Practicing Participatory Value Evaluation

ASSESSING THE APPLICABILITY OF THE PARTICIPATORY VALUE EVALUATION METHOD FOR PUBLIC DECISION-MAKING ON URBAN STORM WATER MANAGEMENT IN A THE HAGUE CASE STUDY

Kieran Dartée | CoSEM Master Thesis, TU Delft | September 2018

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Preface

This document is the final deliverable I will submit for the master Complex Systems Engineering & Management (CoSEM) at Delft University of Technology. I would like to use this opportunity to thank those people that helped me in completing this research.

First of all, I want to thank my graduation committee for helping me throughout this research. Is has been a privilege to have had such an enthusiastic and dedicated graduation committee. My first supervisor Niek granted me the opportunity to pursue the application of "his" PVE-method in USWM. Our many discussions on the PVE-design for my case study, your pragmatic advices and your continuous availability to answer my questions have been invaluable to this project. My second supervisor Neelke has always safeguarded that I would be able to complete my master thesis at some stage despite my overambitious plans. I have really appreciated your sharp reflections upon my choice of wording, the research scope and the scientific quality of this thesis.

I would like to thank my external supervisors and bosses Karina and Wilrik for providing me the opportunity to combine this thesis with an internship at Field Factors. I don't think one can ask for a more inspiring environment to write a master thesis. Thanks to your visionary leadership, the drive and determination to always aim a little higher and do a little different, and our amazing colleagues Mirthe (thank you for helping with the visualisations for this report), Kasper, Alfonsina and Loïc it has been a pleasure coming into the office every day. I would like to explicitly thank Karina for your extensive feedback on the methodological framework and structure of the report, which has definitely pushed the quality of this final deliverable to the next level. I look forward to kick-start my working life at Field Factors.

I would also like to express my gratitude to Perry Borst (SplicedGene) for his efforts in making the PVE-tool comply with all my demands and to Jacobien Bakker, René Janssen, Niels Al en Jaco Devilee for supporting my research on behalf of the municipality of The Hague.

Lastly, I would like to thank my parents, family, friends and Soof for their support and distractions over the last eight years.

Delft, September 2018

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Abstract

One of the pillars of Dutch municipal decision-making is to stimulate citizen participation in agenda-setting and decision-making (VNG, 2018). Involving citizens in the allocation of the public budget for addressing specific challenges is a novel approach to participatory decision-making. This thesis examines the applicability of the Participatory Value Evaluation (PVE) as a participatory budgeting tool to improve the economic assessment of investments with public funds on Urban Storm Water Management (USWM). The PVE method was developed by Mouter, Koster and Dekker (2017) to overcome the economical dispute on the use of consumer Willingness to Pay (WTP) for the valuation of investments with public funds. The PVE-method could be a valuable means to improve the assessment of public investment opportunities and facilitate participation in the decision-making process. However, due to a lack of experience with the actual application of the method in different sectors, scientists and practitioners lack the knowledge to understand whether and how the PVE-method can be applied in different fields and administrative levels of public decision-making. The PVE-method has so far only been applied twice; in a transportation study in the Metropolitan Region of Amsterdam (Mouter, Koster & Dekker, 2017) and in a national Water Safety study by the ministry of Economic Affairs in the Netherlands (Mouter, Koster, Dekker & Borst, 2018a, 2018b). These applications of the PVE-method are significantly different from applying the PVE-method to assess measures for USWM in terms of the scale level of the administration and specific characteristics of the USWM context. Therefore, the applicability of the PVE-method on a municipal level is assessed through the development of a case study in the municipality of The Hague that focused on the topical societal challenge of managing superfluous storm water in the urban environment. In this context, the application of the PVE could help to steer future investments in climate adaptation and USWM strategies, such that the highest value-for-money can be achieved.

This thesis aims to contribute to the development of the PVE-method as a participatory research method and to support the effective use of the municipal budgets for USWM through achieving the following objectives:

1) Evaluate the applicability of the PVE method for participatory research as decision support tool in the field of USWM.
2) Provide an overview of practical lessons for applying the PVE-method for setting up PVE-experiments in the future and to contribute towards a guideline for application of the PVE.

3) Provide input for the municipal authority of The Hague to revise their USWM-strategies based on citizen participation in the assessment of different measures.

The question that this research addresses is: *To what extent is the PVE-method as a participatory research tool applicable in USWM decision-making processes in the Netherlands to improve the alignment of public policies with citizens' preferences?*

The methodological framework is built around a case study, which involves the application of a PVE-experiment on USWM in The Hague. Furthermore, input is gathered through an additional survey on the evaluation of the PVE-method. The experiment provides the empirical data to validate the theoretical assumptions on the applicability of the PVE-method and to learn sector specific boundaries that could drive or hamper the successful application of the PVE.

In the PVE-experiment citizens were asked to allocate a public budget on eleven measures for USWM. For this task, citizens were supplied with information on the effects of the measures on eight attributes. Respondents could select a multitude of each measure in their configuration of measures to deal with superfluous storm water. The qualitative motivations, personal characteristics and follow-up survey were integrated in an adjusted version of the online PVE-tool. The respondents were selected through random sampling of postal codes from adult (18+) inhabitants of the municipality. Participation was on a voluntary basis and completely anonymous. The 5000 invitation letters resulted in 146 completed PVE-experiments (3% success rate), which resulted in demographic statistics on the respondents, quantitative data on the configuration of USWM-measures respondents had selected within the budget constraint, qualitative motivations of the respondents for selecting the measures in their portfolio and the evaluation of the PVE-method that respondents provided in the integrated follow-up survey. The demographic results show that younger people, females, tenants and lower income groups are underrepresented in the sample group. The quantitative results on the stated preference of residents for specific measures and the attributes. The quantitative results show a distinct preference for *green strips* and *permeable paving*. Unfortunately, the econometric choice modelling of the results was not feasible within the scope of this thesis, due to an insufficient number of completed sessions to draw any significant conclusions. The qualitative motivations however indicated that *added green space*, the *effectiveness of a measure against superfluous storm water* and the *looks of the measure in the urban environment* turned out to be the main motivations for respondents when choosing for specific measures. The PVE-method

was evaluated positively by the respondents. Participatory decision-making is considered important, as it *generates support for decision-making, includes the end-users in the decision-making process, enhances knowledge sharing between stakeholders* and *creates awareness* among citizens on the topic at hand. The information that was supplied on the effects of the measures on the attributes was considered the main benefit of the PVE-method, followed by the clearly stated cost effects and created awareness and learning effects. The PVE-experiment for the case study of The Hague can be found via https://bewonderzoek.nl.

The general conclusion is that the PVE-method is a valuable tool as a means to improve the alignment of public policies with citizens' preferences in the field of USWM. However, the applicability of the method in the context of USWM decision-making presents some limitations. The level of participation that is currently achieved with a PVE-method is consulting or potentially advising. The applicability of the PVE-method as a tool for binding co-producing of co-deciding is still too limited and for now undesirable.
The following barriers that should be overcome to improve the applicability of the PVE-method in the context of USMW at a municipal level have been identified:

1) Targeting respondents at municipal level is challenging, yet crucial for the applicability of the PVE. By random sampling inhabitants and asking them to voluntary participate in the experiment via impersonal invitations via paper mail doesn't provide the number of respondents needed to perform the econometric choice modelling.
2) The current set-up of the PVE-experiment on USWM is too complex. Respondents indicated concerns regarding the task complexity. Additionally, the overrepresentation of high-educated people could be an indication of the complexity of the task for respondents.
3) The applicability of the results in the experiment are dependent on how well the sample group represents the population of The Hague.

The extensive discussion on this research and the PVE-method should not to be mistaken for the fact that the PVE-method is not sufficiently developed to be applied on a large scale. Instead, all these suggestions for future research indicate how broad the potential of the PVE-method is and why it is interesting to further explore its opportunities through future research and experiments.

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Table of contents

Chapter 3:

Chapter 4:

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Index of figures and tables

List of abbreviations

PVE	: Participatory Value Evaluation
WTP	: Willingness to Pay
WTA	: Willingness to Allocate
CBA	: Cost-Benefit Analysis
NBS	: Nature-Based Solutions
SCBA	: Social Cost-Benefit Analysis
USWM	: Urban Storm Water Management
MDCEV	: Multiple Discrete-Continuous Extreme Value

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Chapter 1:

Introduction

OUTLINE OF CHAPTER 1

One of the focus points of the Association of Dutch Municipalities (VNG) for 2018 is to improve the responsiveness of municipalities to societal challenges through offering "tailored democracy" (VNG, 2018). One of the pillars of this vision is to stimulate citizen participation in agenda-setting and decision-making. Involving citizens in the allocation of the public budget for addressing specific challenges is a novel approach to participatory decision-making. This thesis examines the applicability of a participatory budgeting tool that improves the economic assessment of investments with public funds. This Participatory Value Evaluation (PVE) method is applied to improve the responsiveness of the municipality of The Hague to the topical societal challenge of superfluous storm water in the urban environment. This chapter introduces the context for this research. In section 1.1 the challenges of superfluous storm are introduced. Section 1.2 discusses why there is a need for a novel (participatory) method to help improve the alignment of public policy with citizens' preferences. Consequently, the problem addressed in this research is stated in section 1.3. In section 1.4 the research objectives are stated and in section 1.5 the research questions are introduced. Section 1.6 and 1.7 discuss the scientific and societal relevance of this research. The last section (1.8) provides a reading guide by explaining the structure of this report.

1.1 EFFECTS OF CLIMATE CHANGE AND URBANISATION TRENDS ON URBAN STORM WATER MANAGEMENT

Extreme rain events are expected to impose serious burdens on the urban environment (Koop & van Leeuwen, 2017). Therefore, climate adaptation is increasingly becoming priority on the agenda of both local and national governments. Climate adaptation refers to the implementation of measures and mechanisms to enhance the resilience of cities against all sorts of climate change related effects. Projections show that temperatures will rise, more wind storms will strike, droughts periods will last longer, yet precipitation will increase in intensity and frequency (Houston et al., 2011; IPCC, 2007; Lenderink, Mok, Lee, & Van Oldenborgh, 2011). The latter could cause superfluous storm water to inundate buildings, roads and other infrastructure in the urban environment (Stumpe & Tielrooij, 2000) and consequently the likelihood of storm water related damages increases (Dekker, Nootenboom, Locher & Spekkers, 2016; Spekkers, Rözer, Thieken, ten Veldhuis & Kreibich, 2017). Those effects not only occur as a result of climate change, but particularly due to the combination of climate change and urbanisation trends. Due to the large amount of impervious surface area (roads, buildings et cetera), urban areas have increased risk of pluvial flooding. Pluvial flooding occurs as a result of *"short intense downpours that cannot be quickly enough be evacuated by the drainage system or infiltrated to the ground*" (Houston et al., 2011). Strong urbanisation and a growing world population, make cities even more densely populated (Population Reference Bureau, 2013). More dwellings, offices, roads and other infrastructures are built to keep up with the increasing demand for a spot in the city. Consequently, the surface ratio shifts towards more and more impervious surfaces and the risk of superfluous storm water increases. How topical this threat is to cities, became clear multiple times in the last year, see figure 1.1-a.

Figure 1.1-a: Newspaper articles on superfluous water causing nuisance in the Netherlands. All written in between July 2017 - July 2018. Collage of digital newspaper articles by Dartée & Snoek, 2018

In light of the expected climate and urbanisation trends, the need for an alternative integrated approach to Urban Storm Water Management (USWM) to help control storm water run-off has become more apparent. For many years, USWM was organised in the subsurface, with sewer systems being the number one measure to manage storm water. The underlying principle is mainly based on installing artefacts to intervene natural water flows and steer the water towards the desired final destination within a controlled environment. The latest addition in approaches towards climate adaptation policies is that of nature-based solutions (NBS). NBS resort to the way nature works itself in order to install mechanisms that could help reduce storm water run-off (e.g. UN-Water, 2018). NBS are expected to provide various co-benefits in addition to their primary water management function (Lara-Pulido, Guevara-Sanginés, & Arias Martelo, 2018; Raymond, et al., 2017). The European Union Floods Directive also emphasizes the impact of (US)WM-measures on the urban environment and the corresponding need for integration of two field of expertise: water management and spatial development (Hartmann & Driessen, 2017; Woltjer & Al, 2007). Altogether, these new approaches to USWM require that the potential returns on public investments in USWM needs to be re-assessed, as the value of integral measures may also be affected by positive and negative externalities, such as their impact on the spatial quality. To be able to assess the potential

return on public investments in integral USWM-measures, a deeper understanding of the total utility that is derived from these measures is required.

