* highest, which is consistent with their focus on data and system integrity. All domains ranked power imbalance (MN12) lowest. This suggests a shared perception that this issue could be addressed through other needs. Remarkably, *trust & legitimacy (MN9) was* ranked within the top two by all domains, indicating a broad consensus on trust as a prerequisite for effective, inclusive participation. In the Technological pillar, there are clear differences between disciplinary domains in how the MNs are ranked. DAU and G&P experts both rank *usability (MN15) and accessibility (MN16)* as the top priorities. This highlights a shared emphasis on the creation of intuitive and inclusive tools. DTS experts, on the other hand, ranked *personalization (MN13)* and *accessibility (MN16)* highest. This highlights a more technical focus on adaptive systems and inclusive design. Across all domains, transparency (MN14) was ranked consistently in the middle region. *Scenario exploration (MN18)* was ranked differently for the domains. While G&P and DTS ranked this lower, DAU experts value it more highly. These experts seem to recognize the relevance of visualizing the impact of an urban development in supporting citizen understanding.

All in all, these differences present that while some of the needs' importance is aligned, others are more domain-specific. This suggests that interdisciplinary collaboration is necessary in participatory design to address a diverse set of barriers.

6.1.3 Final Rankings of the Meta Needs

Throughout the expert domains, *MN1 (ensuring inclusive participation)* and *MN10 (ensuring trust & legitimacy)* were consistently prioritized. This suggests a consensus on core values like inclusivity and trust, and highlights the need to address these foundational principles. The ranking exercise and discussions during the workshop also illustrate how different disciplines view what is most important in citizen participation. By involving all disciplines, the framework became more balanced and deliberate.

It is important to note that the ranking exercise was conducted based on the preliminary version of the MNS, prior to the incorporation of the MNs suggested by the experts. As a result, the new MNs are not included in the ranking. Even though this affects the final ranking, the additional MNs enhance the overall framework and reflect needs that were otherwise overlooked. These MNs ensure the final framework is comprehensive and aligned with expert input. Figure 25 displays the final ranking of the preliminary MNs per pillar.

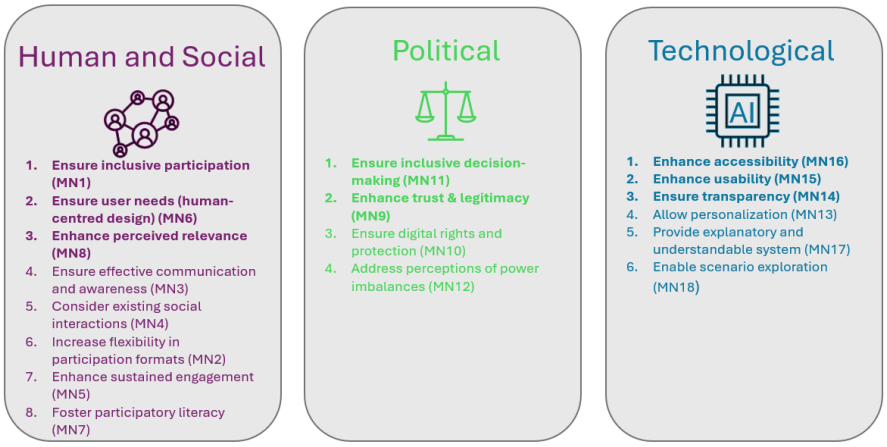

Figure 25: Final ranking of the preliminary MNs per pillar (Author, 2025)

6.2 The Co-Design Empowerment Cycle

The co-design empowerment cycle serves as the overarching framework that brings together the key principles, needs, and functional requirements explored throughout the report. The cycle is designed to guide the development of more inclusive and effective citizen participation processes and digital tools for engaging marginalized groups. The identified priorities in Figure 26 provide a guideline for this cycle. Figure 26 displays the cycles and their chronological phases, and the subsequent sections offer a more detailed explanation of each phase.

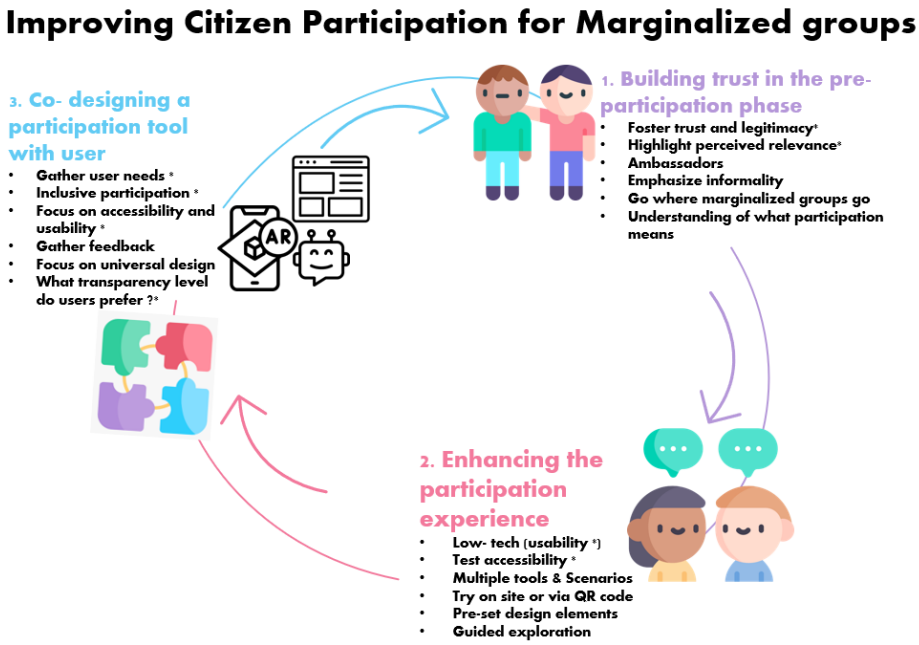

*Figure 26: The co-design empowerment cycle– Framework. The * indicates that the prioritized MNs from Figure 26 were used as inspiration for this phase (Author, 2025)*

6.2.1 Building Trust in the Pre-participation Phase

The first phase introduced within the co-design empowerment cycle is Phase 1: Establishing a trusted relationship. This phase is mentioned in the FRs list as FR1.2 (*Build a trusted relationship with marginalized individuals**). This phase is pre-participation and covers broader social aspects than merely citizen participation. As mentioned previously, marginalized citizens especially face motivational barriers to engage in citizen participation. Various aspects of their lack of motivation (a feeling of not being taken seriously, feeling of not being valuable, etc) are tied with limited trust in themselves and authorities. It is of great importance to first establish a trusted relationship with the marginalized individuals before expecting them to engage in citizen participation. Only once this foundation is established, participatory processes can be introduced.

The key elements of this phase is DN2 *(Engage community ambassadors who understand language/culture)* and several MNs linked to this DN: MN1 (*Ensure inclusive participation**), MN4 (*Consider existing social interactions*), MN7 (*Enhance perceived relevance**), MN8 (*Foster participatory literacy*), MN10 (*Enhance trust & legitimacy*)*. These key elements are included in the visual in Figure 27, which illustrates sequential phases to establish a trusted relationship with marginalized groups.

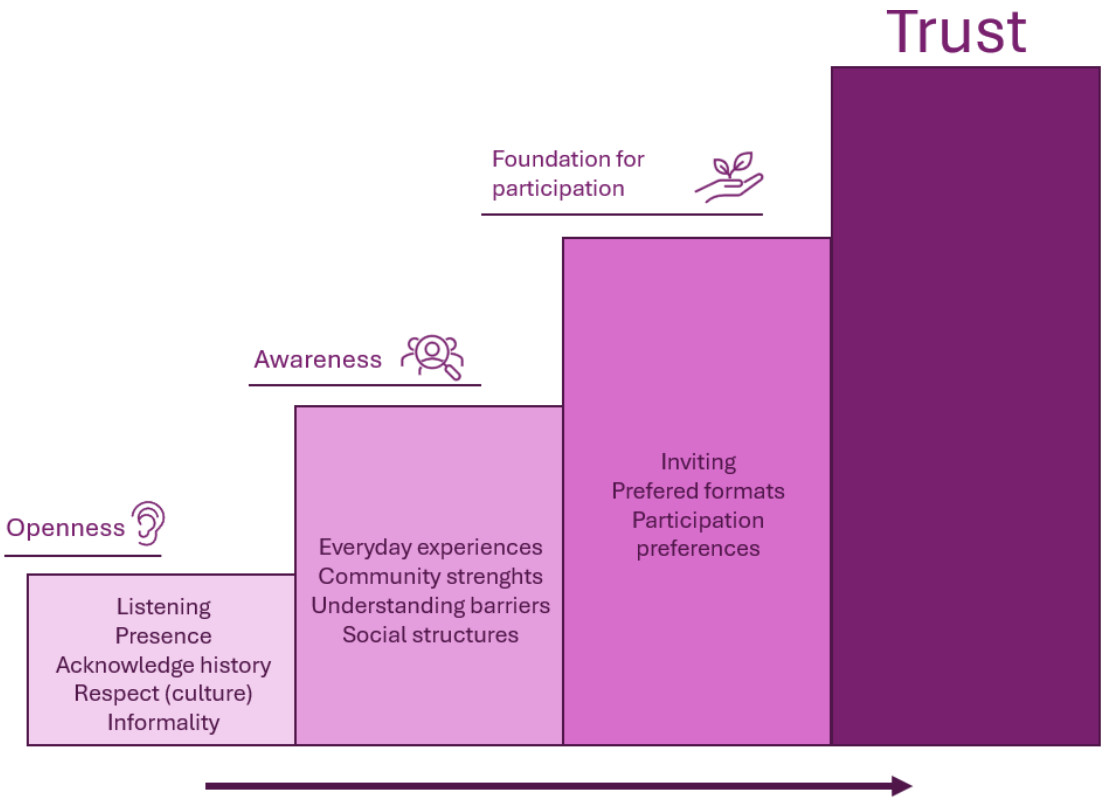

Figure 27: Road to building trust with marginalized groups (Author, 2025)

Openness

The core of this phase is trust. As experts highlight, trust is to be fostered through an individual whom marginalized communities can trust. This can either be a district coordinator of the municipality or another neighborhood figure, as long as they are in close contact with the municipality. These individuals should be consistently present (without a specific agenda) in

community spaces and other places where the target group is present. When applicable, speaking their language or dialect adds value, as it signals respect for the community's culture. Additionally, their communication should be straightforward without the use of municipal jargon (*FR4.1 Use simple communication**). This presence should not be as authorities but as guests, and should be long-term and not one-off. The ambassadors must build a bond with the community through informality and respect. It is also important to acknowledge and get to know them as individuals to gain trust.

