DESIGN OF A PARTICIPATORY APPROACH THAT IMPROVES COMMUNITY FLOOD RESILIENCE

THE CASE OF CULTURAL HERITAGE IN DORDRECHT

Master Thesis

Faculty of Engineering Technology

Civil Engineering & Management

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DORDRECHT

UNIVERSITY OF TWENTE.

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Design of a participatory approach that improves community flood resilience

The case of cultural heritage in Dordrecht

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Preface

In front of you lies my master thesis "*Design of a participatory approach that improves community flood resilience: The case of cultural heritage in Dordrecht*". I performed this thesis in the final phase of the master Water Engineering & Management at the University of Twente in collaboration with the Municipality of Dordrecht, to obtain the degree of Master of Science.

In the past months I had the opportunity to contribute to flood resilience of citizens in Dordrecht, and the cultural heritage they are living in. Throughout my research, I have had the support from many people around me, for which I am very grateful. First of all, I would like to thank the graduation committee from the side of the University of Twente: Karin, Joanne, and Denie, I would like to thank you for taking the scientific level of my research to a higher level every time you provided me with feedback. From the side of the Municipality of Dordrecht, I would like to thank Dana, who made me feel welcome at the Municipality of Dordrecht, and who participated actively in brainstorming activities to also involve local stakeholders in this research.

Besides that, I would like to thank the citizens of Dordrecht, who were willing to invite me into their homes during the focus group sessions, and were willing to take part in door-to-door interviews. You made me feel very welcome, and you contributed to my research by providing me with your perspectives and experiences on flood risk and public participation.

Furthermore, I want to look back on the wonderful six years I had when studying in Enschede. During my years as a civil engineering student, I also had the opportunity to take part in multiple extra-curricular activities. From being a board member at the study association for civil engineering students, to representing students of the university in discussions with the executive board in the university council. I want to thank everyone that was part of these last six years. My student life has been an unforgettable time because of you.

Last but not least I want to thank my family, especially my parents, for their support during the last six years. You always encouraged me to do my best during my studies, while you also supported me when I took part in other, non-study-related, events, that made me the person I am today. Thank you very much.

I hope you enjoy reading this report.

Max de Vries
Enschede, July 2022

Summary

Background information

For many years, the world is experiencing the consequences of climate change. Increased storm intensity, extreme rainfall, high river discharges, and sea level rise influence our way of living. It is expected that these events will increase, influencing the way we live even more. This is especially relevant for urban areas that are vulnerable to floods. To cope with climate change, these areas need to be flood resilient. In the Netherlands, vulnerable areas are situated near the coast and the main rivers. One of these urban areas is the city of Dordrecht. Due to its location, the city flourished in Dutch history. This, together with the preservation of the city centre in the last centuries, resulted in the presence of cultural heritage buildings in the city. To protect this, Dordrecht participates in SHELTER, a project funded by the European Union that aims to increase resilience of climate change impacted cultural heritage. Through this project, the Municipality of Dordrecht aims at increasing the flood resilience of citizens and the buildings they are living in, in a participatory way.

Research objective and methodology

The main objective of this research is to "*Design a participatory approach that improves community flood resilience of citizens and the cultural heritage they are living in*". To achieve this goal, a design science methodology is adopted to structure the research. This methodology focuses on designing a general solution to a certain problem, and consists of three phases: 1) the problem investigation, 2) the design phase and 3) the validation phase. The problem investigation aims at investigating the current state of flood resilience and public participation in Dordrecht, to tailor the participatory approach. This is done by conducting a literature review, organising a focus group and conducting semi-structured interviews with the Municipality of Dordrecht, and organising focus groups and conducting structured interviews with citizens of Dordrecht. The data collected in the problem investigation form the basis for the design phase, whereafter the design was validated with the Municipality of Dordrecht.

Problem investigation

The literature research identified that the importance of public participation in resilience assessments is only implicitly emphasised, where no guidance was given on using participatory methods in resilience assessments. By synthesising literature on both concepts the importance public participation has in resilience assessments is made more explicit. It, among others, contributes to an improved understanding of the local context of citizens, and public participation creates a platform for sharing experiences of citizens in resilience assessments. Additionally, participatory methods were linked to the three phases of resilience assessments, i.e. *understand, measure,* and *improve*. In each phase of a resilience assessment methods are emphasised that can contribute to that particular phase. This research therefore not only emphasises the importance public participation has in resilience assessments, but it also gives guidance on the use of participatory methods when conducting a resilience assessment.

The second and third part of the problem investigation investigates the perspective of the Municipality of Dordrecht and its citizens regarding flood resilience and public participation. The main outcome is that the perspective of the Municipality of Dordrecht regarding flood resilience does not differ significantly from the perspective of the citizens. Both the perspectives of the embanked area and the unembanked area were researched, since flood risks differ per area. In the embanked area most citizens are unaware of their flood risks, while in the unembanked area citizens are aware of their flood risks. When citizens are informed by the municipality about their flood risks, or when they have experienced floods, they are more aware of their flood risks and know better which flood measures they can take to protect themselves and the cultural heritage buildings they are living in. Additionally, what citizens have to do in crisis situations, i.e. when an extreme flood occurs, is not known. Regarding participation, it can be concluded that it is not well embedded within the municipality, where project managers mainly rely on their own experience when applying participation. Besides that, citizens perceive limited participation at the moment.

The findings of the problem investigation were synthesised in a design brief. In this design brief the goal, the user (Municipality of Dordrecht), and design requirements are listed. These requirements should link to literature, contribute to more awareness of crisis situations, be understandable, reach a majority of the citizens, and the approach should be resource-dependent. The latter refers to resources the municipality has at its disposal, e.g. time, money and staff. The design requirements were validated and were found to be complete.

Design and validation

To contribute to flood resilience, a participatory approach is designed. The design brief of the problem investigation, together with an in-depth review of a methodological framework for designing a participatory approach, form the basis for the design. Based on the design requirements, two scenarios are developed. One with low resources, resulting in information provision from the municipality to the citizens, resulting in the lowest participation level. The other is a participatory approach that requires more resources, where citizens are highly involved in the assessment of their resilience. They co-produce the resilience assessment together with the Municipality of Dordrecht, resulting in the highest participation level. The designs link the concepts of public participation and resilience assessment. By incorporating the three phases of resilience assessments a stepwise approach was constructed. Per phase, the goal of that phase, and examples of participatory methods that can contribute to that goal are displayed. This gives guidance on using participatory methods in resilience assessments.

Based on the design requirements the two scenarios of the participatory approach are validated by the Municipality of Dordrecht. Also, general comments on the content of the scenarios are mentioned in the validation phase. Multiple improvements are made towards the final design, with a specific focus on the three resilience assessment phases. The connection between these phases is made more clear, the difference between the low-resources and high-resources scenario is emphasised and a Dutch translation is provided to make the approach more applicable in the context of the Municipality of Dordrecht.

Conclusion

This research presents two scenarios of a participatory approach, which involves citizens in the assessment of their flood resilience, and the resilience of the buildings they are living in. Through an extensive literature study, and research in the Municipality of Dordrecht, literature is combined with specific case study information. This research contributes to the current body of literature by giving guidance on the use of participatory methods in resilience assessments, by explicitly stressing the importance public participation has in resilience assessments. It contributes to community flood resilience in Dordrecht by involving citizens in *understanding* their flood resilience, *measuring* it, and lastly *improving* their flood resilience, and the flood resilience of the cultural heritage they are living in.

Recommendations

Recommendations for future research and practical recommendations were formulated. Future research should be done on implementing and evaluating the participatory approach in practice to complete the design science methodology applied in this research. Also, more research should be done on synthesising the concepts of public participation and resilience assessments in the future.

Practical recommendations refer to the Dordrecht case specifically. It is recommended to appoint an expert in the field of public participation and resilience assessments to implement the participatory approach. Also, an evaluation of the implementation is recommended to determine if any improvements are needed in the participatory approach. Moreover, it is recommended to implement the high-resource scenario in the unembanked area, since the municipality is already providing information about floods in that area and since citizens perceive at the moment limited participation there. For the embanked area it is recommended to start with the low-resource scenario, since there is not yet any information provided in that area. By using that scenario the threshold for citizens to be involved is lower. However, if the municipality strives for a higher participation level, the high-resource scenario could also be implemented in the embanked area.

Samenvatting

Achtergrondinformatie

Sinds vele jaren ondervindt de wereld de gevolgen van klimaatverandering. Verhoogde stormintensiteit, extreme regenval, hoge rivierafvoeren en stijging van de zeespiegel beïnvloeden onze manier van leven. Verwacht wordt dat deze gebeurtenissen zullen toenemen, waardoor onze manier van leven nog meer wordt beïnvloed. Dit is vooral relevant voor stedelijke gebieden die te maken hebben met een hoog overstromingsrisico. Om klimaatverandering het hoofd te kunnen bieden, moeten deze gebieden bestand zijn tegen overstromingen. In Nederland liggen de kwetsbare gebieden in de buurt van de kust en de grote rivieren. Een van deze stedelijke gebieden is de stad Dordrecht. Door haar ligging heeft de stad een bloeiperiode doorgemaakt in de Nederlandse geschiedenis. Dit, samen met het behoud van de binnenstad in de afgelopen eeuwen, resulteert in de aanwezigheid van cultureel erfgoed in de stad. Om dit cultureel erfgoed te beschermen neemt Dordrecht deel aan SHELTER, een door de Europese Unie gefinancierd project dat gericht is op het vergroten van de veerkracht (*EN: resilience*) van cultureel erfgoed dat gevolgen ondervindt van klimaatverandering. In samenwerking met SHELTER wenst de gemeente Dordrecht de overstromingsveerkracht (*EN: flood resilience*) van burgers en de gebouwen waarin zij wonen, op een participatieve manier te verbeteren.

Onderzoeksdoel en methodologie

Het hoofddoel van dit onderzoek is "het ontwerpen van een participatieve aanpak die de overstromingsveerkracht verbetert van de gemeenschap (*EN: community flood resilience*), en het cultureel erfgoed waarin ze wonen". Om dit doel te bereiken, en het onderzoek te structureren, wordt een ontwerpgerichte onderzoeksmethodologie gevolgd. Deze methodologie bestaat uit drie fasen: 1) de probleemanalyse, 2) de ontwerpfase en 3) de validatiefase. De probleemanalyse is gericht op het onderzoeken van de huidige staat van overstromingsveerkracht en publieksparticipatie in Dordrecht, om de participatieve aanpak op maat te maken. Dit wordt gedaan door het uitvoeren van een literatuurstudie, het organiseren van een focusgroep en het afnemen van semigestructureerd interviews met de Gemeente Dordrecht, en het organiseren van focusgroepen en het afnemen van gestructureerde interviews met burgers van Dordrecht. De in de probleemanalyse verzamelde data vormen de basis voor de ontwerpfase, waarna het ontwerp is gevalideerd met de gemeente Dordrecht.

Probleemanalyse

Uit het literatuuronderzoek is gebleken dat het belang van publieksparticipatie bij het toetsen van veerkracht slechts impliciet wordt benadrukt, en dat er geen richtlijnen worden gegeven voor het gebruik van participatieve methoden bij veerkrachtigheidstoetsen (*EN: resilience assessments*). Door een synthese te maken van de literatuur over beide concepten wordt het belang dat publieksparticipatie heeft bij veerkrachtigheidstoetsen explicieter gemaakt. Participatie draagt onder meer bij aan een beter begrip van de lokale context van burgers, en participatie creëert een platform voor het delen van ervaringen van burgers in veerkrachtigheidstoetsen. Ook werden participatiemethoden gekoppeld aan de drie fasen van veerkrachtigheidstoetsen, namelijk *begrijpen*, *meten* en *verbeteren*. In elke fase van een veerkrachtigheidstoets wordt de nadruk gelegd op methoden die kunnen bijdragen aan die specifieke fase. Dit onderzoek benadrukt dus niet alleen het belang van publieksparticipatie bij veerkrachtigheidstoetsen, maar geeft ook richtlijnen voor het gebruik van participatieve methoden bij het uitvoeren van een veerkrachtigheidstoets.

In het tweede en derde deel van de probleemanalyse wordt het perspectief van de gemeente Dordrecht en haar burgers met betrekking tot overstromingsveerkracht en participatie onderzocht. De belangrijkste uitkomst is dat het perspectief van de gemeente Dordrecht wat betreft overstromingsveerkracht niet significant verschilt met het perspectief van de burgers. Zowel de perspectieven van het binnendijkse gebied als het buitendijkse gebied zijn onderzocht, aangezien overstromingsrisico's per gebied verschillen. In het binnendijkse gebied zijn de meeste burgers zich niet bewust van hun overstromingsrisico's, terwijl burgers in het buitendijkse gebied zich hier wel bewust van zijn. Wanneer burgers door de gemeente worden geïnformeerd over hun

overstromingsrisico's, of wanneer ze overstromingen hebben meegemaakt, zijn ze zich meer bewust van hun overstromingsrisico's en weten ze beter welke overstromingsmaatregelen ze kunnen nemen om zichzelf en het cultureel erfgoed waarin ze wonen te beschermen. Verder weten de burgers niet wat ze moeten doen in crisissituaties, wanneer zich een extreme overstroming voordoet. Ten aanzien van participatie kan worden geconcludeerd dat deze niet goed is ingebed binnen de gemeente, waar projectleiders bij het toepassen van participatie vooral op hun eigen ervaring afgaan. Daarnaast ervaren burgers op dit moment beperkte participatie in de gemeente Dordrecht.

De bevindingen van de probleemanalyse zijn samengevat in een ontwerpopdracht (*EN: design brief*). In deze ontwerpopdracht zijn het doel, de gebruiker (Gemeente Dordrecht), en ontwerpeisen opgesomd. Deze eisen sluiten aan bij literatuur, dragen bij aan meer bewustwording van crisissituaties, zijn begrijpelijk en bereiken een meerderheid van de burgers. Verder moet de aanpak afhankelijk zijn van het aantal beschikbare middelen. Dit laatste verwijst naar de middelen die de gemeente tot haar beschikking heeft, bijvoorbeeld tijd, geld en personeel. De ontwerpeisen werden gevalideerd en volledig bevonden.

Ontwerp- en validatiefase

Om bij te dragen aan overstromingsveerkracht wordt een participatieve aanpak ontworpen. De ontwerpopdracht van de probleemanalyse vormt, samen met gronding onderzoek naar een bestaand methodologisch kader voor het ontwerpen van een participatieve aanpak, de basis voor het ontwerp. Op basis van de ontwerpeisen worden twee scenario's ontwikkeld. Een met weinig middelen, waardoor er vooral informatievoorziening plaatsvindt van de gemeente richting de burgers. Dit resulteert in het laagste participatieniveau heeft. Het andere scenario is een participatieve aanpak die meer middelen vergt, waarbij burgers in hoge mate worden betrokken bij de beoordeling van hun veerkracht. In dat scenario toetsen burgers zelf, in samenwerking met de gemeente, hun veerkracht. Dit resulteert in het hoogste participatieniveau. De ontwerpen verbinden daardoor de concepten publieksparticipatie en veerkrachtigheidstoetsen. Door het integreren van de drie fasen van veerkrachtigheidstoets is een stapsgewijze aanpak geconstrueerd. Per fase wordt het doel van die fase en voorbeelden van participatieve methoden die kunnen bijdragen aan dat doel weergegeven. Dit geeft een leidraad voor het gebruik van participatieve methoden bij het toetsen van overstromingsveerkracht.

Op basis van de ontwerpeisen worden de twee scenario's van de participatieve aanpak gevalideerd met de gemeente Dordrecht. Ook worden in de validatiefase algemene opmerkingen gemaakt over de inhoud van de scenario's. Meerdere verbeteringen werden aangebracht in het definitieve ontwerp, met specifieke aandacht voor de drie fasen van een veerkrachtigheidstoets. Het verband tussen deze fasen wordt duidelijker gemaakt, het verschil tussen het scenario met lage- en hoge-middelen wordt benadrukt en er wordt een Nederlandse vertaling gemaakt om de aanpak beter toepasbaar te maken in de context van de gemeente Dordrecht.

Conclusie

Dit onderzoek presenteert twee scenario's van een participatieve aanpak, die burgers betrekt bij het toetsen van hun overstromingsveerkracht, en de veerkracht van de gebouwen waarin ze wonen. Door middel van een uitgebreide literatuurstudie, en onderzoek in de gemeente Dordrecht, wordt literatuur gecombineerd met specifieke informatie uit de gemeente Dordrecht. Dit onderzoek draagt bij aan de huidige literatuur door richtlijnen te bieden voor het gebruik van participatieve methoden bij het toetsen van veerkracht, door expliciet het belang te benadrukken dat publieksparticipatie heeft bij veerkrachtigheidstoetsen. Het draagt daarom bij aan de overstromingsveerkracht van de gemeenschap in Dordrecht door burgers te betrekken bij het *begrijpen* van hun overstromingsveerkracht, het *meten* ervan, en ten slotte het *verbeteren* van hun hun overstromingsveerkracht, en de veerkracht van het cultureel erfgoed waarin ze wonen.

Aanbevelingen

Er werden aanbevelingen voor verder onderzoek en praktische aanbevelingen geformuleerd. Verder onderzoek moet worden gedaan naar de implementatie en evaluatie van de participatieve aanpak in de praktijk, om de ontwerpgerichte methodologie die in dit onderzoek is toegepast af te ronden. Ook moet meer onderzoek worden gedaan naar de synthese van de concepten van publieksparticipatie en veerkrachtigheidstoetsen in de toekomst.

Praktische aanbevelingen hebben specifiek betrekking op de gemeente Dordrecht. Aanbevolen wordt om een expert op het gebied van publieksparticipatie en veerkrachtigheidstoetsen aan te stellen om de participatieve aanpak uit te voeren. Ook wordt een evaluatie van de implementatie aanbevolen om te bepalen of er verbeteringen nodig zijn in de participatieve aanpak. Bovendien wordt aanbevolen het scenario met veel middelen uit te voeren in het buitendijkse gebied, aangezien de gemeente daar al informatie verstrekt over overstromingen en de burgers daar op dit moment een laag niveau van participatie ervaren. Voor het binnendijkse gebied wordt aanbevolen te beginnen met het scenario dat weinig middelen verschaft, aangezien er in dat gebied nog geen informatie wordt verstrekt. Door dat scenario te gebruiken is de drempel voor burgers om betrokken te zijn lager. Als de gemeente echter een hoger participatieniveau nastreeft, kan ook in het binnendijkse gebied het scenario met meer middelen worden toegepast.

Contents

1. Introduction

1.1. Background

High river discharges and coastal storms have long been threatening flood-prone areas, and will threaten them even more in the future. Flood events are increasing in frequency and intensity due to the changing climate (ENW, 2021; IPCC, 2021). This is caused by higher peak discharges and an increase in extreme rainfall events (IPCC, 2021). An increase in flood events, in combination with the expected sea level rise, is especially problematic for low-lying, urban areas close to rivers or other water bodies, making them more vulnerable to floods (IPCC, 2021). In the Netherlands, many urban areas are situated below sea level or built close to major rivers. In the summer of 2021 a period of exceptionally high rainfall and subsequent river discharges occurred, resulting in substantial economic losses in flood-prone areas in the Netherlands (ENW, 2021). Vulnerable areas need to be protected to prevent damage and casualties in the future due to an increase in flood risks exacerbated by climate change.

The city of Dordrecht is such a vulnerable area situated near the North Sea, and surrounded by three main rivers (i.e. the Oude Maas, Beneden Merwede, and the Noord, see Figure 1). The location of Dordrecht makes the city more prone to floods than other, high-lying urban areas. Nevertheless, its location in the delta of three rivers made the city flourish in Dutch history (Monumentenzorg Dordrecht, 2022). This, together with the well-preserved city centre, resulted in the presence of multiple cultural heritage buildings. To address the challenges arising from climate change, the Municipality of Dordrecht participates in a European collaboration project called SHELTER. The SHELTER project is funded by the European Union and aims to reduce vulnerability and increase resilience of climate change impacted cultural heritage throughout Europe (SHELTER, 2020).

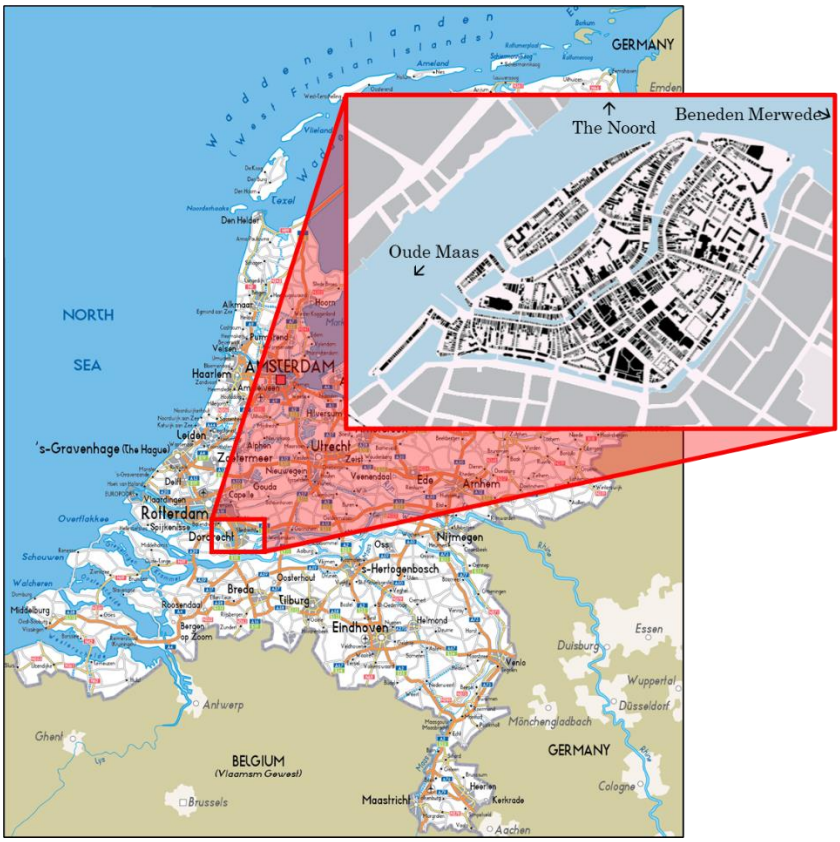

Figure 1: Dordrecht and its location in the Netherlands including the three main rivers surrounding the city, the Oude Maas the Beneden Merwede, and the Noord (situated at the north side of the junction of the Oude Maas and the Beneden Merwede). Adapted from Gemeente Dordrecht (2014) and Worldometer (2022).

Since minor floods occur regularly in Dordrecht, and risks of large-scale flood events are not negligible, flood resilience of citizens is important. However, it is yet unknown how flood resilient the citizens of Dordrecht are. Dordrecht is a special case in the Netherlands, since a major part of the historical city centre is located outside the flood defence barrier, i.e. the unembanked area, where flood resilience might differ compared to the embanked area. In assessing flood resilience of citizens and cultural heritage, citizens living in flood-prone cultural heritage can play a role. They can, for example, take flood measures, e.g. sandbags, waterproofing walls, and portable flood barriers. These are not only contributing to flood resilience of citizens, but also to flood resilience of the cultural heritage buildings they are living in. However, how citizens can be involved in the assessment of their flood resilience is yet unknown. Therefore, this MSc thesis will identify how citizens can be involved in the assessment of their flood resilience, and the flood resilience of their buildings.