1.2 NEED FOR NEW MEANS TO ECONOMICALLY ASSESS USWM-MEASURES

The utility of a measure is dependent on the extent to which the solution and its effects are *desirable* for all stakeholders. Whether a measure is desirable depends on a multitude of characteristics of the measure. For example, a measure can be desirable because it reduces the likelihood of hazardous events or because the citizens like the look of it. However, the extent to which certain effects of a measure are desirable might be restricted by the other characteristics of the measure. Someone might like the looks of a measure, but if the measure doesn't reduce the risk of a hazardous event or is very expensive, it might still be undesirable to implement that measure.

Various methods exists to determine the utility one derives from an alternative (Baarsma, 2000; Bateman et al., 2002). Most often, public authorities would estimate the cardinal and/or ordinal[1] utility of a measure through estimating the public desire with various tools that use standardized utility values for specific characteristics to determine the overall utility, as they do not have the resources to determine the utilities in dedicated valuation studies (Sijtsma, van Hinsberg, Kruitwagen, & Dietz, 2009; Steunpunt Economische Evaluatie, 2012). More recently, the demand for participatory processes to determine the preference for specific choice alternatives has risen within public authorities (Havekes et al., 2016; Erik Hans Klijn & Koppenjan, 2000; Roth, Vink, Warner, & Winnubst, 2017). Roth et al. (2017) discuss how the demand for more inclusive decision-making processes in Dutch water safety decision-making originates from the desire to deal with conflicts with citizens groups that opposed new interventions. Even though some participatory processes were still running while the projects were already realized, they at least helped to prevent extensive resistance against the government plan. As citizen participation is believed to help gather support for decisions by the public authority, stimulate awareness, steer behavioural change of participants

[1] *According to (neo-)classical economists, the utility can be quantified. According to modern economists the utility function can only be used for ordinal scaling of different choice alternatives.*

and enhance knowledge sharing, participatory decision-making could prevent undesired conflicts and improve the quality of decision-making.

Since inhabitants are the *end-users*, their preferences for specific USWM-measures are highly relevant to be considered when defining the total utility that is derived from multi-functional USWM-measures (Havekes et al., 2016). The challenge in assessing investment opportunities for water infrastructure development is that the value of the related projects is not per se monetary. Despite policy-makers and academia being aware of the importance and existence of social benefits in certain measures, still limited decision-making tools are available that successfully include the value of social benefits in the decision-making processes. One regularly used method that includes social and environmental benefits/losses in decision-making processes, is the Social Cost-Benefit Analyses (SCBA) (Silvis & Van Der Heide, 2017). The SCBA is even obligatory to be performed in larger infrastructure development project in the Netherlands (Beukers, Bertolini, & Te Brömmelstroet, 2012). However, the method is not undisputed among economists (i.a. Ackerman & Heinzerling, 2004; Alphonce, Alfnes, & Sharma, 2014; Hauer, 1994; Jara-Díaz, 2007; Kelman, 1981; Mackie & Fowkes, 1999; Marglin, 1963; K Nyborg, 2000; Sagoff, 1988; Sunstein, 2005) and doesn't actively involve citizens in the decision-making process. An alternative approach is that of participatory budgeting to gain the necessary deeper understanding of the total utility that citizens derive from multi-functional USWM-measures. A new method, the Participatory Value Evaluation (PVE), was developed to overcome the economical dispute on SCBA by providing an alternative means to gain the necessary deeper understanding of the total utility that citizens derive from specific projects or measures and to stimulate the participation of citizens in the decision-making process.

Particularly in the field of USWM, the need for a thorough assessment of the value citizens derive from different measures is high. USWM to date has resulted in sunk-costs in the existing sewerage infrastructure. Large investments[2] have been made and budgets are allocated to the operation, maintenance and renewal of this infrastructure for the long future. Since the sewer system is still an

[2] *in 2013 Dutch municipalities spent 1,76 billion euros in total on water management tasks (Havekes et al., 2016), according to the Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken (2017) municipal authorities spent 1,57 billion euros on Urban Water Management in 2014.*

effective measure, there hardly is any incentive for municipalities to deviate from this as the main measure against superfluous water (see appendix V on workshop with The Hague). If municipalities are to deviate from the "standard" measure, investments should be justifiable despite the sunk-costs. Therefore, the total utility (including the value of additional benefits) of other measures should be significant. If it turns out the assumption that specific solutions provide valuable co-benefits is false, it will prevent unnecessary waste of prior and future investments. The assessment based on a participatory budgeting approach with the PVE-method could therefore help to steer future investments in climate adaptation and USWM-strategies, such that the highest value-for-money can be achieved.

1.3 PROBLEM STATEMENT

The PVE-method provides an alternative to the disputed use of Willingness to Pay (WTP)-based SCBA for the economic assessment of investments with public funds. The use of WTP-based methods is problematic, because these private choices might not reflect how individuals want public policies to change as a result of classic public-good problems (Sen, 1985). In their research, Mouter, van Cranenburgh and Van Wee (2017) did also find the empirical evidence to support the assumption that the type of budget that is to be allocated (private or public) impacts a person's preference (Mouter, Van Cranenburgh, & Van Wee, 2016). The PVE-method could help to overcome the problems of incorrect valuations of alternatives based on WTP. However, the PVE-method has so far only been applied twice; in a transportation study in the Metropolitan Region of Amsterdam and in a national Water Safety study by the ministry of Economic Affairs in the Netherlands. These applications of the PVE-method are significantly different from applying the PVE-method to assess measures for USWM on two aspects:

1) The previous PVE-experiments in these studies were performed at a regional and national scale respectively. Decision-making on USWM takes place at a local, municipal level. This has its implications on the applicability of the PVE-method in this field. First of all, because a large number of respondents is needed to perform the econometric choice modelling that is used to determine the utility functions of the different choice alternatives, the ability to generate sufficient response within a municipality determines to what extent the PVE-method can be used to determine the utility citizens derive from various USWM-measures. Moreover, the role of the PVE-method as a tool to stimulate inclusive-decision making to generate support for decisions, improve the quality of the decisions and to enhance local

democracy by bridging the gap between public authorities and inhabitants (Erik Hans Klijn & Koppenjan, 2000) is different at a local level than at the larger scale. As the PVE-method initiates a participatory process that is different from other inclusive decision-making processes, it is unclear how the PVE-method (and its results) can be positioned in the context of decision-making at a municipal level. Lastly, the assumption that the PVE-methods reports the preferences of citizens from a societal perspective, applying the PEV-method on a local scale might still incentivize strategic choice behaviour to maximise personal gains and not-in-my-back yard (NIMBY)-votes. As a result, it is still unknown to what extent the PVE-method is applicable as a decision-support tool in local decision-making processes.

2) The field of USWM is different from the topic of transportation. Choosing between different transport modalities, travel times and road safety are much more familiar choices for citizens, than to determine how much risk of superfluous water one is willing to accept in exchange for more green space or parking places. The field of national flood protection shows more similarities in the trade-offs that should be represented in the PVE-experiment on USWM, but is still very different. Therefore, it is unclear whether alteration to the PVE-tool are needed to make the PVE-method applicable in this field of research and public administration.

As such, the PVE-method theoretically has the potential to be a valuable means to improve the assessment of public investment opportunities and facilitate participation in the decision-making process, however due to the limited experience with the actual application of the method in different sectors, scientists and practitioners are lacking the knowledge to understand whether and how the PVE-method can be applied in different fields and levels of public decision-making like USWM.

Overcoming these knowledge gaps requires empirical evidence to be obtained from an actual real-life application of the PVE-method on USWM. This application was not straightforward though, as no clear guideline was available (in parallel to this research, Pak (2018) has been working to resolve this through setting up an experiment on the transition towards gas-free neighbourhoods) on how to set-up a PVE-experiment to assess different investment opportunities. The guideline that is being developed by Pak (2018) is only a first attempt and dedicated to the field of energy transitions. It is unknown to what extent this approach needs to be altered to be applicable for setting up a PVE-experiment in the field of USWM.

1.4 RESEARCH OBJECTIVES

This thesis aims to contribute to resolving the problems stated in section 1.3 through achieving of the following objectives:

4) Evaluate the applicability of the PVE method for participatory research as decision support tool in the field of USWM.
5) Provide an overview of practical lessons for applying the PVE-method for setting up PVE-experiments in the future and to contribute towards a guideline for application of the PVE.
6) Provide input for the municipal authority of The Hague to revise their USWM-strategies based on citizen participation in the assessment of different measures.

1.5 RESEARCH QUESTIONS

The question that this research addresses is: *To what extent is the PVE-method as a participatory research tool applicable in USWM decision-making processes in the Netherlands to improve the alignment of public policies with citizens' preferences?*

The *applicability* of the PVE-method is assessed through the development of a PVE-experiment. In the PVE-experiment, the following assessment criteria are considered:

The applicability of the PVE as a means to define the utility derived from public investments:

- The quality of the representation of the municipal population in sample group
- The extent to which expectations are created for the inhabitants that can(not) be fulfilled

The applicability of the as a participatory decision-making tool at a municipal level:

- The representation of actual trade-offs in the decision-making process in the experiment
- The added value of the results to the decision-making process
- Feasibility of performing the PVE within the resource constraints of a municipal authority

The evaluation of the PVE-method by respondents:

- Positive effects of the method for respondents and/or decision-makers
- Negative effects of the method for respondents and/or decision-makers

This thesis does not aim to define which assessment criteria should be used for assessing the applicability of this method. The assessment criteria used in this research should therefore not be considered exhaustive.

The input needed for answering the research question is generated through addressing the following five sub questions:

SQ 1: Which methodological steps are needed to complete a successful Participatory Value Evaluation study?

Since no clear guideline is available on the set-up of a PVE-experiment, the first step is to determine which methodological steps should be completed in order to successfully complete a PVE-study. These steps are then taken in order to set up a PVE-experiment for the case study of USWM in The Hague.

S2: What is the design of a PVE-experiment that can be used to determine the applicability of the PVE in USWM?

The input for answering the research question is for a large part obtained through the application of the PVE-method in a The Hague USWM case study. The set-up of this experiment is key for obtaining the desired results. The design of the PVE-experiment needs to be tailored to the specific context of the case study. For the design, choices need to be made as to which measures should be included in the PVE-design, which attributes are considered in the experiment, what task is given to the respondents, how the budget is allocated, what the height of the budget is, and how the online tool should be set-up.

SQ3: What results can be obtained from the PVE-experiment in The Hague and how can these be used in the decision-making processes on USWM?

In this research, the PVE-experiment is applied for the assessment of different USWM-measures to be implemented in a neighbourhood in the municipality of The Hague. The design of and amount of response to the PVE-experiment impacts what results can be derived from the PVE-experiment. The PVE-experiment provides both quantitative and qualitative data, from which relevant insights could be derived for the decision-making process at the municipal level.

SQ4: How do respondents of the PVE-experiment in the case study of USWM in The Hague evaluate the PVE-method?

The applicability of a PVE-method is highly dependent on the response given by the citizens. If respondents don't trust the tool, they will remain sceptical of the results. If the respondents don't like the interface of the tool, they cannot make well-funded selections. If the respondents don't like the tool, they are less likely to participate in future studies. Or by contrast, the PVE-method might provide additional (un)expected benefits as a method for citizen participation. These assumptions are checked by given special attention to the way respondents of the PVE-experiment in the case study evaluate the PVE-method.

SQ5: What practical lessons can be learned from the application of the PVE-experiment in the case study of The Hague?