Awareness
Once initial trust has been fostered through presence, listening, and respect, the second step focuses on the community's lived experience and their social structures and dynamics. This step aims to explore the characteristics of the community, their strengths, and the barriers they face in interacting with authorities or institutions, and their internal structures. Such exploration helps develop empathy and generate deeper insights. Ambassadors can ask questions about how people live, how they relate to the neighborhood, and similar topics.

Foundation for participation
Once ambassadors reach this step, trust has been fostered and understanding developed. Collaborative participation can now start to take shape. This is not about inviting communities directly, but on their own terms. The focus will be on co-shaping conditions for participation. This involves asking communities how they want to engage (*FR1.3 Ensure participation preference setting**), what kind of processes they are comfortable with, and how they would feel empowered. They can use flyers to inform participants on events (*FR1.4 Provide a local outreach toolkit*). This step also revolves around aspirations. People are not driven by formal policies or calls to engage in citizen participation; they are motivated by better futures for their neighborhood – safer areas, opportunities for their children, and high-quality housing!

6.2.2 Enhancing the Participation Experience

Once a foundation of trust has been established in Phase 1, this second phase facilitates meaningful, inclusive experiences with digital participation tools (*FR3.1 Facilitate experience through a digital tool**). Experts emphasize that marginalized groups are often unfamiliar with digital tools, reducing their likelihood of engaging with them. To address this, this phase introduces the concept of a "Digital Playground"- an interactive environment where participants can explore and experiment with various tools in an informal setting. This digital playground concept involves various stands, each introducing a digital tool in a trial version.

Previously mentioned literature on "Empowerment in HCI", also highlights that technological experiences can be empowering (Schneider et al., 2018). This experience can affect the psychological components (feeling, knowing, doing) of the user.

The key elements of this phase relate to, for example, DN4 (*Provide onboarding and training modules),* DN7 *(Foster user confidence),* and DN11 *(Explain AI use).* The highest priorities of the Technological pillar are also emphasized during this phase: MN17 (*Ensure Transparency*)*, MN18 (*Enhance usability*)*, MN19 (*Enhance accessibility*)*.

The aim of this phase is not simply to let users try a tool, but to let them experience it in a guided, intuitive, empowering way. This should feel like an extension of Phase 1, fostered by a low-tech environment.

Marginalized groups should be enabled to experience a broad range of digital tools, as suggested during the workshop. These tools may range from immersive technologies such as VR and AR (to visualize planning proposals, for example), to more conventional digital platforms that incorporate various (AI-enhanced) features. Moreover, this digital playground allows for explanation to the citizens about the function of AI in participation, as this is a relatively complex concept. The goal is to expose marginalized individuals to the potential of digital tools within a safe environment, ensuring that the tools are accessible, relevant, inclusive, and culturally appropriate.

On this "Digital Playground", participants can engage with a variety of tools, organized into three thematic categories: AI interfaces, digital platforms, and immersive reality (VR/AR). The digital playground is proposed as having various physical stands (*FR1.6 Use a physical stand*) displaying these three categories. While AI is technically embedded within both digital platforms, as immersive environments, it is intentionally presented separately to highlight its importance. AI can seem intimidating, especially for those unfamiliar with its use and how it can contribute to citizen participation. To address this, the AI stand not only offers demonstrations of AI-enhanced tools, but also includes a clear, non-technical explanation about the concept of AI and its potential. Figure 28 illustrates the concept of the "Digital Playground" and the tool categories. This figure especially emphasizes the interconnectedness of the AI features and digital platforms, presented by a Venn diagram.

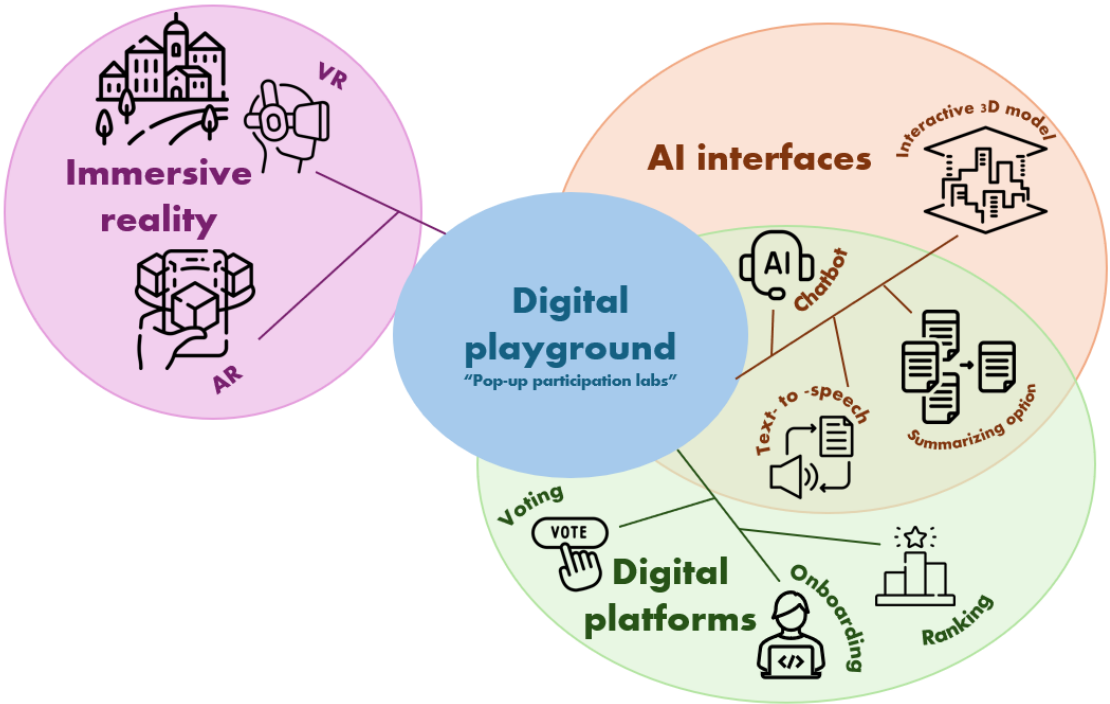

Figure 28: "Digital playground" concept and the corresponding tool categories (Author, 2025)

Table 26 presents a list of tools, the goal they address, and their application that can be incorporated into a "Digital playground". This phase actively facilitates the use of AI features, such as the ones proposed in functional requirements FR6.1 – FR6.10. In this way, AI is made more accessible, understandable, and adaptable to the user's needs. These features can be

experienced on a digital platform, as well as other (non-AI) features. The non-AI features that are commonly preferred by users according to the literature can be provided to reveal whether they are also effective for marginalized groups, as suggested in recent studies (Gonçalves et al., 2024).

Table 26: Suggested range of digital tools presented at the "Digital Playground"

Tool type	Goal of the stand	Example use
AI interface (technically part of the digital platform)	Even though AI features are embedded within the platform, this stand can specifically highlight how AI can enhance the participatory process. In this way, this stand offers educational content about what AI is and how it works in the participation context. This enhances transparency and understanding.	FR6.1 : Multi-language interface FR6.2 : Accessibility controls FR6.3 : Text-to-speech functionality FR6.4 : Speech-to-text functionality FR6.5 : Simplified language option FR6.6 : Summarizing option FR6.7: Mobile and desktop compatibility FR6.8 : Adaptive content complexity FR6.9: Conversational agent (e.g. Bestie) FR6.10: Interactive 3D models
Digital platform	Allow users to try out a participation platform and their features	Essential features as suggested by Gonçalves et al., (2024): Voting, ranking options, interacting on a map, open-ended questions, uploading pictures, interacting with a 3D environment, storytelling, uploading videos, audio recording. Additionally, the layout of the platform should be simple and clear (*FR4.2 Apply an intuitive interface structure*).* An onboarding walkthrough of the platform can also be provided (*FR2.7 Ensure digital confidence support through an onboarding walkthrough*).
Immersive reality	Demonstrate how the urban environment can change by offering immersive experiences. This aims to foster understanding about the relevance of the interventions and highlights its impact on the neighborhood (perceived relevance)	VR and AR: for example a "walk-through" of proposed urban changes to see how it would look like in context

As mentioned previously, these "Digital Playground"- sessions can be held using stands. These "pop-up participation labs" can be located in the neighborhood itself (schools, libraries, community centres). Mobile set-ups can also be used to bring the tool to the people instead

of expecting them to come to the playground. These sessions should be held multiple times at different times (*FR1.1 Provide dual participation channels*) to give people the opportunity to join at a time that suits their schedule (during working hours or not).

Figure 29 displays the stands located at the digital playground. As presented in the visual, every category has its own stand. In order to make the stands accessible and approachable to all marginalized groups, the stands display flags, such as those representing English and Dutch, visually indicating the language spoken by the professional present at the stand. This simple gesture promotes accessibility and encourages interaction. Besides the experts supporting the use of the digital tools, the community ambassadors should also be present on this event. After all, they are the ones who have gained the trust of the marginalized groups and understand their difficulties. The interaction should primarily be informal and straightforward; language used should be simple as well (*FR4.1 use simple communication*).

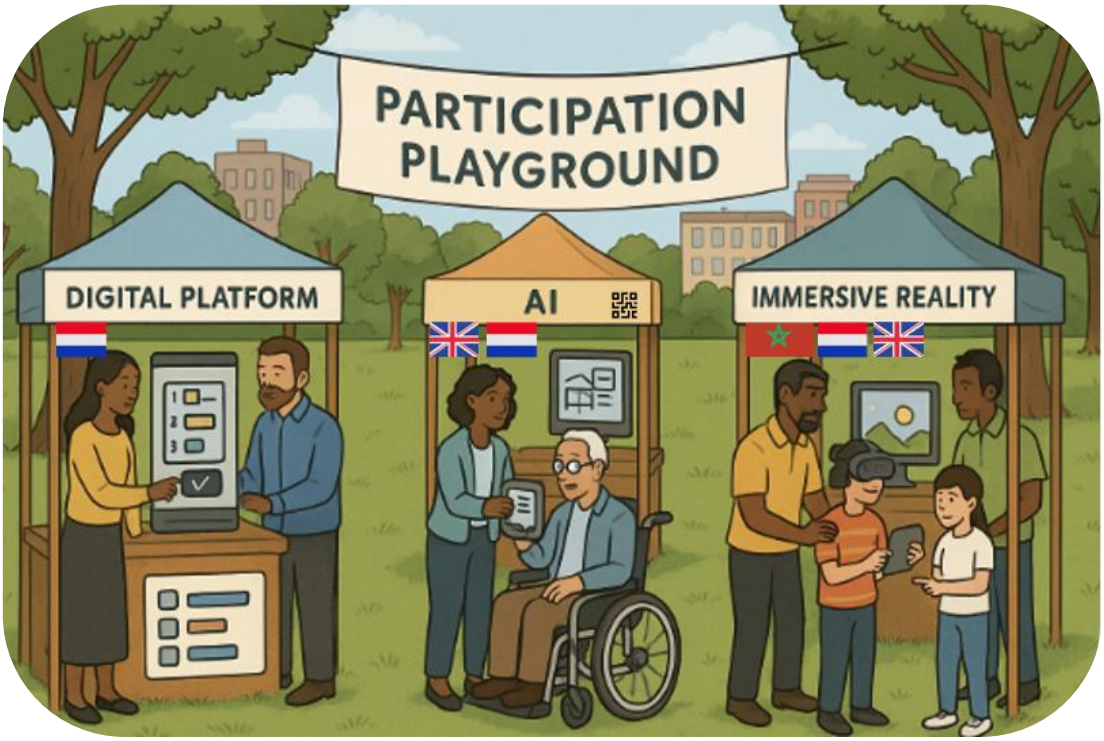

Figure 29: Impression of Phase 2 – Facilitating experience. A "pop-up participation lab" is visualized (Image generated using OpenAI, 2025)

Figure 30 illustrates how such an AI interface on a digital platform could look like: an interactive, user-friendly dashboard where participants can hover over various AI-supported functions, try them, and explore their purposes. It is about giving people the time to play, and discover their needs.