1.2. State of the art

1.2.1. Flood resilience

The term resilience is often used in defining how a system can cope with acute shocks or long-term stresses. The resilience of a system, e.g. an urban area, is often referred to as withstanding to, adapting to, and transforming after stresses and shocks (Biggs et al., 2021; Meerow et al., 2016; Moghadas et al., 2019; Sayers et al., 2013; Walker et al., 2004). However, resilience is more than physical resilience, since it is also related to how communities cope with disturbances, i.e. community resilience (Aldrich & Meyer, 2015; Bertilsson et al., 2019; Fan, 2013; Mayunga, 2007; Norris et al., 2008; Skertich et al., 2013). Disturbances, such as stresses and shocks, can be interpreted in different contexts. In this MSc thesis, the focus is on floods in urban areas.

Hegger et al. (2016) operationalised resilience in the context of floods, i.e. flood resilience. They summarised different perspectives into one approach to evaluate flood resilience for urban areas based on three capacities: 1) the capacity to resist, 2) the capacity to absorb and recover and 3) the capacity to transform and adapt. The first capacity is related to the traditional approach that is used in flood protection strategies, which is to increase the threshold of the physical system to protect against floods (Hegger et al., 2016; Snel, 2021). The second capacity focuses less on resisting a flood, but more on absorbing and recovering from floods. The "Room for the River" approach in the Netherlands is an example of this second capacity, where water is absorbed through retention areas to prevent floods and cope with floods (Hegger et al., 2016; Rijksoverheid, 2021; Snel, 2021). The third capacity focuses more on stakeholders and citizens that have to adapt and transform to floods (Hegger et al., 2016). The focus of this capacity is therefore more on the resilience of the community than on the resilience of the physical system. Because the operationalisation by Hegger et al. (2016) focuses on both physical and community resilience, and this study focuses on both the physical cultural heritage and the citizens living in it, the definition used in this study for flood resilience is as follows:

Flood resilience is defined as the capacity to resist floods, the capacity to absorb and recover from floods, and the capacity to adapt and transform to future floods.

1.2.2. Resilience assessment

A resilience assessment provides an *understanding* of how to *improve* the resilience of a system or community, by *measuring* certain system or community-specific characteristics (Herrera & Kopainsky, 2020; Quinlan et al., 2016; Resilience Alliance, 2010; Sharifi, 2016; Tong, 2021). It first gives guidance to the *understanding* of a system or community, to identify how it can cope with shocks and stresses. In this phase, communication helps citizens to understand the meaning of resilience, and to understand how disturbances influence their resilience (Herrera & Kopainsky, 2020; Quinlan et al., 2016; Sharifi, 2016). Then it *measures* where (spatial scale) and when (temporal scale) which areas are resilient (Herrera & Kopainsky, 2020; Sharifi, 2016). After the resilience is *understood* and *measured* the resilience assessments give insights into strategies to *improve* the resilience to cope with shocks and stresses (Resilience Alliance, 2010; Sharifi, 2016; Tong, 2021).

To conduct a resilience assessment, various frameworks and tools have been developed (Tong, 2021). Some resilience assessment frameworks focus mainly on resilience principles (Wardekker et al., 2010), or focus on dimensions and capacities of a system or community (Hosseini et al., 2016), where resilience is measured either qualitatively or quantitatively. The latter is mainly used in stakeholder-driven approaches to identify the perspectives of citizens as part of a community or system (UNDP, 2013). For assessing community resilience, Sharifi (2016) proposed six elements that a framework should contain. One element in particular stresses that public participation in resilience assessments is important, i.e. that resilience assessments have to be implemented with stakeholders through participatory approaches. However, the argumentation why to include participatory approaches in resilience assessments is not discussed extensively in resilience assessment literature, resulting in only an implicit link between resilience assessments and public participation literature. Also, there is no guidance on which participatory methods are usable in a resilience assessment. Sharifi (2016) concludes that "*more attention needs to be paid to stakeholder participation in developing assessment tools"* (Sharifi, 2016, p.629). Therefore in this study, more research is conducted to identify a more explicit approach that combines participation, participatory methods, and resilience assessments.

1.2.3. Public participation

Multiple definitions are describing what public participation is. In the context of climate adaptation, it is often referred to as "*an umbrella term incorporating various forms of interaction with people, from informing and listening through dialogue, debate and analysis, to implementing jointly agreed solutions"* (Hügel & Davies, 2020, p.2). Since this research focuses on the local context, the term *people* are referred to as *citizens*. Public participation is therefore a method that involves citizens in decisions of private and public institutions. Public participation in general has the goal to increase the validity and improving the quality of a decision (Dietz & Stern, 2008). In decision-making processes in the environmental context, governments apply public participation approaches since they can build relations and trust, because it involves citizens in decisions that affect them (Coenen, 2009; Reed, 2008; Reed et al., 2009). Public participation can therefore have significant effects on decisions made by governments.

Participation can be conducted by using a participatory approach, which is defined in the water management context by Krywkow (2009, p.45) as "*the interaction of experts […] with lay people throughout a planning procedure with the aim of including the perspectives and views of these lay people to support a decision-making process"*. In this research, lay people are considered to be the citizens of Dordrecht, since they do not have experience in the assessment of their flood resilience. Multiple arguments for applying public participation are present in literature offering insights into why governments want to make use of participatory approaches to involve citizens (Coenen, 2009; Reed, 2008; Reed et al., 2009; Sarzynski, 2015). Arguments why to include participatory approaches in decision-making overlap with reasons why more attention needs to be paid to public participation in resilience assessments. However, to what extent they overlap has to be researched in this study to identify how public participation can contribute to resilience assessments. Furthermore, which arguments for implementing public participation apply to the Municipality of Dordrecht, in particular, is still unexplored and is further researched in this study.

1.3. Problem statement

Floods are significantly influencing the urban area, resulting in economic damage and casualties. Flood risks are increasing, since floods are expected to increase in frequency and intensity due to climate change (IPCC, 2021). This is especially problematic for vulnerable locations, situated in flood-prone areas such as river deltas or areas below sea level. To cope with floods in the present and the future, systems and communities need to be flood resilient. They need to resist floods, absorb and recover from floods, and adapt and transform to future floods (Hegger et al., 2016). In this MSc thesis, the city of Dordrecht is used as a case study, due to its vulnerability to floods caused by its location. Another reason is that Dordrecht is participating in the European research project SHELTER, which aims at increasing resilience of cultural heritage that is impacted by climate change (SHELTER, 2020). Currently, minor floods are occurring in the city of Dordrecht.

However, climate change increases flood risks, and to cope with this, citizens need to be flood resilient for themselves and the cultural heritage they live in. Nevertheless, it is yet unknown how flood resilient they are.

To *understand*, *measure,* and *improve* flood resilience, resilience assessments are conducted. Multiple resilience assessment frameworks have been developed, assessing the resilience of systems or communities. In these assessments, special attention needs to be paid to the involvement of citizens. The latter is referred to as public participation. However, how public participation can contribute to the three phases of resilience assessments is not yet explored. Furthermore, no guidance is present on what type of participation has to be implemented when conducting resilience assessments.

Additionally, different reasons for conducting a resilience assessment are present in Dordrecht. The embanked and unembanked areas face different challenges due to their locations inside and outside the flood defence barrier. The challenges not only relate to flood risk, and flood type, but also to the responsibilities of flood risks. Governments are responsible for informing citizens living in the unembanked area about flood risks, which might result in more flood risk awareness in that area (Deltares, 2018; Rijksoverheid, 2021). However, citizens in the unembanked area are responsible for protecting themselves against floods, e.g. by taking flood protection measures like sand bags and portable flood barriers, while governments are responsible for protecting citizens in the embanked area. However, whether or not this results in more or less flood risk awareness in practice is not yet explored. This is thereafter further researched in this MSc thesis.

Thus, at the moment there are no guidelines on what type of participation can contribute to resilience assessments. This study tries to identify how public participation can be used in resilience assessments for the city of Dordrecht, especially concerning the cultural heritage citizens are living in, by designing a participatory approach.

1.4. Research objectives

To integrate the concepts of public participation and resilience assessments, a case study is done in Dordrecht where cultural heritage and citizens are threatened by floods. Thus, their flood resilience has to be assessed accordingly. By doing so in a participatory way, citizens are involved in the assessment of their flood resilience. The main objective of this study is therefore as follows:

"*Design a participatory approach that improves community flood resilience of citizens and the cultural heritage they are living in*"

The methodology that is used to meet the main objective is the design science methodology (Van Aken, 2007; Van Aken & Romme, 2009), which is structured by the design cycle of Wieringa (2014). The main objective will be reached via multiple sub-objectives:

1. *Investigate the current state of flood resilience and public participation in Dordrecht to tailor the participatory approach.*
   - *1.1. Conduct a literature study to synthesise literature on public participation and resilience assessments.*
   - *1.2. Investigate the perspective of the Municipality of Dordrecht regarding flood resilience and public participation.*
   - *1.3. Investigate the perspectives of citizens of Dordrecht regarding flood resilience and public participation.*
   - *1.4. Determine design requirements for the participatory approach.*
2. *Design a participatory approach that contributes to flood resilience of citizens in Dordrecht, and the cultural heritage they are living in.*
3. *Validate the participatory approach with the Municipality of Dordrecht to determine if the participatory approach meets the design requirements.*

These sub-objectives form the basis of the research. They follow the design cycle of Wieringa (2014) and are explained in more detail in chapter 2.

1.5. Research scope

The study focuses on resilience assessments and public participation, with the city of Dordrecht as a case study. Dordrecht is one of the areas participating in the SHELTER project, which aims to improve resilience of cultural heritage (SHELTER, 2020). Cultural heritage in Dordrecht is mainly located in the historical city centre. Therefore, only the historical city centre of Dordrecht is taken into account in the design of the participatory approach. In this area, approximately 800 buildings are listed as cultural heritage (Gemeente Dordrecht, 2021). The areas that are researched are displayed in Figure 2, where 1 is the unembanked area and 2 is the embanked area. The red dotted line represents the flood defence barrier separating the two areas.

Both owners and inhabitants of cultural heritage can play a role in taking measures against floods and make themselves and the cultural heritage more flood resilient. Therefore, both owners *and* inhabitants are taken into account in this research. Since the focus is on citizens living in cultural heritage buildings, only residential cultural heritage buildings are taken into account in this MSc thesis. Shops, museums, businesses, and other cultural heritage are therefore not included. The research furthermore focuses on floods induced by high water in the rivers and floods induced by heavy rainfall. Whilst the first type of flood in the Netherlands is usually seen as the largest threat, the latter can have an impact on citizens and cultural heritage in especially the embanked area as well, since this area is lower than the rivers surrounding it. This means that the water is not able to flow away freely. The flood risk awareness might differ per area, which has to be considered in the design steps of this research.

The design methodology that is used consists of multiple steps, namely the problem investigation, the design phase, the validation phase, the implementation phase, and the evaluation phase (Wieringa, 2014). In this research, only the first three steps are considered since the goal of the study is related to *designing* an approach instead of *implementing* one. The implementation phase takes place after finishing this MSc thesis. The design phase is based on a participatory framework that is developed in the context of water management (Krywkow, 2009).

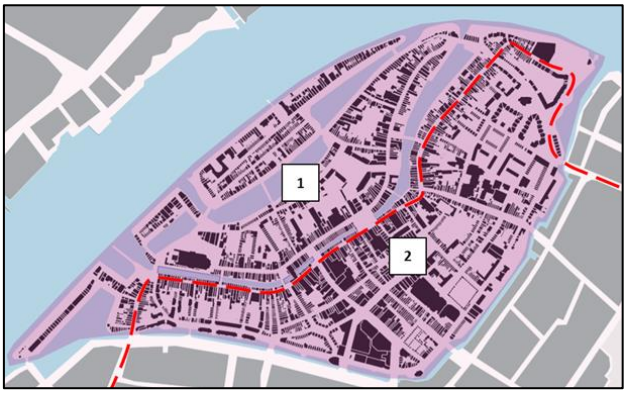

Figure 2: Research area displaying the historical city centre of Dordrecht. The red dotted line represents the primary flood defence. Area 1 is the unembanked area, while area 2 is the embanked area. Adapted from Gemeente Dordrecht (2014) and Worldometer (2022).

1.6. Report outline

The report is structured into eight chapters in total. The second chapter explains the methodology that is used in the research. The third chapter investigates the problem, whereafter in chapter four the design is made. In chapter five the design is validated and in chapter six the final design is displayed. In chapter seven the results are discussed and in the last chapter the conclusions and recommendations of the research are presented.

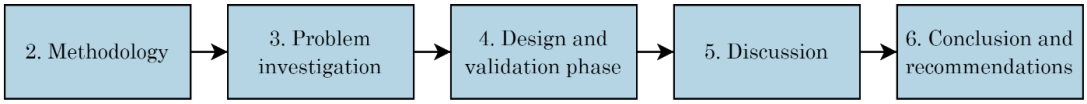

Figure 3: Schematisation of the report outline.

2. Methodology

This chapter describes the design science methodology that is adopted in this MSc thesis research. First, the design science methodology itself is introduced. Then, the data collection methods that are used in this study are elaborated on, whereas in the last two sections these are discussed in more detail per research objective.

2.1. Design science

This study uses a design science methodology to reach the aim of the study. According to Van Aken (2004), the objective of research in design sciences is to "*develop valid and reliable knowledge to be used in designing solutions to problems*" (p.225). Research in design science focuses on field problems, which are problems that should be solved according to stakeholders (Van Aken, 2013). The stakeholder perspective is therefore of significant relevance to identifying the problem that has to be solved. The product of design science is a *general* solution concept that is used to address the field problem (Van Aken, 2013). *General* means that it is not designed for a specific situation or problem (Van Aken & Romme, 2009). To identify a solution, first the field problem needs to be investigated, which in this study is based on the case of the city of Dordrecht.

To structure the design science methodology, Wieringa (2014) constructed the engineering cycle, which consists of five phases: (1) The problem investigation phase, (2) the design phase, (3) the validation phase, (4) the implementation phase and (5) the evaluation phase. This MSc thesis focuses on designing a participatory approach, which will be implemented by the Municipality of Dordrecht. Therefore the implementation phase, and corresponding evaluation phase, are not included. The first three phases of the engineering cycle as part of this research are referred to as the design cycle (Wieringa, 2014). It gives context to the different elements of the study, however, it does mean that after the validation phase the design is not yet complete. The design cycle is an iterative process with multiple feedback loops. The steps that were followed in this research are displayed in Figure 4, where the red arrow indicates the design cycle used in this study. A detailed overview of the steps, their characteristics, and methods, are linked to the objectives of this study in the following sections.

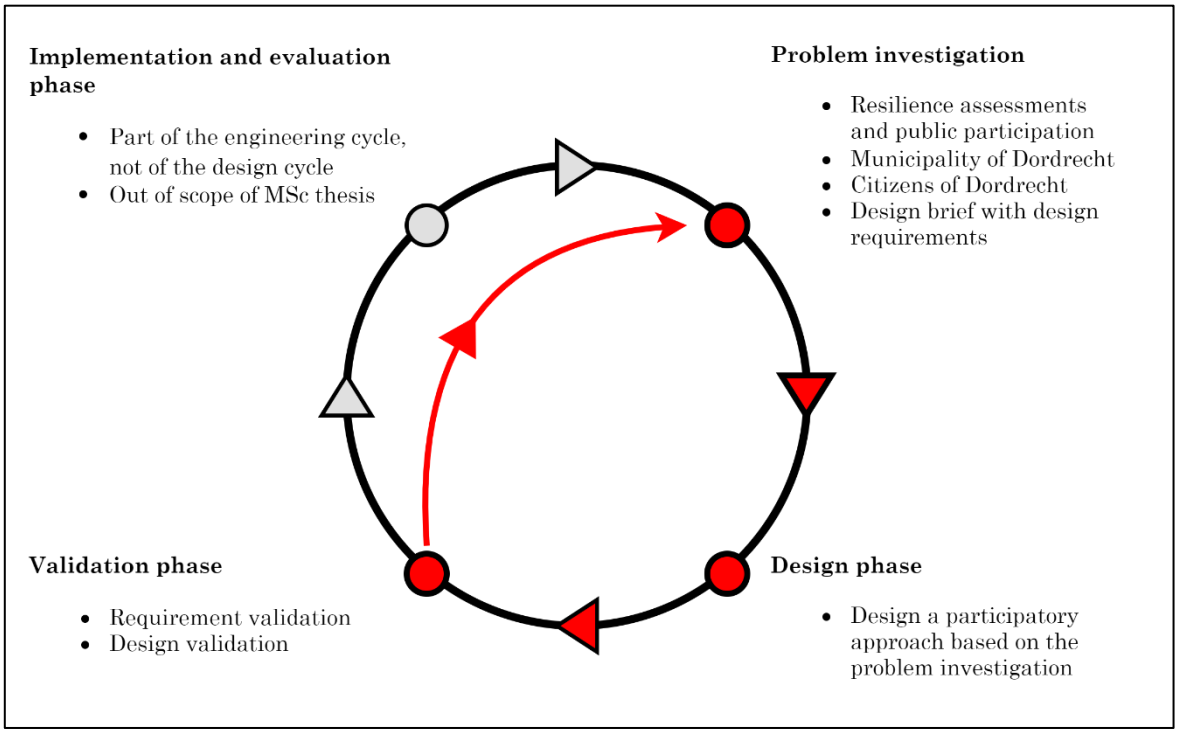

Figure 4: Design cycle (red) which was used in this study, with the grey elements indicating the implementation and evaluation phase as part of the engineering cycle. Adapted from Wieringa (2014).

2.2. Data collection methods

Different data collection methods were used in this study. A literature study was conducted, documents were analysed, focus groups were organised and interviews were conducted. In Table 1 the data collection methods that were used in each phase of the design cycle as displayed in Figure 4 are summarised.

Table 1: Data collection methods used in the three phases of the design cycle.

Elements of the design cycle	Data collection method
Problem investigation	
Resilience assessments and public participation	• Literature review • Document analysis
Problem investigation Municipality of Dordrecht	• Focus group (FG1) • Four semi-structured interviews with employees of the Municipality of Dordrecht (I1 – I4)
Problem investigation citizens of Dordrecht	• Two focus groups (FG2 and FG3) • 17 structured interviews unembanked area (I5 – I21)
Design brief	• Synthesis of previous information
Design phase	
Design the participatory approach	• Design brief • Literature review • Feedback retrieved in the validation phase
Validation phase	
Validation of design requirements and design content	• Validation session municipality (I22) • Progress meetings with supervisors of the University of Twente and the Municipality of Dordrecht

In Table 2 the participants of the focus groups and interviews are displayed. Appendix A and B present the questions that guided the discussion for the focus groups and interviews for the Municipality of Dordrecht and the citizens. The data was processed to ensure the anonymity of the participants in the focus groups and interviews. In sections 2.3 and 2.4, the data collection methods are discussed in more detail, divided into the phases of the design cycle.

Table 2: Participants per data collection method.

#	Reference to participants	Date
Problem investigation		
Problem investigation municipality of Dordrecht		
FG1	Three employees of the Municipality of Dordrecht - Expert in creating a lively city centre - A policy advisor on water and climate - Trainee project leader	09/03/2022
I1	Neighbourhood manager	10/03/2022
I2	Project manager focusing on participation	16/03/2022
I3	Communication manager	23/03/2022
I4	Advisor cultural heritage	30/03/2022
Problem investigation citizens of Dordrecht		
FG2	Four citizens living in the embanked area	22/03/2022
FG3	Five citizens living in the unembanked area	28/03/2022
I5 – I9	Five structured interviews with citizens living in the embanked area	21/03/2022 22/03/2022
I10 – I21	12 structured interviews with citizens living in the unembanked area	21/03/2022 22/03/2022
Validation phase		
I22	Policy advisor water and climate of the Municipality of Dordrecht	01/06/2022

2.3. Problem investigation

The goal of the problem investigation as part of the design cycle is to identify the scientific and practical problem. It is divided into four parts. First, a literature study was conducted on public participation and resilience assessments, then the problem perspective from the side of the Municipality of Dordrecht was researched followed by an investigation of the problem perspective of the citizens living in both the embanked and the unembanked areas in Dordrecht. In the fourth part, all this information was synthesised in a design brief, including the requirements for the design phase of the participatory approach.

2.3.1. Resilience assessments and public participation

A literature study was conducted on the concepts of public participation and resilience assessments. First, a literature study was conducted on resilience assessments, focusing on a system and community scale to identify the concepts of both types of resilience. A separate literature study focusing on public participation and how public participation is incorporated in resilience assessment literature was conducted afterwards. This is to identify if guidelines exist on how public participation can be incorporated into resilience assessments. An existing public participatory approach was found that paid specific attention to participatory methods and participation levels to identify which elements are of importance when designing a participatory approach. These three separate aspects were eventually synthesised to link resilience assessment literature with participatory goals and methods. Mainly the literature database of Scopus was used to find literature by searching for, and combining, the terms participation, public participation, approach, framework, resilience, community resilience, resilience assessment, and flood resilience. The relevance of the papers was determined by reading the abstract, and by filtering on a specific subject area, such as engineering and social sciences. Afterwards additional literature was found via snowballing. Also, literature provided by the supervisors of this MSc thesis was used, where snowballing was applied as well.

2.3.2. Problem investigation Municipality of Dordrecht

The aim was to understand the perception of participation, floods, and cultural heritage in the Municipality of Dordrecht. To identify the problem of the municipality, a focus group and four semi-structured interviews were conducted with employees of different departments within the organisation. The positions of the focus group participants and the interviewees are displayed in Table 2. An expert in creating a lively city centre, a policy advisor water and climate, a trainee project leader, and a neighbourhood manager were contacted for the focus group to gain specific information about how floods are affecting citizens in the city centre of Dordrecht. A project manager was interviewed specifically focusing on participation in projects, who advised to also contact the communication manager since the project manager experienced an overlap between participation and communication. Lastly, the advisor cultural heritage was contacted to gain insights into flood resilience of cultural heritage specifically. No overlap in functions was present between the participants of the focus group and the semi-structured interviews.

The coding software MAXQDA was used to analyse the qualitative data, which consisted of the transcripts of the interviews. This was based on an inductive coding approach where codes are determined based on the collected qualitative data, instead of using a predetermined set of codes (deductive coding). A shortcoming of an inductive coding approach in qualitative data analysis is that the researcher only selects data that gives plausible results for his research (Barbour, 2014). However, since this research is based on a case study, it was considered that a predetermined set of codes should not meet the context-specific characteristics of this specific case. The codes identified were cultural heritage, communication, participation, and awareness. These codes were chosen based on the focus group with the Municipality of Dordrecht where three sub-themes, i.e. cultural heritage, participation, and awareness, were discussed. The code communication was determined when interviewing the project manager about participation, who advised contacting the communication manager. Sub-codes per code theme were drafted as well while analysing the qualitative data. The code tree including sub-codes is displayed in Figure C1 in Appendix C.

2.3.3. Problem investigation citizens of Dordrecht

Also, the perspective of citizens living in cultural heritage was researched in this MSc thesis to identify the problem they perceive regarding participation and flood resilience. The perspectives of the municipality were compared with those of the citizens in both the embanked and the unembanked areas. This was done via one focus group with four participants and five structured interviews in the embanked area, and with one focus group with five participants and twelve structured interviews in the unembanked area (Table 2). The focus groups were organised via the neighbourhood manager. This was done since the neighbourhood manager knew which people were willing to be involved in focus groups. The results of the focus groups were summarised and sent to the participants to check if the interpretations were done correctly. Additionally, structured interviews were held with citizens living in cultural heritage. Based on the results of the problem investigation with employees of the municipality, interview questions were drafted, focusing on awareness, measures to protect cultural heritage, and citizen perspectives on participation.