This final sub question is answered through providing an overview of lessons-learned from setting up the PVE-experiment, from analysing and interpreting the results, and on basis of the feedback given by the respondents in the evaluation step of the PVE-Experiment.

1.6 SCIENTIFIC RELEVANCE

The assumption that the PVE-approach might be better suitable to assess the value of public investments than using estimations based on consumer WTP has already been studied extensively (Mouter et al., 2018b). In order to overcome three limitations (hypothetical projects, restricted number of alternatives and no insights in the effects of the alternatives) of most budget allocation-studies, Mouter, Koster, Dekker, 2017 introduced the PVE-method. This thesis contributes to the scientific knowledge on the application of the PVE in three ways:

1) By performing a PVE-experiment in a case study in the context of USWM to test the applicability of the PVE in this sector. As USWM is a task of local public authorities, the capacity for generating response, internal knowledge to organise a PVE and the role of the PVE in the actual decision-making process might differ from previous applications of the PVE. Additionally, a PVE-design for the specific characteristics of USWM context is developed, providing empirical evidence on the applicability of the PVE-method.

2) By gathering user feedback through explicitly asking respondents to evaluate the PVE-method. This evaluation provides suggestions for future improvement of the PVE-method, as well as the necessary insights for the positioning of the PVE-results in the decision-making process at the municipal level. In the applications of the PVE-method to date, hardly any attention was given to the different stages of the decision-making processes within the public authorities and how/when the PVE-method is most valuable to that process.
3) By providing an overview of practical lessons learned from setting up and interpreting the PVE in the case study of The Hague. These lessons learned provide valuable input for future applications of the PVE and towards the necessary future work on the development of a clear methodological guideline for applying the PVE-method.

Additionally, the use of citizen participation in public decision-making is still something that is not fully understood. In contrast to the extensively studied formal citizen participation (elections, referenda's et cetera), the understanding of informal engagement with citizens on project bases is still in its infancy (Warren, 2009). This thesis contributes, be it only marginal, to the empirical understanding of the drivers and barriers of such participatory processes.

1.7 SOCIETAL RELEVANCE

The societal relevance of this research lies in the involvement of citizens and *end-users* in the decision-making processes on public investments by the municipality. The PVE allows actually stated preferences to be considered in the decision-making process, rather than have those preferences be estimated by experts. Public expenditures are often justified by the claim that they contribute to social welfare and have societal benefits. A better assessment of the actual value of those benefits, perceived by citizens, could help decision-makers to better allocate public funds, lead to more mutual trust between governments and citizens, and increase legitimacy of public decisions (Public Agenda, 2016).

Moreover, investments in USWM are expected to increase in the coming years, particularly now that municipalities are obliged under the 'Deltaplan Ruimtelijke Adaptatie' to perform stress tests to assess their resilience to climate change (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2017). To be able to deal with the increased frequency and intensity of extreme rain events, combinations of public and private adaptation measures need to be implemented. Involving inhabitants in the search for the most appropriate measures, will create awareness among inhabitants on the issues of superfluous water and potential measures, which can incentivize

residents to contribute to the USWM by taking measures themselves. Additionally, the participation generates support for the municipal decisions, improves the alignment of the municipal policies with citizen preferences and the mutual trust between the municipality of The Hague and its inhabitants. This thesis contributes to the evaluation of whether the PVE-method can provide these benefits by generating empirical evidence through a case study in The Hague.

1.8 STRUCTURE OF THIS MASTER THESIS

After this introduction, chapter 2 addresses the position of the PVE-method in econometric theory, before introducing the methodological framework of this research. Chapter 3 discusses the set-up of the PVE-experiment for the case study in The Hague. Consequently, chapter 4 elaborates on the results from that PVE-experiment. The conclusions are presented in chapter 5 and the discussion and suggestions for future research can be found in chapter 6.

Chapter 2:

Methodology

OUTLINE OF CHAPTER 2

This second chapter presents the methodological framework that is used throughout this research. The approach is built around the application of the PVE-method in a case study approach. Section 2.1 discusses the concepts of participatory budgeting and, more specifically, the PVE-method in the context of economic theory. The methodological framework of this thesis is introduced in section 2.2. The methodological framework is built around a case study. In the case study, a PVE-experiment is performed on USWM in The Hague (section 2.2.1) and a survey is held among the respondents of the PVE-experiment (section 2.2.2). This chapter discusses the methodological approach applied to this case study. The set-up and results of the case study are discussed in chapter 3 and 4 respectively.

2.1 EMBEDDING THE PVE-METHOD IN ECONOMIC THEORY

The PVE-method is based on the principles of participatory budgeting. In order to facilitate the interpretation of the results that follow from a PVE-experiment and the application in the decision-making processes on USWM policies, this section elaborates on the economic foundations of the PVE-method.

2.1.1 WILLINGNESS TO PAY VS WILLINGNESS TO ALLOCATE

As mentioned in section 1.2, the use of Social Cost Benefit Analyses to assess the utility of public investments has not been undisputed. This method has its roots in neoclassical economics and is based on the WTP of consumers for specific benefits (Bateman et al., 2002). The dispute mainly addresses that this WTP is not a valid indication of the value citizens derive from public goods. Nyborg (2014) points clearly that the results from a SCBA may help to gain insights into the net WTP, but should not be mistaken as a tool that indicates social welfare. The main argument against the SCBA provided for by Mouter and Chorus (2016), is that people show different behaviour as citizens or as consumers (Mouter, Van Cranenburgh, & Van Wee, 2016; Nyborg, 2014; Raybould, 2005). Someone might not present their true preferences for a public good (Musgrave & Buchanan, 1960) to prevent being charged as beneficiaries of a public good investment (Ostrom & Ostrom, 1977). Particularly as citizens have already paid taxes to fund the supply of public goods, they are expected to be less willing to contribute to investments in public goods from their consumer budgets. Thus, various researchers argue that it is better not to value governmental projects on basis of consumer behaviour (see Mouter et al. (2016) on Kelman 1981; Sagoff, 1988; Sunstein, 2005). Preferably, insights should be obtained in the way the effects of such projects are valued by citizens, rather than by consumers. Since traditional SCBA are based on consumer WTP, rather than on the preference of citizens for the allocation of a public budget (Willingness to Allocate - WTA), citizens' preferences are not properly assessed in the evaluation of public investment alternatives, which makes the application of SCBA less appropriate.

2.1.2 CONCEPT OF PARTICIPATORY BUDGETING

A different approach to determining the social desirability of a set of alternatives (Broadway and Bruce, 1984), is that of participatory budgeting. This method originated in Latin America (Cabannes, 2006) as a means to enhance social justice and democratic decision making. The concept of participatory budgeting has meanwhile evolved from an innovation in public decision-making, to a new instrument for determining economic value participants derive from various alternatives

(Aragonès & Sánchez-Pagés, 2009). The participatory budgeting approach has been applied is different settings. Walczak and Rutkowska (2017) analysed a case study in Poznan (Poland) in which citizens were asked to spend a public budget on various development projects in the area. Participatory budgeting has also been used to redistribute a share of energy (Capaccioli, Poderi, Bettega, & D'Andrea, 2017). The underlying principle of participatory budgeting is that citizens are asked to help allocate the public budget to various investment opportunities the public authorities are considering. Because respondents are asked to allocate the public budget, they actually state their WTA as citizens, and not their WTP as consumers. (Mouter et al., 2018b) place the concept of WTA as an alternative to WTP in economic theory in further detail than what is discussed in this thesis.

2.1.3 Introduction to the PVE-method

From an economic theory point of view, participatory budgeting is a better alternative for defining the social value of public investments than to base decision on consumer WTP. However, participatory processes generally are expensive, time-consuming, and are vulnerable to undesirable over- and underrepresentation of specific groups in the participants. Therefore, (Mouter, Koster and Deller (2017) have developed a participatory budgeting tool, the PVE-method, to tackle those downsides. They developed an online approach to evaluate various transport policies in the Netherlands and recently completed a study on the use of the PVE in the water safety sector. The underlying principle of the PVE, and participatory budgeting in general, is that public funds are allocated in a process which involves multiple stakeholders. Whereas traditional budgeting takes place in workshops and face-to-face discussions with stakeholders, the PVE involves an online tool in which respondents are asked to allocate the available budget to a selection of possible projects. The main advantages of the PVE compared to traditional face-to-face participation of citizens are that a larger number of respondents can be included in the analysis, that it only takes about 25 minutes to complete the PVE, and that more insights can be derived through more detailed information on the individual responses. On basis of the budget allocations, one can derive the value that is given to each project alternative. Additionally, respondents are asked to elaborate on the motives for allocating the budget in the way they did, which provides insights into the way citizens value specific project characteristics.

2.2 METHODOLOGICAL FRAMEWORK

The methodological framework for the assessment of the applicability of the PVE-method in the decision-making processes on USWM policies is built around a case study. The case study involves the application of a PVE-experiment on USWM in The Hague. Furthermore, input is gathered through an additional survey on the evaluation of the PVE-method by respondents that is held after completion of the PVE-experiment (see figure 2.2-a). The actual applicability of the PVE-method in the decision-making processes on USWM policies is determined on basis of the effect of the PVE on the assessment criteria discussed in section 1.5. An overview of the research approach, the applied methods and the relation among the research questions and the sections in this report is provided in figure 2.2-b. The case study in The Hague provides the empirical data to validate the theoretical assumptions on the applicability of the PVE-method and to learn sector specific boundaries that could drive or hamper the successful application of the PVE.

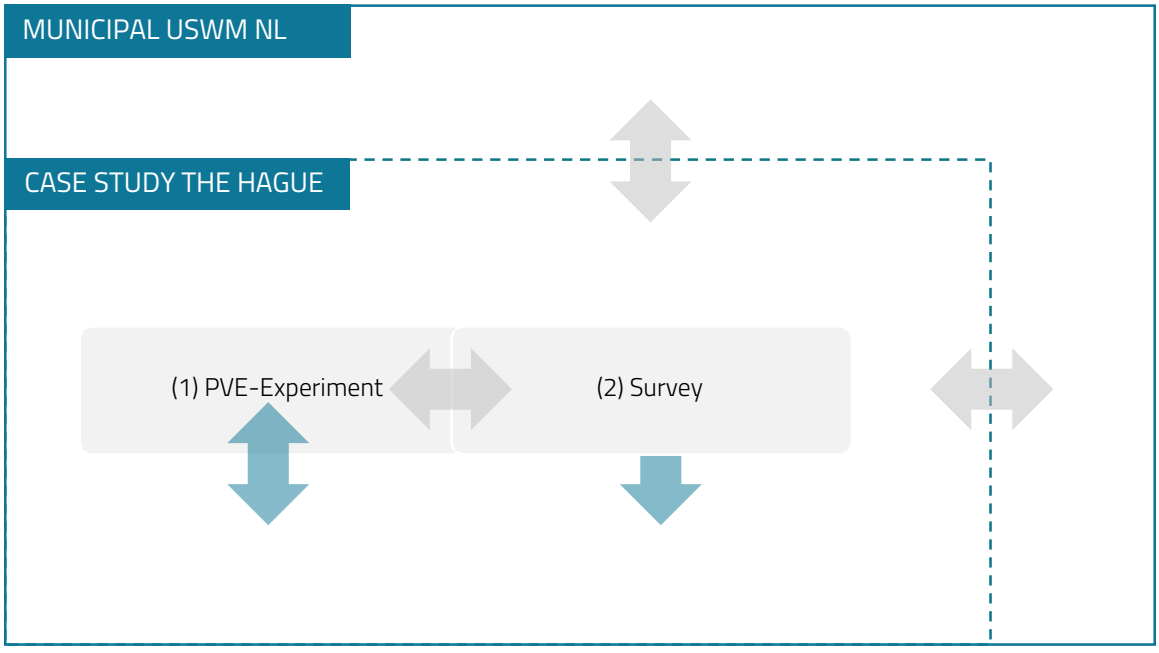


Figure 2.2-a: Methodological framework is built around a case study which consists of the actual application of the PVE and a survey.