Please note that the following screenshots of the platform interface are retrieved and modified from the municipal website of the Gemeente Best (2025).

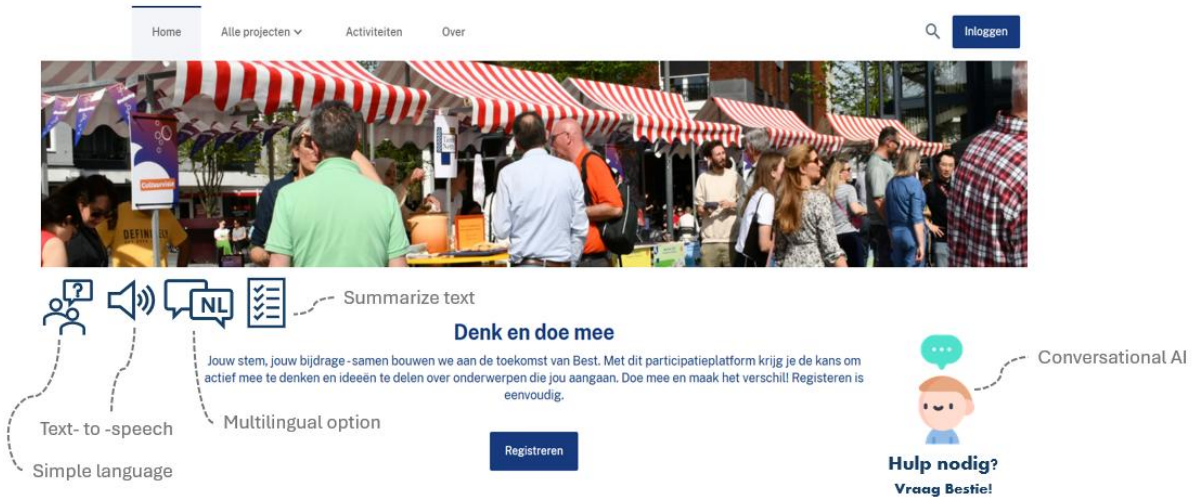

Figure 30: Incorporation of AI features in the interface of the Municipality of Best (adapted from Gemeente Best, 2025) (Author, 2025)

Each AI function is clearly labeled, including a clear "Powered by AI" sign (*FR5.1 Provide a clear AI explanation module and AI-label*). This ensures that users are always aware when AI is being used. Moreover, FR5.2 (*Provide a consent control panel**), and FR5.3 (*Set privacy by default*) add to the transparent use of AI and addresses privacy concerns. This additionally ties back to the principle of trustworthy transparency (DP5). In this way, AI is introduced as a transparent, helpful tool, not as a black box. Figure 31 highlights the AI feature mentioned in FR6.6 *(Apply a summarizing option*).* This function provides the option to summarize a text into bullet points, aiming to improve the clarity and comprehension.

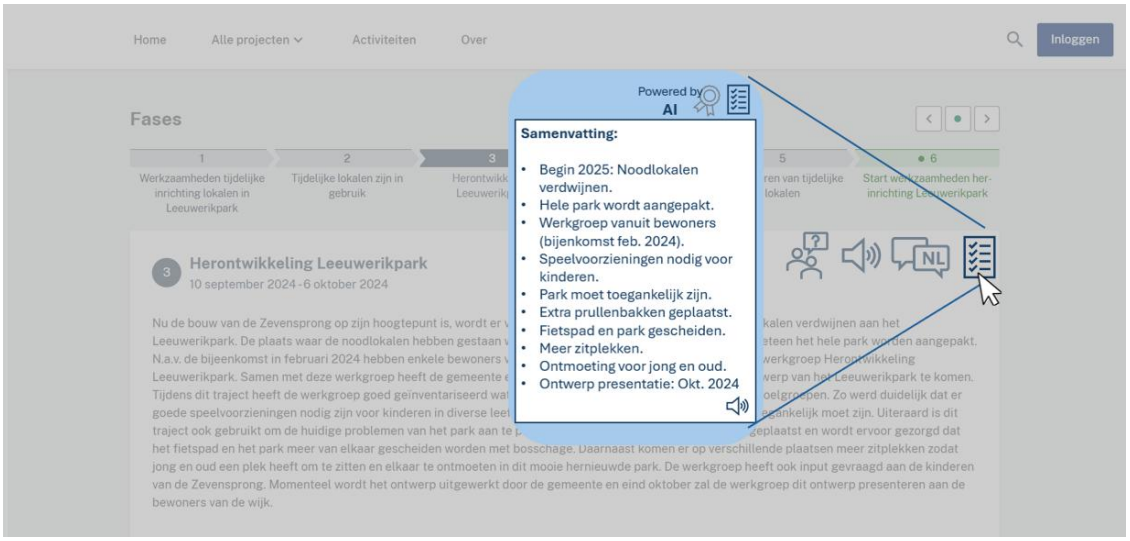

Figure 31: AI feature - Summary function, FR6.6 (adapted from Gemeente Berst, 2025) (Author, 2025)

Figure 32 displays a concept of FR6.5 *(Apply a simplified language option*).* When selecting this option, the text is reformatted in simpler, concise sentences.

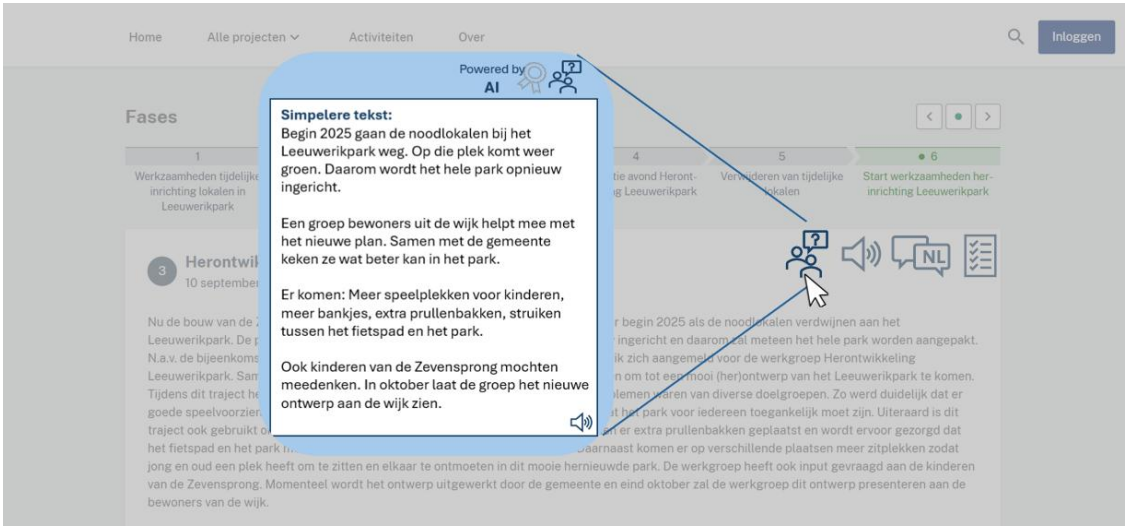

Figure 32: AI feature – Simpler text, FR6.5 (adapted from Gemeente Best, 2025) (Author, 2025)

Figure 33 displays the AI feature of a multi-language interface. This ties to FR6.1 *(Apply a multilingual interface*).* This feature can be customized according to the language most frequently spoken within a municipality.

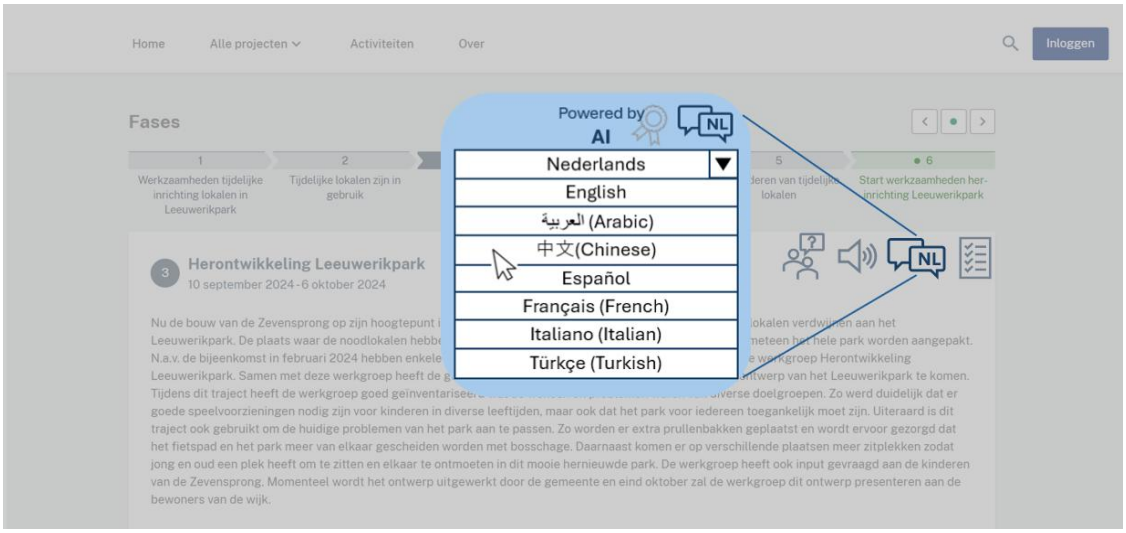

Figure 33: AI feature - Multilingual interface, FR6.1 (adapted from Gemeente Best, 2025) (Author, 2025)

During multiple interviews, the idea of integrating a conversational AI (chatbot), was highlighted as a promising way to lower participation barriers for both marginalized groups and the general public. To enhance accessibility and user engagement, a conversational AI assistant, Bestie, has been introduced as part of a digital participation platform. Bestie functions as a chatbot integrated into the interface, offering real-time support to users navigating the platform. This support can include navigation of the platform, understanding content, and finding relevant information. This feature is particularly useful for individuals who are unfamiliar with digital tools or who face barriers related to language and literacy. Bestie is visible in the corner of the platform interface. Bestie also incorporates several features, such as text-to-speech (FR6.3) and speech-to-text (FR6.4).