To know if a building is cultural heritage, a list of cultural heritage buildings (divided into national monuments, municipal monuments, and iconic buildings [NL: beelbepalende panden]) was drafted via the website of the municipality (Monumentenzorg Dordrecht, 2022). This list was exported and divided into buildings in the embanked and in the unembanked area, which was used when selecting respondents. Citizens were interviewed, unannounced, based on this list, and based on their location in the city centre. An equal distribution among the embanked and unembanked areas was preferred, to gain information about the city centre as a whole, and not only about one specific area. The locations of the interviews and focus group participants were marked, which elucidated which areas in the city centre were underrepresented in the data. The locations are shown in Figure 5 on the next page where the red dots represent the interviews, and the blue dots the participants of the focus groups. In square 1 in the embanked area, no interviews were conducted. This is because mainly shops were situated there, and these are not part of the scope of the MSc thesis. Square 2 in the embanked area is a relatively new part of Dordrecht without any cultural heritage. Therefore, no interviews took place in these areas resulting altogether in fewer respondents in the embanked area than in the unembanked area.

The qualitative data collected in the focus groups and structured interviews were analysed via interview codes in MAXQDA. As for the interviews and focus group with the municipality an inductive coding approach was used. Since in an inductive coding approach the researcher can select data that gives plausible results for his research, positive and negative codes regarding public participation were defined. The code tree with codes and sub-codes is displayed in Figure C2 in Appendix C with the main codes flood awareness, crisis situation, and participation which were chosen based on the problem investigation at the Municipality of Dordrecht.

2.3.4. Design brief

All information that was collected in the first three parts of the problem investigation was synthesised in a design brief. This formed the starting point of the design phase and includes the goal and the design requirements that the participatory approach should meet. The design requirements resulted from the first three parts of the problem investigation, which all had separate inputs for the design requirements. The goal of the participatory approach and the appropriateness and completeness of the design requirements was validated by the Municipality of Dordrecht.

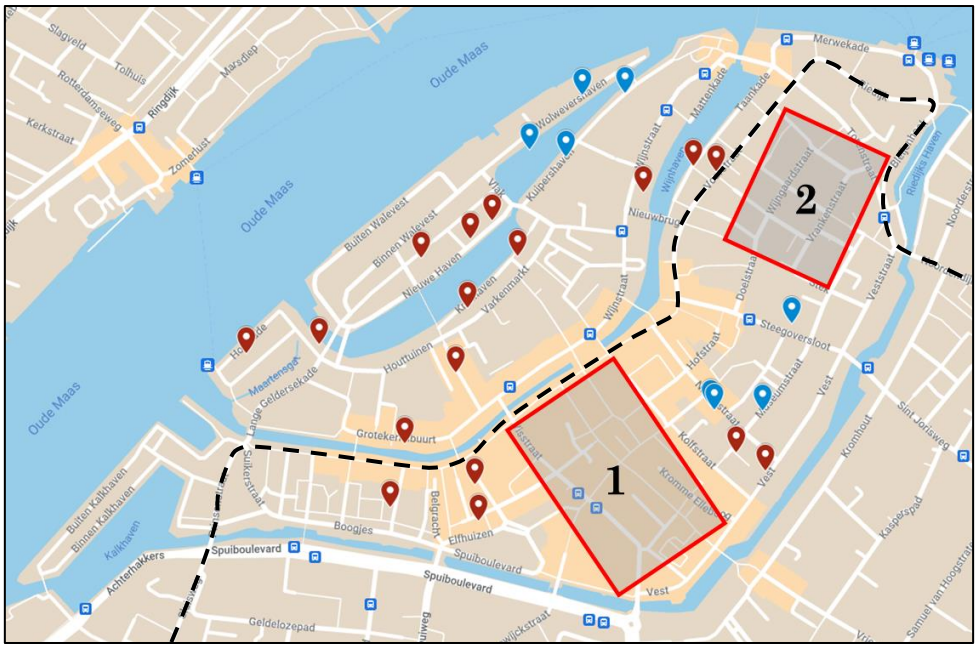

Figure 5: Map displaying the locations of the focus groups (red) and interviews (blue). Also, the areas where no interviews took place are highlighted, i.e. 1 representing a shopping area and 2 a neighbourhood without cultural heritage. The black dotes line represents the primary flood defence.

2.4. Design and validation phase

In designing the participatory approach the design brief, which resulted from the problem investigation, with corresponding design requirements was used as a basis. Based on the findings of the design brief, through an iterative process of redesigning, a participatory approach was designed which combines public participation and resilience assessments. The concept design constructed was validated with the Municipality of Dordrecht, whereafter improvements were made to design the final participatory approach.

In the validation session first the design brief was elaborated on to introduce the requirements and the concept design. Thereafter the design requirements were discussed, and whether or not they were complete and suitable for the Dordrecht case. Then, the concept design was introduced and validated based on the design requirements. Each design requirement was discussed and validated separately. Lastly, the content of the participatory approach was discussed to identify additional improvements that were not directly related to the design requirements. Throughout the design process, the informal (bi-)weekly meetings with the supervisor(s) were also used to receive feedback on the design requirements and the concept design of the participatory approach.

The regular informal meetings regarding the design requirements and the concept design resulted in an iterative design process where multiple improvements were made concerning the requirements and the concept design. The validation session with the Municipality of Dordrecht was the last iteration step in the validation process, resulting in the final design of the participatory approach.

3. Problem investigation

The problem investigation as the first phase of the design cycle aims to discover why a participatory approach has to be designed, verify the assumptions made in the problem statement in the introduction, and to further delve into that problem. Furthermore, by identifying the problem, inputs for the design are constructed, which are used as guidelines in developing the design requirements in the design brief. In this chapter first the theory about resilience assessments and public participation, which are discussed separately in the introduction, is further elaborated on whereafter it is synthesised. Secondly, the problem investigation based on the municipality is discussed. Thirdly the results of the problem investigation with the citizens in Dordrecht are evaluated whereafter the fourth part concludes the findings of the three individual elements together in a design brief.

3.1. Resilience assessment and public participation

This section of the MSc thesis delves deeper into literature about resilience assessments (section 3.1.1), public participation (section 3.1.2), and an existing participatory approach (section 3.1.3). The information is eventually combined in a synthesis (section 3.1.4.).

3.1.1. Resilience assessment

Resilience assessment frameworks assess the resilience of a system or a community (Herrera & Kopainsky, 2020; Hosseini et al., 2016; Quinlan et al., 2016; Resilience Alliance, 2010; Sharifi, 2016; Tong, 2021). To assess the resilience of urban systems, Wardekker et al. (2010) proposed six resilience principles. The first three are more related to absorbing disturbances, i.e. buffering, redundancy, and omnivory, while the last three refer to quick response, self-organisation, and learning, i.e. homeostasis, flatness, and high flux. The table below displays and explains the six principles of Wardekker et al. (2010).

Table 3: Resilience principles to assess resilience of a system. Adapted from Wardekker (2018) and Wardekker et al. (2010).

Resilience principle	**Definition**
Buffering	Over dimensioning dimensions to increase a certain threshold capacity (e.g. raising the dikes more than needed).
Redundancy	Overlapping copied functions inside the system, if one fails, another takes its place (e.g. multiple roads or evacuation routes).
Omnivory	Different approaches can be used simultaneously to diversify options, and can be used to back-up other approaches.
Homeostasis	Incorporating multiple feedback loops to keep the system and its dimensions constant (e.g. spatial planning reducing impacts of floods).
Flatness	Prevents the system to be too much top-down. Focus on citizen involvement to make a flatter system to reach decision-makers faster.
High flux	Resources moving fast to ensure rapid access for citizens to recover from a flood.

If an urban system scores high on each of the above-mentioned principles, the resilience of that system is high. The principles mainly relate to the resilience of an urban system, while the last three are to some degree related to the community.

Besides resilience assessments that focus mainly on the urban system (Wardekker et al., 2010), there are also frameworks for assessing the resilience of a community. An example of such a framework is the Community Based Resilience Analysis framework CoBRA (UNDP, 2013). This framework analyses community aspects of resilience to develop indicators used in the resilience assessment and it identifies factors that have an impact on building resilience through a qualitative participatory approach via focus groups and interviews (UNDP, 2013). The approach is bottom-up, where communities choose the focus of the resilience assessment themselves. A community first identifies their most important characteristics, whereafter they are asked to assess the

characteristics themselves, and assess how well they are achieved in both a normal situation and a crisis situation (UNDP, 2013). This bottom-up, community based approach is an example of a resilience assessment where citizens are actively involved in the assessment of self-chosen resilience objectives.

In both system resilience and community resilience, participation is mentioned either implicitly or explicitly. Thereafter in the next section public participation is further elaborated on, and how public participation is incorporated in resilience assessment literature.

3.1.2. Public participation and resilience assessments

Arguments why participatory methods have to be implemented in decision-making can be divided into *normative* arguments and *instrumental* arguments. *Normative* arguments focus on the process where public participation is used to legitimise decisions, suggesting that citizens have the democratic right to participate in decision-making (Coenen, 2009; Reed et al., 2009). They aim at getting a shared responsibility between the government and the citizens to legitimise decisions where the emphasis lies on democratic values (Coenen, 2009). *Instrumental* arguments are related to the process of how governments can manage the behaviour of citizens to the outcomes that they desire, related to public problems such as trust, accountability, and knowledge (Sarzynski, 2015). These arguments also focus on the quality of decisions through engaging citizens and identifying how citizens adopt a decision (Reed, 2008). They also aim at protecting the interest of the public, it broadens the public support for decisions and reduces the level of conflict (Coenen, 2009).

The arguments mentioned above in the water management context (Krywkow, 2009), environmental context (Coenen, 2009; Reed, 2008; Reed et al., 2009), and the context of climate change adaptation in cities (Sarzynski, 2015), offer an insight in why governments want to make use of a participatory approach to involve its citizens. However, as mentioned in the previous section, public participation is also used in resilience assessments. Sharifi (2016) discussed that public participation in resilience assessments is important, since it improves local understanding of risks and it creates a platform for sharing experiences.

Cundill et al. (2015) discussed an implicit link between resilience assessments and involving citizens. According to Cundill et al. (2015), participation supports resilience of social-environmental systems through social learning, where social learning is defined as "*a change in understanding that goes beyond the individual to become situated within communities through social interactions between actors within social networks*" (Cundill et al., 2015, p.178). The underlying mechanisms enhancing social learning are knowledge sharing and co-production, however, these processes supporting the resilience of social-environmental systems are often unplanned and not facilitated (Cundill et al., 2015). Cundill et al. (2015) concluded, through experience, that social learning can raise the resilience of social-environmental systems by its influence on decision-making processes and governance. This is only the case when learning is supported for the long-term, interaction is formally organised between stakeholders, participation is diverse and representative, there is effective facilitation to understand the perspectives of stakeholders, there are sufficient resources and a network is present to provide each other with knowledge and experience (Cundill et al., 2015).

In the context of urban planning, Figueiredo et al. (2018) mentioned that urban resilience is enhanced by the participation of stakeholders. Participation is required when taking into account context-specific indicators, since local stakeholders, e.g. citizens, have significant knowledge of their surroundings to contribute to a resilience assessment. Besides gaining knowledge, governments leading resilience assessments gain in legitimacy and effectiveness in their strategies when creating a resilient city (Figueiredo et al., 2018). Morelli et al. (2021) stressed that in the assessment of flood resilience in coastal areas the opinions of stakeholders are needed to identify different points of view in the assessment. Lastly, Herrera & Kopainsky (2020) argued that it is essential to involve stakeholders already at the beginning of the assessment process to deal with potential conflicts and to validate the chosen process based on the perspectives of stakeholders.

In multiple contexts, the importance of involving citizens in resilience assessments is stressed. However, there are no guidelines present about the use of participatory methods in resilience assessments. Therefore, existing literature that guides the use of participatory methods concerning participatory goals has to be researched to identify if participatory methods can contribute to resilience assessments.

3.1.3. Existing participatory approach

Krywkow (2009) designed a framework for participatory processes in the context of water management. It is the only framework that gives guidance in the use of participatory methods in public participation in the water management sector. In that framework a differentiation is made between 1) an overarching scheme consisting of participatory goals, classes of participatory methods and levels of participation, and 2) implementation criteria for choosing participatory methods. This was the only participatory approach found that explicitly combines participatory goals with levels of participation and participator methods for the water management context.

Goals, classes of participatory methods and levels of participation

To design a participatory approach, the goals of that approach have to be clarified before methods are used, since achieving a certain goal should be the main driving force behind a participatory approach (Krywkow, 2009). Arguments why participatory approaches are implemented in the context of water management are already linked to participatory methods (Krywkow, 2009). The participatory goals are based on a literature study conducted by Krywkow (2009) of legal documents and case study documents and are displayed in Table 4 (Hare & Krywkow, 2005; Krywkow, 2009).

Table 4: Participatory goals mentioned in legal documents and case study documents, based on a literature study conducted by Hare & Krywkow (2005); Krywkow (2009).

Legal documents	**Case study documents**
Informing the public	Identifying relevant stakeholders
Consulting the public	Knowledge extraction
Being transparent	Resolve conflicts
Identifying constraints	Social learning
Knowledge- and experience sharing	Finding consensus
Creativity	
Acceptance and recognition of perspectives	

After identifying participatory goals, corresponding participatory methods used to achieve the goals are drafted in designing participatory approaches, whereafter Krywkow (2009) gives guidance on when to use which methods in which participation level. These steps from identifying goals, linking the goals to methods, and linking the methods to participation levels are referred to as the *macro structure* in Krywkow (2009). Since a wide variety of participatory methods is present in literature, 9 groups of methods that have similar functions are introduced by Hare & Krywkow (2005) as *classes of participatory methods*. These classes are displayed in Table 5, including examples of participatory methods (Hare & Krywkow, 2005; Krywkow, 2009):

Table 5: Classes of participatory methods (Hare & Krywkow, 2005; Krywkow, 2009).

No.	**Classes of participatory methods**	**Example of participatory method**
1	Public information provision	Website, flyers, posters
2	Education	Lectures, workshops
3	Interviews	(Semi)structured interviews
4	Surveys	Focus groups, postal/online surveys
5	Events	Open days, school visits, field trips
6	Popular involvement campaigns	Sponsorships, partnerships
7	Fora	Newsletters, TV/Radio
8	Meetings	Public meetings
9	Workshops	Role-playing, computer simulation

Krywkow (2009) linked classes of participatory methods with the participatory goals listed in Table 4 to give guidance on when to include which method. The participatory goals linked with the participatory methods in the water management context are displayed in Table 6 where the numbers of method classes correspond with the 9 classes listed in Table 5 (Hare & Krywkow, 2005; Krywkow, 2009).

Table 6: Participatory goals mentioned in legal documents and case study documents, based on a literature study conducted by Hare & Krywkow (2005; Krywkow (2009) linked to classes of participatory methods.

Legal documents	Method class	Case study documents	Method class
Informing the public	1, 2, 7, 8	Identifying relevant stakeholders	3, 4, 7, 8
Consulting the public	2, 3, 4, 5, 7, 8, 9	Knowledge extraction	3, 4, 7, 8, 9
Being transparent	1, 6, 7, 8, 9	Resolve conflicts	2, 5, 6, 7, 8, 9
Identifying constraints	3, 4, 7, 8, 9	Social learning	5, 6, 8, 9
Knowledge- and experience sharing	1, 2, 5, 6, 7, 8, 9	Finding consensus	8, 9
Creativity	2, 5, 6, 9		
Acceptance and recognition of perspectives	2, 6, 7, 8, 9		

A participatory approach can be assigned to different levels of participation, which are introduced by Mostert (2003), based on Arnstein (1969). Krywkow (2009) combined the views of Mostert (2003) and Arnstein (1969) into levels of participation, and identified which of the method classes should be used at which level. The levels identified by Krywkow (2009) are listed below:

1. **Information provision**, which is mainly one-way communication with flyers, websites, letters, etc. This one-way communication is often not referred to as *participation,* since no collaboration between two parties is present (Hügel & Davies, 2020; Krywkow, 2009). Yet it is considered an essential part of a participatory process, as it can reach people while keeping the threshold low.
2. **Consultation**, where problems are introduced to the citizens as well as measures to solve these problems. With the response of citizens, local knowledge and perspectives are received.
3. **Active involvement** differs from consultation since in the latter only knowledge and opinions are exchanged. In active involvement, citizens are actively taking part in the design process, and the implementation process.
4. **Social learning** can be seen as "*a process to collectively examine, analyse and modify individual beliefs […] with the aim of achieving planning goals with the greatest level of approval among the participants*" (Krywkow, 2009, p.54).

However, the last step mentioned by Krywkow (2009) is more of a process. It is therefore in this thesis not considered to be a level of participation, but something that can be achieved over time by constantly involving citizens to modify the belief of the individual. The term chosen in this thesis as the fourth step on the participation ladder is co-production (Sarzynski, 2015):

4. **Co-production** refers to a level where both participants from the government and the community are intensely involved in not only the planning process, but also in the implementation process (Sarzynski, 2015). This refers to the context of urban climate adaptation, and it, therefore, links to this MSc thesis.

Figure 6 below is adapted from Krywkow (2009) and displays the classes of participatory methods discussed earlier assigned per level of participation, giving guidance on the use of participatory methods.

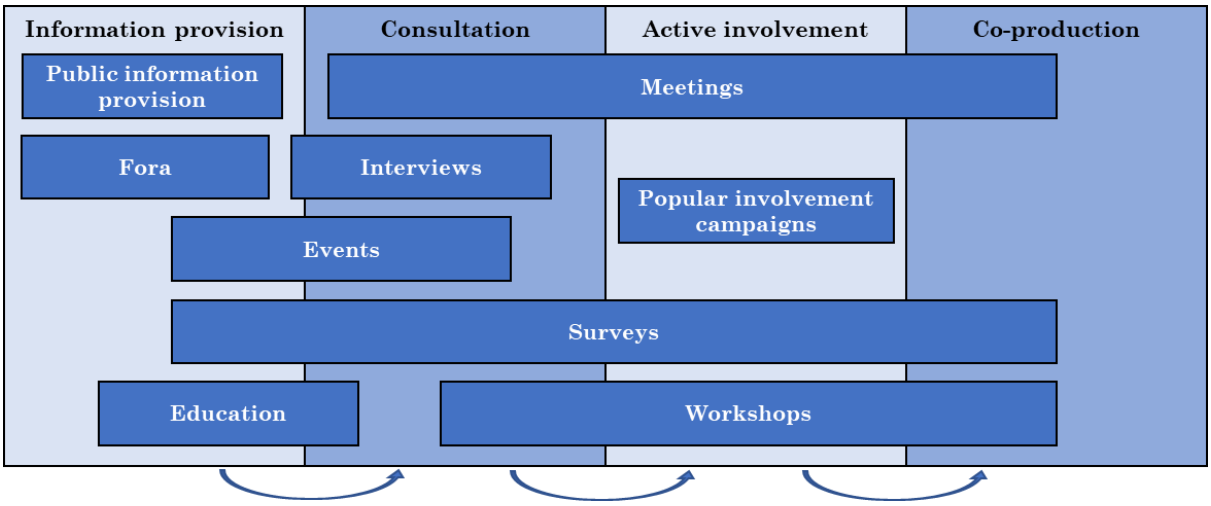

Figure 6: Method classes assigned to the four levels of participation, where each next level of participation increases the resources needed. Adapted and based on Krywkow (2009) and (Sarzynski, 2015).

Implementation criteria for participatory methods

Implementation criteria, also referred to as constraints, determine which participatory methods can be used in a participatory approach. These implementation criteria are used to determine whether a method can be used and applied by the ones implementing it, e.g. governmental institutions like the Municipality of Dordrecht. The criteria are as follows, according to Krywkow (2009), and determine which participatory methods can be selected or not:

1. **Resources share** refers to resources such as costs, time, and staff for preparation, implementation, and analysis;
2. **User mode** is a criterium to indicate the method based on the number of individuals expected at each activity, varying from individuals to large groups;
3. **Moderator skills** are skills needed to organise methods such as workshops and meetings;
4. **The level of application skills** indicates the extent to which expertise is required to apply a participatory method because methods such as interviews, or doing surveys, require certain knowledge and skill. This expertise is divided into experience, scientific knowledge, and technical expertise;
5. **Special software**, e.g. computer models or websites is in some classes of methods necessary, but it requires the expertise and resource to execute it.

In this MSc thesis criteria five, special software, is combined with the moderator skill since both need certain expertise to execute it. Criteria one is incorporated in the participatory approach since the participatory approach is based on two scenarios. One for a situation with low resources, and one with high resources. By doing so, less quantitative data is necessary (e.g. costs, staff), and the Municipality itself can determine which participatory approach they can use based on their available resources. The scenarios are explained in more detail in chapter 4.

The guidelines about when to include which method referred to decision-making in the water management context. Such guidelines are not present in the context of resilience assessments. The next and last section of this chapter combines the literature on public participation and resilience assessments to give guidance on when to include which methods in resilience assessments.

3.1.4. Synthesis of public participation and resilience assessments

This section synthesises the results of the literature study on resilience assessments and public participation by combining the two. It aims to identify the importance of using participatory approaches in resilience assessments. This is to identify if participatory methods could be linked to resilience assessments by combining arguments why participation is used in resilience assessments with participatory goals.

In general, more attention needs to be paid to public participation in resilience assessments (Sharifi, 2016). The arguments why participation should be used in resilience assessments are listed below based on the literature study of the previous sections:

- Improve local understanding (Sharifi, 2016);
- Sharing knowledge and experience (Cundill et al., 2015; Sharifi, 2016);
- Increasing social learning (Cundill et al., 2015);
- Taking into account context-specific indicators (Figueiredo et al., 2018);
- Gain in legitimacy and effectiveness (Figueiredo et al., 2018);
- Identifying different points of view (Morelli. et al., 2021);
- Deal with potential conflicts (Herrera & Kopainsky, 2020);
- Validate a chosen process based on a stakeholder perspective (Herrera & Kopainsky, 2020).

These arguments were compared with the participatory goals of Krywkow (2009) to identify if they overlap. When this overlaps with arguments to include participation in resilience assessment literature, method classes can be assigned to these arguments, since Krywkow (2009) already linked classes of participatory methods to participatory goals. Therefore, in Table 7 arguments why participation is used in resilience assessments are set out against the participatory goals mentioned by Krywkow (2009) in Table 6. In the last column of Table 7, the classes of participatory methods that link with the participatory goals of Krywkow (2009) are displayed to illustrate which type of methods link explicitly with arguments to include participation in resilience assessments. Table 7 can be used as guidance on determining which participatory methods can be used in resilience assessments, depending on the reason why a resilience assessment has to be conducted. The list below explains why arguments are linked to certain participatory goals of Krywkow (2009), with the numbers corresponding to the arguments listed in Table 7.

1. Improve local understanding (Sharifi, 2016) overlaps with two participatory goals. 1) "Informing the public" and 2) "Consulting the public" are chosen since a local understanding of the problem can be improved through informing and consulting the public, without actively involving the public, meaning that fewer resources are needed.
2. Sharing knowledge and experience (Cundill et al., 2015; Sharifi, 2016) links directly to the participatory goal of "Knowledge and experience sharing".
3. Increasing social learning (Cundill et al., 2015) links directly to the participatory goal of "Social learning".
4. Taking into account context-specific indicators (Figueiredo et al., 2018) from the perspective of the initiator, e.g. a municipality, is linked to "Knowledge extraction". This is because through knowledge extraction context-specific indicators can be identified, such as which area people live in (embanked- or unembanked) or whether they live in their own house, or a rented house.
5. Identifying different points of view (Morelli. et al., 2021) is linked to two participatory goals: 1) "Knowledge extraction", since knowledge is extracted from local stakeholders when different points of view are identified and 2) "Knowledge- and experience sharing" since multiple points of view can be identified when knowledge and experience are shared.
6. The gain in legitimacy and effectiveness (Figueiredo et al., 2018) is linked to two goals, namely 1) "Identifying constraints" to make the process more effective, and 2) "Finding consensus" so that the stakeholders somewhat agree on the decisions made and legitimacy is increased.