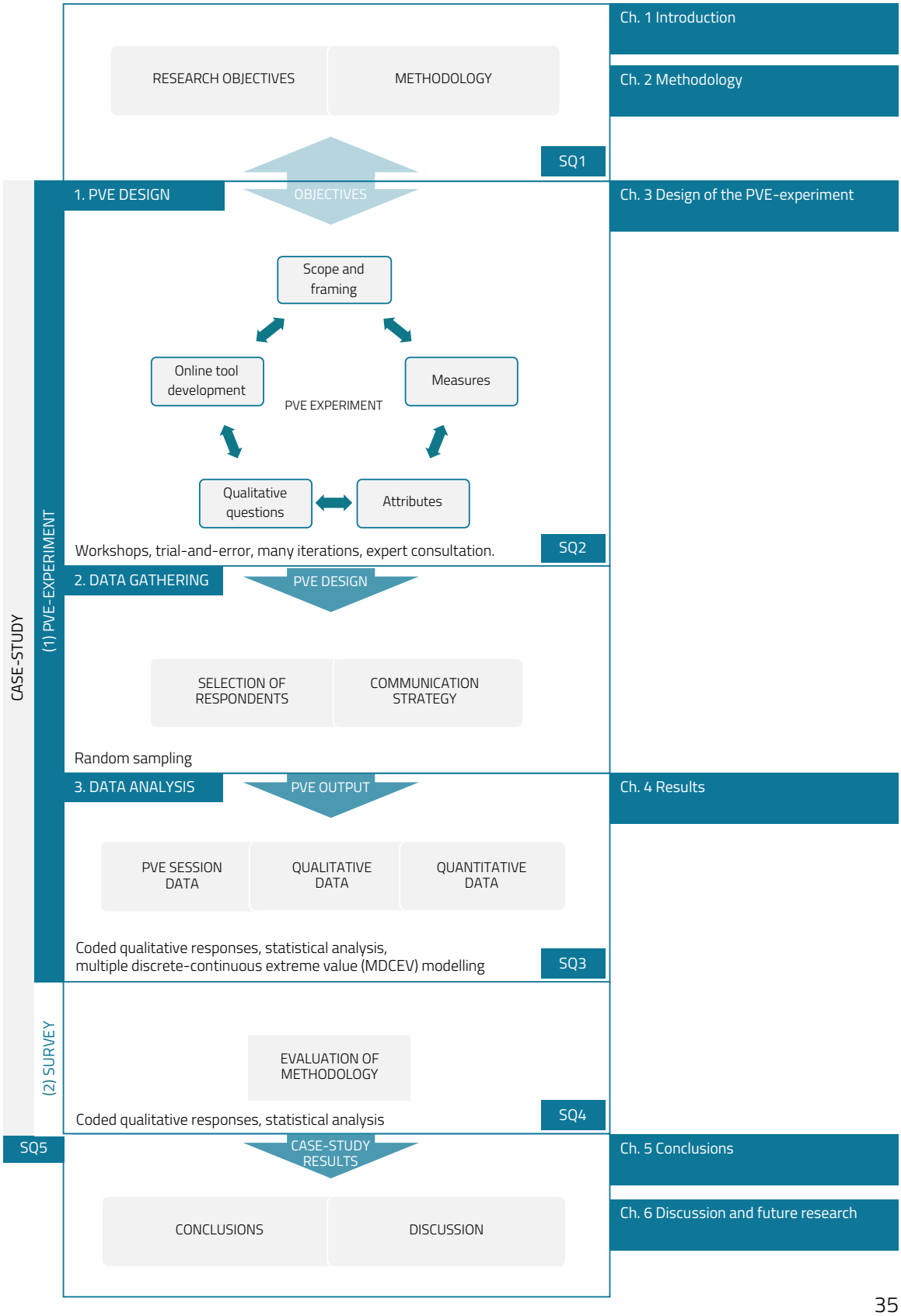


Figure 2.2-b: Methodological framework and structure of this master thesis.

2.2.1 Setting up the PVE-experiment

Performing a PVE-experiment in the field of USWM in The Hague provides the underpinning of this research. The selected approach to set up the PVE-experiment is derived from insights gathered from conference proceedings, working documents and consultation of the developers of the PVE-method. In parallel with this research, the PVE-method was also applied in two other studies which are used to benchmark the steps that should be taken to set-up a PVE-experiment, namely: A study on the participatory value evaluation of different projects for a national water management program in the Netherlands by Mouter et al. (2018); and a study on the applicability of the PVE-method in the field of energy transition in a case study in Hengstdal, the Netherlands by Pak (2018). The set-up of the PVE-experiment has been executed in three stages in consequential order: (1) Design of the PVE-experiment, (2) Data gathering; and (3) Data analysis. Designing a PVE-experiment is an iterative process of five steps that are highly interlinked. The design of the PVE follows the basic lay-out of the PVE-method and is bounded by related restrictions. Therefore, the lay-out of a typical PVE-experiment and the related restrictions are discussed first.

Lay-out of a PVE-experiment

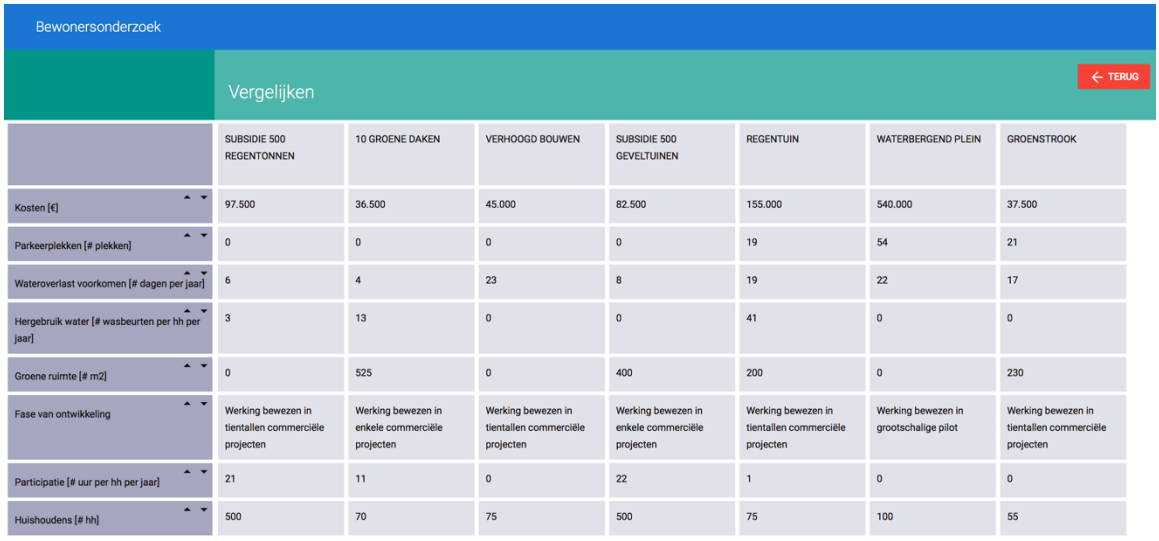
The lay-out of a PVE-experiment consists of three parts:

1) An introduction and instruction
2) The comparison matrix of attributes and measures
3) Questions on the qualitative motivations

The PVE-experiment starts with providing the relevant introduction and background information to the respondents. After the introduction and instruction, the respondents are provided with an overview of the projects they can allocate the budget to. The costs for selecting a measure needs to be covered with the given budget. Respondents are asked to select different measures that can be realised within the given budget constraint. It is important that the budget is limited, such that respondents are forced to choose between measures. To make this selection, the respondents can compare the effects of the measure on a set of attributes that is similar to all measures (see table 2.2-a and figure 2.2-c). The effect of each measure on a specific attribute varies. By varying the magnitude of the effect in different versions of the PVE, the in- or decrease of the effect on a specific attribute influences the choice behaviour of the respondents. Conclusions can only be drawn if the number of respondents that have completed a specific version is large enough to derive significant results. Respondents are provided with more descriptive background information on each of the projects, like visualisations or the location of the project.

Table 2.2-a: Simplified overview of the basis of a typical PVE design

	Project 1	Project 2	Project 3	BUDGET:
	€ XXX,-	€ YYY,-	€ ZZZ,-	€AAAA,-
Attribute 1	Effect P1 on Attribute 1	Effect P2 on Attribute 1	Effect P3 on Attribute 1	
Attribute 2	Effect P1 on Attribute 2	Effect P2 on Attribute 2	Effect P3 on Attribute 2	
Attribute 3	Effect P1 on Attribute 3	Effect P2 on Attribute 3	Effect P3 on Attribute 3	
SELECT?	YES/NO	YES/NO	YES/NO	



	SUBSIDIE 500 REGENTONNEN	10 GROENE DAKEN	VERHOOGD BOUWEN	SUBSIDIE 500 GEVELTUINEN	REGENTUIN	WATERBERGEND PLEIN	GROENSTROOK
Kosten [€]	97.500	36.500	45.000	82.500	155.000	540.000	37.500
Parkeerplekken [# plekken]	0	0	0	0	19	54	21
Wateroverlast voorkomen [# dagen per jaar]	6	4	23	8	19	22	17
Hergebruik water [# wasbeurten per hh per jaar]	3	13	0	0	41	0	0
Groene ruimte [# m2]	0	525	0	400	200	0	230
Fase van ontwikkeling	Werking bewezen in tientallen commerciële projecten	Werking bewezen in enkele commerciële projecten	Werking bewezen in tientallen commerciële projecten	Werking bewezen in enkele commerciële projecten	Werking bewezen in tientallen commerciële projecten	Werking bewezen in grootschalige pilot	Werking bewezen in tientallen commerciële projecten
Participatie [# uur per hh per jaar]	21	11	0	22	1	0	0
Huishoudens [# hh]	500	70	75	500	75	100	55

Figure 2.2-c: Overview of the comparison page in the PVE-tool used for the case study in this thesis.

After the respondent has selected the measures to be realised with the public budget according to his/her preference, the second part of the PVE-experiment is finished. In the third part, the respondents are asked to give a brief qualitative motivation for each of the selections they have made. This allows for the identification of special motivations that could not be derived by only performing the econometric choice modelling based on the selected measures. The PVE generally ends with a brief survey to fulfil specific knowledge needs. For example, respondents are asked whether they have a car as this might impact their preference for maintaining or sacrificing parking spots in favour of other benefits. This final part of the PVE is a regular survey integrated in the online environment of the PVE.

Restrictions in setting up a PVE-experiment

The PVE is restricted by the number of measures and attributes that can be included in one experiment. The human brain capacity to perform cognitive and neuropsychological processes is constrained by a limited number of variables (Halford, Baker, McCredden, & Bain, 2005). Even though the cognitive tasks that Halford et al. (2005) studied are different from the task for a respondent of a PVE-experiment, the limitation is similar. If respondents have to consider too many variables, they will not be able to make correct comparisons as they cannot oversee the total effect of their decisions. Therefore, a selection should be made of attributes and measures to be compared within this one PVE-experiment. The first step towards this selection is to determine the maximum number of attributes and measures that can be included. Ever since Stated-Choice experiments have been used as a research method, academia have been given attention to the burden these experiments place on respondent's cognitive capacity (Rose & Bliemer, 2005). Various methods have been developed to reduce task complexity per respondent, for example through *blocking* or *random assignment*. Mouter, Koster and Dekker (2017) did consider the cognitive constraint of processing large numbers of variables in earlier applications of the PVE. In the current lay-out of the PVE-tool, 10-16 projects and 6-10 attributes is the maximum number of variables that can be included in one PVE-experiment.

2.2.1.1 Phase 1: Design of a PVE-experiment

The PVE-experiment is designed through an iterative process, consisting of (1) Scoping and framing the experiment, (2) Selecting and characterising measures, (3) Selecting and characterising attributes, (4) Developing the qualitative survey and (5) Developing the online tool (see figure 2.2-d). Since no alterations can be made to the PVE-design once the data gathering has started, the design of the PVE-experiment must first be completed and thoroughly tested. This process can be lengthy, particularly if the objectives of the research are not clearly stated as then the process of converging to a final selection of measures and attributes can become challenging. Adding or removing one measure or attribute from the design has implications for the balance in the PVE-design and thus the in-/exclusion of other measures and attributes and eventually the results that follow from the PVE. If projects are funded out of different (public) budgets, they require multiple designated WTA-experiments to be performed for each of those allocated budgets (see Mouter et al., 2018).