Interviewed experts also emphasized the potential benefits of designing a chatbot as a human-like persona to foster trust and relatability. However, among interviewees, the opinions on this feature were divided, as some experts felt that this would be misleading and possibly damaging to the relationship between the resident and municipality.

Besides the potential of a conversational AI, its quality is key. Poorly performing chatbots that misunderstand questions or provide irrelevant responses can cause frustration, as mentioned by interviewees. To address this, Bestie is proposed as more than a basic chatbot, including features like dialect recognition and low-literacy detection.

Bestie aims to empower all users by offering personalized and accessible support. Therefore, Bestie is more than a tool; it represents the inclusive image the municipality wants to convey. Figure 34 displays the interface of Bestie, including the corresponding features.

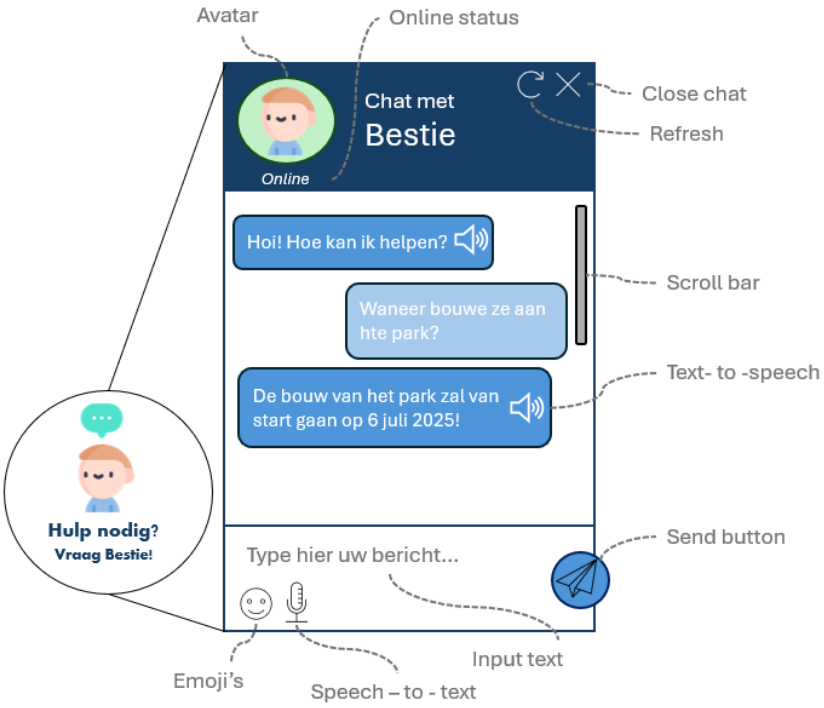

Figure 34: AI feature - Conversational agent "Bestie" (Author, 2025)

6.2.3 Co-designing Participation Tools with Users

The third and final phase of the co-design empowerment cycle focuses on co-designing digital participation tools with the users (*FR3.2 Facilitate a community co-design session*).*

By this stage, the marginalized individuals have established a meaningful and trusted relationship with the authorities (Phase 1) and have experienced various tools (Phase 2). This experience puts them in a stronger position to express their preferences and needs. In contrast to the previous phase, which included demos of various digital tools aiming to facilitate experience with such tools and features, the goal of this phase is to co-create a tool in collaboration with marginalized groups, ensuring it directly addresses these needs. This tool may incorporate features participants liked during the digital playground sessions, or new features they feel are missing. Together, they can create a tool including features that reflect their needs and would motivate them to engage in citizen participation. The paper by

Schneider et al. (2018) also highlights participatory, human-centered design as empowering (Schneider et al., 2018).

This phase is grounded in DP3 (*Principle of participatory co-design*). The aim of this phase is to gather user needs, supported by MN6 *(Ensure user needs*)* and MN1 *(Inclusive participation*).* Moreover, this phase also reinforces key elements such as MN17 *(Ensure transparency*),* MN18 *(Enhance usability*),* and MN19 *(Ensure accessibility*).*

In this final phase, community ambassadors invite marginalized groups to participate in co-design sessions. These invitations can be delivered orally, by mail, or through other preferred channels, depending on individual preferences. To ensure attendance, participants should be reminded of these sessions, in line with FR2.9 (*Use reminders to participate**).

During these sessions, participants are encouraged to reflect on their experiences with the digital tools in phase 2. They are asked to identify their needs; what they found helpful, what was challenging, and what could be improved. Based on these insights, participants, municipal employees, and the community ambassadors take part in iterative prototyping. FR3.3 (*Inclusive prototyping kit*) supports this process by offering resources for inclusive engagement in co-design. To further support honest and open opinions, FR3.4 *(Anonymous idea submission)* can be applied through an anonymous submission box. Through the iterative sessions, new prototypes emerge and are shared with participants for feedback. This feedback can be gathered through easy-to-understand forms as described by FR2.8. It is essential that this feedback is visibly integrated into the next version of the tool, or, if integration is not possible, a clear explanation for this should be provided. The feedback given during the session can be posted online or via mail as well, ensuring everyone can stay up to date and enhancing transparency (*FR2.5 Feedback visibility**). Finally, participants should be rewarded for their participation to show appreciation for their contribution. This can, for example, be done by providing food and drinks or other tangible rewards like gift cards (*FR2.4 Provide tangible appreciation for participation*).

In addition to incorporating the FRS as mentioned, this phase also offers opportunities to include AI in supportive ways. For example, AI can assist in summarizing key themes and ideas that emerge during co-design sessions. Automatic translation tools can enhance inclusivity by enabling non-Dutch participants to engage in discussions. Moreover, generative AI can be used to create real-time visualizations of design choices (for example, interface previews). This allows participants to immediately see how their inputs and contributions could be implemented. However, it is important to note that this phase should remain personal and not rely on AI fully. The strength of this phase remains with the personal approach, fostering a trusted, inclusive environment.

This phase goes beyond fostering higher quality and relevance of the digital tools. Co-design also enhanced a stronger commitment. Involving marginalized groups in the design of a real digital tool ensures that their inputs and opinions are taken seriously. When individuals feel like their ideas are reflected in the tools they use, engagement and trust in the process are strengthened. Figure 35 presents a visualization of a co-design workshop.

Figure 35: Impression of Phase 3 - Co-designing tools with users (Image generated using OpenAI, 2025)

Figure 36 displays the connections between the phases of the co-design empowerment cycle and the functional requirements that can be implemented in this phase. It should be emphasized that not all requirements are presented within the framework. FR1.5 (*Use a community event scheduling system*), FR2.1 (*Enable single sign-on*), FR2.2 (*Provide a knowledge base),* FR2.3 (*Allow shared project management*), and FR2.6 (*Provide interactive feedback & progress tracker*)* represent system-level, organizational, or administrative features rather than directly contributing to the goals of the cycle. While valuable, these FRs are more tailored to the infrastructure of a platform and the efficiency of the organization within the municipality. Including these features in one of the phases could overwhelm the participants. Even though they fall outside the scope of the cycle, they are important to keep in mind for later stages and can still be incorporated into the broader system architecture.

This co-design empowerment cycle spans from establishing trust and openness, through experiential engagement, to collaborative co-design. The cycle serves as a framework for empowering marginalized groups. By fostering an inclusive environment at each state, this cycle paves the way for more equitable decision-making and a society where every voice truly matters. Ultimately, this approach aims to strengthen communities and promote more meaningful participation that reflects the diverse perspectives and needs within society

Figure 36: Linking the Functional Requirements to the phases of the co-design empowerment cycle (Author, 2025)

6.3 The Future Outlook on AI in Citizen Participation

This chapter examined the co-design empowerment cycle and its potential to support marginalized groups in the development of digital (AI-enhanced) participation tools. This framework includes trust-building, experiential engagement with digital tools, and iterative co-design sessions of a participation tool. The focus was especially on AI functions such as conversation agents (e.g. Bestie), text-to-speech functionality, multilingual support, et cetera. These features are aimed at lowering barriers to participation and fostering inclusivity.

To conclude, it is valuable to zoom out from this niche context and consider the broader implications of AI for citizen participation in the upcoming decade. It is important to consider the potential role of AI in citizen participation. While current applications already contribute to enhancing accessibility and inclusivity, future developments could lead to more meaningful forms of citizen participation. Future thinking helps envision how AI might enable new forms of participation. Without ignoring its challenges and ethical concerns, these perspectives highlight AI's potential.

For example, AI-equipped sensors and cameras could be used during participation events to analyze facial expressions, vocal tones, and body language of participants to detect engagement levels, confusion, satisfaction, or exclusion. When emotional reactions or signs of

disengagement are detected, municipal employees or community ambassadors are notified in real-time on their devices (e.g., mobile phones or smartwatches). This would allow facilitators of the event to respond effectively in the moment. They could adjust their approach or address uncertainties. Such monitors are especially valuable as they may capture subtle hints that facilitators might otherwise overlook. This helps create a more supportive and inclusive environment.

Secondly, chatbots could be further developed, as also mentioned by two interviewees. Beyond text comprehension, future conversational AIs could be trained to recognize emotions and respond in more empathetic, human-like ways. This allows individuals to share their opinions without feeling like they are interacting with a computer. This has the potential to make digital participation feel more personal. Additionally, such a remote interaction takes away any potential social pressures.

In addition, AI could act as a co-creator during participation sessions. Participants may give raw ideas (e.g., through voice notes, text, or sketches) as input, which AI, powered by LLMs and image-generation models, could help develop into more refined concepts. Besides co-creation, AI can also serve as a visual note-taker in real-time. Spoken ideas during meetings could be translated into mind maps, diagrams, or infographics. This can support understanding and reflection. In settings where sticky notes are used, AI-equipped cameras with image recognition capabilities could capture and summarize inputs, helping to interpret information in an effective way.

One interviewee also highlighted the potential of real-time multilingual interpretation. This would allow non-Dutch speakers to participate in Dutch meetings. Automatic translation delivered through mobile devices or headphones could significantly enhance accessibility and foster a more inclusive participation environment.

Altogether, these speculative applications illustrate how AI could expand the possibilities for more inclusive and engaging forms of citizen participation. In this future, participation is not about ticking boxes and distant technologies. Instead, AI is seen as a collaborative partner. While technological innovations like these alone cannot address deeply-rooted social inequalities, the integration of AI (in an ethical way) holds valuable potential to reshape current participation practices.