7. Deal with potential conflicts (Herrera & Kopainsky, 2020) links directly to the participatory goal 1) "Resolving conflicts" and is therefore linked. Additionally, also 2) "Acceptance and recognition of perspectives" is linked. This is because it is expected that when perspectives are accepted throughout a community, it can help in resolving conflicts. The last participatory goal that is linked is 3) "Being transparent", since a lack of transparency results in less trust, which can enhance conflicts
8. Validate a chosen process based on a stakeholder perspective (Herrera & Kopainsky, 2020) is linked to two participatory goals. 1) "Consulting the public" is linked since consulting the public can result in a validation session where stakeholder perspectives are taken into account. Goal 2) "Finding consensus" is linked since striving for consensus can validate a certain decision or not.

The participatory goals "Creativity" and "Identifying relevant stakeholders" displayed in Table 6 were not linked to one of the eight arguments. This is since it was assumed that creativity is not necessarily a goal, but more a way to design participatory approaches. Identifying relevant stakeholders were not linked since it is considered not a goal, but a requirement *before* conducting participatory approaches.

Despite the different contexts, i.e. community resilience, resilience of social-environmental systems, urban resilience, and flood resilience in coastal areas, the arguments to include participation in resilience assessments were linked to some of the participation goals drafted by Krywkow (2009). This resulted in a link between arguments to include participation in resilience assessments (column 1 Table 7), participation literature (column 2 Table 7), and classes of participatory methods (column 3 Table 7). It can be stated that the multiple participatory goals as displayed in Table 7 play a role in resilience assessments.

The following design inputs are drafted for the participatory approach based on the literature study:

- The approach is bottom-up where the community identifies their most important characteristics themselves based on the capacities of Hegger et al. (2016), and assesses them accordingly;
- The approach is drafted based on the methodological framework for designing participatory approaches constructed by Krywkow (2009) in the water management context;
- The approach can apply participation in multiple participation levels introduced by Krywkow (2009);
- The approach is designed based on Table 7 which gives guidance on which method class has to be used when achieving particular goals related to public participation and resilience assessment, and it links this to goals mentioned in practice in the following sections.
- The approach is diverse and representative and formally organised to understand the perspectives of stakeholders.

Table 7: Arguments to include participation in resilience assessments linked to participatory goals and participatory methods of Krywkow (2009).

Arguments to include participation in resilience assessments	**Goals of a participatory process (Krywkow, 2009)**	**Classes of participatory methods**								
		Public information provision	Education	Interviews	Surveys	Events	Popular involvement campaigns	Fora	Meetings	Workshops
1) Improve local understanding (Sharifi, 2016)	Informing the public	X	X					X	X	
	Consulting the public		X	X	X	X		X	X	X
2) Sharing knowledge and experience (Cundill et al., 2015; Sharifi, 2016)	Knowledge- and experience sharing	X	X			X	X	X	X	X
3) Increasing social learning (Cundill et al., 2015)	Social learning					X	X		X	X
4) Taking into account context-specific indicators (Figueiredo et al., 2018)	Knowledge extraction			X	X			X	X	X
5) Identifying different points of view (Morelli. et al., 2021)	Knowledge- and experience sharing	X	X			X	X	X	X	X
	Knowledge extraction			X	X			X	X	X
6) Gain in legitimacy and effectiveness (Figueiredo et al., 2018)	Identifying constraints			X	X			X	X	X
	Finding consensus								X	X
7) Deal with potential conflicts (Herrera & Kopainsky, 2020)	Resolve conflicts		X			X	X	X	X	X
	Acceptance and recognition of perspectives		X				X	X	X	X
	Being transparent	X					X	X	X	X
8) Validate a chosen process based on a stakeholder perspective (Herrera & Kopainsky, 2020)	Consulting the public		X	X	X	X		X	X	X
	Finding consensus								X	X

3.2. Problem investigation municipality

The results of the problem investigation at the Municipality of Dordrecht are displayed per interview code as explained in chapter 2. These results are based a data collection through a focus group and semi-structured interviews.

3.2.1. Cultural heritage

Whether or not a building is cultural heritage can be found in the cadastre, a government-led institution for property and real-estate registration. It also has to be present in the contract when someone is buying a property (I4). The municipality advises about national monuments and municipal monuments regarding construction works to make sure the monumental value is not affected negatively. A permit is needed when a citizen wants to change aspects of the house, and the municipality advises about these permits (I4). Only when major changes are made to the building, the Cultural Heritage Agency (NL: Rijksdienst voor Cultureel Erfgoed) is asked for additional advice. When iconic buildings are changed by citizens, only changes on the front part of the building need to be assessed. Other parts of the buildings can be changed without consulting the municipality (I4).

The "monumental value" of a monument is determined by multiple criteria. When something is changed in cultural heritage, a report of the history of the building is requested in which parts of the building are classified into three categories, 1) high monumental value, 2) positive monumental value and 3) indifferent monumental value. The criteria of a monument that make up the value a monument has are 1) cultural-historical value, 2) architectonic value and 3) history of the user or the building (I4). The combination of these values determines the total monumental value of cultural heritage.

Measures to protect the building and its occupants can be taken without consulting the municipality when nothing is changed or removed from the building. An example of such a measure is the placement of sandbags, which are an addition to the building only in situations with expected high waters. Regarding portable flood barriers, only small additions have to be made near the doors of the buildings. With such minor additions, without damaging the original construction and without affecting the monumental value, portable flood barriers can also be installed without consulting the municipality (I4). Only for measures impacting the structure or monumental value significantly the municipality has to be consulted, e.g. removal of a window where water passes through in case of a flood. Even in such extreme cases, the municipality is willing to approve substantial changes to the building if the value of the buildings will be affected by floods otherwise (I4).

3.2.2. Communication

The methods the municipality is often using to communicate to the citizens are local newspapers, but also municipal news, the website, and social media. Also, the use of short movies via the local tv, RTV Dordrecht, is sometimes used as a communication method (I3). Additionally, posters are designed as well, which can be hung in citizens' houses to be aware of the risks there are regarding water safety. The website the municipality uses to communicate about water-related issues is groenblauwdordecht.nl, but on the municipal website there is barely structured information on participation or water safety. The communication department is not involved in the participation strategies of the municipality of Dordrecht, which makes the collaboration between communication and participation in projects of the Municipality of Dordrecht troublesome (I3).

3.2.3. Participation

The municipality of Dordrecht has made a Guideline for Participation Policy (NL: Handreiking participatiebeleid) for initiators and permit requesters (Gemeente Dordrecht, n.d.). This guideline explains what participation is and it explains elements of the participation ladder used in Dordrecht. Methods to communicate to fellow citizens are not mentioned in the plan and there is not a clear plan that can be followed (I2). The Guideline for Participation Policy explains what elements a participation plan for permit requesters has to contain, such as consequences of the

permit or initiative, and who was involved in the process. However, examples and ways to conduct participation are not included in the guideline. This is since the participation strategy of the Municipality of Dordrecht is not yet complete (I2). Besides the Guideline for Participation Policy, also a Policy Framework for Participation (NL: Beleidskader participatie) is constructed which focuses more on the assessment and evaluation of whether or not participation is well implemented in a project (Gemeente Dordrecht, 2022). The reason to use participation in projects in the Municipality of Dordrecht is to (FG1, I1, and I2):

- Create a support base;
- Inform;
- Explain challenges;
- Make plans and gain ideas;
- Create awareness;
- Offer a perspective for action.

The overall goal regarding flood resilience is that every citizen knows what they have to do to protect themselves, their building, and others against floods (FG1). To reach this, citizens need to be involved, however, at the moment there is not a general participatory approach the municipality of Dordrecht uses (I2). This results in project managers consulting a company to conduct participation in the municipality, or employees applying participatory methods based on gut feeling. In the latter case, the citizens are approached based on different methods, such as letters, folders, posters, surveys, information evenings, expositions, and short movies. Due to the absence of a participation strategy and the absence of someone responsible for participation, participation is not well applied in the municipality according to the project manager (I2). The still-to-be-developed general participation strategy can contribute to that problem, which will be finished in late 2022. This strategy is meant as a practical guideline that designs participation for initiators where participatory methods are listed that can be used. This strategy is especially relevant for:

1. External initiators, such as citizens and project developers;
2. Internal initiators are the employees of the municipality of Dordrecht.

In this participation strategy, the municipality is planning to construct a toolbox for external and internal initiators explaining how to construct participation in which phase of a project, and which methods are useful per phase. This toolbox will consist of offline as well as online participatory methods. That particular participation strategy is for design projects, ranging from small scale to larger scale. The main difference with the participatory approach that will be designed in this MSc thesis, is that in this thesis the focus of the participatory approach is specifically on assessing the flood resilience of citizens. However, it is expected that this research can contribute to the general participatory approach of the Municipality of Dordrecht, since perspectives of citizens regarding participation are investigated in this research as well.

3.2.4. Awareness

Heavy rainfall

The Municipality of Dordrecht expects that people living in the unembanked area are not harmed by heavy rainfall, since water can flow away freely. Also, they expect that people in the embanked area are more familiar with floods by heavy rainfall since it happens regularly, which might result in the fact that citizens in the embanked area are aware of the risks of these floods (FG1).

High river water

Due to the protocols used in the unembanked area when high water approaches the city, the Municipality of Dordrecht expects that the citizens are aware of their risks and they know what to do to prevent damage caused by floods (FG1). That protocol consists of a yearly letter that informs citizens about their flood risk and where sandbags can be found. It also informs about a mobile application that sends notifications if high water in the rivers is approaching. During the focus group session with the municipality, employees mentioned that they expect that people living in

the embanked area are less aware of their risks, since no active communication is present and major floods did not happen in recent history (FG1).

Crisis situation

The Municipality of Dordrecht expects that the citizens are not aware of their risks in a crisis situation, which in this thesis is defined as an extreme flood. For the unembanked area, the view of the municipality is that citizens do not yet know what to do in a crisis situation, although high waters in the rivers happen regularly. This is also the case for the embanked area, where people do not have any experience with high water in the rivers. In an extreme situation, certain people in the municipality have specific tasks in a disaster management plan (NL: Rampenplan). Although these plans exist, and employees have certain tasks, employees are typically not aware if they have any responsibilities (I1).

In an extreme situation, citizens can go to the evacuation location De Staart, which is constructed multiple meters above mean sea level. This is located northeast of the historical city centre and is safe in case of a crisis situation (Figure 7). However, when everybody flees to the same place at the same time, traffic hindrance occurs. Citizens might not be aware of De Staart as an evacuation location since it is not yet communicated actively. Moreover, on the website of the municipality, there is no information displayed about what to do in a crisis situation. The strategy behind making citizens aware of a major flood is three-fold (I3). 1) First citizens need to think about where they can hide or evacuate to, then 2) people have to think about an emergency package and prepare, and lastly 3) citizens need to think about people around them who might need extra help.

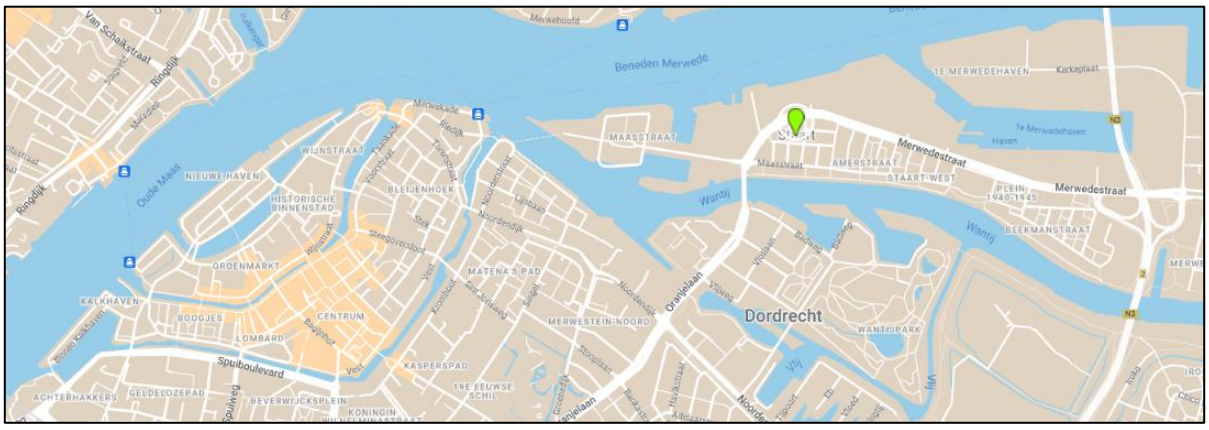

Figure 7: Location of De Staart (green point) in the Municipality of Dordrecht northeast of the historical city centre.

3.2.5. Synthesis problem investigation municipality

The Municipality of Dordrecht expects that citizens owning cultural heritage are aware of the fact that the buildings they are living in are assessed as such. Moreover, when cultural heritage is located in a flood-prone area, the Municipality of Dordrecht is willing to approve adaptive measures (e.g. waterproofing walls or removing windows) if the monumental value is affected otherwise by the flood. They furthermore assume that 1) citizens in the unembanked area are aware of their risk to minor floods induced by rivers, 2) citizens in the embanked area are aware of the risk caused by heavy rainfall, but not aware of floods induced by rivers and 3) that citizens in both the embanked- and unembanked area are not aware of possible crisis situations which can occur when an extreme flood occur unannounced (e.g. when a flood defence fails). Regarding the latter, it can also be concluded that employees of the Municipality of Dordrecht do not know if they have any responsibilities in a crisis situation. They have certain tasks, however, since crisis situations do not occur regularly and the leading role in these crisis situations is assigned to the safety region, employees do not know what their role is.

To increase flood risk awareness among citizens, so that they know what they have to do to protect themselves, their houses, and others against floods, communication and participation can play an essential role. However, due to the absence of a participation strategy and someone responsible for

participation, participation is not well applied in the municipality. Furthermore, in communicating with its citizens, the Municipality of Dordrecht does not have a clear strategy. Instead, a wide variety of methods is used to reach most citizens. Through informal meetings with the policy advisor water and climate, it became clear that the approach has to be resource-dependent (i.e. when there are fewer resources less citizen involvement will suffice resulting in a lower participation level). Additionally, the participatory approach has to be easy to understand.

The following design inputs are drafted for the participatory approach based on the problem investigation from the perspective of the Municipality of Dordrecht:

- The approach prepares both employees and citizens for crisis situations;
    - It links to the three-step approach for a crisis situation: Where can I evacuate to? What do I pack? And who around me needs further support?
- The approach increases flood risk awareness in the embanked area;
- The approach focuses on measures citizens can take to protect themselves and their houses against floods;
- The approach is flexible, i.e. the intensity level regarding the participation levels depends on resources that are available in the Municipality of Dordrecht;
- The approach is easy to understand for civil servants of the Municipality of Dordrecht.

3.3. Problem investigation citizens

In this chapter, the problem is investigated through focus groups and structured interviews with citizens living in cultural heritage in the historical city centre of Dordrecht. It is structured based on the qualitative interview codes as mentioned in chapter 2.

Table 8 (page 25) summarises the results of the interviews and focus groups based on the interview codes per area (embanked/unembanked). The majority of the citizens interviewed possessed their own house and are therefore responsible to take protective measures themselves. However, citizens that do not own a house think that it is the responsibility of the owner, e.g. a housing corporation, to take flood preventive measures. These citizens are also less likely to take flood protective measures than house owners (I5, I8, I9, I12, I17).

Persons that have recently moved to a house in either the embanked or the unembanked area are less aware of the flood risks and flood measures (I13). In the unembanked area, they are informed yearly, so these citizens are informed within a year about their flood risk (I10 – I21). Citizens in the embanked area are not informed about their flood risk, and are only aware of their risks when a flood happens, or when they accidentally hear about it (I5 – I9).

During the focus group sessions, the participants were asked about their thoughts on the response bias of that particular focus group. In both focus groups, the overrepresentation of elderly, higher educated people, and self-reliant people was mentioned by the participants (FG2 and FG3). According to them, the participatory approach that is designed should therefore not only focus on the sample size of the focus groups and interviews, but also on lower educated, younger, less self-reliant persons, that were not present during the focus group sessions.

3.3.1. Flood risk awareness

Heavy rainfall

Only citizens that experienced problems with heavy rainfall in the embanked area were aware of the risks of heavy rainfall (I8, I9). Citizens without experience were not informed about the chances and risks of pluvial floods and are less aware of their flood risk (FG2, I5, I6, I7). The difference between the embanked- and the unembanked area is that the embanked area is more vulnerable to pluvial floods since water can not flow away freely.

Rivers

There is little awareness regarding floods induced by the rivers in the embanked area (FG2, I5, I6, I8, I9). This is mainly because the probability of a flood is low, and because there is no information provision about the chances and risks of the floods occurring (FG2, I5, I6, I8, I9). In the unembanked area, it is the other way around. Due to floods occurring regularly, and due to a well-organised flood information strategy by the Municipality of Dordrecht, citizens in the unembanked area are aware of the chances and risks of flooding (FG3, I10 – I12, I14 – I21). Only citizens living in the area relatively short are not aware since they did not receive any information about floods yet (I13). Also, when citizens buy a house, they are not informed by the Municipality of Dordrecht about their flood risk (FG2, FG3).

Flood protection measures

Mainly sandbags and portable flood barriers are mentioned by the citizens as flood protection measures. Sandbags are distributed in the unembanked area in case of a flood, so citizens living there are aware of this measure due to information provided by the municipality. Nevertheless, no information is given about indirect damage, e.g. furniture and other belongings. In the embanked area citizens only know about sandbags and portable flood barriers through experience and information channels not linked to the municipality (FG2, I6, I7, I8, I9).

3.3.2. Crisis situation

Awareness

The main point of view, of both the citizens living in the embanked- and the unembanked area, is that the chance of a flood resulting in a crisis situation is negligible (I7 – I13, I15 – I17). Citizens are not informed about the chances and risks of such a situation, and they mention that when an extreme flood will occur they will flee to a higher level in their building. Moreover, the other two aspects of the crisis strategy, "What do I pack?" and "Who around me needs further support?" are not known.

Evacuation De Staart

Citizens are not aware that there is a location to evacuate to in a crisis situation, which is De Staart. They know that it is an area in Dordrecht, but information about De Staart being an evacuation location is not present (FG2, FG3, I5 – I21).

3.3.3. Participation

Experience

In general, the views on participation in both the embanked- and the unembanked area are not positive. Only positive experiences occur in the unembanked related to the information provision of floods induced by rivers (FG3, I10 – I21). In the embanked area no information is present, and in both areas the general idea is that active participation has to come from the citizens, e.g. "*participation through escalation*" (FG2). The current approaches are not tailor-made and they do not focus explicitly on less self-reliant people. The citizens feel that a sense of urgency is missing in the municipality and the citizens think that the municipality does not understand that citizens are needed for a well-structured participatory approach. Besides that, the citizens perceive that the first step of participation is always coming from them, and that the municipality is not taking an active role when initiating a participatory approach (FG2, FG3).

Future

According to the citizens in Dordrecht, the municipality has to take up an active role in organising participation (FG2, FG3). At the moment participation does not reach everyone, which has to change in the future. Also, citizens see it as the municipal's duty to inform them correctly and involve them in participation. They think that well-structured information provision and participation can increase trust between the municipality and its citizens (FG2, FG3).

Methods

Information is preferred that focuses on the risks, chances of risks, and preparedness via letters, mail, or inbox of the municipality, but citizens also mention that a wide variety of methods have to be used (FG2, FG3). For active collaboration, information sessions (online and offline) are mentioned as a preferred method. Local newspapers or unaddressed letters are not preferred, since they often do not reach everyone.

3.3.4. Synthesis problem investigation citizens

In general, there is more flood risk awareness in the unembanked area compared to the embanked area. This is mainly because minor floods happen regularly in the unembanked area, and because there is a structured flood information protocol from the municipality that informs the unembanked area. Also, citizens in the unembanked area are more positive about current participation, mainly about the lowest participation level *information provision*, than citizens in the embanked area, because the municipality informs them yearly about their flood risks. However, when looking further than information provision alone, the perception is that participation is embedded only limitedly in the municipality. The citizens feel that the municipality is only actively collaborating with them if the first step is initiated by the citizens, while they think that it is the responsibility of the municipality to initiate that first step. People who are living in buildings they do not own themselves are less inclined to take flood preventive measures than homeowners.

The following design inputs are drafted for the participatory approach based on the problem investigation from the perspective of the citizens of Dordrecht:

- The approach reaches all citizens by using diverse participatory methods;
- The approach is initiated and executed by the municipality;
- The approach focuses on creating flood risk awareness in the embanked area;
- The approach strives to gain awareness about a crisis situation in both the embanked and the unembanked area;
- Citizens that recently moved to the area have to be provided with flood information as soon as possible;
- The approach focuses on both private houses and houses owned by an external party, due to differences in responsibilities between them.

Table 8: Perspectives regarding floods and participation of citizens living cultural heritage in the embanked- and unembanked area in the historical city centre of Dordrecht.

		Embanked area	Unembanked area
Flood risk awareness	Heavy Rainfall	Citizens are aware of pluvial floods, since it happens more often. Citizens without experience of floods by heavy rainfall are less aware of risks due to a lack of information provision.	Citizens are aware that heavy rainfall occurs, but they do not have any experience with it since the water can flow freely.
	Rivers	There is no awareness regarding floods induced by the rivers. This is the case since floods do not occur often, and since the municipality does not inform citizens about possible risks.	There is much experience of floods caused by high water in the rivers. This is because floods happen regularly and this is due to the municipal flood protocol.
	Flood protection measures	Citizens are aware of sandbags and portable flood barriers. However, measures to prevent flood damage are not communicated.	Sandbags are provided by the municipality. Some citizens also use portable flood barriers, but these are not distributed.
Crisis situation	Awareness	There is no information present from the municipality on what to do when a crisis situation occurs. The citizens are not informed about the risks and chances. Citizens mention that, if there is such a situation, they will flee to a higher level of their building.	The majority of the citizens mention that they will flee to a higher level in their building in case of an emergency. However, they do not know what to do in such a situation. Also, they think that the chance of a crisis situation happening is negligible.
	Evacuation De Staart	Citizens are not aware of De Staart as a crisis situation. That it can be used as a place to evacuate to is not known and communicated.	De Staart as a place to evacuate to is not known to the citizens. There has not been communication about it.
Participation	Experience	Citizens find the information provision about their vulnerability and about measures they can take minimal. The general idea is that active participation (not only informing) has to come currently from the citizens, and not from the municipality. It is also not representative, since the same group of citizens constantly takes up that active role. Information in non-water-related projects is well structured at the beginning, but it deteriorates afterwards.	Citizens are positive about the information provision regarding floods, since they are yearly informed about it. On non-water-related topics they are less positive, since information provision lacks in the long term. The current approach is not tailor-made and focuses not explicitly on less self-reliant people. Participation in the current state has to come from the citizens, instead of from the municipality. They miss a sense of urgency in involving citizens in policy processes.
	Future	The municipality has to take up an active role in organising participation. Citizens see it as the duty of the municipality to inform them correctly, and to also involve them in participation. Some citizens want to be actively involved, and some do not. Participation, therefore, has to be diverse to reach a variety of citizens.	A platform or structure for participation has to be created, based on the different neighbourhoods. This functions as a place (online or offline) to go to for participation, which can increase trust between the municipality and the citizens when there is constant information provision. Participation does not reach everyone at the moment, which therefore has to change in the future.
	Methods	More written information (letters, mail, mailbox Rijksoverheid) is preferred with the focus on risks, chances of risks, and preparedness. Besides written information also online information can be useful for certain groups. For active collaboration, information sessions are mentioned in both an online and in-person setting.	A wide variety of methods is mentioned, varying from offline to online methods, and from methods of information provision to methods emphasising active involvement. Local newspapers or unaddressed letters are not preferred, since they often do not reach everyone.