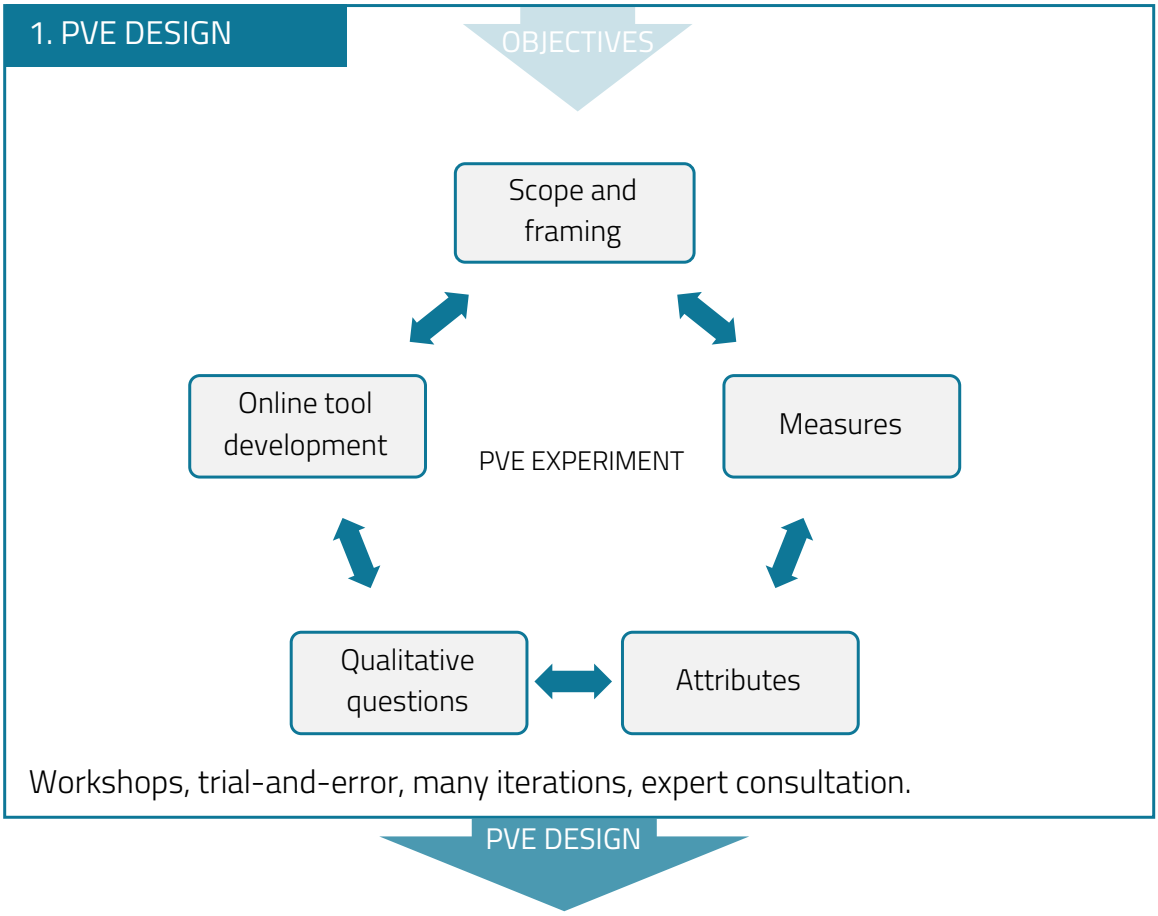


Figure 2.2-d: Steps in the PVE design process.

Throughout the design phase, literature study and workshops are the main methods that are applied. Where the literature study is focused on exploratory research and knowledge gathering, the workshops aimed at tailoring that knowledge to the context of USWM in the Netherlands. In this phase, the objectives with the PVE-experiment are defined in collaboration with project commissioners.

Literature study

Initially, a literature study focused on the different approaches in USWM, and different types of measures (grey infrastructure, green infrastructure and hybrid solutions). The Eklipse framework (Raymond et al., 2017) and CICES classification (Lara-Pulido et al., 2018) were useful starting points for further exploring the concepts of ecosystem services and co-benefits. The lists of co-benefits supplied in these frameworks are further expanded and tailored to the scale of urban water management to define a long-list of potential value defining attributes. Furthermore, the literature

study focused on identifying potential measures for climate adaptation and USWM specifically. Deltares' Adaptation Planning Support Toolbox (Voskamp & Van de Ven, 2015) and platforms like Amsterdam Rainproof (2018) and Rotterdam Climate Initiative (2018) were starting points for this research. The exploration of potential measures for USWM had a much more practical approach in comparison with the more theoretical study of types of measures and related value defining attributes. The literature study resulted in a long-list of measures for USWM and related attributes.

Workshops

Once the necessary background information is gathered, the next step is to converge that input to a selection of measures and attributes for the PVE-experiment. Workshops have played an important role in defining the design of the PVE-experiment applied in this thesis. Getting a grasp of the trade-offs present in decision-making on climate-adaptation is easier in a setting in which discussions are held between stakeholders. Therefore, three workshops have been conducted which resulted in valuable insights in the key decision-variables for selecting specific measures. The first two workshops focused on defining the relevant attributes for the case study. In a third workshop the defined attributes were validated with stakeholders involved in the recent implementation of one of the measures. The outcomes of the workshops are discussed in the appendix.

2.2.1.2 Phase 2: Data gathering

Once the design of the PVE was accurate, the next challenge was to generate enough responses to generate the needed *power* to perform the Multinomial Logit Modelling (Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996). This data gathering consists of the selection of respondents and selecting to means to reach out to these respondents (see figure 2.2-e). Just one group of respondents (the citizens of The Hague) is targeted and additional analysis is performed on the data to make sure an accurate representation of the municipal society is achieved in the final dataset. At the end of this phase, the data sets are updated with the final input for analysis and interpretation of the results. In this research, the respondents were targeted through invitation letters sent by the municipality of The Hague. Respondents were given five weeks for completion of the experiment, before the data analysis phase was initiated.

For this PVE-experiment, 5000 inhabitants (18+ years old) of the municipality of The Hague were targeted through random sampling of postal codes. There was no reference group of respondents living outside the impacted neighbourhoods in the municipality of The Hague. This is mainly because of practical issues with reaching a sufficient number of respondents to make this reference group statistically sound. Additionally, in this experiment the reference group is not very applicable, since

all measures would be taken in the municipality of The Hague and the specific neighbourhood is not specified (see chapter 3). Respondents therefore did not know whether they would be impacted or if other inhabitants of the municipality of The Hague would be impacted from a selected measure. Therefore, no reference group was needed to correct for or compare decisions taking out of self-interest rather than in the public interest.

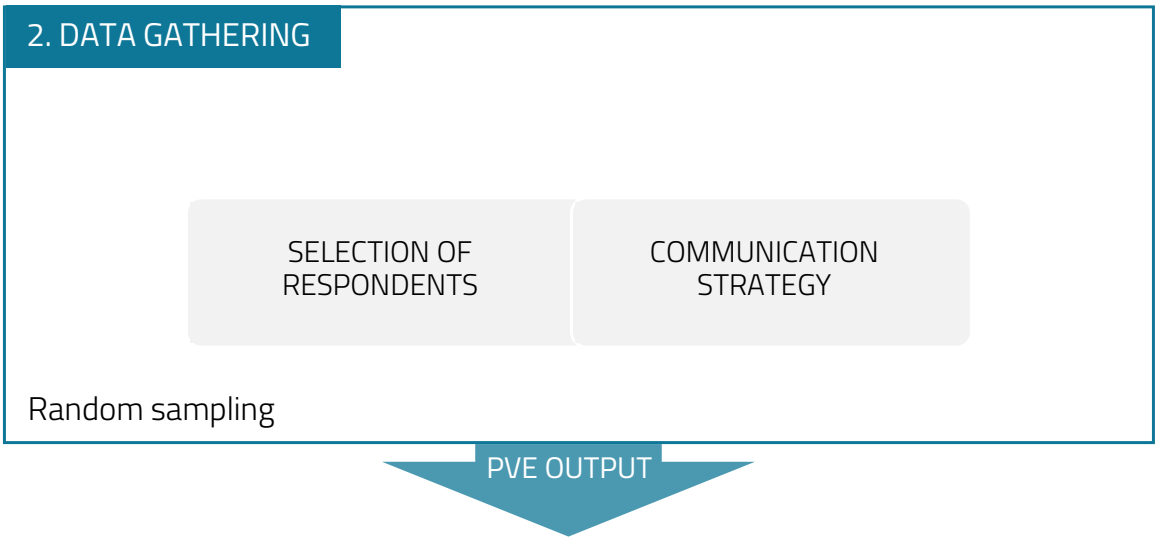


Figure 2.2-e: Steps in data gathering for PVE-experiment

2.2.1.3 Phase 3: Data analysis of results PVE-Experiment

This phase consists of the analysis and interpretation of the gathered data (see figure 2.2-f). The PVE-tool uses cookies to track user actions throughout completion of the experiment. This allows the researcher to download different data sheets that consist of all relevant information for analysis of the responses to the PVE. Three different types of analysis are applied in this research to assess the quality of the representation of the municipal population in sample group and the added value of the results to the decision-making process (see assessment criteria in section 1.5).

SPSS Descriptive statistics

First, the descriptive results of the experiment were analysed using frequency tables in SPSS. These frequencies focused on the successful response ratio and the number of times each measure was selected or not. Additionally, the sample of respondents was compared with the population in The Hague based on age, gender, household composition, income, education, tenure and current employment status to check for a fair representation of the population in the respondent group. Since the PVE is a computer-based tool, the group of elderly people was expected to be underrepresented.

Coded qualitative responses

After having selected the desired configuration of measures, respondents were asked to provide a qualitative motivation for each selection they have made. These qualitative responses have been coded in order to derive the most-frequently mentioned motivation categories. Where possible, answer categories were merged, as long as this did not cause ambiguous interpretation of the data. The same motivational categories were used in the coding of the motivation for all measures, such that a comparison can be made between the importance of a motivation for that specific measure and the number of times that motivations was mentioned in general.

Econometric choice modelling

Lastly, the version data and the selected configuration of measures have been combined into econometric choice models in order to model the utility function for each measure. For the analysis, the multiple discrete-continuous extreme value model (MDCEV) is used (Bhat, 2008). More details on this method and its applicability for the analysis of PVE results can be found in the work of (Mouter et al., 2018b, 2018a).