7. Discussion and Conclusion

The results of this research offer valuable insights into inclusive citizen participation processes and digital tools. However, this research also faces some limitations that should be taken into account.

The initial objective of this study was to develop a conceptual design for an AI-enhanced digital tool to support inclusive citizen participation. However, during the interviews, it became evident that the topic was too complex and required more in-depth investigation. The issue at hand presents a wicked problem, and the gap between the ambitions and the knowledge and resources available was simply too large to address in the period of this study.

As a result, the focus shifted toward a more in-depth exploration of inclusive participation and how digital (AI-enhanced) tools and processes could support it. This led to the formulation of the following research question:

"How can marginalized groups be integrated into public participation for decision-making of urban interventions through inclusive (AI-enhanced) digital tools and processes?

This chapter reflects the research process, including the limitations and their consequences on the research. Moreover, the relevance of this thesis and recommendations for future research will conclude this chapter.

7.1 Summary and Interpretation of the Results

Section *1.2 Problem Statement* highlighted that the needs and barriers of marginalized individuals are often not sufficiently addressed in participation frameworks and digital tools, contributing to persisting inequities. Moreover, the benefits that AI-enhanced digital tools could present remain underexplored. Additionally, the literature on inclusive design for citizen participation processes and tools remains limited.

To address these gaps, a Design Science Research (DSR) Methodology was applied, including problem investigation, treatment design, and treatment validation (Wieringa, 2014). Additionally, the cycle by van Aken and Romme (2009) was incorporated as this cycle focuses more on the problem investigation, which was particularly relevant in this study. Before designing the solution, a thorough understanding of the problem and context was necessary.

The findings reveal that certain groups - youth, immigrants, people with lower socio-economic status or education levels, the elderly, individuals with disabilities, and those with limited literacy skills - are consistently underrepresented in citizen participation. Interestingly, the findings did not highlight women and single individuals as marginalized groups, in contrast to the literature.

Previous research suggests that these groups (and the general public) face practical, personal, motivational, and socio-economic barriers (Lightbody, 2017). While the majority of the barriers mentioned in the literature align with this study's findings, this research reveals a strong emphasis on the motivational challenges, such as a lack of trust in authorities and perceived irrelevance. Although existing literature suggests that enhanced accessibility

(through AI-technologies), could increase diversity and engagement (Lahdili et al., 2024), the findings of this research suggest more is required. Practical accessibility was not the biggest concern raised in the interviews. Instead, the main barriers identified by the interviewees were social rather than technological. Issues related to existing social structures, cultural differences, and the need for community building were unexpected, as the literature review did not touch upon these. These insights highlight the deeply social and culturally rooted nature of participation barriers.

Furthermore, literature states AI systems should be transparent, accountable, reliable, safe, and trustworthy, and that the tools should not be designed behind closed doors (Wong et al., 2022). This principle was strongly emphasized and confirmed by the results of this thesis, eventually expressed in Phase 3 of the co-design empowerment cycle.

The motivational challenges were mainly addressed through the development of Meta Needs (MNs), which were organized under three pillars: Human & Social, Political, and Technological. Experts prioritized inclusive participation, user-centered design, and perceived relevance (Human & Social), inclusive decision-making, trust & legitimacy (Political), and accessibility, usability, and transparency (Technological).

The Design Needs (DNs) refined these MNs into more specific needs, and address themes like municipality-neighborhood collaboration, stakeholder understanding & information access, clarity and communication gaps, and functional scope & feature definition.

While AI-enhanced digital tools (e.g. chatbots, text-to-speech, and multi-language support) show potential for inclusive participation, the findings clearly indicate that technology is not the ultimate solution to unequal participation. Instead, the solution to this “wicked” problem lies at the intersection of inclusive citizen participation processes and tools.

The treatment design phase resulted in six guiding Design Principles: the Principle of Inclusive Outreach, Empowering Engagement, Participatory Co-design, Clarity and Simplicity, Trustworthy Transparency, and Adaptive Accessibility. These were translated into functional Requirements (FRs) and ultimately led to the “Co-Design Empowerment Cycle” framework. This framework emphasizes building trust, involving marginalized groups early on in the process, and the co-design of digital tools.

The results should be interpreted as a call to rethink how citizen participation is approached, specifically when targeting inclusivity. While digital tools are promising, the barriers that marginalized groups experience are predominantly social and motivational, rather than technological. The underscores that effective, inclusive participatory strategies start with long-term relationships, not technologies.

A key insight is that marginalized groups can not be expected to adapt to pre-designed participation tools. Instead, municipalities and designers should adapt their tools and processes to the lived experiences, preferences, and barriers of these groups. The co-design empowerment cycle reflects this by prioritizing trust-building through community ambassadors, learning from experiences, and gradually introducing digital tools before co-designing them with users.

Moreover, the results present that municipal commitment, capacity, and resources are critical for inclusive participation. Without these elements, even the most sophisticated tools will fail to reach the marginalized groups.

Finally, the integration of marginalized groups requires more than inclusive features; it asks for an inclusive mindset and inclusive processes. Eventually, this will result in true empowerment.

7.2 Limitations

One of the main limitations that poses a shortcoming of this research is the absence of direct input from the marginalized groups for validation and identification of barriers. Although attempts were made early on in the process to reach the target group, this proved more difficult than anticipated. While the interviewees had relevant experiences and provided valuable insights, some observations are speculative and can not be fully confirmed. Therefore, although the identified barriers are considered sufficiently reliable for this exploratory study, they might not fully reflect the real-life context. This thus remains a limitation, as direct engagement with marginalized individuals would have added greater depth and validity to the findings.

Moreover, the various marginalized groups identified were not studied individually but treated collectively under a general “marginalized group” category. This choice relied on the explorative nature of this study, which aimed to develop a thorough understanding of inclusive participation before delving deeper into the specific groups. As a result, certain group-specific needs may have been overlooked.

Thirdly, the ranking exercise during the workshop only involved the original set of Meta Needs, excluding the Meta Needs that were added during the workshop itself. Consequently, the actual final rankings might differ slightly from those reported.

Lastly, the co-design empowerment cycle developed in this study has not been validated by experts or by the target group due to time constraints. Even though the framework is grounded in experts' insights and literature, its effectiveness and relevance were not tested. Similarly, the Design Science Research (DSR) methodology suggests the last step is Treatment Implementation, which was excluded in the scope of this study. As such, the proposed framework, design principles, and functional requirements should be regarded as preliminary.

7.3 Answering the Research Questions

This thesis discussed the engagement of marginalized groups in citizen participation through a DSR (Design Science Research) methodology. The central objective was to explore how citizen participation processes and (AI-enhanced) digital tools can be designed and implemented to foster the inclusion of marginalized groups into decision-making for urban interventions in the Netherlands. The study aimed to explore the field of inclusive citizen participation and the role of emergent digital technologies in this. The research served a multi-perspective angle to retrieve a view of the current participation practices. The main question was as follows:

“How can marginalized groups be integrated into public participation for decision-making of urban interventions through inclusive (AI-enhanced) digital tools and processes?

This central question was supported by the sub-questions:
Q1: What is public participation and what does social inclusivity mean in this context?
Q2: What are traditional methods of citizen participation?
Q3: Which marginalized groups are underrepresented in public participation for decision-making of urban interventions?
Q4: What challenges and barriers do marginalized groups face in (digital) participation
Q5: What are digital tools, their functions, and what is the role and potential of Artificial Intelligence (AI)?
Q6: What are the critical design elements and features that are necessary for a citizen participation process and digital tool to be inclusive and effective?
Q7: What do stakeholders think of the conceptual needs for an inclusive citizen participation process and tool?
Q8: How can citizen participation processes and (AI-enhanced) digital tools be implemented for usability and inclusivity among marginalized groups?

These sub-questions were (explicitly) answered throughout the study, and all contribute to answering the main research question.

The aim of the first research question was to clarify the concepts of public participation and social inclusivity within the context of citizen participation. *Public participation* indicates the involvement of citizens in decision-making processes that affect their everyday lives, communities, and urban environment. Arnstein offers one of the most influential definitions, and refers to it as: “the redistribution of power that enabled the have-not citizens, presently excluded from the political-economic processes, to be deliberately included in the future.” (Arnstein, 1969, p.216). Her “Ladder of Participation” outlines various levels of involvement, from consultation to full citizen control. She emphasizes the importance of active involvement and contributions from the early start of a project (Arnstein, 1969). These, and various other frameworks, such as IAP2’s Spectrum of Public Participation (IAP2, 2018), emphasize the potential for meaningful citizen engagement and highlight the importance of empowering individuals to engage in decision-making that concerns their daily lives. *Social inclusivity* refers to ensuring that all citizens, especially those from marginalized groups, have equal chances to engage in societal activities (Nwachi, 2021). The World Bank (2013) defines social inclusion as “The process of improving the terms on which individuals and groups take part in society – improving the ability, opportunity, and dignity of those disadvantaged based on their identity.” (World Bank, 2013). Together, these concepts underscore the importance of inclusive governance: ensuring meaningful and equitable opportunities for all citizen to influence decisions that affect their living environments.

The second sub-question aimed to identify and understand traditional methods used to engage citizens in participation. Traditional methods – such as public hearings, surveys, and focus groups – are primarily designed to inform or consult the public, rather than give them decision-making opportunities (Rowe & Frewer, 2013 ; Shipley & Utz, 2012). Petts and Leach (20000) classify these methods as “traditional” as their focus is on information provision and feedback collection, in contrast with more innovative forms of participation.
Sub-question three has been addressed through both literature and interviews, and the types of citizens participating have been identified. One distinguishes engaged (active) and

disengaged (passive) citizens (Agger, 2012). One category of the disengaged citizens is the non-participants, in other words, the marginalized citizens (Li & Marsh, 2008). The literature identifies several groups as part of this category: youth, immigrants, refugees, ethnic minorities, individuals with lower socio-economic status or levels of education, the elderly, women, people with disabilities, individuals with limited literacy skills, and those who are single, either never married or previously married. These findings mostly align with interview results. However, contrary to the literature, women and individuals who were once married or never married have not been mentioned during the interviews.

In response to the fourth sub-questions, both literature and interview findings highlight a broad range of barriers that citizens face in (digital) citizen participation. Lightbody (2017) categorized the barriers into four types: practical, personal, motivational, and socio-economic barriers. Practical barriers are, for example, a lack of resources available (e.g., financial) or no access to digital devices or the internet. Personal barriers include low self-confidence, language difficulties, limited knowledge of participation processes, and digital illiteracy (especially among older adults or those with limited educational background). Motivational barriers were most emphasized during the interviews. Interviewees highlighted the lack of trust in authorities, skepticism about the value of their input, discomfort, and a general idea that participation is not “targeted at them”. Socio-economic barriers are less detailed in the literature, but touched upon during the interviews. Poverty, migration stress, discrimination, and a general lack of empowerment were highlighted as key factors limiting their engagement. Moreover, barriers specifically in the digital environment include unequal access (e.g. digital divide), poor user interface design, and limited digital skills. Overall, the results show that marginalized groups face various (overlapping) barriers that significantly hinder their engagement in both traditional and digital citizen participation.