3.4. Design brief

Synthesis problem investigation

In the literature study, the concepts of resilience assessment and public participation were synthesised. It was also found that there is currently no guidance present in implementing resilience assessments in a participatory way. Therefore, arguments why participation should be used in resilience assessments were linked to participatory goals, and thereafter to classes of participatory methods. This emphasised the importance public participation has in resilience assessments, and it resulted in classes of participatory methods that can be used in resilience assessments (Table 7).

Additionally, the problem was investigated based on the experience and perspectives of citizens living in cultural heritage in Dordrecht. A distinction was made between citizens living in the embanked area and the unembanked area. Citizens in the unembanked area are aware of their flood risks in normal situations, with only minor damage, since minor floods happen regularly in that area and since they are informed yearly about their flood risks. At the same time, most citizens in the embanked area are unaware of their flood risks. Both since there is no information present about flood risks, and since they have only experienced pluvial floods. Experience and information provision in both areas are therefore significant factors contributing to flood risk awareness. There is furthermore no awareness regarding crisis situations in both areas, and within the municipality civil servants do not know if any responsibilities are assigned to them when a crisis situation occurs. Flood measures to protect citizens and their buildings, such as sandbags and portable flood barriers, are only known to citizens that experienced floods, or to citizens that have been informed by the municipality. Furthermore, the municipality does not have a participatory strategy, which might result in less involvement of its citizens which thereafter does not enhance trust-building between the municipality and the citizens.

Considering the aspects of the problem investigation based on the concepts of resilience assessments and public participation, the Municipality of Dordrecht, and the citizens, a participatory approach will be designed. This approach has to connect the research fields of resilience assessments and public participation, based on the experiences and perspectives of the municipality and the citizens. Additionally, the participatory approach should distinguish between a situation with limited and ample resources.

Design goal

This MSc thesis aims to contribute to flood resilience of citizens in the urban area, and the cultural heritage they are living in, by designing a participatory approach that satisfies the design requirements (Table 9) based on the problem investigation. The approach gives guidance to the Municipality of Dordrecht on which participatory methods can be used in resilience assessments. The participatory approach involves citizens in a participatory way in the assessment of their flood resilience, contributing to a flood resilient community. The preferred outcome of the participatory approach is that flood resilience of the community is improved.

The Municipality of Dordrecht

The participatory approach has to be initiated by employees of the Municipality of Dordrecht in the context of flood resilience. Experience in organising or executing participatory approaches, while communicating this to citizens, is preferable. This is to narrow the current gap between communication and participation departments within the municipality. The guidance for application is discussed in more detail in the design chapter.

Design requirements

Based on the problem investigation, it was found that a participatory approach with two scenarios is preferred. 1) a scenario where the municipality has a low amount of resources, resulting in a low-intensity participatory approach focusing mainly on information provision and 2) a scenario where the municipality has a high amount of resources which consequently results in a higher participation level aiming to actively involve citizens. For the participatory approach, requirements were drafted, which applied to both a low and a high-resource scenario. These design requirements

are based on the design inputs that were drafted after each separate section in the problem investigation. In Table 9 six design requirements are displayed, where the sixth requirement is divided into a low-resource scenario and a high-resource scenario. What should be noted is that a low-resource approach does not mean that fewer citizens are involved, but that the level of involvement is less than in a high-resource approach. The design requirements below are used to draft the design of the two scenarios of the participatory approach.

Table 9: Set of design requirements of the participatory approach based on the problem investigation.

#	Design requirement	Source
1	The participatory approach should link to trusted sources about resilience assessment literature and public participation literature.	Section 3.1.
2	The participatory approach should give guidance on which participatory methods can be used in the different phases of resilience assessments.	Section 3.1.
3	The participatory approach should contribute to the preparation of both the municipality and citizens for crisis situations, linked to the three-step crisis approach: 1) Where can I go? 2) What do I pack? 3) Who around me needs further support?	Section 3.2.
4	The users of the participatory approach should be able to understand and execute the approach, making it easy to implement.	Section 3.2.
5	The participatory approach reaches a majority of citizens by using a wide range of participatory methods, with a specific focus on less self-reliant citizens, citizens who just moved to flood-prone areas and on the division between public and privately owns houses.	Section 3.2. and 3.3.
6	The participatory approach should be initiated and executed by the municipality, where	Section 3.2. and 3.3.
Low	in a low-resource scenario, citizens are involved in the assessment of their flood resilience by providing information about flood resilience on a low participation level, while the user identifies their resilience capacities based on Hegger et al. (2016).	Section 3.1, 3.2. and 3.3.
High	in a high-resource scenario, citizens are involved in the assessment of their flood resilience by co-producing an assessment of their flood resilience on a high participation level, while citizens identify their resilience capacities themselves based on Hegger et al. (2016).	Section 3.1, 3.2. and 3.3.

4. Design and validation phase

The design brief as formulated in the previous chapter forms the basis for the participatory approach. In this chapter first the two scenarios of the participatory approach are presented, whereafter the outline of the design is discussed. Lastly, the validation phase is elaborated on.

4.1. Final design

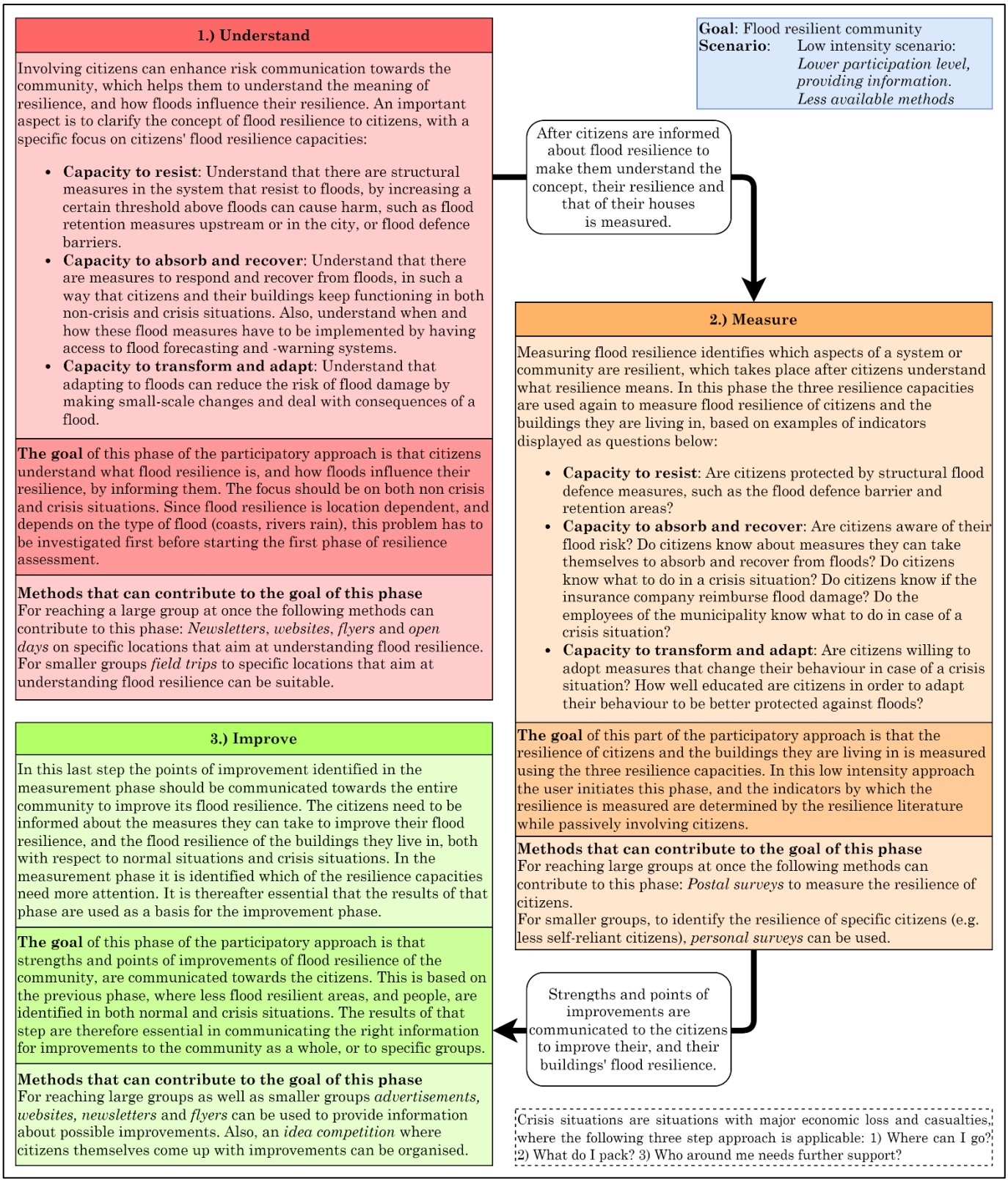

Figure 8: Final design of a low-resource participatory approach.

Goal: Flood resilient community
Scenario: High-resource scenario: *Higher participation level, co-producing. More available methods*

1.) Understand

Involving citizens can enhance risk communication towards the community, which helps them to understand the meaning of resilience, and how floods influence their resilience. An important aspect is to clarify the concept of flood resilience to citizens, with a specific focus on citizens' flood resilience capacities:

- **Capacity to resist**: Understand that there are structural measures in the system that resist to floods, by increasing a certain threshold above floods can cause harm, such as flood retention measures upstream or in the city, or flood defence barriers.
- **Capacity to absorb and recover**: Understand that there are measures to respond and recover from floods, in such a way that citizens and their buildings keep functioning in both non-crisis and crisis situations. Also, understand when and how these flood measures have to be implemented by having access to flood forecasting and -warning systems.
- **Capacity to transform and adapt**: Understand that adapting to floods can reduce the risk of flood damage by making small-scale changes and deal with consequences of a flood.

The goal of this phase of the participatory approach is that citizens are actively involved in understanding what flood resilience is, and how floods influence their resilience. The focus should be on both non crisis and crisis situations. Since flood resilience is location dependent, and depends on the type of flood (coasts, rivers rain), this problem has to be investigated first before starting the first phase of resilience assessment.

Methods that can contribute to the goal of this phase
Newsletters, websites, flyers, open days and *field trips* are examples of methods that can be used in a low intensity approach. In a high intensity approach these methods can still be used, complemented with additional methods that can be of value to reach a higher level of involvement, such as:
Simulations (e.g. where floods are simulated), *public meetings* and *workshops* are additional methods that can be used to make citizens understand what flood resilence is, and how floods influence their resilience.

After citizens are engaged in understanding flood resilience, their resilience and that of their houses is measured.

2.) Measure

Measuring flood resilience identifies which aspects of a system or community are resilient, which takes place after citizens understand what resilience means. In this phase the three resilience capacities are used again to measure the flood resilience of citizens and the buildings they are living in, but citizens need to define indicators themselves to incorporate in the measurement step of their resilience. The questions below, based on indicators from literature, can be used as a guide for the citizens:

- **Capacity to resist**: Are citizens protected by structural flood defence measures, such as the flood defence barrier and retention areas?
- **Capacity to absorb and recover**: Are citizens aware of their flood risk? Do citizens know about measures they can take themselves to absorb and recover from floods? Do citizens know what to do in a crisis situation? Do citizens know if the insurance company reimburse flood damage? Do the employees of the municipality know what to do in case of a crisis situation?
- **Capacity to transform and adapt**: Are citizens willing to adopt measures that change their behaviour in case of a crisis situation? How well educated are citizens in order to adapt their behaviour to be better protected against floods?

The goal of this phase of the participatory approach is that the resilience of citizens and the buildings they are living in is measured using the three resilience capacities as a basis. However, in this high intensity approach citizens themselves identify the indicators that assess these capacities. Based on these indicators their resilience is assessed together with the user. Flood resilience of less involved citizens can be measured by the user with the indicators identified by the more actively involved citizens.

Methods that can contribute to the goal of this phase
Focus-groups, *interviews*, *card-sorting methods* and *workshops* are methods with a higher intensity, where citizens themselves can identify indicators to assess their resilience.
To reach citizens that do not want to be actively involved, the indicators determined by other citizens can be used to measure their resilience via low intensity methods such as *postal surveys* and *personal surveys*. The latter is especially relevant for reaching small groups such as less self-reliant citizens, citizens who just move to flood prone areas or to identify the division between public and private houses.

3.) Improve

In this last phase the points of improvement identified in the measurement phase should be communicated towards the entire community to improve its flood resilience. The citizens need to be informed and actively engaged in taking measures to improve their flood resilience, and the flood resilience of the buildings they live in, both with respect to normal situations and crisis situations. In the measurement phase it is identified which of the resilience capacities need more attention. It is thereafter essential that the results of that phase are used as a basis for the improvement phase.

The goal of this phase of the participatory approach is that strengths and points of improvements of flood resilience of the community, are communicated towards the citizens, and that citizens are actively engaged in improving their resilience. This is based on the previous phase, where less flood resilient areas, and people, are identified in both normal and crisis situations. The results of that step are therefore essential in communicating the right information for improvements to the community as a whole, or to specific groups.

Methods that can contribute to the goal of this phase
Newsletters, websites, flyers and *advertisements* are examples of methods that can be used in a low intensity approach, together with an idea competition where citizens themselves come up with improvements. In a high intensity approach these methods can still be used, complemented with additional methods that can be of value to reach a higher level of involvement, such as:
Workshops, *public meetings* and *sponsorships* are additional methods that can be used to improve flood resilience of citizens and the buildings they are living in.

Strengths and points of improvements are communicated to the citizens to improve their, and their buildings' flood resilience.

Crisis situations are situations with major economic loss and casualties, where the following three step approach is applicable: 1) Where can I go? 2) What do I pack? 3) Who around me needs further support?

Figure 9: Final design of a high-resource participatory approach

4.2. Outline of design

The basis of the design for both a scenario with low resources and a scenario with high resources is the same, since both approaches have to contribute to the same goal: to improve flood resilience of citizens and the cultural heritage buildings they are living in. A low resource scenario (Figure 8) links to the lowest level of participation, i.e. information provision. In this scenario the Municipality of Dordrecht has fewer resources, such as time and staff, to implement the participatory approach. A scenario with a high amount of resources (Figure 9) should reach a higher participation level, i.e. co-production. When more resources are present, also more participatory methods can be used. The following sections describe the outline of the design, focusing on phases of resilience assessments, how goals and methods are selected for the participatory approach, which constraints result in the choice of participatory methods, and finally, guidance for application is given.

4.2.1. Resilience phases and capacities

The approach is based on existing resilience literature, where the design is divided into the three phases of resilience assessments, i.e. *understand*, *measure,* and *improve* (Herrera & Kopainsky, 2020; Hosseini et al., 2016; Quinlan et al., 2016; Resilience Alliance, 2010; Sharifi, 2016; Tong, 2021). In each of the phases, a link is made with the resilience capacities of Hegger et al. (2016). All three phases have to be executed to contribute to flood resilience and eventually improve flood resilience of citizens. An explanation of the phases and capacities is given below:

- The goal of the *understand* phase is that citizens understand what flood resilience is, and how floods influence their resilience. The three resilience capacities form the basis (Hegger et al., 2016) where citizens have to 1) understand that there are structural measures to resist floods (capacity to resist), that 2) there are measures to respond and recover from floods in such a way that they, and their cultural heritage buildings, keep functioning in both crisis and non-crisis situations (capacity to absorb and recover) and that 3) they have to understand that adapting to floods can reduce the risks of flood damage (capacity to transform and adapt).
- The goal of the *measure* phase is that the resilience of citizens and the cultural heritage they are living in is measured using the three resilience capacities with corresponding indicators (Hegger et al., 2016). In a low-resource approach, the indicators are assessed by the municipality, while in a high-resource approach the indicators are community-based, where citizens themselves identify indicators on which their resilience is assessed (where the indicators of Hegger et al. (2016) can be used as a basis). Example indicators of Hegger et al. (2016) are displayed below and divided into three capacities:
    - Capacity to resist: More on a system scale, related to major flood protection measures such as flood defences and retention areas.
    - Capacity to absorb and recover: Flood risks awareness, are citizens aware of flood measures, do they know what to do in a crisis situation, do they know if the insurance company reimburses flood damage, etc.
    - Capacity to transform and adapt: Are citizens willing to adopt measures that change their behaviour? How well educated are citizens to adapt their behaviour?
- The goal of the *improvement* phase is to communicate the strengths and improvements that resulted from the *measure* phase to all citizens. In the *measure* phase, strengths and improvements are identified per capacity (by the municipality in a low-resource approach, or by citizens themselves in a high-resource approach). These can contribute to an increase in flood resilience of the entire community when improvements are communicated to the citizens.

4.2.2. Selecting goals and classes of participatory methods

To give guidance to the three phases of resilience assessments, method classes are linked to arguments why participation is used in resilience assessments, as displayed in Table 7 (Krywkow, 2009). The goal of the participatory approach is linked to these arguments (Cundill et al., 2015; Figueiredo et al., 2018; Morelli. et al., 2021; Sharifi, 2016). Together with the Municipality of

Dordrecht the arguments in Table 7 were discussed and verified for both a low-resource scenario and a high-resource scenario. From this verification arguments 1 – 5 were selected, since these were reasons why the Municipality of Dordrecht wants to include participation in resilience assessments. The arguments that were selected by the Municipality of Dordrecht are listed below, with an explanation of how these arguments contribute to flood resilience and the three phases of resilience assessments:

1. Improve local understanding (Sharifi, 2016): Contributes to flood resilience by improving local understanding of risks. This contributes to flood resilience mainly since citizens better *understand* their risks;
2. Sharing knowledge and experience (Cundill et al., 2015; Sharifi, 2016): By creating a platform for sharing experiences citizens enhance their *understanding* of risks and resilience, which contributes to the *understand* phase of resilience assessments.;
3. Increasing social learning (Cundill et al., 2015): According to Cundill et al. (2015), social learning contributes to resilience since it influences decision-making processes. Besides governments that take decisions, also citizens need to decide if they want to take flood measures. This, therefore, contributes to the *improvement* phase of resilience assessments;
4. Taking into account context-specific indicators (Figueiredo et al., 2018): Citizens have specific knowledge of their surroundings, which is enhancing the *measurement* phase of resilience assessments;
5. Identifying different points of view (Morelli. et al., 2021): When conducting a resilience assessment the identification of different points of view contributes to *understanding* flood risks and resilience. The opinions of the citizens differ, and these different views can help other citizens understand their flood risks and resilience. Besides that, identifying the different points of view also contributes to the *measurement* phase, since different views can help other citizens in identifying indicators for measuring their resilience.

The numbers correspond to the numbers in Table 7. Numbers 1 – 4 apply to a low-resource scenario, while numbers 1 – 5 apply to a scenario with high resources. The reason why number five only applies to the high resource scenario is that it is assumed that when identifying the different points of view more interaction is needed. This can not be reached when only providing information to citizens. Then, based on Figure 6 and Table 7 a link was made with classes of participatory methods to identify which method classes apply to which scenario.

A low resource scenario takes only the first level of participation into account, which is information provision, resulting in fewer classes of participatory methods. Based on Figure 6 it can be said that five of the nine classes of participatory methods are applicable for the lowest participation level. In a high resource scenario, all classes of participatory methods can be used since in that scenario there is aimed at the highest level of participation, i.e. co-production (Figure 6). Figure 10 (low-resource scenario) and Figure 11 (high-resource scenario) on pages 33 and 34 schematise how arguments why participation is used in resilience assessment are linked with participatory goals and corresponding classes of participatory methods.

4.2.3. Implementation criteria for participatory methods

Which specific methods are applicable per method class is determined through multiple implementation criteria, or constraints, as discussed in chapter 3.1.3., following a design approach of Krywkow (2009). The constraints taken into account were the user mode (number of participants), the skills of the moderator, and the level of application skill. First, a division was made between methods used in large groups, mid-size groups, and small groups. Then, based on the required moderator skill (not required, low, or high) multiple methods were left out. Lastly, methods were selected based on the level of application skill (low or high), i.e. the required expertise needed to apply certain methods. This resulted in a list of methods, which differs per scenario. The difference between the low resource scenario and the high resource scenario is displayed in Table 10, where in a scenario with high resources all method classes can be used, and a higher level of application skill and moderator skill is required. Since literature discusses a wide variety of

participatory methods, the methods mentioned per method class are examples based on the framework of Krywkow (2009) to give guidance on which *type* of method can contribute to assessing resilience in a participatory way. **Bold** refers to a large group (> 50), *italic* to a mid-size group (20 – 50), and underline to a small size group (< 20). Combinations could be made, e.g. methods applying to both a **large** and a *mid-size* group are ***bold/italic***.

Table 10: Example methods per method class based on the constraints of user mode, moderator skill, and level of application skill for both the low-resource and the high-resource approach, for **large groups**, *mid-size groups,* and small groups.

Method class	Low- resource	High-resource
Public information provision	***Websites***, **flyers**, **advertisements**	***Websites***, **flyers**, **advertisements**
Education	***Lectures***	***Lectures***, workshops
Interviews	-	*Interviews*, card-sorting method
Surveys	**Postal surveys**, *door-to-door surveys*	**Postal surveys**, *door-to-door surveys,* focus groups
Events	**Open days**, ***idea competition***, *field trip*	**Open days**, ***idea competition***, *field trip*
Popular involvement campaigns	-	***Sponsorships***
Fora	**Newsletters**, ***internet forum***	**Newsletters**, ***internet forum***
Meetings	-	**Public meetings**
Workshops	-	Simulations, role-playing games

4.2.4. Guidance of application

The participatory approach is based on the case study of Dordrecht. Therefore in this section, the guidance of application is given to the Municipality of Dordrecht and divided into three sub-themes: Who should implement the participatory approach? When should it be implemented? And lastly, where is which scenario preferred based on the problem investigation?

Who? The Municipality of Dordrecht should take the lead in implementing the participatory approach. The civil servant implementing the participatory approach should know about both resilience assessments and participatory processes. Besides that, experience with communication, or having a profound relationship with the communication department is preferable, since communication and participation currently overlap in the municipality resulting in problems regarding the responsibility of initiating participation.

When? At the moment there is already a flood protection protocol at the Municipality of Dordrecht warning citizens living in the unembanked area about their flood risks. When this flood protection protocol is incorporated into the participatory approach, it already contributes to the resilience phases *understand* and *measure*. It is therefore recommended to start implementing the participatory approach along with the flood protection protocol.

Where? The context of application of the participatory approach is the historical city centre of Dordrecht. As problems differ between the unembanked and embanked area in the city centre, the participatory approach should take the problem investigation of this MSc thesis as a basis to improve flood resilience in both areas. Since there is an absence of information provision in the embanked area, the low-resource scenario aiming at the first participation level can contribute to an increase in flood resilience by providing information. In the unembanked area already a thorough information provision campaign is present, but citizens still feel less involved. The high resources scenario in that area contributes therefore not only to flood resilience, but might also lead to an increase in trust when the Municipality of Dordrecht actively involves these citizens.