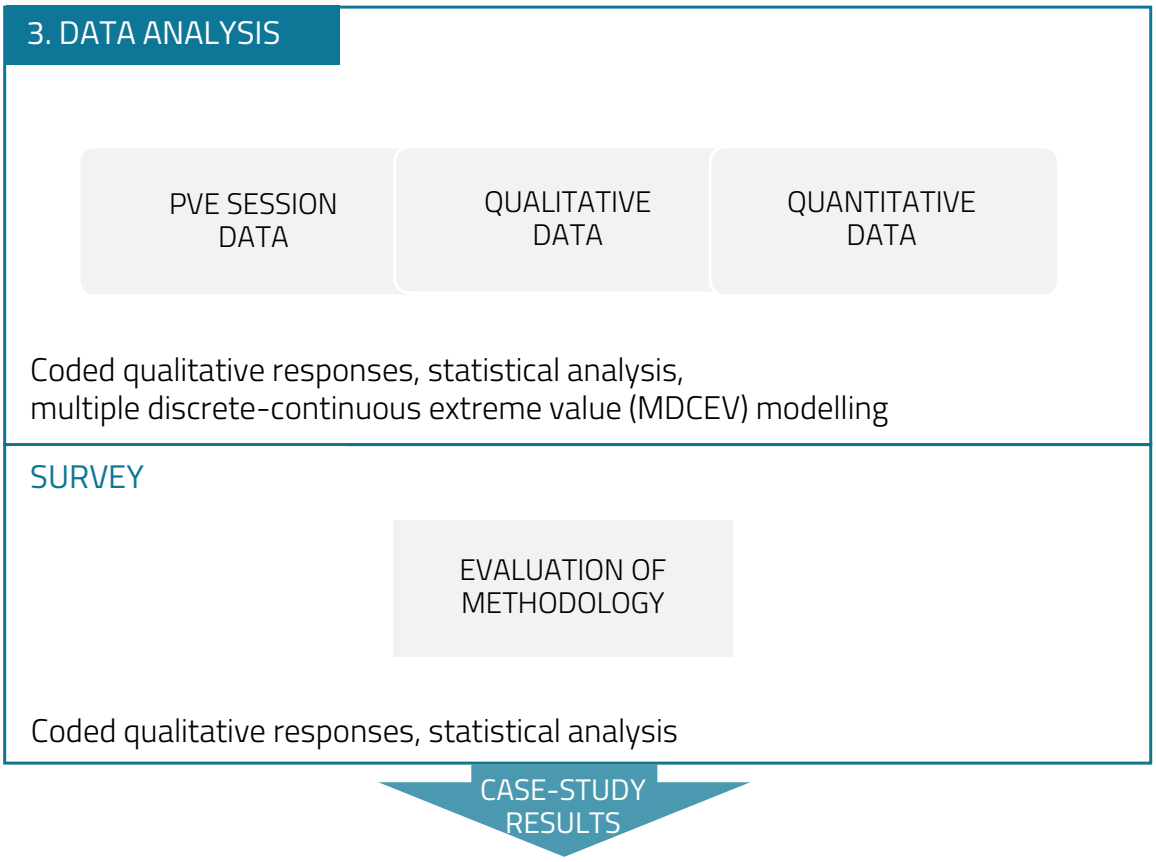


Figure 2.2-f: Steps in data analysis PVE-experiment

2.2.2 A SURVEY FOR EVALUATION OF THE PVE-METHOD

The case study not only targets to learn from the set-up and results of the PVE-method, but also provides an interesting opportunity to ask respondents to evaluate the PVE-method. The evaluation method, in the form of a survey directly after completion of the PVE, is designed to be brief, in order to reduce the task load on the respondents.

The questions in the survey are focused on gathering input on the expectations respondents have regarding the use of the results of the PVE-experiment and how they evaluate the PVE-method (see assessment criteria in section 1.5). A combination of open and multiple-choice questions is used, to allow for both quantitative assessments and qualitative assessments of the perception of citizens regarding the PVE-method and participatory processes in general. As such, some questions focused on the PVE-method specifically, while others are focused more on the generic principle of citizen participation.

The results of the survey are analysed using the same methods as were used for the analysis of the PVE-results (see section 2.2.1.3). The qualitative motivation on the open questions in the survey were analysed using a similar coding approach, except that new categories have been identified for each of these questions.

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Chapter 3:

The Hague case study

OUTLINE OF CHAPTER 3

This chapter elaborates on the case study of USWM in The Hague. Section 3.1 discusses the scope and framing of the case study. An iterative process of stakeholder consultations, workshops, literature study and testing, resulted in the selection and characterisation of eleven measures (section 3.2) and eight attributes (section 3.3). Section 3.4 discusses the data gathering approach. Section 3.5 addresses the development of the online PVE-tool. Lastly, section 3.6 describes the development of the follow-up survey that is asked respondents directly after completion of the PVE-experiment.

3.1 SCOPING AND FRAMING THE CASE STUDY

Since the results of the PVE are most useful if the responses come from one designated area (as then the sample of respondents can be compared with the population in that area and people perceive more consequential effects of their choices), the PVE-experiment was framed to target respondents in the municipality of The Hague specifically. The importance of framing in an experiment is emphasized by Kørnøv and Thissen (2000). The framing of the context of the experiment, the ordering of alternatives and specific ways of presenting the information play a role in one's judgement of a situation (Kahneman & Tversky, 1979), and thus the choice that they make based on that perception. Therefore, special attention was given to the framing of the experiment, measures and attributes. The scope of the project is a random neighbourhood in The Hague. The location is not specified, such that every respondent has the idea that their preference might actually impact the developments in their own neighbourhood as well. This enhances the perceived consequential effects of respondents, which presumably helps to raise the response rate and increases the likelihood that respondents indeed select their true preferences.

3.1.1 USWM IN THE HAGUE

Within the municipality of The Hague two policy documents play a major role in current USWM-strategies:

1) "Gemeentelijk rioleringsplan 2016-2020" (Gemeente Den Haag, 2015)
2) "Toekomstbestendig Haags Water 2015-2020 (RIS280008)" (Hoogheemraadschap van Delfland & Gemeente Den Haag, 2014)

In meetings with representatives of the municipality, it was mentioned that the current USWM-strategies are still effective. Due to the budget allocation within the municipality, there is a designated budget for installing, operating and maintaining sewer systems. Due to large sunk-cost, the singular budget allocation and effectiveness of the sewer, the municipality has no urge to change their USWM-strategies. Even though the sewer system is still the number one measure for USWM, the municipality of The Hague also actively stimulates the implementation of other climate adaptation strategies. For example, the "Operatie Steenbreek"-program tries to reduce the amount of impervious surface in the city by replacing pavements with green. Additionally, the municipality offers subsidies for the realisation of green roofs. Green roofs are typically multifunctional in their climate adaptation potential, for example because they not only create retention capacity for storm water, but also offer better insulation of roofs, stimulates biodiversity and reduces heath island effects. So even though green roofs might not be a viable alternative to the sewer system from a

singular USWM-perspective, it could be a beneficial alternative if it were to be assessed from a multi-faceted approach. This research allows the municipality to tailor their portfolio of potential measures to the needs of its inhabitants and expand their portfolio of participatory research methods. Additionally, it could be used in an internal evaluation of the current USWM-strategies and single-focused budget allocation.

3.1.2 Use of fictive projects

In this experiment, the choice was made not to work with real-life projects. First of all, since the municipality of The Hague was particularly interested in an evaluation of the applicability of the PVE-method, rather than in a value assessment of real-life projects they were planning to realise. Using real-life project could cause some issues that were undesirable. For example, using real-life projects could cause that project owners are not willing to share (sensitive) data on their projects publicly or present their own projects more advantageous than they actually are. It could also be harsh on a project owner if the results of the PVE show that citizens actually do not like the project at all. Alternatively, if a project would be selected by a majority of the respondents, it could create expectations for the actual realisation of that project. Since the municipality had no intention of implementing measures directly as a result of this research, real-life projects were only used as a basis for constructing fictive projects that cannot be led back to the real-life projects.

Secondly, rather than having the binary option to select a measure or not, this experiment allowed respondents to configure the USWM in the fictive location according to their own preferences. This meant they could select a multitude of each measure. If a real-life project with a designated geographical location would be used, it would have been harder to allow for this configuration (see figure 2.2-a). Moreover, using an undefined neighbourhood, made it possible for respondents select their ideal configuration, without having to consider location specific circumstances. This allowed for a less biased analysis of which attributes and characteristics of the measures drove respondents to select them or not. So, the data used for determining the effects of the measures on each attribute was based on ratio's derived from literature and measures implemented in real-life. The calculations used to determine the effects of the measures are discussed in greater detail in Appendix V.

A downside from not using real-life projects is that the PVE is believed to perform at best when people perceive a consequential effect of their stated preferences. In other words, if people feel like their input to the PVE might actually determine whether such project will be realized, they probably take their task as a respondent more serious, which leads to more realistic results. This consequential perception could also help tackle the so-called hypothetical bias, which refers to the

fact that people's actual behaviour can be very different from what they say they would do in fictive scenarios (Ajzen & Madden, 1986). This problem was alleviated through framing the research as an evaluation of the USWM-measures that will be included in the plans for future USWM-interventions throughout the municipality. Since respondents could not acknowledge whether they might be impacted by interventions based on their responses, the assumption is that they still perceived some consequential effect of their choices.

3.1.3 A NEIGHBOURHOOD IN THE HAGUE

A geographically undefined neighbourhood is chosen as the scope for the case study in The Hague (see figure 3.1-a). The objective is to define the ideal configuration of USWM-measure for the neighbourhood of the (near) future. The only restriction is the available budget. The following characteristics are specified for the neighbourhood:

1) Area: 100 ha. The area is based on the average neighbourhood in The Hague.
2) Population: 2750 households. Based on the average density in The Hague.
3) Household size: 2.2 people per household

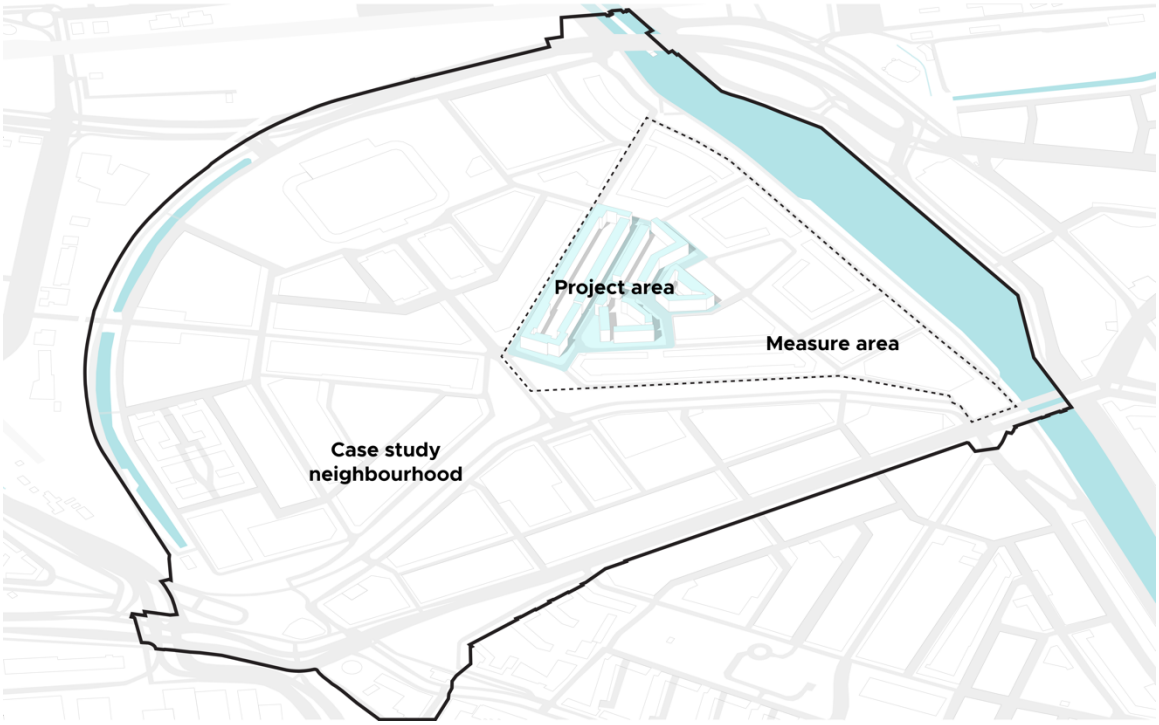

Figure 3.1-a: Visualisation of scope case study The Hague. The size of the neighbourhood is set to 100ha, hosting 2500 households. No geographical location was defined in this case study, other than that the case study is located in The Hague.

Whereas previous PVE-experiments have evaluated actual project alternatives, in this experiment different types of measures are evaluated. Additionally, respondents are given the opportunity to select a multitude of each measure, rather than the binary select /do not select option. An overview of the actual framing of the case study as presented to the respondents on the website is included in the appendix of this thesis.