The fifth sub-question was included to introduce digital participation tools and the potential of these in inclusive citizen participation. Especially after 2020, a shift was made towards the digital world. Following the pandemic, (digital) lives are enhanced through technologies like Artificial Intelligence (AI). Digital participation refers to the engagement of individuals in activities facilitated by digital technologies. This digital participation aims to overcome the challenges that traditional citizen participation methods introduce. The functions of digital tools range from human-human interactions to human-machine interaction and artificial intelligence (AI) (Shin et al., 2024). These three categories include multiple functions. The first category, for example, holds voting, surveys, and gamification, while human-machine interaction refers to functions like 3D modelling and virtual reality (VR). The last category includes functions like speech recognition, multi-language support, and natural language programming. Literature shows high hopes for AI in citizen participation as it can potentially break down accessibility barriers. AI can, for example, support a multilingual digital environment and tailor content to the needs of individuals through personalization. AI-enhanced tools like chatbots and voice assistants can empower marginalized groups. While these technologies can improve usability and accessibility, both literature and interviews highlight concerns related to bias, transparency, and the safety of the use of AI. Also, AI (and digital tools in the broader sense) should be seen as supportive elements within the broader human-centered approach.

The sixth sub-question is answered by the interviewees. This sub-question aimed to identify actual design features for a future digital tool aimed at engaging marginalized groups in citizens' participation. Even though the interviewees mainly provided insights about the citizen participation process in general, some features were mentioned as potentially improving accessibility and usability. These features are: multi-language support, simplified text option, chatbots, summary option, 3D visualization, generative AI, and text-to-speech functionality. Moreover, many interviewees emphasized that meaningful engagement must begin with a deeper understanding of the marginalized groups. Additionally, they stressed that no single digital tool will be able to solve the complex challenge. These groups are very diverse and have different needs. This means a one-size-fits-all approach is unrealistic.

Sub-question seven addresses the validation of the Meta Needs (MNs) and Design Needs (DNs) during the workshop (treatment validation) by the experts. During this workshop, the MNs and DNs were presented, and the experts were asked for their feedback and additional suggestions. Overall, they agreed with the proposed needs and supported the focus on human & social, political, and technological factors. The political pillar in particular was emphasized. They noted issues such as a lack of commitment, time, and resources within municipalities. Also, there is a need for municipal employees to be familiar with the citizen participation process and digital tools. This led to the addition of the following MNs: Ensure commitment from political authorities (MN13), Ensure time capacity to support participation by local authorities (MN14), and Ensure ownership of participation tools (MN15). Additionally, some overlapping MNs were merged as suggested by the experts. They were also asked to link barriers – practical, personal, motivational, and socio-economic - to the MNs. From this, it became clear that the motivational barrier is most often addressed, emphasizing that the nature of the challenge is social, not technological. When asked to rank the MNs, experts value inclusive participation, ensuring user needs, and enhancing perceived relevance the most within the Human & Social pillar. Regarding the political pillar, inclusive decision-making and ensuring trust & legitimacy are prioritized. Lastly, for the technological pillar, accessibility, usability, and transparency were ranked highest. The experts also reviewed the DNs and agree with most of them. However, they suggested additional DNs focused on the role of municipalities. In many cases, public authorities do not have the capacity and expertise for participation. This emphasizes the need to embed participation into existing planning processes. Furthermore, they stressed the importance of clearly communicating information about the project (time-line-wise, the big frame) to the residents. This resulted in the addition of the following DNs: Integrate participation into existing municipal workflow (DN3), Provide institutional onboarding and training modules (DN4), Support interdepartmental collaboration (DN5), and Communicate project context & timeline clearly (DN9). Finally, the experts highlight that the solution should not begin with tool design and expect the marginalized groups to adapt to these. The core issues are social, not technical, as had also emerged from earlier interviews.

The final sub-question is addressed through the development of the co-design empowerment cycle. To ensure that citizen participation is usable and inclusive, marginalized individuals must be involved early in the development of the participation tool and methods. This cycle offers a practical framework for municipalities that are committed to meaningfully engaging marginalized groups in their communities. The phases of this cycle stem directly from insights gathered during both interviews and the workshop. The aim of the cycle is to guide the design

of a digital tool that fits the needs of marginalized communities. Prioritized MNs from the workshop have been translated into the structure of the cycle, with MNs, DNs, Design Principles (DPs), and Functional Requirements (FRs) integrated in various phases. The first phase focuses on establishing a trusted relationship with the marginalized group (through a community ambassador). This includes listening, showing respect, and being present in informal, community settings. After this, awareness should be raised and everyday experiences, social structures, barriers, and strengths of the community should be researched. Lastly, the target group can be invited to participate in phase 2. During this phase, residents are allowed to experience various digital tools. Through (supervised) experience, they can form opinions on such tools and different features and functionalities. This helps them to identify what works for them and what does not. In the third and final phase, participants are actively involved in the co-design of the digital tool. Their needs and preferences are directly addressed, and their feedback is used to shape the design of the tool. This participatory approach ensures that the final product reflects the user's needs.

7.4 Scientific Relevance

This thesis holds scientific relevance by contributing to the growing, but still underdeveloped, body of literature on inclusive citizen participation, specifically focusing on digital tools. There remains a significant gap in understanding and addressing how marginalized groups can be meaningfully involved in (digital) citizen participation processes. By proposing the co-design empowerment cycle – consisting of trust-building, facilitating experience, and collaborative tool development – this study offers a practical and theoretical framework that supports empowerment and active, long-term participation of marginalized groups.

Furthermore, a key scientific contribution is the recognition of this problem being complex and “wicked”, which cannot be solved by a one-size-fits-all solution. This led to a shift in the research, from developing a digital tool to a broader framework for inclusive participation. The research adopts a multi-perspective approach, which captures this complexity of inclusive design. This approach emphasizes the multifaceted nature of inclusion, emphasizing the interconnectivity of human & social, political, and technological factors. By doing so, this thesis not only contributes to theoretical research but also offers practical guidance. These preliminary findings provide a foundation upon which future research can build, further exploring methods for empowering marginalized groups through co-design.

7.5 Social Relevance

This thesis holds significant societal relevance as it addresses the challenge of engaging marginalized citizens in decision-making processes for urban interventions. By exploring how AI-enhanced digital tools, in combination with an inclusive participation process, can empower these groups, this study contributes to broader democratic and societal objectives. The findings of this thesis aim to promote social inclusion, enhance active citizenship, and reduce barriers that marginalized groups experience in decision-making processes. These efforts are of great importance to ensure equitable governance that genuinely reflects the needs and voices of all citizens, including those who are often underrepresented. Ultimately, insights from this research support more inclusive cities, where marginalized groups are heard, respected, and meaningfully involved in shaping decisions that affect their neighborhoods and daily lives.

The results offer actionable insights for municipalities by identifying needs across different levels. These needs, along with the outlined principles, requirements, and the final co-design empowerment cycle, provide a concrete foundation for local governments to take informed and inclusive action. Furthermore, the study offers practical value to citizen participation organizations and innovators in the field of inclusive engagement.

7.6 Recommendations

As this thesis offers an exploratory investigation into the intersection of citizen participation, marginalized groups, and digital (AI-enhanced) tools, further research is essential to deepen the understanding and validate findings. First of all, as Phase 1 of the co-design empowerment cycle suggests, future studies should focus on identifying and understanding the barriers that marginalized groups face (from their perspectives). This required building trusted relationships, ideally in collaboration with community ambassadors who can act as mediators and advocates. In addition, moving beyond a generalized view of “marginalized groups” to consider more specific characteristics, such as ethnicity, disability, and socio-economic background, will enable more targeted and responsive participation strategies. Tailoring processes to the unique experiences and needs of different groups is critical to designing effective and inclusive interventions.

The co-design empowerment cycle should be tested in real-world settings to assess its usability and relevance for marginalized communities. Gathering direct feedback on this framework will provide valuable insights into how it can be adapted and improved in practice. While this thesis benefited from input across several expert domains, further interdisciplinary collaboration is needed to enhance the depth and applicability of the findings.

Finally, Phase 2 of the participation cycle – focused on co-design and prototyping – warrants further exploration. This includes the development and testing of AI-enhanced functionalities proposed in this study, to evaluate how they perform in practice and how they are perceived by users. By continuing this line of inquiry, future research can build on the foundations laid here to develop more inclusive, responsive, and equitable citizen participation processes, ensuring that digital innovation not only enables participation but actively empowers those who are too often left out of it.

7.7 Final Conclusion

In conclusion, the findings from the sub-questions come together in the co-design empowerment cycle, offering a comprehensive, actionable response to the main research question. Marginalized groups can be integrated into the public participation for decision-making around urban interventions by involving them early and meaningfully in the design of digital tools and participation processes. This requires an approach that starts with trust-building and a thorough understanding of the lived experiences, needs, and barriers of these groups. By establishing a trusted relationship, municipalities can create a foundation for meaningful engagement. Once a trusted relationship has been built, experience with digital tools can be facilitated, eventually leading to co-design with the user.

True empowerment of marginalized groups starts with understanding their lived experiences and involving them directly in designing the tools and processes that shape their participation.

The main objective of this research was to explore how public participation processes and (AI-enhanced) digital tools can be designed and implemented to foster the inclusion of marginalized groups into decision-making. This objective was addressed through a methodology that included a literature review, semi-structured interviews with experts from various fields, a validation workshop, and the development of an inclusive co-design empowerment framework. Although the initial approach included interviewing individuals from marginalized groups, the decision to focus on academic and professional experts still provided valuable insights. However, this still poses a notable shortcoming that should be addressed in future research.

Initially, the project aimed to develop a concept for a digital tool that would help support marginalized groups in decision-making processes. However, during the interviews, it became clear that the issue is a complex, multifaceted problem with social causes (a “wicked” problem), which can not be easily solved by a one-size-fits-all solution. For this reason, the focus shifted toward a broader, bird-eye view of inclusive participation processes and digital tools. This shift allowed for a more comprehensive understanding of the needs and requirements necessary for meaningful engagement. Ultimately, this led to the development of an actionable framework, instead of a specific digital tool.

All in all, this research provides new insights into an emerging field that intersects citizen participation with digital tools and addresses marginalized groups within this context. Valuable insights are retrieved with relevance for both academia and municipalities. Even though the study faces some limitations, it succeeded in framing a practical, human-centred approach to a complex societal issue.