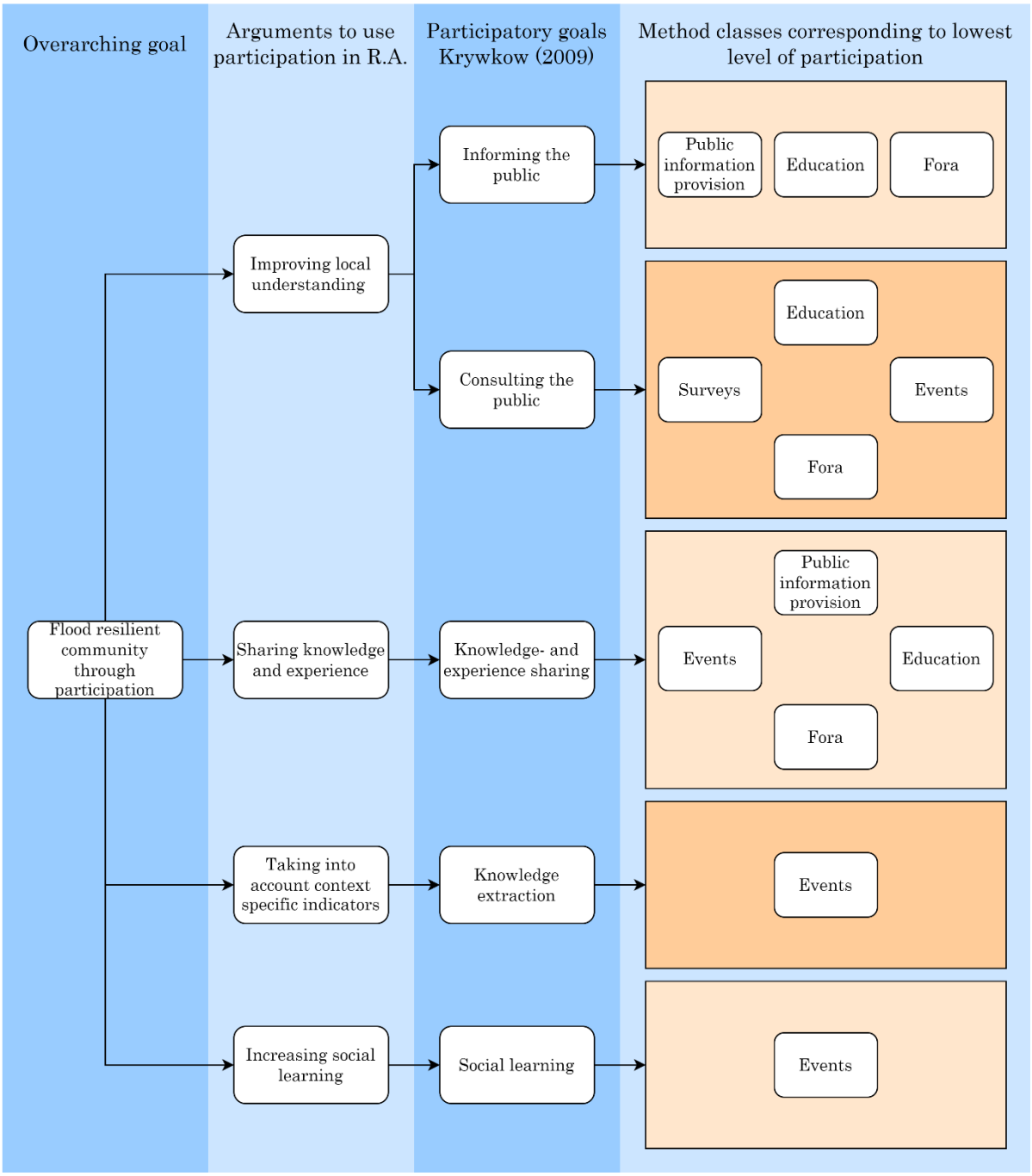

Figure 10: Schematisation of goals, linked to arguments why participation is used in resilience assessments and participatory goals, resulting in classes of participatory methods for a low-resource scenario.

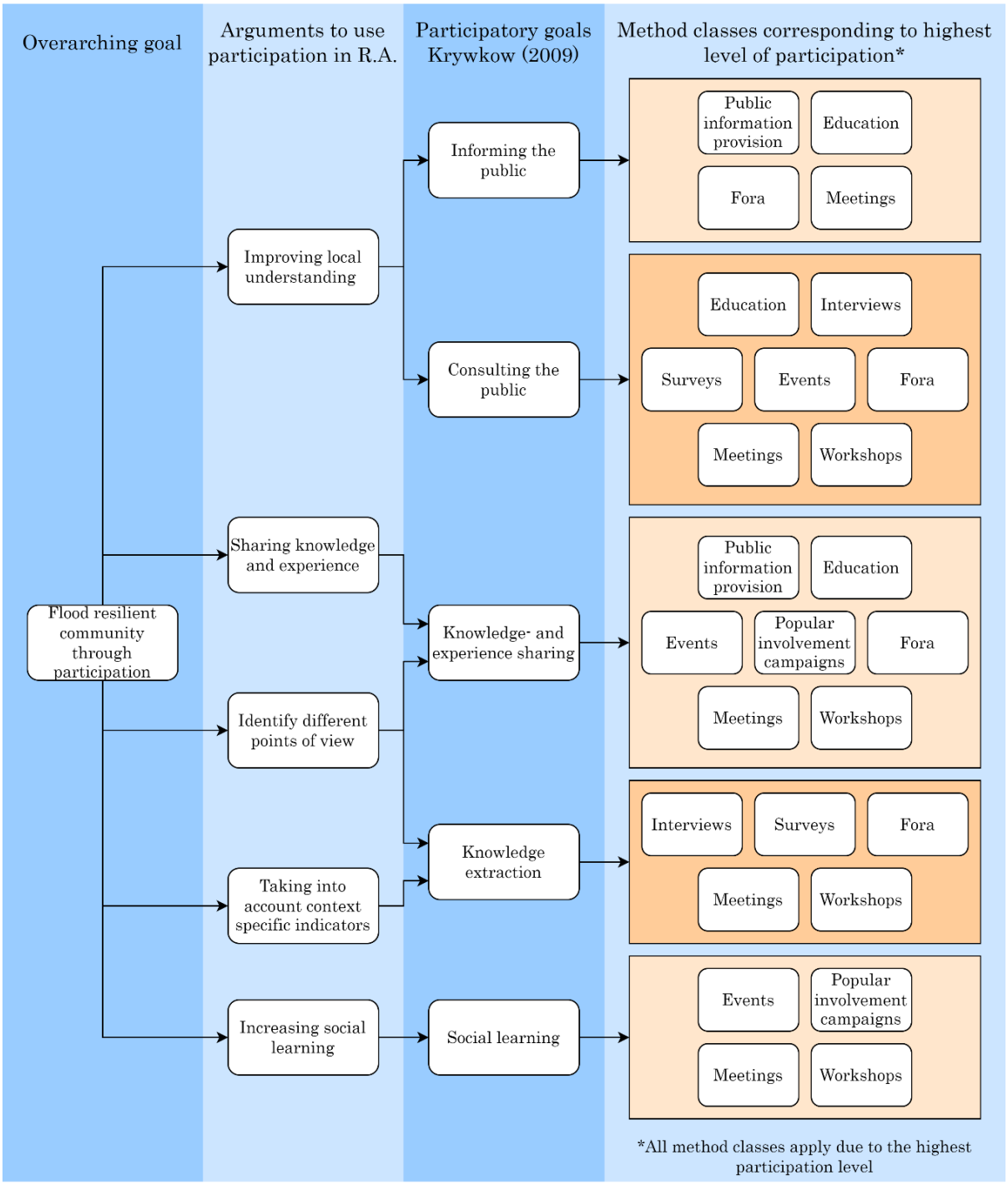

Figure 11: Schematisation of goals, linked to arguments why participation is used in resilience assessments and participatory goals, resulting in classes of participatory methods for a high-resource scenario.

4.3. Design validation

Whether the concept design (Figure D1 and Figure D2 in Appendix D), meets the requirements was validated with the Municipality of Dordrecht. The results of the validation session are displayed in this chapter. First, the validation of the requirements is discussed, then general comments on the content made by the Municipality of Dordrecht are presented. Lastly, improvements made in the final design after validating the concept designs are elaborated on.

4.3.1. Validation of requirements

Table 11 summarises the discussion held per requirements, the last column displays whether or not the requirement is met. It shows that requirements 1, 4, 5, 6, and 6-low are met, while requirements 2, 3, and 6-high are partially met and will need improvements in the final design.

Table 11: Validation of the design based on the satisfaction of the design requirements.

#	Design requirement	Discussion	Met?
1	The participatory approach should link to trusted sources about resilience assessment literature and public participation literature.	The integration with assessment literature was clear due to the different elements of resilience assessments (capacities, phases)	Met
2	The participatory approach should give guidance on which participatory methods can be used in the different phases of resilience assessments.	Which methods can be used was clear, however, how *understand*, *measure,* and *improve* are related should be clarified by linking them more explicitly.	Partially
3	The participatory approach should contribute to the preparation of both the municipality and citizens for crisis situations, linked to the three-step crisis approach: 1) Where can I go? 2) What do I pack? 3) Who around me needs further support?	This step is mentioned in the *understand* and *measure* phase. However, in the *improvement* phase, no additional information is given about crisis situations in specific.	Partially
4	The users of the participatory approach should be able to understand and execute the approach, making it easy to implement.	The Municipality of Dordrecht mentioned that the participatory approach is understandable. It can be upgraded by a translation in Dutch for the Dordrecht case.	Met
5	The participatory approach reaches a majority of citizens by using a wide range of participatory methods, with a specific focus on less self-reliant citizens, citizens who just moved to flood-prone areas and on the division between public and privately owns houses.	In the design, a wide range of methods that can be used are mentioned. These methods can reach a majority of citizens. Also, in both scenarios, more attention is paid to specific citizen groups.	Met
6	The participatory approach should be initiated and executed by the municipality, where	The initiative of assessing resilience comes from the municipality.	Met
Low	in a low-resource scenario, citizens are involved in the assessment of their flood resilience by providing information about flood resilience on a low participation level, while the user identifies their resilience capacities based on Hegger et al. (2016).	It was clear that in a low-resource approach the focus is mainly on informing than on engaging, and that it is the municipality that needs to identify the citizens' flood resilience.	Met
High	in a high-resource scenario, citizens are involved in the assessment of their flood resilience by co-producing an assessment of their flood resilience on a high participation level, while citizens identify their resilience capacities themselves based on Hegger et al. (2016).	It was clear that in a high-resource approach mainly methods are used to involve citizens in a resilience assessment. However, how citizens identify their resilience capacities themselves is not yet clear.	Partially

4.3.2. Validation of the content

As shown in Table 11, the participatory approach does not yet meet all the design requirements. Some requirements need only minor improvements, such as a clearer formulation, or a Dutch version to make the approach suitable for the situation in Dordrecht. However, some additional aspects related to the content needed more explanation according to the Municipality of Dordrecht.

The goal of the approach was clear. Nevertheless, the division between a low-resource and a high-resource scenario was first not completely understood. There was asked if a low-resource approach also means that fewer citizens are involved in the assessment of their flood resilience. The purpose of the division in approaches does not result in *fewer* people involved, it will result in a *different level* of involvement. In a low-resource approach, the citizens are mainly informed on a level of information provision, while in a high-resource approach a higher level of participation is aimed for, i.e. co-production. This, therefore, needs to be clarified in the final design.

There was also unclarity about the *understand* phase. This resulted from the fact that the municipality did not know if this phase applied to them or the citizens. However, a participatory approach is designed to involve the *citizens* in an assessment of their resilience. The phase, therefore, refers to citizens that need to *understand* the concept of flood resilience, i.e. that they understand how floods, and measures against floods, can influence their flood resilience, whereafter the citizens' resilience is *measured* and *improved*. The task of the municipality in the *understand* phase is to implement the approach in such a way that citizens are involved in understanding resilience. It is therefore important that the municipality understands the underlying problem that has to be treated when assessing resilience, and that they learn from the perspectives of citizens. The problems in the case of Dordrecht were already researched in this MSc thesis and can therefore be used when implementing the participatory approach.

It is also discussed whether or not the approach is designed as a general approach or a context-specific approach. A general approach is less context related, but it can be used in wider contexts than only for the city of Dordrecht, which is more favourable for future research. A downside of a more general approach could be that it is less implementable for the Municipality of Dordrecht. However, it was mentioned that also a more generic approach without context-specific elements can be implemented by the Municipality of Dordrecht, since the approach is based on problems investigated in Dordrecht.

The last point that was discussed was that the different phases in the resilience assessment are interconnected. An example is that when citizens are involved in the *understand* phase, they are also part of a *measurement* phase since they are already involved in discussing what flood resilience is. Therefore in the *measurement* phase, it should be discussed with the citizens whether or not the *understand* phase contributed to an increase in flood resilience.

4.3.3. Improvements made to the final design

Improvements were made based on the validation session with the Municipality of Dordrecht, for both the low-resource scenario and the high-resource scenario. The difference between a low-resource and a high-resource approach is made more clear by adding information about the participation level. Additionally, in the *understand* phase it is emphasised that the citizens need to understand the concept of resilience, and not the employees implementing it, since it is assumed that the employees are already familiar with the concept. The link between the three phases of resilience has been made more explicit as well, by adding information on the arrows between the phases (req. 2). Furthermore, the crisis situation is made more explicit. Not only in the *improvement* phase, which was missing in the concept design round (req. 3), but also in general by emphasising the three steps identified for crisis situations: 1) Where can I go? 2) What do I pack? 3) Who around me needs further support. Additionally, the context-specific elements of the design were removed, since the participatory approach depends on the local context, which differs between the embanked and unembanked areas as described in the problem investigation. Since the design is based on a case study in Dordrecht, a Dutch translation of both scenarios is provided in Appendix E (req. 4).

5. Discussion

This section discusses the findings of the research. First by elaborating on the theoretical contribution of this study (section 5.1), then by reflecting on the design approach (section 5.2),) next on the internal validity (section 5.3), and finally on the sensitivity (section 5.4) and applicability of this research (section 5.5).

5.1. Theoretical contribution

This research designed a participatory approach that contributes to flood resilience of citizens, and the cultural heritage they are living in. The problem investigation identified a research gap in the current body of literature, which was that public participation is often implicitly part of resilience assessments. To fill this gap the importance of public participation in resilience assessments as advocated in different contexts was evaluated (Cundill et al., 2015; Figueiredo et al., 2018; Herrera & Kopainsky, 2020; Morelli. et al., 2021; Sharifi, 2016). This was thereafter synthesised with public participation literature in the context of water management (Krywkow, 2009). By first combining resilience assessment literature, and thereafter linking it with public participation goals, the importance public participation can have in resilience assessments became more clear. This research, therefore, contributes to the existing body of literature, by emphasising the importance public participation has in resilience assessments linked to existing participation literature.

Another research gap found was that there are currently no guidelines for using participatory methods in resilience assessments in practice. Synthesised literature on resilience assessments and public participation as mentioned above, was combined with a methodological framework for participatory processes in the water management context. The latter already identified which participatory methods contributed to specific participatory goals. By designing a participatory approach that contributes to flood resilience the research gap was filled. This approach links the three phases of a resilience assessment, i.e. *understand, measure,* and *improve* with specific participatory goals. This research, therefore, contributes to the existing literature by explicitly guiding participatory methods in the three phases of a resilience assessment.

5.2. Reflection of the design approach

A design science methodology is applied in this research, based on the design cycle of Wieringa (2014). This cycle starts with a problem investigation, whereafter a design is made and validated. The literature study as part of the problem investigation consisted of scientific papers and document research, which covered most of the information necessary to synthesise resilience assessments and public participation. When synthesising both concepts, the participation goals of creativity and identifying relevant stakeholders were not combined with arguments why public participation is important in resilience assessments since it was assumed that they are more related to the process than to the outcome of that process. In retrospect, this assumption needs to be discussed, since these participatory goals might also contribute to the outcome of a participatory process. Creativity is not only contributing to the process, but it might also contribute to creative and innovative solutions. Identifying relevant stakeholders can also contribute to a different outcome, since the results of a participatory approach depend on the input from stakeholders. It is therefore recommended to future research to also incorporate this participatory goal to avoid certain stakeholder groups being overlooked. The choice of not incorporating these participatory goals should therefore be reconsidered in future research.

The design science methodology focuses on creating a general solution concept to address a certain field problem. In design science, *general* means that it is not designed for a specific situation (Van Aken & Romme, 2009). However, whether or not the participatory approach as designed in this study is a general solution is a point of discussion. On the one hand, context-specific aspects are not directly incorporated in the participatory approach, while on the other hand the participatory approach is based on a specific situation, i.e. floods in the city of Dordrecht. The participatory approach is therefore a *general* solution concept to address a specific field problem, in a specific situation, i.e., address flood resilience in flood-prone urban areas.

The data gathered in the focus groups and interviews with the Municipality of Dordrecht and its citizens reflect the views and perspectives of local stakeholders. The data collection resulted in a broad problem investigation which formed the basis of the participatory approach. However, designing a solution based on the perspectives of stakeholders has some limitations, since the design can vary based on which stakeholders are selected. In this research respondents for the focus groups were selected based on already existing resident groups. These groups represent a larger group of citizens and they regularly give their opinion on municipal decision-making. This results in a bias of respondents that *want* to be involved, since otherwise, they would not have been part of these existing resident groups. An implication of this might be that the perspectives of less involved citizens are not taken into account. This research tries to deal with this by also interviewing citizens living in cultural heritage unannounced to make the data collection more diverse by reaching a wider variety of citizens.

Also, the results of the data collection could be different when other people were participating. The respondents consisted mainly of elderly people, however, if this was representative for the researched area was not investigated. Moreover, opinions of the respondents of focus groups and interviews can change over time, increasing the chance of different outcomes. Due to the short time in which this research was conducted not a second round of interviews and focus groups was conducted. It is therefore recommended to conduct a quick review of the respondents' opinions and perspectives after the participatory approach is implemented to see whether or not their perspectives changed. This evaluation can be part of a larger evaluation step as part of the design science methodology by Wieringa (2014), and can therefore help to identify an increase in flood resilience of the citizens living in Dordrecht.

In the validation phase, the design was validated with the Municipality of Dordrecht to verify whether the design met the design requirements. The last two steps in the design science methodology by Wieringa (2014), i.e. implementation and evaluation, were not part of the scope of this research and were therefore not executed. Nevertheless, it is recommended to implement the participatory approach and evaluate it, to increase its validity. By doing so the engineering cycle of Wieringa (2014) is completed, and improvements in the design process can be made based on the evaluation phase.

5.3. Internal validity

To describe the validity of the interpretations in this research, descriptive validity is used (Wieringa, 2014), which describes the accuracy of the information gathered in the research. To increase the validity of the interpretation, triangulation and member checking can be applied (Wieringa, 2014). Triangulation, which is referred to as using "*multiple, independent ways of producing your interpretations*" (Wieringa, 2014, p.138), is applied in this study by using multiple methods of collecting the qualitative data. In the problem investigation, triangulation is applied by reviewing literature and other documents, and by retrieving qualitative data in the case study area through focus groups, structured interviews, and semi-structured interviews. In the design phase, literature about an existing participatory approach is used in combination with the synthesised data of the problem investigation. In the validation phase, only one validation session was held with the Municipality of Dordrecht due to time constraints, which means that triangulation was not applied in the validation phase. A consequence of not applying triangulation is that differences in interpretations can not be validated, meaning that the design is validated based on only one research method. It is therefore recommended to future research to include an additional method to validate a design.

Another way to achieve descriptive validity is by using member checking, where respondents verify the research results (Wieringa, 2014). The summaries of the focus groups were sent to the respondents to verify if the results were interpreted correctly. The respondents were asked to react if they perceived that the summaries conflicted with their own perspectives. After sending the summaries, the respondents did not make additional comments. It was therefore concluded that they agreed with the summaries. The design requirements and design itself were validated with

the Municipality of Dordrecht. Also, throughout the design process, multiple informal meetings were held with the Municipality of Dordrecht. Expert judgement regarding the design was considered, but not executed due to time constraints. Experts could therefore not voice their opinions on how they think the participatory approach will behave in the context of Dordrecht. In future research it is recommended to validate a participatory approach with experts from both the fields of resilience assessments and public participation, to increase the validity of the design.

5.4. Sensitivity

The two scenarios of the participatory approach are based on the case of the city of Dordrecht. The problem investigation focused on citizens and the cultural heritage they are living in, making it applicable for that particular context. However, its applicability might be extended to citizens living in non-cultural heritage buildings as they might also be interested to increase their flood resilience. In that case, the approach can, for example, improve flood resilience of non-cultural heritage buildings as well. Whether the approach can be used in other contexts is up for discussion, since the problem investigation phase did not include non-cultural heritage buildings. However, since it is expected that citizens in the city centre, that are not living in cultural heritage, experience the same problems regarding floods, it is recommended to the Municipality of Dordrecht to also implement, and evaluate, the participatory approach in a flood-prone urban area without cultural heritage. This is preferably done in the city of Dordrecht, to identify if there is a difference between cultural heritage buildings and non-cultural heritage buildings. In a different context than the Municipality of Dordrecht the local context changes. Differences in vulnerability, demography, and cultural heritage buildings occur when the context changes. Therefore, when implementing the approach in a different context first an investigation has to be conducted on the local problems. Additionally, it is recommended to the municipality, and for future research, to evaluate the participatory approach as part of the last step in the design approach. The evaluation phase shows if the implemented approach contributes to flood resilience. If this is less than expected, the design needs to be improved.

The participatory approach focuses mainly on residential cultural heritage buildings, without focusing on businesses, shops, and the cultural heritage artifacts inside the buildings (e.g. furniture and art). This means that in the context of Dordrecht not all cultural heritage is taken into account. To also make the participatory approach applicable to assess flood resilience of that particular cultural heritage, it is recommended that the Municipality of Dordrecht conducts a problem investigation with a specific focus on non-residential cultural heritage. For this, a thorough investigation of non-residential cultural heritage needs to be conducted. Also, perspectives of private and public institutions and companies need to be included in such a participatory approach. Due to an already low flood risk awareness among citizens, it is recommended to only start involving other stakeholders after the implementation and evaluation phase of the currently designed participatory approach is completed.

Lastly, the difference in responsibility regarding flood safety between owners and occupants of buildings is only implicitly taken into account in the participatory approach. Sometimes the occupant is not necessarily the owner of a building, meaning that responsibilities need to be researched to take effective measures that improve flood resilience of cultural heritage buildings. To conclude, several improvements can be made to make the participatory approach also applicable in wider contexts. This reduces the sensitivity of the approach. However, to make the approach applicable for different situations a thorough problem investigation is required first. In such a situation the designed participatory approach can be used as a basis, tailor-made by the results of the problem investigation in other local contexts.

5.5. Applicability

The final design constructed gives guidance on which type of methods can contribute to different phases and goals of resilience assessments. However, to define if the approach contributes to flood resilience in the context of the city of Dordrecht it first has to be implemented and evaluated. This implementation and evaluation is part of the design science methodology of Wieringa (2014), and should be executed by the Municipality of Dordrecht. The participatory approach should be implemented in the historical city centre of Dordrecht, first focusing explicitly on cultural heritage buildings and the citizens living in them. However, the problem investigation showed that respondents perceive a lack of participation, which might also be the case for citizens living in non-cultural heritage buildings. To improve the views on participation as a whole, and to contribute to flood resilience of citizens living in non-cultural heritage as well, it is recommended to also involve these citizens in the participatory approach.

Two scenarios for the participatory approach were constructed, based on a low amount of resources and a high amount of resources. It differentiates between only providing information, when there is a low amount of resources present, and co-production where the Municipality of Dordrecht has ample resources to execute a more elaborate participatory approach. A consequence of choosing the low-resources scenario is a lower citizen participation level. This is since participatory methods chosen in a scenario with low resources mainly provide information to the citizens, resulting in less interaction with the Municipality of Dordrecht, resulting in a lower participation level. In the high-resource scenario the Municipality of Dordrecht might have more time, staff, and other resources, to involve its citizens more extensively. This higher level of involvement, where citizens produce the resilience assessment themselves, refers to the highest level of participation. However, there are also two levels of participation discussed in this research which are situated between the levels of information provision and co-production. These are consultation and active involvement. In these levels, citizens are not directly assessing their own resilience, i.e. co-production, but they are actively involved while the municipality assesses their resilience. When designing an approach for these particular participation levels the same methodology can be used in defining which classes of participatory methods can be used in that particular participation level. It is relevant to also design scenarios for these participation levels, since a low-resource scenario might result in fewer improvements regarding flood resilience, while a high-resource scenario requires excessive resources. These scenarios might require fewer resources, but still, result in a higher participation level (consultation and active involvement) than only information provision.