3.2 MEASURES FOR USWM IN THE PVE-EXPERIMENT

In this research, the PVE is applied to assess the value citizens derive from various USWM measures. In order to produce a final design for the PVE that would generate the desired insights, within the limitation of eight attributes and sixteen measures, an iterative process was applied. The first phase focused on defining the measures and attributes that play a role when choosing for a specific measure. Moreover, in order to get a thorough understanding of the trade-offs that arise in decision-making on specific climate adaptation measures, workshops with various stakeholders were organised. Through testing with various combinations of measures and attributes, valuable insights into the feasibility, comprehensibility and applicability of those combinations were gathered. Given the interlinkages between these three approaches and interaction of stakeholders, attributes and measures, continuous iterations have been made in order to get to the final design of the PVE-experiment used in this research. The main objective of this research is to assess how citizens value different measures for USWM in The Hague. Given the constraint of task complexity mentioned in section 2.2.1, respondents cannot be asked to value all possible USWM-measures. The task at hand in this PVE-experiment is actually even more complex than the original version, since respondents not only have the binary choice to select a measure or not; they are also asked to specify how many of those measures they would implement in the neighbourhood. Therefore, the number of variables might need to be limited even further.

3.2.1 SELECTION OF MEASURES

A selection had to be made out of the long-list of measures that was identified in the exploratory phase of this research. A *program of requirements* was developed from the literature studies, workshops, research objectives and method-specific limitations and opportunities. The requirements stated in that program and how they affected the design of the PVE-experiment are discussed below.

3.2.1.1 Balancing types of measures

In the final selection a fair balance should be present between different types of measures. The typology is not explicitly stated in the experiment, nor is it communicated to the respondents in the introduction or instruction of the PVE. It has been considered to explicitly add these typologies as attributes. However, three very good reasons were identified why this was not desirable:

1) Adding the typology as an attribute would increase the task complexity for the respondents and would require them to read even more background information to be able to make informed decisions.
2) The objective is to evaluate multiple measures for USWM and evaluate those decision-variables that inhabitants value the most. Choosing between the types of measures is not a goal as such.
3) Additionally, even without explicitly stating the typology one can draw conclusions on the preferences of residents on either of the typologies, as the typology is known to the researchers. As the typology itself is not assumed to be an influential decision-variable the balance in typology is only maintained implicitly.

3.2.1.2 Participation

During the workshop with the municipality of The Hague, they showed particular interest in the willingness of inhabitants to put an effort into improving the cities climate resilience. This meant some measures needed to be included which should be operated by inhabitants themselves. Since the concept of the PVE is to allocate a public budget, and not someone own investments in USWM-measures, these measures would be offered as subsidies to inhabitants to install USWM-measures themselves.

3.2.1.3 Different scales of impact

Whether a measure can be realized on a specific project location is dependent on many variables. To make it even more complex there are hardly two identical project locations within Dutch cities. As the case study covers an entire neighbourhood, various types of measures should be included in the project. As is shown in figure 3.2-a, some of the included measures are developed subsurface, others on street level and some even on roofs. Additionally, some measures are centrally coordinated (like the sewage system), while others are local solutions, yet publicly organized (e.g. Public Rain Gardens on a square), and some other are even completely local and privately managed, like the individual water tanks.

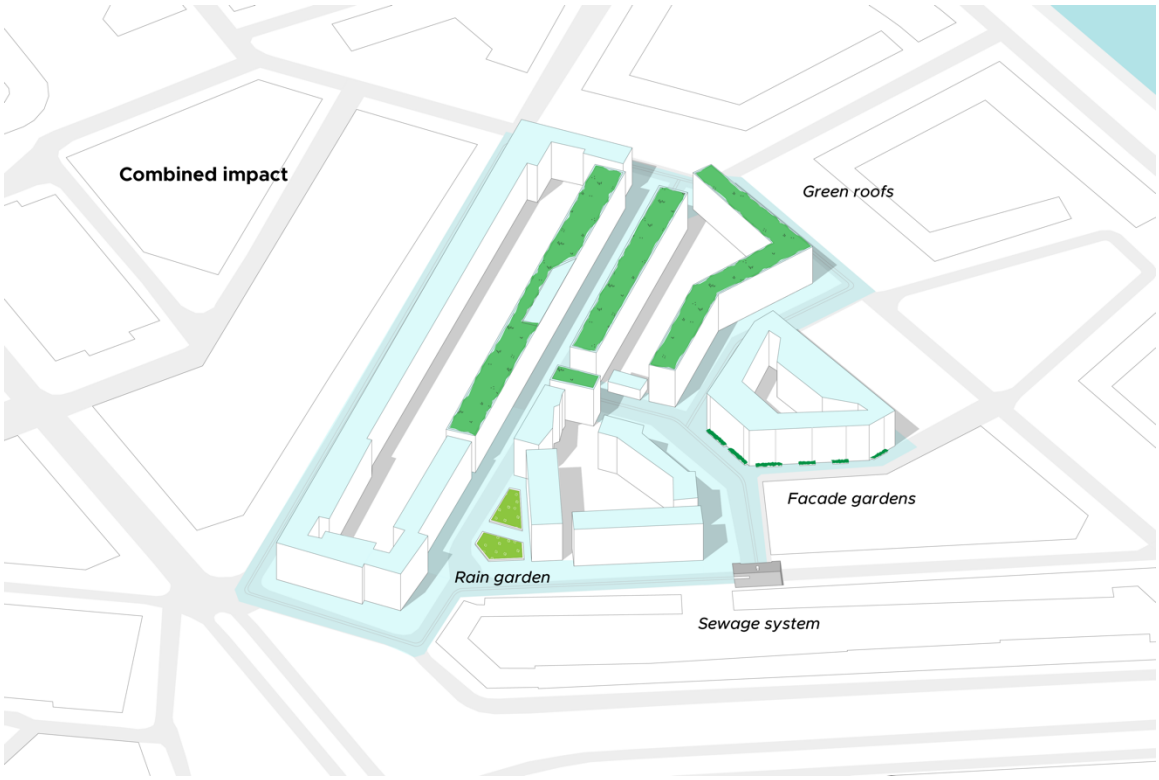

Figure 3.2-a: Visualisation of a configuration of measures in a neighbourhood. © Field Factors, Snoek, 2018

3.2.1.4 Primary function: reducing superfluous storm water

During the workshop with Field Factors, the suggestion was made to also include various measures for drought management, as some multi-functional USWM-measures do also allow for the re-use of (storm) water. However, the frame of the experiment needed to be kept simple, so only one primary function could be at the heart of the PVE. If drought management would also have been considered to be a primary function, also other measures solely focused on drought management had to be included. However, it is impossible to compare a measure for drought management and a measure for storm water discharge on similar attributes, as both challenges have very different characteristics (Merk, Saussier, Staropoli, Slack, & Kim, 2012) The re-use of storm-water was eventually included as an attribute, as then it would be a co-benefit and the problems mentioned above would not arise.

3.2.1.5 Significant effect

The measures that were included in the experiment needed to have significant capacity to have an impact on the scale of the neighbourhood. A ten-litre bucket might also be used for managing urban run-off, but that's is not the scale at which municipal decision making on USWM takes place. The individual rain tanks have long been up for debate on whether that measure meets this requirement. For some measures, the significant effect can be achieved through the large-scale implementation of the measure (Vegter & Philippart, 2016) . That is for example, why the façade gardens are sold in packages of 500 units.

3.2.1.6 Innovative measures

The last criterium was that some innovative measures needed to be included in order to test whether participants might be willing to settle more a little more uncertainty in exchange for a potential larger pay-out. Municipal investments are often said to be very safe, yet climate adaptation requires some exploration outside of the traditional paths. Therefore, the extent to which inhabitants would be willing to take those risks with a public budget could provide valuable input for internal consultation on the municipal risk management strategies.

3.2.2 CHARACTERISATION OF MEASURES

The final selection of measures consisted of 11 measures. Each measure was assigned a descriptive title, such that respondents can easily differentiate the projects on the home screen of the experiment (see figure 3.2-b).

3.2.2.1 Visualisations

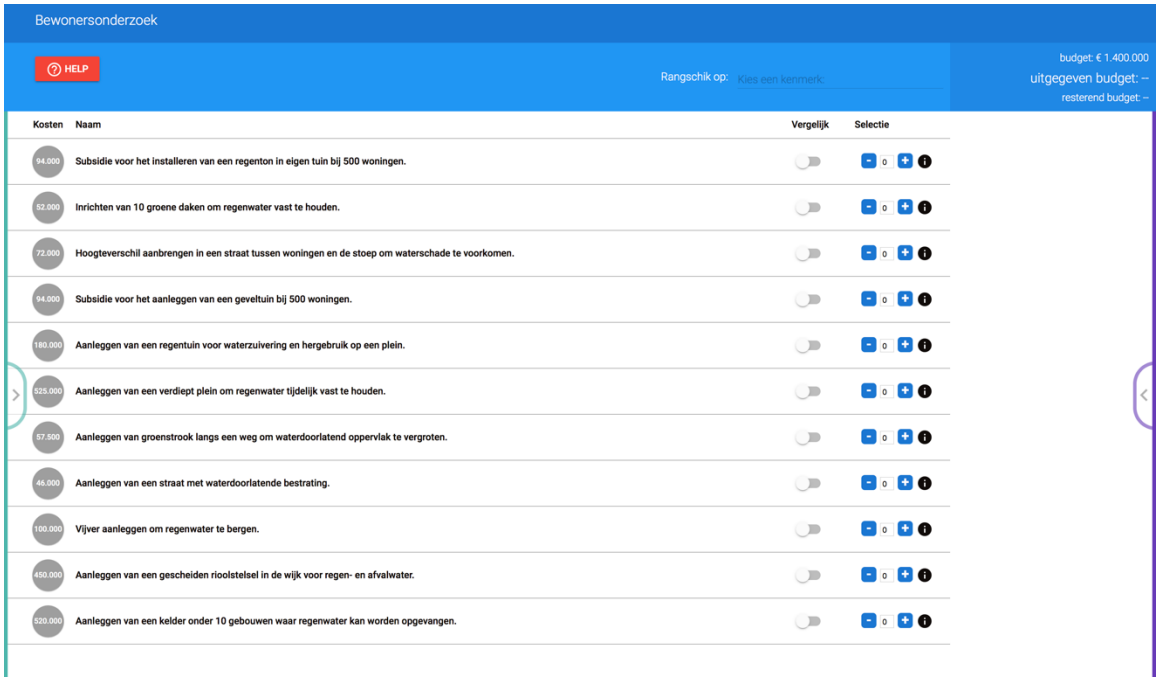

Figure 3.2-b: Screenshot of the home-screen of the experiment on the PVE-website providing an overview of all eleven measures

In order to help respondents to better understand how the solution works and what it looks like, the description of the measures was enriched by the visualisations that can be found in figure 3.2-c and figure 3.2-d. The visualisation highlights four things:

1) The catchment of the storm water
2) The retention or discharge of the storm water
3) The location in the urban setting where the solution would be implemented
4) The green space that would be added with the implementation of that measure

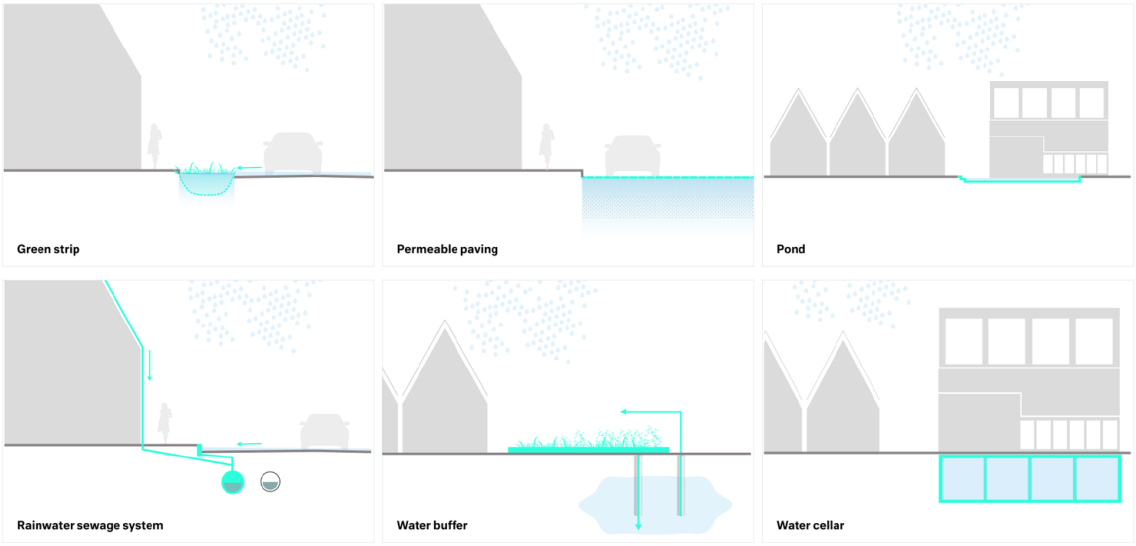

Figure 3.2-c: Visualisation of measures included in the PVE I © Field Factors, Kok & Peña, 2018

Being able to explain all those things in one overview was one of the two main reasons why a schematic visualisation was chosen over pictures of the measures. The second reason has to do with biases in interpretation form pictures. Each person who looks at a picture, focuses on other aspects and interprets the picture differently. For example, something as little as the brightness of the picture could make people love or hate the looks of a solution. Moreover, it is near to impossible to find similar quality photos of all eleven measures. Thus, in order to minimise any biases and to show the technical functioning of the systems, these visualisations were applied.