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9. Appendices

Appendix I - Informed Consent Form

Information sheet for research project "Advancing Inclusivity: Exploring AI-Enhanced Digital Tools for Marginalized Groups in Citizen Participation"

1. Introduction

Eindhoven University of Technology (TU/e) invites you to take part in this research project which aim is to explore how AI-enhanced digital tools can promote inclusive public participation for marginalized groups in active decision-making in the Netherlands, particularly in decision-making for active living interventions. The collected data will be used for a master thesis as well as scientific publications . You receive this invitation because your insights will contribute valuable perspectives to this research.

Your participation in this study is entirely voluntary. You will not receive financial compensation for your participation.

Joining this research project is your choice. Your participation is completely voluntary and does not pose any physical, legal or economic risks. You are not obliged to answer questions you are uncomfortable with, and you can withdraw from the research at any time without explaining why. Declining or withdrawing will not have negative impact for you.

Before you decide, please read the following information to understand what the project is about, what we expect from you and how we handle your personal data. After reading, you can sign up by completing the attached form.

If you have questions, feel free to contact us (contact details below). You can also discuss this information with people you trust.

2. Who are we?

This research project is conducted by:

Technische Universiteit Eindhoven (TU/e) De Groene Loper 3 5612 AE Eindhoven	Data controller

How to contact us?

Sannah Musters	s.e.musters@student.tue.nl
Privacy Operations	privacy@tue.nl
Data Protection Officer	dataprotectionofficer@tue.nl

3. What will taking part in the research project involve?

In the research project we will collect your personal data using the following methods:

- Interviewing you about your opinions and experience on (digital) citizen participation in the Netherlands, and to write down your answers/record your answers via audio. Also, we will make a transcript of the interview, where your name will be anonymized.
- Survey about demographic data such as gender, age, nationality, first (and second) language, salary range, housing, and education. We will ask you to fill in the survey after the interview.
- We might ask you to join a workshop in which we present a concept and ask for feedback/discussion.

4. What personal data from you do we gather and process?

We collect and process the following personal data which is necessary for the project purpose:

Category and type	Personal data	Purpose	Retention period

Contact data (regular personal data)	*Name, e-mail*	*To communicate with you and invite you to interviews and workshops*	*6 months after data collection*
Demographic data	*Gender, age, nationality, first (and second) language, salary range, housing, and education.*	*Analyze data in relation to your personal characteristics*	*10 years after research is complete*
Job profile (experts only)	Job title or role, experience	*Analyze data in relation to your personal characteristics*	*10 years after data collection*

Your data is retained only for the time period as specified in the table. Keeping your data for this period helps us to comply with scientific principles, such as producibility and verification.
After this period, your personal data will be deleted or anonymized to ensure it can no longer be linked to you. Unless you explicitly agree to the use of your identifiable information in publications (for example your quotes or your name).

5. Stopping your participation and your rights

If you end your participation in the research we will not use your data anymore from that moment on.
For questions, ending your participation or complaints, please contact the researcher via the contact details as provided in the table under section 2.

For concerns or questions about the handling of personal data, you can e-mail the data protection officer as indicated in the table under section 2. You can also file a complaint with the Dutch data protection authority: the Autoriteit Persoonsgegevens.

You have the right to request access, rectification, objection, erasure or adaptation of your data. Submit your request through team Privacy Operations via the contact details as provided in the table under section 2.

6. Legal basis for processing your personal data

The TU/e processes your personal data to conduct scientific research, which is the university's public task as stated in article 1.3 of the Dutch Wet Hoger onderwijs en Wetenschappelijk onderzoek. The TU/e always follows the applicable codes of conduct for research integrity and the scientific standards when conducting research.

7. Who has access to your personal data?

Only authorized employees involved in the research have access to your personal data if this is necessary for their tasks. The authorized employees will keep your personal data confidential.
Other parties/processors that have access to the data are listed in the table below:

Party/processor	**Why access?**	**Category**	**Processing within the European Economic Area?**
Microsoft (Netherlands)	*Storage solution, conduct interviews and create transcripts*	*All data*	*Yes*
Lime Survey	*Survey tool*	*Demographic data*	*Yes*

TU/e has a suitable agreement with these parties to protect your personal data. We will not share your personal data with any other party, unless we are required to do so by law.
TU/e will process your personal data within the European Economic Area (EEA) by storing your data on a server inside the EEA. In addition, TU/e has implemented appropriate technical and organizational measures to protect your personal data. These measures include using centrally managed and verified research- and storage tools.

8. Future research

During the research project, your personal data may also prove useful for new, socially important research. In such case, we would like to reuse your data for the new research. This will only happen if (1) your personal

data is truly necessary, (2) the recognized ethical standards for scientific research are followed, and (3) the new research objectives align with the current research objectives. If your personal data is used in future research, we will take all reasonable steps to inform you about this. You can object to the use of your personal data for new research.
This research has been assessed and approved by the ethical committee of Eindhoven University of Technology.

***** Scroll down for the form *****

Consent form for participation by an adult

By signing this form, I confirm:

1. I have enough information about the research project from the separate information sheet. I have read it and I had the chance to ask questions, which have been answered to my satisfaction.

2. I take part in this research project voluntarily. There is no explicit or implicit pressure for me to take part in this research project and I understand I can stop my participation at any moment, without explaining why. I do not have to answer any question I do not want to answer.

3. I know my personal data will be collected and used for the research, as explained to me in the information sheet.

Furthermore, I consent to the following parts of the research project:

1. I consent to my personal data, such as answers or quotes I gave during the research, to be used by the researcher in publications and/or in presentations – without including my name.

   YES ☐ NO☐

Name of Participant:	Name of researcher:
Signature:	Signature:
Date:	Date:

Appendix II - Interview Guide

The Semi-Structured Interview Guide

Experts

When decisions are being made about urban interventions such as new parks, bicycle paths, and other public spaces that promote walking and cycling, it is important that every citizen can voice their opinions, also those from marginalized groups.

By "marginalized groups," we mean individuals who, according to existing literature, often participate less or not at all in decision-making processes. This leads to a situation where the participation process is mainly led by the "usual suspects"—those who are already more involved and have easier access to these opportunities. Many marginalized groups face barriers such as a lack of basic skills, language difficulties, lack of knowledge, or even fear and stress to express their opinion etc.

Research suggests that digital tools, including AI, have the potential to lower these barriers and make participation more accessible. Features such as personalized support, adaptive interfaces, translation options, and the ability to contribute from home—eliminating physical barriers—can help ensure that more people are included in shaping their communities.

This interview is about how digital tools, particularly AI-enhanced platforms, can support public participation, especially for marginalized groups, in decision-making processes related to urban interventions. The goal is to understand how these technologies can create more inclusive and equitable participation processes, ensuring that all community members – especially those who are often excluded - have an equal say in shaping public spaces.

Your expertise will help us assess the potential of these tools to create more inclusive opportunities for people to be active and live healthier, more engaged lives.

The interview will consist of four parts which will all have a different focus.

Section 1: Barriers to Digital Participation

Power-over	• Q1: In your experience, who are the most marginalized in terms of (digital) participation? ○ Can you think of a specific demographic or provide any real-life examples to illustrate why they are particularly marginalized?
Power-to	• Q2: Have you ever conducted or been involved in a participation campaign? If so, what challenges and barriers did marginalized groups face in their participation? • Q3: Have you ever worked with digital tools (mobile apps, websites, VR, platforms, etc) for public participation in active living interventions? What challenges and barriers did marginalized groups face when using these tools?

Section 2: AI-enhanced Platforms and Digital Empowerment

Feeling (psychological component)	• Q4: How do you think marginalized groups feel about participating in public decision-making?
	  ○ How can digital tools (mobile apps, websites, VR, platforms) motivate marginalized groups and make them feel encouraged and self-sufficient?
	• Q5: What are the best ways to engage marginalized groups in digital platforms (or other digital mediums) so they feel empowered?
	  ○ What makes these strategies effective from your perspective?
	  ○ Which stakeholders need to be involved to ensure these strategies work?
	  ○ How can these engagement strategies be sustained over time to ensure continued participation and empowerment for marginalized groups?
	  ○ What kind of features that are used and helpful in traditional citizen participation could be transferred to a digital setting?

Knowing (psychological component)	• Q6: What specific skills or knowledge do marginalized groups often lack that may hinder their effective engagement with digital participation tools, and how can these gaps be addressed?
Doing (psychological component)	• Q7: In what ways do you think AI could help empower marginalized communities through digital participation? Specifically, how can AI tools address existing gaps, such as language barriers, accessibility issues, or usability challenges? • Q8: What factors would influence your decision to use or avoid using AI in a digital platform for public participation? (e.g., concerns about privacy, trust, or effectiveness) • Q9: How can people be a part of the decision-making process by using an AI-enhance digital tool? • Q10: How can AI-based digital tools be implemented for useability and inclusivity among marginalized groups? ○ What challenges or considerations should be taken into account when developing AI-based tools for public participation to ensure that marginalized groups can engage with them effectively?

Section 3: Design and Inclusivity in Digital Tools

Participatory design mindset	• Q11: How important is it for designers to involve/collaborate with marginalized communities in the development of digital platforms?
Expert Design	• Q12: From an expert's perspective, what critical design elements are necessary for a digital tool (AI-enhanced or otherwise) to be inclusive and effective for marginalized groups?

	For example, how should the interface be made accessible (easier to use), how can data privacy be ensured, and what kind of user support (multi-language support, chatbot, FAQs, accessibility features, etc.) would be helpful?

Section 4: Additional Research Questions/Final Thoughts

	• Q13: Finally, from your perspective, what is the potential of AI-enhanced digital platforms to empower marginalized groups and create more fair participation in decision-making?
	  ○ What indicators would you use to measure the success or effectiveness of digital tools in engaging marginalized groups for active living interventions?
	  ○ If you had the power to change current practices, what improvements would you make? What features or tools do you think would encourage greater participation from marginalized groups and help you engage with them more effectively and meaningfully?

Appendix III - Thematic Analysis: Color-coding

Theme	Code
Municipality-neighborhood collaboration	Local governance & Community roles → E.g. Trust, transparency, need for district coordinators, societal structures, etc.
	Feedback channels → E.g. Feeling of being taken seriously, getting response, expectation management
	Engagement flow → E.g. Outreach and event engagement, co-design with citizens
	Participation motivation & Social support → E.g. Barriers (time, effort, etc), do they feel welcome, empowered, people who don't see the importance, etc.
Functional scope & feature definition	AI support & Conversational agents
	Adaptable design → E.g. different interfaces
	Usability & Effort → Ease of use
Stakeholder understanding & information access	Information seeking & Accessibility → Multi-channel participation (online, offline, different ways of communicating
	Prior knowledge & Context → E.g. feeling of not being important enough (due to lack of knowledge), feeling of not being worthy, lack of understanding of the process
	Minority inclusion & Accessibility barriers → E.g. language barriers, low literacy, digital divide etc.
	Personal Relevance
Clarity & communication gaps	Language & Cultural inclusivity → E.g. Provide multiple languages, provide easier language for people with low literacy, etc.
	Visual presentation & Layout
	Rights & Boundaries → E.g. Worries about the use of AI, limitations of AI, reluctance

Appendix IV - Matching the Meta Needs to the Barriers (workshop template)

EQUAL Workshop
08-05-2025
Please note that multiple barriers can be linked to one meta need and there is no equal division of barriers!