In the approach, the three phases of resilience assessments are separated and displayed as consecutive steps. However, in practice it is expected that in the first phase, i.e. *understand*, citizens are already informed of, or actively engaged in, flood resilience concepts. This already makes them think about their flood risk awareness, and other aspects that are part of the second, *measurement* phase. It can therefore be stated that the *measurement* phase in practice already starts in the *understand* phase since citizens are already involved in the main aspects of flood resilience. This is relevant information, since in that case, the *measurement phase* might help to identify the impact and progress of the *understand* step. How the three phases interact in practice, and contribute to the other phases, needs to be evaluated. This evaluation afterwards is the last step in the design science methodology of Wieringa (2014), which is a necessary step to execute when also implementing the participatory approach. If improvements are necessary, the problem investigation should be reconsidered since perspectives of citizens regarding their flood resilience could have changed during the resilience assessment

All in all, it is expected that, in the case of Dordrecht, the approach contributes to flood resilience of citizens living in cultural heritage, since the participatory approach is based on an elaborate problem investigation in the Municipality of Dordrecht.

6. Conclusion and recommendations

In this last chapter, the main findings of the research are summarised. Also, recommendations for future research and practical recommendations are provided.

6.1. Conclusion

In this research, a participatory approach was designed which enables the Municipality of Dordrecht to involve its citizens in the assessment of their flood resilience, and the flood resilience of the cultural heritage buildings they are living in. A design science methodology was used based on the design cycle of Wieringa (2014) to achieve the main objective, which was:

"*Design a participatory approach that improves community flood resilience of citizens and the cultural heritage they are living in*"

In the problem investigation, a gap was found between the literature on public participation and resilience assessments, where the importance of public participation was stressed only implicitly. In resilience assessment literature no guidance was given about the use of participatory methods in resilience assessments. However, public participation literature did connect participatory methods with participatory goals. This is crucial since this study combined resilience assessment literature with public participation goals, and consequently participatory methods. Therefore it was identified which participatory methods could be used in resilience assessments. The research gap identified in this research was filled by explicitly stressing the importance public participation has in resilience assessment, and by giving guidance on the use of participatory methods in the different phases of resilience assessments, i.e. *understand, measure,* and *improve*.

Through focus groups and interviews with employees of the Municipality of Dordrecht and its citizens, the local situation was investigated. The main outcome is that the perspective of the municipality does not differ significantly from the perspective of the citizens. Citizens in the unembanked area are aware of their risk regarding regular occurring floods. However, most citizens in the embanked area are unaware of their flood risks. When citizens have experienced floods and/or were informed by the municipality, they were more aware of their flood risks, and knew better which flood measures they could take to protect themselves and the buildings they are living in. There is no awareness among citizens regarding crisis situations related to extreme flood conditions in both areas, and within the municipality there is no awareness of the responsibilities they have in these situations. Moreover, the municipality does not have a general participatory approach, which results in employees mainly including public participation in projects based on their own experience. Additionally, the citizens are experiencing limited participation initiated by the municipality, whereas they find it the responsibility of the municipality to start participating.

Based on design requirements that resulted from the problem investigation, two scenarios of a participatory approach were designed. One with low resources, resulting in the lowest participation level, resulting in information provision from the municipality to the citizens. The second approach requires more resources, focusing on co-production with citizens, who are highly involved in the assessment of their own flood resilience. The resource-dependent scenarios give guidance on the use of participatory methods in each phase of a resilience assessment.

To conclude, the design science methodology used in this study structured the design of the participatory approach. This research emphasised the importance public participation has in resilience assessments, by identifying participatory methods that involve citizens in the three phases of a resilience assessment. Additionally, perspectives on public participation and flood resilience in Dordrecht were investigated to tailor the participatory approach. Both the low and high-resource scenarios enable the Municipality of Dordrecht to involve citizens in the assessment of their flood resilience. It is the first study of its kind that explicitly emphasised the importance public participation has in resilience assessments, by indicating participatory methods that contribute to the three phases of a resilience assessment. When implemented it will contribute to flood resilience of citizens in Dordrecht, and the cultural heritage buildings they are living in.

6.2. Recommendation for future research

Multiple recommendations can be made regarding this research. This research excluded the design cycle phases of implementation and evaluation (Wieringa, 2014). Therefore, for future research, it is recommended to analyse the implementation and evaluation of the participatory approach in the Municipality of Dordrecht. This is to fully complete the design science methodology and to determine and evaluate challenges that arise with the participatory approach.

Also, a synthesis of the concepts of public participation and resilience assessment is constructed based on Krywkow (2009), which in particular focused on the link between participatory goals and classes of participatory methods. This enabled the synthesis of resilience assessments based on these participatory methods. In the future, more research should be conducted that investigates to what extent public participation contributes to resilience assessments. Also, more research on citizen perspectives needs to be executed to identify differences in perspectives throughout the participatory process. Furthermore, in future research it is recommended to make use of expert judgement of the design methodology and final design, to increase the validity of the design by inviting experts from both the fields of resilience assessments and public participation.

6.3. Practical recommendations

Specifically for the Municipality of Dordrecht, it is recommended to appoint an expert in the field of public participation and resilience assessments to implement the participatory approach, and who can combine participation with communication. The latter is important since the problem investigation showed that at the moment the division of responsibilities regarding communication in participation projects is not clear. Additionally, such a position will give clarity to employees and citizens about who is responsible. Furthermore, the Municipality of Dordrecht should initiate the participatory approach, since citizens perceive that participation should be initiated by the municipality. Besides that, the participatory approach has to be evaluated by the Municipality of Dordrecht after it is implemented to determine if any improvements are needed afterwards. This evaluation should preferably be the responsibility of an external party to identify the views from the side of the municipality and the citizens. With these appointments, the entire engineering cycle of Wieringa (2014) is finished, which might result in improvements made to the participatory approach.

Moreover, it is recommended to conduct research into the applicability of the participatory approach in a different context than Dordrecht, after it has been implemented and evaluated in Dordrecht. Since the current participatory approach is based on the problem investigation conducted in the city of Dordrecht, problems have to be identified first in a new case study. These problems should be related to the urban area and flood risks. It is therefore recommended to the SHELTER project to identify if other cultural heritage sites face similar problems as the city of Dordrecht and investigate the local problems of these sites.

Both the low-resource scenario and the high-resource scenario aim at contributing to community flood resilience in the city centre. However, the approach to achieve this differs per scenario. In the unembanked area, it is recommended to implement the high-resource scenario, because in the unembanked area the Municipality of Dordrecht is already providing information to its citizens. When a high-resource scenario is implemented, citizens will be intensely involved in the assessment of their flood resilience through a higher participation level, which is beneficial in the unembanked area since at the moment citizens perceive limited participation. Regarding the embanked area it is recommended to start with the low-resource scenario, since information is not yet provided in this area about the flood resilience of citizens. By using that particular scenario the threshold for citizens to be involved is lower. Also, what should be considered is using both scenarios in the same area, where for example the majority is reached via the low-resource scenario, and that specific attention is paid to specific citizen groups through the high-resource scenario.

Lastly, regarding the applicability of the participatory approach in Dordrecht, a final recommendation can be made. It is recommended to start implementing the participatory approach alongside the flood protection protocol. This prepares citizens for the flood season, and is therefore an ideal starting point for the participatory approach as well. The three phases of the resilience assessments will thereafter be executed consecutively, contributing to the overall flood resilience of the community. By implementing both approaches in the different areas of the historical city centre, based on the detailed problem investigation, citizens are involved in the assessment of their flood resilience, improving the flood resilience of the community as a whole.

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Appendices

A. Focus group and interview information Municipality of Dordrecht

This appendix provides details about the questions asked during the focus group and semi-structured interviews with the Municipality of Dordrecht. One focus group (FG1) with three participants was organised and four semi-structured interviews were conducted (I1 – I4). The following table provides the interview protocol that was used, consisting of the main questions. Also, sub-questions were drafted to focus on the details of the main questions. However, due to the detailed answers of the respondents, these sub-questions were in most cases not needed.

Table A1: Interview protocol for focus group and semi-structured interviews with employees of Municipality of Dordrecht. [NL]

Deel 1: Introductie
- Voorstellen. - Doel onderzoek toelichten. - Rol van deelnemer toelichten in organisatie. - Opzet van focus-groep of interview toelichten. - Vragen of de deelnemers akkoord is met het opnemen van de focus-groep of het interview.
Deel 2: Inhoudelijke deel focus groep en semi gestructureerde interviews.
FG1 (9 maart 2022)

- Waarom is een participatieproces nodig?
- Is er een verschil per gebied (binnen- en buitendijks) waarom een participatieproces nodig is?
- Waar moet het participatieproces bereiken?
  - Wat is er tot nu toe gedaan om dit te bereiken?
  - Waarom wordt het wel/niet bereikt?
- Waar moet het participatieproces aan voldoen?
- Welke mensen moeten worden betrokken bij het participatieproces?

I1 (10 maart 2022) – Wijkmanager
- Wat is op dit moment de situatie in het buitendijkse gebied wat betreft overstromingen? - Wat is op dit moment de situatie in het binnendijkse gebied wat betreft overstromingen? - Wat is de rol van participatie in beide gebieden? - Wat moet een nieuw te ontwerpen participatieproces bereiken? - Wat is er tot nu toe gedaan om dit te bereiken?
I2 (16 maart 2022) – Projectmanager (participatie)
- Wat is het doel van participatie in het algemeen, en wat zorgt ervoor dat die doelen wel of niet worden gehaald? - Hoe ziet een participatieproces eruit bij de gemeente Dordrecht?   - Hoe worden bewoners betrokken? Welk participatieniveau wordt naar gestreefd? Bij wat voor projecten wordt participatie ingezet? - Heeft de gemeente Dordrecht al eerder een participatieproces toegepast m.b.t. overstromingen?
I3 (23 maart 2022) – Communicatiemanager
- Hoe worden bewoners geïnformeerd als het gaat om overstromingen/waterbescherming? - Hoe worden bewoners in het algemeen geïnformeerd over participatie? - Is er specifiek aandacht voor minder zelfredzame personen? - Hoe gaat een communicatieproces in zijn werk? - Welke middelen heeft de gemeente Dordrecht om te communiceren richting haar inwoners?
I4 (30 maart 2022) – Adviseur cultureel erfgoed
- Hoe wordt cultureel erfgoed aangewezen? - Wat is de rol van SHELTER in cultureel erfgoed in Dordrecht? - Krijgen bewoners informatie over het nemen van maatregelen om hun huizen te beschermen? - Zijn er specifieke procedures als bewoners hun huizen willen beschermen? - Hoe krijgt cultureel erfgoed zijn waarde? En hoe kunnen overstromingsmaatregelen bijdragen aan deze waarde?
Deel 3: Afsluiting
- Vragen of deelnemers nog vragen of opmerkingen hebben. - Bedanken voor deelname. - Contactgegevens delen.

B. Focus group and interview information citizens Dordrecht

This appendix provides details about the questions asked during the focus groups and semi-structured interviews with the citizens in Dordrecht. The exact locations of the respondents are known to the researcher. The interviews took place in both the embanked area and the unembanked area. For privacy reasons, only the streets are displayed, without the exact number where the respondents live. The following table displays the locations of the structured interviews and focus groups. The interviews all took place on March 22 and March 23. The focus group in the embanked area took place on the March 23, and the focus group with citizens in the unembanked area took place on March 28.

Table B1: Details of locations of focus group participants and respondents of the structured interviews.

#	Details of location
	Embanked area
FG2	Four respondents in the embanked area: - Nieuwstraat - Nieuwstraat - Steegoversloot - Museumstraat
I5	Botgenstraat
I6	Lange Breestraat
I7	Lombardstraat
I8	Arend Maartsenhof (lower side)
I9	Arend Maartsenhof (higher side)
	Unembanked area
FG3	Five respondents in the unembanked area, which all lived in the Wolwevershaven and Kuipershaven.
I10	Hooikade
I11	Hoge Nieuwstraat
I12	Nieuwe Haven
I13	Nieuwe Haven
I14	Knolhaven
I15	Vleeshouwersstraat
I16	Grotekerksbuurt
I17	Wijnstraat
I18	Taankade
I19	Voorstraat
I20	Knolhaven
I21	Engelenburgerbrug

The protocol used in the focus groups with the citizens in both the embanked (FG2) and the unembanked area (FG3) is displayed in Table B2 on page 49 in Dutch. For both focus groups, the same protocol was used. The questions asked were guidelines, since in a focus group interaction between participants is of significant value.

The interview protocol used in the structured interviews with citizens (I5 – I21) is displayed in Table B3 on page 50 in Dutch.

Table B2: Protocol with questions for the focus groups with citizens in Dordrecht. [NL]

Vragen voor focus-groepen met bewoners in het binnendijks, en buitendijks, gebied.
Deel 1: Introductie
- Voorstellen. - Doel onderzoek toelichten door middel van een presentatie. - Opzet van focus-groep toelichten door middel van een presentatie. - Vragen of er aan de hand van de presentatie vragen zijn.
Deel 2: Ervaringen met overstromingen
- Wat zijn uw ervaringen met overstromingen vanuit de rivieren? - Wat zijn uw ervaringen met wateroverlast door regenval? - Welke maatregelen heeft u genomen om uw woning te beschermen tegen overstromingen? - Hoe wordt u ingelicht over de gevolgen van een overstroming? - Welke rol heeft de gemeente wat betreft uw overstromingsrisico, en de gevolgen daarvan? - Weet u wat u moet doen in het geval van een crisis situatie? - Bent u bekend met de evacuatie/opvangplek De Staart?
Deel 3: Participatie
- Op wat voor manier wordt u meegenomen in projecten van de gemeente Dordrecht? - Vindt u de mate waarin de gemeente Dordrecht u betrekt voldoende, waarom wel/niet? - Wat is uw ervaring met participatie als het specifiek gaat over overstromingen en wateroverlast? - Op welke manier zou u willen dat de gemeente u inlicht m.b.t. overstromingen en wateroverlast? - Op welke manier zou u actief willen worden betrokken m.b.t. overstromingen en wateroverlast? - Hoe ziet een ideaal participatieproces eruit volgens u? - Op wat voor manier zou de gemeente aandacht moeten geven aan minder zelfredzame personen in een participatieproces?
Deel 4: Afsluiting
- Vragen of deelnemers nog vragen of opmerkingen hebben. - Bedanken voor deelname. - Contactinformatie delen.

Table B3: Interview protocol for structured interviews with citizens in Dordrecht. [NL]

Vragen voor gestructureerde interviews met bewoners in Dordrecht
Deel 1: Introductie
- Voorstellen. - Doel onderzoek toelichten. - Vragen of de respondent deel wil nemen aan het onderzoek.
Deel 2: Overstromingen, wateroverlast en maatregelen
- Heeft u ervaringen met overstromingen vanuit de rivieren? *Wel ervaring:* - Wat doet u in zo'n situatie? - Welke maatregelen heeft u genomen, of neemt u in zo'n situatie? *Geen ervaring:* - Wat zou u doen als zo'n situatie plaatsvindt? - Weet u welke maatregelen u kunt nemen tegen overstromingen? - Heeft u ervaringen met wateroverlast door regenval? *Wel ervaring:* - Wat doet u in zo'n situatie? - Welke maatregelen heeft u genomen, of neemt u in zo'n situatie? *Geen ervaring:* - Wat zou u doen als zo'n situatie plaatsvindt? - Weet u welke maatregelen u kunt nemen tegen wateroverlast? - Heeft u ervaringen met het nemen van maatregelen die speciaal gericht zin op het beschermen van uw woning, welke is gemarkeerd als cultureel erfgoed?
Deel 3: Crisissituatie
- Heeft u ervaring met een crisissituatie door overstromingen? - Weet u wat u moet doen in het geval van een crisis situatie? - Bent u bekend bij de evacuatie/opvangplek De Staart, of een andere opvangplek?
Deel 4: Participatie
- Wordt u meegenomen in projecten van de gemeente Dordrecht d.m.v. participatie? *Zo ja* - Bent u daar tevreden mee? - Op wat voor manier zou u betrokken willen worden? *Zo nee* - Op wat voor manier zou u betrokken willen worden?
Deel 5: Representativiteit
- Wat is uw leeftijd?
Deel 6: Afsluiting
- Bedanken voor deelname.

C. Code trees

The coding procedure took place in MAXQDA with an inductive coding approach. This means that the codes are constructed while reviewing the qualitative data, while in a deductive approach predetermined codes are used to review the data. In this appendix both the code tree constructed for reviewing the qualitative data gathered from the municipality (Figure C1) and the code tree for the data gathering on the citizen side are displayed (Figure C2).

Code tree interviews and focus groups with the municipality

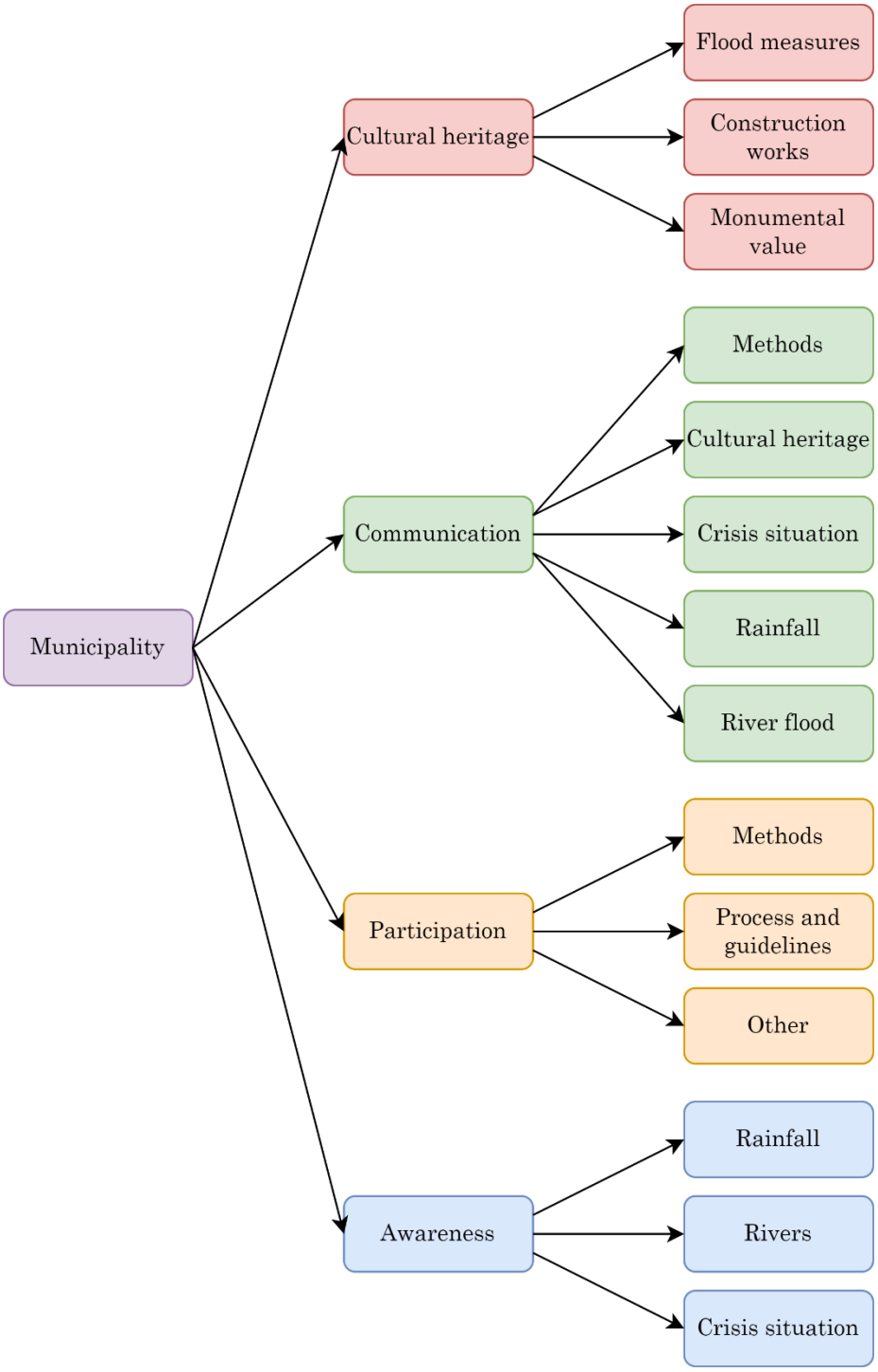

Figure C1: Code Tree Interviews and Focus Groups with the municipality

Code tree interviews and focus groups with the citizens

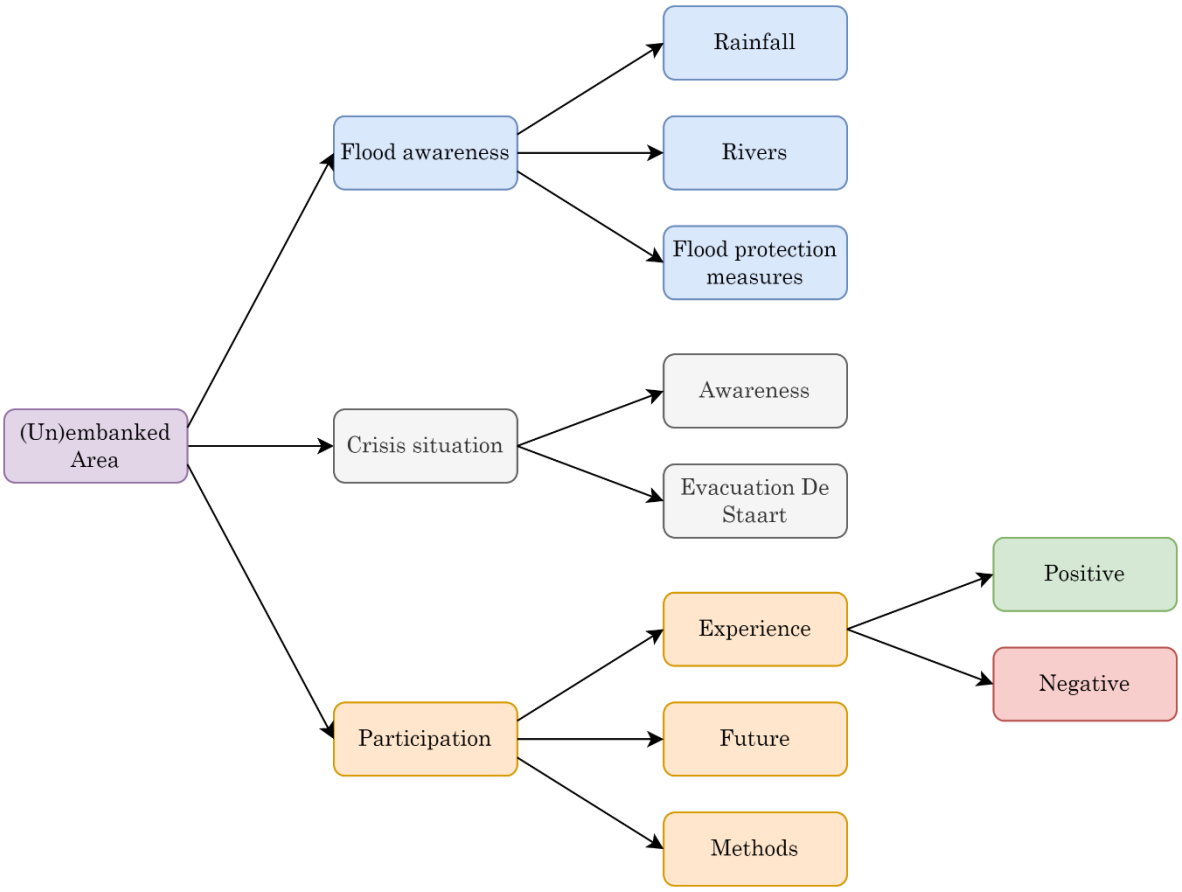

Figure C2: Code Tree Interviews and Focus group with the citizens

D. Concept designs

In this section of the appendix, the concept designs for both a low-resource scenario (resulting in a lower participation level) and a high-resource scenario (resulting in a higher participation level) are displayed. These were validated with the Municipality of Dordrecht based on the design requirements, leading to improvements for the final design.