Pillar	Meta Needs	Barrier addressed from literature/interviews	Practical barrier	Personal barrier	Motivational barrier	Socio-economic barrier	Comments or suggestions
Human and Social	Ensure inclusive participation (**MN1**)	Lack of inclusion of marginalized groups in citizen participation					
	Increase flexibility in participation formats (**MN2**)	Feeling that the internet is too complicated, and unequal access					
	Ensure effective Communication and Awareness (**MN3**)	Lack of confidence, stress, and fear					
	Consider existing social interactions (**MN4**)	Lack of human-centered design, existing social structures, lack of interest, and lack of time					
	Enhance sustained Engagement (**MN5**)	Lack of interest, lack of time, lack of positive payoff when engaging					
	Ensure user needs (human-centered design) (**MN6**)	Lack of human-centered design, no one-size-fits-all solution					
	Foster participatory literacy (**MN7**)	Lack of understanding about the citizen participation process					
	Enhance perceived relevance (**MN8**)	Feeling that their opinion is not valid and uncertainty about the impact on their personal lives					
Additional MNs and the barriers they address:							

EQUAL Workshop
08-05-2025
Please note that multiple barriers can be linked to one meta need and there is no equal division of barriers!

Pillar	Meta Needs	Barrier addressed from literature/interviews	Practical barrier	Personal barrier	Motivational barrier	Socio-economic barrier	Comments or suggestions
Political	Enhance trust & Legitimacy (**MN9**)	Lack of trust between citizens and government, skepticism					
	Ensure digital rights and protection (**MN10**)	Privacy concerns, security risks, protection of personal data					
	Ensure inclusive decision-making (**MN11**)	Feeling that input is not taken seriously, limited influence over decisions					
	Address perceptions of power imbalance (**MN12**)	The feeling that input will not be taken seriously or that decision-making is biased					

Additional MNs and the barriers they address:

EQUAL Workshop
08-05-2025
Please note that multiple barriers can be linked to one meta need and there is no equal division of barriers!

Pillar	Meta Needs	Barrier addressed from literature/interviews	Practical barrier	Personal barrier	Motivational barrier	Socio-economic barrier	Comments or suggestions
Technological	Allow personalization (**MN13**)	Low digital literacy, discomfort with digital tools, and lack of confidence					
	Ensure Transparency (**MN14**)	Lack of trust and Transparency in AI decision-making					
	Enhance usability (**MN15**)	Poor design, usability challenges, digital literacy/divide					
	Enhance accessibility (**MN16**)	Unequal access, digital literacy/divide, language barriers					
	Provide explanatory and understandable system (**MN17**)	Lack of technical knowledge and AI comprehension					
	Enable scenario exploration (**MN18**)	Lack of understanding how the urban interventions will affect their neighborhood					

Additional MNs and the barriers they address:

Appendix V – Design Needs (workshop template)

Themes	Design Needs	Description	Meta Needs link
1) Municipality-neighborhood collaboration	Support diverse participation pathways (**DN1**)	Provide citizens with diverse ways for engaging in shaping urban interventions (online, offline, mobile, etc.), ensuring marginalized groups are included. Use a combination of platforms (social media, SMS, email, community events) to reach diverse demographics.	MN1, MN2, MN6, MN16
	Engage community ambassadors (**DN2**)	The citizen participation process should engage local ambassadors to encourage and guide citizen participation in decision-making for urban interventions, ensuring marginalized groups feel welcomed and represented.	MN1, MN4, MN7, MN8, MN9, MN12
2) Stakeholder understanding & information access	Provide a clear feedback mechanism (**DN3**)	The process should ensure that participants receive clear, transparent feedback on how their input has influenced spatial planning decisions, fostering legitimacy and sustained involvement. This strengthens trust and long-term participation.	MN3, MN5, MN7, MN9, MN11, MN12
	Foster user confidence (**DN4**)	The process should provide guidance, and support to increase users' confidence in citizen participation for decision-making for urban interventions.	MN3, MN5, MN8, MN9, MN11, MN16, MN17
	Enable co-design with citizens, consider their needs (**DN5**)	The design should actively involve citizens — especially marginalized groups — in shaping tools and processes for citizen participation in their physical environment to ensure relevance, inclusivity, and improved usability for diverse users.	MN1, MN4, MN5, MN6, MN15, MN18
3) Clarity & communication gaps	Ensure Data Security and Privacy (**DN6**)	When collecting participation input for urban planning, ensure strong data protections and clear communication on data usage to foster trust.	MN9, MN10
	Explain AI use and influence clearly (**DN7**)	The design should communicate how AI systems work and impact urban development decisions, using accessible, non-technical language.	MN3, MN14, MN17
	Implement transparent Consent Processes (**DN8**)	The design should allow users to understand, manage, and withdraw consent easily, with clear forms and settings.	MN3, MN9, MN10, MN14
4) Functional scope & Feature definition	Design for intuitive interaction (**DN9**)	The interface should be simple, familiar, and easy to navigate, minimizing barriers for users with diverse digital skills	MN5, MN6, MN13, MN15, MN16
	Allow personalization of AI by the user (**DN10**)	The design should allow users to adjust features (e.g., layout, contrast, language) to suit their needs and preferences and thus not be uniform.	MN1, MN13, MN15, MN16
	Support digital literacy and comprehension (**DN11**)	The design should include tools and aids (e.g., tutorials, chatbots, speech-to-text) to support users with limited digital experience.	MN1, MN3, MN15, MN16, MN17
	Enable 3D visualization (**DN12**)	The design should allow users to see the changes of the urban intervention to the neighborhood in 3D	MN7, MN8, MN18

Appendix VI - Elaborations on the Meta Needs

MN1: The need for marginalized groups to be included in decision-making processes related to the built environment.
MN2: The need for accessible and user-friendly ways for citizens to engage with built environment projects through diverse digital and non-digital channels.
MN3: The need for clear, confidence-building communication that reduces fear, stress, or confusion among citizens to participate in planning or the transformation of physical spaces.
MN4: The need to design participation processes that align with citizens' existing social structures, relationships, and routines in design interventions in within the built environment.
MN5: The need for continuous, meaningful participation that offers perceived value and rewards over time in shaping the built environment.
MN6: The need for participatory processes to reflect diverse user needs, values, and preferences of different community members when shaping the built environment.
MN7: The need for improving citizens' understanding of what participation is, how it works, and how they can get involved.
MN8: The need for making participation feel personally meaningful and directly connected to citizens' daily lives and communities.
MN9: The need for helping citizens visualize and understand the real-life impact of urban interventions through accessible, engaging tools.
MN10: The need for participatory processes in the built environment that are trustworthy and fair and that build confidence in governance.
MN11: The need to safeguard citizens' digital rights, including privacy, security, and data security, when using digital tools for engagement in the built environment.
MN12: The need for citizens to believe that their input is considered in decision-making processes in a meaningful way, and to address perceptions of power imbalance, to ensure that citizens' input is valued and has a genuine impact on outcomes.
MN13: The need to ensure long-term commitment from authorities. There should be a genuine drive and desire to actively support and sustain citizen participation processes.
MN14: The need to ensure that local authorities have sufficient time, resources, and capacities to enable meaningful citizen participation.
MN15: The need to ensure that political figures and authorities (e.g. municipalities) take ownership and responsibility for digital participation tools, and have the necessary technological literacy to implement and effectively sustain them.
MN16: The need for digital participation tools that adapt to individual preferences, needs, and comfort levels to support meaningful engagement in the built environment.
MN17: The need for understandable and transparent digital participation tools, especially when they involve complex technologies like AI, so that citizens can grasp how these tools function (when they want to know this) and how they influence decisions.
MN18: The need for digital participation tools that are easy to use, intuitive, and accommodating of varying digital skill levels.
MN19: The need for inclusive digital participation tools that overcome barriers related to language, disability, or literacy in built environment contexts.

Appendix VII - Ranking of the Meta Needs (workshop template)

Pillar	Ranking 1 = Most important 8 = Least important	Meta Needs	Barrier addressed from literature/interviews	Explanation
Human and Social		Ensure inclusive participation (**MN1**)	Lack of inclusion of marginalized groups in citizen participation	
		Increase flexibility in participation formats (**MN2**)	Feeling that the internet is too complicated, and unequal access	
		Ensure effective Communication and Awareness (**MN3**)	Lack of confidence, stress, and fear	
		Consider existing social interactions (**MN4**)	Lack of human-centered design, existing social structures, lack of interest, and lack of time	
		Enhance sustained Engagement (**MN5**)	Lack of interest, lack of time, lack of positive payoff when engaging	
		Ensure user needs (human-centered design) (**MN6**)	Lack of human-centered design, no one-size-fits-all solution	
		Foster participatory literacy (**MN7**)	Lack of understanding about the citizen participation process	
		Enhance perceived relevance (**MN8**)	Feeling that their opinion is not valid, and uncertainty about the impact on their personal lives	

Pillar	Ranking 1 = Most important 4 = Least important	Meta Needs	Barrier addressed from literature/interviews	Explanation
Political		Enhance trust & Legitimacy (**MN9**)	Lack of trust between citizens and government, skepticism	
		Ensure digital rights and protection (**MN10**)	Privacy concerns, security risks, protection of personal data	
		Ensure inclusive decision-making (**MN11**)	Feeling that input is not taken seriously, limited influence over decisions	
		Address perceptions of power imbalance (**MN12**)	The feeling that input will not be taken seriously or that decision-making is biased	

Pillar	Ranking 1 = Most important 6 = Least important	Meta Needs	Barrier addressed from literature/interviews	Explanation
Technological		Allow personalization (**MN13**)	Low digital literacy, discomfort with digital tools, and lack of confidence	
		Ensure Transparency (**MN14**)	Lack of trust and Transparency in AI decision-making	
		Enhance usability (**MN15**)	Poor design, usability challenges, digital literacy/divide	
		Enhance accessibility (**MN16**)	Unequal access, digital literacy/divide, language barriers	
		Provide explanatory and understandable system (**MN17**)	Lack of technical knowledge and AI comprehension	
		Enable scenario exploration (**MN18**)	Lack of understanding how the urban interventions will affect their neighborhood	