Goal: Flood resilient community
Version: Low intensity version

1.) Understand

Involving citizens can enhance risk communication towards the community, which helps them to understand the meaning of resilience, and how floods influence their resilience. An important aspect is to clarify the concept of flood resilience, with a specific focus on citizens' flood resilience capacities:

- **Capacity to resist**: understand that there are structural measures to resist to floods when increasing a certain threshold above floods can cause harm, such as flood retention measures upstream or in the city.
- **Capacity to absorb and recover**: understand that there are measures to respond and recover from floods, in such a way that the citizens and their buildings keep functioning in both non-crisis and crisis situations. Also, understand when and how these flood measures have to be implemented by having access to flood forecasting and -warning systems.
- **Capacity to transform and adapt**: understand that adapting to floods can reduce the risk of flood damage by making small-scale changes and deal with consequences of a flood.

The goal of this phase of the participatory approach is that citizens understand what flood resilience is, and how floods influence their resilience. The focus should be on both the embanked- as the unembanked area. In both areas the focus should be on crisis-situations and flood measures citizens can take. In the embanked area specific focus has to be on floods induced by high water in the rivers and by heavy rainfall, due to a lack of flood risk awareness.

Methods that can contribute to the goal of this phase
For reaching a large group at once the following methods can contribute to this phase: *Newsletters*, *websites*, *flyers* and *open days* to specific locations that aim at understanding flood resilience.
For smaller groups *field trips* to specific locations that aim at understanding flood resilience can be of value as well.

2.) Measure

Measuring flood resilience identifies which aspects of a system or community are resilient, which takes place after citizens understand what resilience means. In this phase the three resilience capacities are used as well to measure the flood resilience of citizens and the buildings they are living in, based on indicators displayed as questions below:

- **Capacity to resist**: Do citizens know that they are protected by structural flood defence measures, such as the flood defence barrier and retention areas that increase the threshold above which floods can cause harm?
- **Capacity to absorb and recover**: Are citizens aware of their flood awareness? Do citizens know about measures they can take themselves to absorb and recover from floods? Do citizens know what to do in a crisis situation? Do citizens know if the insurance company reimburse flood damage? Do the employees of the municipality know what to do in case of a crisis situation?
- **Capacity to transform and adapt**: Are citizens willing to adopt measures that change their behaviour in case of a crisis situation? How well educated are citizens in order to adapt their behaviour to be better protected against floods?

The goal of this phase of the participatory approach is that the resilience of citizens and the buildings they are living in is measured using the three resilience capacities and corresponding indicators. In this low intensity approach the user initiates this phase, and the indicators by which the resilience is measured are determined by the resilience literature where citizens are passively involved.

Methods that can contribute to the goal of this phase
For reaching large groups at once the following methods can contribute to this phase: *Postal surveys* to measure the resilience of citizens.
For smaller groups, to identify the resilience of specific citizens (e.g. less self-reliant citizens), *personal surveys* can be used.

3.) Improve

In this last phase the points of improvement identified in the measurement step should be communicated towards the entire community to improve its flood resilience. The citizens need to be informed about the measures they can take to improve their flood resilience, and the flood resilience of the buildings they live in. In the measurement phase (2), it is identified which of the resilience capacities need more attention whereafter improvement steps are taken accordingly. It is thereafter essential that the results of that phase are used as a basis for the improvement step.

The goal of this phase of the participatory approach is that strengths and points of improvements of flood resilience of the community, measured in the measurement phase, are communicated towards the citizens.

Methods that can contribute to the goal of this phase
For reaching large groups as well as smaller groups *advertisements*, *websites*, *newsletters* and *flyers* can be used to provide information about possible improvements. Also, an *idea competition* where citizens themselves come up with improvements can be organised.

Figure D1: Concept design of a low-resource participatory approach.

Goal: Flood resilient community
Version: High intensity version

1.) Understand

Involving citizens can enhance risk communication towards the community, which helps them to understand the meaning of resilience, and how floods influence their resilience. An important aspect is to clarify the concept of flood resilience, with a specific focus on citizens' flood resilience capacities:

- **Capacity to resist**: understand that there are structural measures to resist to floods when increasing a certain threshold above floods can cause harm, such as flood retention measures upstream or in the city.
- **Capacity to absorb and recover**: understand that there are measures to respond and recover from floods, in such a way that the citizens and their buildings keep functioning in both non-crisis and crisis situations. Also, understand when and how these flood measures have to be implemented by having access to flood forecasting and -warning systems.
- **Capacity to transform and adapt**: understand that adapting to floods can reduce the risk of flood damage by making small-scale changes and deal with consequences of a flood.

The goal of this phase of the participatory approach is that citizens are actively involved in understanding what flood resilience is, and how floods influence their resilience. The focus should be on both the embanked- as the unembanked area. In both areas the focus should be on crisis-situations and flood measures citizens can take. In the embanked area specific focus has to be on floods induced by high water in the rivers and by heavy rainfall, due to a lack of flood risk awareness.

Methods that can contribute to the goal of this phase
Newsletters, *websites*, *flyers, open days* and *field trips* are examples of methods that can be used in a low intensity approach. In a high intensity approach these methods can still be used, complemented with additional methods that can be of value to reach a higher level of involvement:
Simulations (e.g. where floods are simulated), *public meetings* and *workshops* are additional methods that can be used to make citizens understand what flood resilience is, and how floods influence their resilience.

2.) Measure

Measuring flood resilience identifies which aspects of a system or community are resilient, which takes place after citizens understand what resilience means. In this phase the three resilience capacities are used as well to measure the flood resilience of citizens and the buildings they are living in, but indicators the citizens come up with themselves are also incorporated in the measurement step of their resilience.:

- **Capacity to resist**: Do citizens know that they are protected by structural flood defence measures, such as the flood defence barrier and retention areas that increase the threshold above which floods can cause harm?
- **Capacity to absorb and recover**: Are citizens aware of their flood awareness? Do citizens know about measures they can take themselves to absorb and recover from floods? Do citizens know what to do in a crisis situation? Do citizens know if the insurance company reimburse flood damage? Do the employees of the municipality know what to do in case of a crisis situation?
- **Capacity to transform and adapt**: Are citizens willing to adopt measures that change their behaviour in case of a crisis situation? How well educated are citizens in order to adapt their behaviour to be better protected against floods?

The goal of this phase of the participatory approach is that the resilience of citizens and the buildings they are living in is measured using the three resilience capacities as a basis. However, in this high intensity approach citizens themselves identify the indicators that assess these capacities, whereafter they measure their flood resilience themselves. Flood resilience of less involved citizens can be measures by the user, while using the indicators identified by the more actively involved citizens.

Methods that can contribute to the goal of this phase
Focus-groups, *interviews*, *cart-sorting methods* and *workshops* are methods with a higher intensity, where citizens themselves can identify indicators to assess their resilience.
To reach citizens that do not want to be actively involved, the indicators determined by other citizens can be used to measure their resilience via low intensity methods such as *postal surveys* and *personal surveys*. The latter is especially relevant for reaching small groups such as less self-reliant citizens, citizens who just move to flood prone areas or to identify the division between public and private houses.

3.) Improve

In this last phase the points of improvement identified in the measurement step should be communicated towards the entire community to improve its flood resilience. The citizens need to be informed and actively engaged about the measures they can take to improve their flood resilience, and the flood resilience of the buildings they live in. In the measurement phase (2), it is identified which of the resilience capacities need more attention whereafter improvement steps are taken accordingly. It is thereafter essential that the results of that step are used as a basis for the improvement phase.

The goal of this part of the participatory approach is that strengths and points of improvements of flood resilience of the community, measured in the measurement step, are communicated towards the citizens.

Methods that can contribute to the goal of this phase
Newsletters, websites, flyers and *advertisements* are examples of methods that can be used in a low intensity approach, together with an idea competition where citizens themselves come up with improvements. In a high intensity approach these methods can still be used, complemented with additional methods that can be of value to reach a higher level of involvement:
Workshops, *public meetings* and *sponsorships* are additional methods that can be used to improve flood resilience of citizens and the buildings they are living in.

Figure D2: Concept design of a high-resource participatory approach.

E. Dutch version of participatory approaches

Here the translated versions of the participatory approaches are displayed. Context-specific aspects of the case of Dordrecht are displayed in the problem investigation, discussion, and recommendation in the report. Figure E1 is the low-intensity approach, and Figure E2 is the high-intensity approach.

1.) Begrijpen

Het betrekken van burgers kan de risicocommunicatie naar de gemeenschap toe verbeteren, wat hen helpt de betekenis van "resilience" (veerkracht) te begrijpen, en te begrijpen hoe overstromingen hun veerkracht beïnvloeden. Een belangrijk aspect is het verduidelijken van het begrip "overstromingsveerkracht", met de focus op verschillende vermogens van burgers:

- **Vermogen om te weerstaan**: Begrijpen dat er structurele maatregelen zijn die weerstand bieden tegen overstromingen, door een bepaalde drempel te verhogen waarboven overstromingen schade kunnen aanrichten. Voorbeelden zijn retentiegebieden stroomopwaarts of in de stad, of waterkeringen.
- **Vermogen om te absorberen en te herstellen**: Begrijpen dat er maatregelen zijn om overstromingen te absorberen, en er van te herstellen, zodanig dat burgers en hun gebouwen zowel in niet-crisis- als in crisissituaties kunnen blijven functioneren. Ook begrijpen wanneer en hoe deze maatregelen moeten worden uitgevoerd door toegang te hebben tot overstromingsvoorspellings- en -waarschuwingssystemen.
- **Veranderings- en aanpassingsvermogen**: Begrijpen dat aanpassen aan overstromingen het risico op schade kan verminderen door kleinschalige veranderingen door te voeren.

Het doel van deze fase van de participatieve aanpak is dat burgers begrijpen wat overstromingsveerkracht is, en hoe overstromingen hun veerkracht beïnvloeden door hen te informeren. De nadruk ligt op zowel niet-crisis- als crisissituaties. Aangezien de veerkracht tegen overstromingen locatie afhankelijk is, en afhangt van het type overstroming (kust, rivieren, regen), moet dit probleem eerst worden onderzocht voordat wordt begonnen met de eerste fase van de veerkrachtigheidstoets (*gedaan in hoofdstuk 3 van MSc thesis*).

Methoden die kunnen bijdragen aan het doel van deze fase
Om een grote groep in één keer te bereiken kunnen de volgende methoden worden gebruikt: *Nieuwsbrieven*, *websites*, *flyers* en *open dagen* op specifieke locaties die gericht zijn op het begrijpen van overstromingsveerkracht.
Voor kleinere groepen kunnen *excursies* naar locaties die gericht zijn op het begrijpen van overstromingsveerkracht geschikt zijn.

3.) Verbeteren

In deze laatste fase worden de verbeterpunten die in de meetfase zijn geïdentificeerd, gecommuniceerd naar de hele gemeenschap om de overstromingsveerkracht te verbeteren. Burgers worden geïnformeerd over de maatregelen die zij kunnen nemen om hun overstromingsveerkracht, en die van hun gebouwen, te verbeteren, zowel met betrekking tot normale situaties als crisissituaties. In de meetfase wordt vastgesteld welke van de veerkrachtvermogens meer aandacht nodig hebben. Het is essentieel dat de resultaten van die fase worden gebruikt als basis voor de verbeteringsfase.

Het doel van deze fase is dat de sterke punten en verbeterpunten van de overstromingsveerkracht van de gemeenschap worden gecommuniceerd naar de burgers. Dit is gebaseerd op de vorige fase, waarin minder overstromingsveerkrachtige gebieden en mensen zijn geïdentificeerd, zowel in normale als in crisissituaties. De resultaten van die stap zijn daarom essentieel voor het communiceren van de juiste informatie voor verbeteringen aan de gemeenschap als geheel, of aan specifieke groepen.

Methoden die kunnen bijdragen aan het doel van deze fase
Om zowel grote groepen als kleinere groepen te bereiken kan gebruik worden gemaakt van *advertenties*, *websites*, *nieuwsbrieven* en *flyers* om informatie te verstrekken over mogelijke verbeteringen. Ook kan een *ideeënwedstrijd* worden georganiseerd waarbij burgers zelf verbeteringen bedenken.

Doel: Overstromingsveerkrachtige gemeenschap
Scenario: Weinig middelen:
Lager participatieniveau
informatie verstrekken.
Minder beschikbare methoden

Nadat burgers zijn geïnformeerd over overstromingsveerkracht , wordt hun veerkracht en die van hun huizen gemeten.

2.) Meten

Het meten van de overstromingsveerkracht identificeert welke aspecten van een systeem of gemeenschap veerkrachtig zijn, wat plaatsvindt nadat burgers begrijpen wat veerkracht betekent. In deze fase worden de drie vermogens opnieuw gebruikt om de overstromingsveerkracht van burgers en de gebouwen waarin zij wonen te meten, aan de hand van voorbeelden van indicatoren die hieronder als vragen worden weergegeven:

- **Vermogen om te weerstaan**: Worden burgers beschermd door structurele maatregelen, zoals waterkeringen en retentiegebieden?
- **Vermogen om te absorberen en te herstellen**: Zijn burgers zich bewust van hun overstromingsrisico? Weten burgers welke maatregelen zij zelf kunnen nemen om overstromingen te absorberen? Weten de burgers wat ze in een crisissituatie moeten doen? Weten de burgers of de verzekeringsmaatschappij overstromingsschade vergoedt? Weten de medewerkers van de gemeente wat ze moeten doen in geval van een crisissituatie?
- **Veranderings- en aanpassingsvermogen**: Zijn burgers bereid om maatregelen te nemen die hun gedrag veranderen in geval van een crisissituatie? Hoe goed zijn de burgers opgeleid om hun gedrag aan te passen met het oog op een betere bescherming tegen overstromingen?

Het doel van dit deel van de participatieve aanpak is dat de veerkracht van burgers en hun gebouwen wordt gemeten aan de hand van de drie veerkrachtvermogens. In deze lage-intensiteitsversie neemt de gebruiker het initiatief, en de indicatoren waarmee veerkracht wordt gemeten worden bepaald a.d.h.v. veerkrachtliteratuur terwijl burgers passief worden betrokken.

Methoden die kunnen bijdragen aan het doel van deze fase
Om grote groepen in één keer te bereiken kunnen de volgende methoden worden gebruikt: *Schriftelijke enquêtes* om de veerkracht van burgers te meten.
Voor kleinere groepen, om de veerkracht van specifieke burgers (bv. minder zelfredzame burgers) te bepalen, kunnen *huis-aan-huis enquêtes* worden gebruikt.

Sterke punten en punten van verbetering worden meegedeeld aan burgers om hun overstromingsveerkracht en die van hun gebouwen te verbeteren.

Crisissituaties zijn situaties met grote economische verliezen en slachtoffers, waarin de volgende driestappenaanpak van toepassing is: 1) Waar kan ik heen? 2) Wat neem ik mee? 3) Wie om mij heen heeft hulp nodig?

Figure E1: Participatieve aanpak voor een scenario met weinig middelen [NL]

Doel: Overstromingsveerkrachtige gemeenschap
Scenario: Veel middelen:
Hoger participatieniveau,
co-productie.
Meer beschikbare methoden

1.) Begrijpen

Het betrekken van burgers kan de risicocommunicatie naar de gemeenschap toe verbeteren, wat hen helpt de betekenis van "resilience" (veerkracht) te begrijpen, en te begrijpen hoe overstromingen hun veerkracht beïnvloeden. Een belangrijk aspect is het verduidelijken van het begrip "overstromingsveerkracht", met de focus op verschillende vermogens van burgers:

- **Vermogen om te weerstaan**: Begrijpen dat er structurele maatregelen zijn die weerstand bieden tegen overstromingen, door een bepaalde drempel te verhogen waarboven overstromingen schade kunnen aanrichten. Voorbeelden zijn retentiegebieden stroomopwaarts of in de stad, of waterkeringen.
- **Vermogen om te absorberen en te herstellen**: Begrijpen dat er maatregelen zijn om overstromingen te absorberen, en er van te herstellen, zodanig dat burgers en hun gebouwen zowel in niet-crisis- als in crisissituaties kunnen blijven functioneren. Ook begrijpen wanneer en hoe deze maatregelen moeten worden uitgevoerd door toegang te hebben tot overstromingsvoorspellings- en -waarschuwingssystemen.
- **Veranderings- en aanpassingsvermogen**: Begrijpen dat aanpassen aan overstromingen het risico op schade kan verminderen door kleinschalige veranderingen door te voeren.

Het doel van deze fase van de participatieve aanpak is dat burgers actief worden betrokken bij het begrijpen van wat overstromingsveerkracht is, en hoe overstromingen hun veerkracht beïnvloeden. De nadruk ligt op zowel niet-crisis- als crisissituaties. Aangezien de veerkracht tegen overstromingen locatie afhankelijk is, en afhangt van het type overstroming (kust, rivieren, regen), moet dit probleem eerst worden onderzocht alvorens de eerste fase van de veerkrachtigheidstoets start (*gedaan in hoofdstuk 3 van MSc thesis).*

Methoden die kunnen bijdragen aan het doel van deze fase
Nieuwsbrieven, *websites*, *flyers*, *open dagen* en *excursies* zijn voorbeelden van methoden die kunnen worden gebruikt bij een aanpak met minder middelen. Bij een aanpak met meer beschikbare middelen kunnen deze methoden nog steeds worden gebruikt, aangevuld met extra methoden om een hoger niveau van betrokkenheid te bereiken.
Simulaties (waarbij overstromingen worden gesimuleerd), *openbare bijeenkomsten* en *workshops* zijn aanvullende methoden die kunnen worden gebruikt om burgers duidelijk te maken wat overstromingsveerkracht is, en wat de invloed is van overstromingen.

Nadat burgers zijn geïnformeerd over overstromingsveerkracht, wordt hun veerkracht en die van hun huizen gemeten.

2.) Meten

Het meten van de overstromingsveerkracht identificeert welke aspecten van een systeem of gemeenschap veerkrachtig zijn, wat plaatsvindt nadat burgers begrijpen wat veerkracht betekent. In deze fase worden de drie vermogens opnieuw gebruikt om de overstromingsveerkracht van burgers en de gebouwen waarin zij wonen te meten, aan de hand van voorbeelden van indicatoren die hieronder als vragen worden weergegeven:

- **Vermogen om te weerstaan**: Worden burgers beschermd door structurele maatregelen, zoals waterkeringen en retentiegebieden?
- **Vermogen om te absorberen en te herstellen**: Zijn burgers zich bewust van hun overstromingsrisico? Weten burgers welke maatregelen zij zelf kunnen nemen om overstromingen te absorberen? Weten de burgers wat ze in een crisissituatie moeten doen? Weten de burgers of de verzekeringsmaatschappij overstromingsschade vergoedt? Weten de medewerkers van de gemeente wat ze moeten doen in geval van een crisissituatie?
- **Veranderings- en aanpassingsvermogen**: Zijn burgers bereid om maatregelen te nemen die hun gedrag veranderen in geval van een crisissituatie? Hoe goed zijn de burgers opgeleid om hun gedrag aan te passen met het oog op een betere bescherming tegen overstromingen?

Het doel van deze fase van de participatieve aanpak is dat de veerkracht van burgers en de gebouwen waarin zij wonen wordt gemeten met de drie vermogens van veerkracht als basis. In deze hoge-intensiteitsversie bepalen burgers echter zelf de indicatoren die deze vermogens beoordelen. Op basis van deze indicatoren wordt hun veerkracht samen met de gebruiker beoordeeld. De veerkracht van minder betrokken burgers kan door de gebruiker worden gemeten met de indicatoren die door de meer actief betrokken burgers zijn vastgesteld.

Methoden die kunnen bijdragen aan het doel van deze fase
Focus-groepen, *interviews*, *kaart-sorteermethoden* en *workshops* zijn methoden met een hogere intensiteit, waarbij burgers zelf indicatoren kunnen bepalen om hun veerkracht te beoordelen.
Om burgers te bereiken die niet actief betrokken willen worden, kunnen de door andere burgers vastgestelde indicatoren worden gebruikt om hun veerkracht te meten via methoden met een lage intensiteit, zoals *schriftelijke enquêtes* en *huis-aan-huis enquêtes*. Dit laatste is vooral relevant voor het bereiken van kleine groepen, zoals minder zelfredzame burgers, burgers die net naar overstromingsgevoelige gebieden verhuizen of om de verdeling tussen openbare en particuliere woningen vast te stellen.

3.) Verbeteren

In deze laatste fase worden de verbeterpunten die in de meetfase zijn geïdentificeerd, gecommuniceerd naar de hele gemeenschap om de overstromingsveerkracht te verbeteren. Burgers worden geïnformeerd over de maatregelen die zij kunnen nemen om hun overstromingsveerkracht, en die van hun gebouwen, te verbeteren, zowel met betrekking tot normale situaties als crisissituaties. In de meetfase wordt vastgesteld welke van de veerkrachtvermogens meer aandacht nodig hebben. Het is essentieel dat de resultaten van die fase worden gebruikt als basis voor de verbeteringsfase.

Het doel van deze fase van de participatieve aanpak is dat sterke punten en verbeterpunten van de overstromingsveerkracht van de gemeenschap worden gecommuniceerd naar de burgers, en dat burgers actief betrokken worden bij het verbeteren van hun weerbaarheid. Dit is gebaseerd op de vorige fase, waarin minder overstromingsveerkrachtige gebieden en mensen zijn geïdentificeerd, zowel in normale- als in crisissituaties. De resultaten van die stap zijn dan ook van essentieel belang bij het communiceren van de juiste informatie voor verbeteringen aan de gemeenschap als geheel, of aan specifieke groepen.

Methoden die kunnen bijdragen aan het doel van deze fase
Nieuwsbrieven, *websites*, *flyers* en *advertenties* zijn voorbeelden van methoden die kunnen worden gebruikt bij een aanpak met een lage intensiteit, samen met een *ideeënwedstrijd* waarbij burgers zelf met verbeteringen komen. Bij een hoge-intensiteitsaanpak kunnen deze methoden nog steeds worden gebruikt, aangevuld met extra methoden die van waarde kunnen zijn om een hoger niveau van betrokkenheid te bereiken.
Workshops, *openbare bijeenkomsten* en *sponsoring* zijn aanvullende methoden die kunnen worden gebruikt om de overstromingsveerkracht van burgers en de gebouwen waarin zij wonen te verbeteren.

Sterke punten en punten van verbetering worden meegedeeld aan burgers om hun overstromingsveerkracht en die van hun gebouwen te verbeteren.

Crisissituaties zijn situaties met grote economische verliezen en slachtoffers, waarin de volgende driestappenaanpak van toepassing is: 1) Waar kan ik heen? 2) Wat neem ik mee? 3) Wie om mij heen heeft hulp nodig?

Figure E2: Participatieve aanpak voor een scenario met veel middelen [NL]