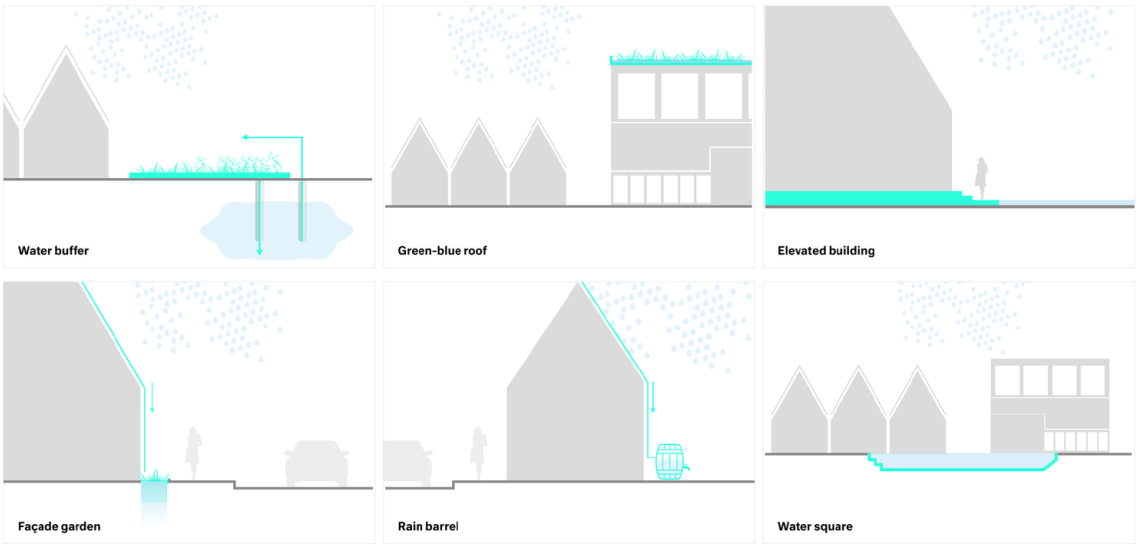

Figure 3.2-d: Visualisation of measures included in the PVE I © Field Factors, Kok & Peña, 2018

3.2.2.2 Framing

The eleven measures that were selected for the PVE were:

1) Subsidies rain tanks
2) Green roofs
3) Elevated building at street level
4) Subsidies for façade gardens
5) Water buffer / Rain Garden
6) Water square
7) Green strips
8) Permeable paving
9) Ponds
10) Separated sewer system for waste and storm water
11) Water cellar

Each of these measures had to be framed in order to scope their spatial and water managing impact. For example, the subsidies for the individual rain tanks and façade gardens would supply 500 households with a free tank or garden and the rain gardens were dimensioned at 200m2 each. The dimension of the measures was determined such that the costs and effects of the measure were in similar order of magnitude. For example, the costs of the most expensive measure should not be more than 10-12 times the costs of the cheapest measure. An overview of the full description, framing and dimensions of the measures can be found in the appendix or on the PVE-website. In those descriptions, the use of technical terms was tried to be kept at a minimum, while making sure to remain as neutral as possible in the formulations. Yet, any differentiating characteristics of the measures could be emphasized in the summary of what the measures entails.

3.3 ATTRIBUTES IN THE PVE-EXPERIMENT

The selection of attributes for the PVE-experiment is generated through a similar approach as was used for the selection of measures. A long list consisting of decision-variables related to investments in USWM, co-benefits of measures and specific points of interest were gathered through workshops, literature review and expert consultation. This led to the following criteria for selecting the attributes.

3.3.1 SELECTION CRITERIA FOR ATTRIBUTES

1) Key for the attributes is that a they represent realistic trade-offs between attributes in the decision-making processes. As such, it is not possible to solely consider co-benefits of measures as attributes (see Appendix V on workshop Field Factors).
2) Costs and the effect on reducing the risk of superfluous storm water are key attributes, given the objective of this experiment

3) The willingness of residents to actively participate in USWM themselves should be addressed. This could either be done explicitly in a follow-up question in the survey, or by including participation as an attribute in the PVE-design. The latter was chosen, to be able to analyse how important the amount of effort put in by residents themselves is considered, relative to the other attributes in the PVE-design.
4) The amount of green space was of particular interest to all and allowed for a comparison of nature-driven solutions compared to constructed grey infrastructure measures.
5) The spatial impact of the measure is what is of particular interest for the integral approach to USWM. Therefore, one attribute should be included that addresses whether the solutions impact the spatial environment aboveground and if so, it should create a trade-off with green space/recreational use.
6) Sustainability was considered to be most relevantly addressed as the ability to re-use the rainwater that is harvested by the measure. Other types of sustainability, like the materials used, are not assessed in this PVE-design.

In order to create a sufficient number of trade-offs in the PVE-design, the maturity level of the technology underlying the measures was included as well. Some innovative solutions, and most green solutions were scoring rather positive in the test-sessions, even though the effectiveness of some of those solutions cannot be guaranteed yet. This attribute helped to regain a balance in sufficient trade-offs for all measures.

The multifunctional use of the system area was also of particular interest for decision-making on USWM. However, in order to properly assess this variable, it should be specified in further detail. What functions can be combined impacts whether people would like that or not. Using the area for parking purposes is just as much multifunctional use as having a playground on the square. As the objective of this experiment was not to assess different functions of the spatial environment, this attribute was not explicitly concerned in the design of the PVE-experiment. To some extent, the multifunctional use is represented though, by the green space and parking spaces.

The last attribute (no order of importance is applied though) is the number of households impacted by each measure. This attribute was needed to address the different impact levels of the measures as was introduced in section 3.1.3.

3.3.2 Characterisation of attributes

For each of the attributes, units and indicators had to be determined. This definition was dependent on two criteria: (1) availability of data and (2) comprehensibility for the respondents. The field of

USWM is a rather technical environment, yet most respondents do not have any technical knowledge on the effects of the measures. Therefore, all attributes should be framed such that respondents can relate to it and make the corresponding trade-offs in their selections.
The following attributes and indicators were included in the PVE-design (see also Appendix III).

1) Costs [€]
2) Parking spaces [#parking spaces that is removed for the measure to be implemented]
3) Superfluous water prevented [#days of the 240 rainy days a year superfluous storm water can be prevented by the measure]
4) Re-use of storm water [#wash cycles a household can do using harvested storm water]
5) Green space [#m2 green (space that is added with the implementation of the measure]
6) Reliability [how often the effectiveness has been proven in other (pilot) projects]
7) Participation [#hours inhabitants have to spent on operation and maintenance every year]
8) Impacted households [#households that benefit from a reduced risk of superfluous water]

3.4 DEVELOPMENT OF THE ONLINE PVE-TOOL

In framing the setting of the PVE-experiment, an important consideration was to use the effect on superfluous water as a, or even as the main, constraint in the task that was given to the respondents. This idea was suggested in the workshop with the municipality of The Hague (see appendix V). However, not using the costs of the measures as the main constraint, would undermine some of the economic principles underlying the PVE-method. For example, having the costs as a regular attribute, without providing any costs constraint, would cause the same problems with cost-anchoring as contingent valuation methods (CVM) that assess WTP (McFadden & Train, 2017; Train, personal communication 15 May, 2018). It would be possible though, to use both the effect on water management and the costs of the measure as constraints. In the final design of the PVE-experiment, a *light* version of that approach was used. The effect on reducing the water-related risk was not included as a hard constraint (like a threshold that should be realised), for two reasons: (1) it would put too much emphasis on making a trade-off on costs and effectiveness against storm water, while the actual objective of this study was to assess to what extent a more integral approach to USWM would be desirable, and (2) because not considering dealing with water hindrance as a hard constraint allows to assess whether people might actually be willing to deal with some water nuisance every now and then, if that would allow for the budget to be spent differently. Therefore, the effect of the total configuration of measures on superfluous water is simplified to the number of the 240 rainy days superfluous water would still occur after realisation of the selected measures.

In the PVE-experiment applied in this research, the remaining budget is said to be saved and that a decision on the allocation of that remaining budget would be made in the future. It is expected that the allocation of the remaining budget could significantly impact the preferences stated by the respondents (Mouter, Doorn Peña & Kok, personal communication 2 May 2018; Train, personal communication 15 May 2018). For example, if the remaining budget would be transferred to a different municipality, respondents would have an incentive to spend as much of the budget as possible, even though they would not feel the measure/project is actually *worth* the extra spending. Or if the remaining budget would be allocated to road safety, respondents might be inclined not to spend anything on USWM measures, if they feel road safety is way more important. One option to resolve this problem would be to use a dynamic budget as was done in the research by (Mouter et al., 2018b). However, using a flexible budget was considered undesirable, as it would increase the task complexity with an extra variable and it could impose unwanted expectations on the municipality of The Hague, as people might perceive that it would indeed be possible in real-life to save on taxes paid to the municipality.

Since participation is on complete voluntary basis (no compensation of any kind was offered in exchange for participating), the option to delegate the decision to experts or other participants was not offered in this PVE-experiment. This option to delegate has been used in other PVE experiment in which respondents earn money/credits for filling out the questionnaire. If people would delegate their decision in those experiments, their financial/credit compensation would be lower than if they had completed the entire experiment themselves. Since this trade-off is absent in case of complete voluntary basis, delegating the decision would not provide the desired insights in the WTP for a specialist to make the decision for you. Therefore, it was decided not to provide the delegation option, in order to stimulate respondents to complete the entire experiment themselves

The specific task and context of the PVE-experiment required the following adjustments to be made to the PVE-tool:

1) The use of the PVE as a configuration tool, which required the tool to be adjusted with the possibility to select a multitude of each measure. The reasons for including the option to select a measure multiple times were already discussed in section 2.
2) The use of an undefined project location, instead of real-life project plans with a designated geographical location. Again, the motivations for this alteration are discussed in section 2.
3) The option to delegate the task to an expert or to the representation of the population, as was applied by Mouter et al. (2018), is not included in this PVE-experiment. The design of the PVE for USWM would have improved if the option to delegate the decision to an expert was be included. Particularly, as this resolves some of the problems related to the complexity of the task for respondents. However, this option is less useful, if there is no trade-off for respondents in their decision to delegate. In the PVE-experiment used by Mouter, Koster, Dekker and Borst (2018), the respondents would earn less NIPO points (rewards for participating in research studies) if they delegated the decision to an expert or to a reference group. That specific trade-off is not applicable if targeted respondents are inhabitants of a municipality that are asked to participate voluntarily. An exploration of other trade-offs that could be created for delegating a decision, did lead to satisfactory options.
4) The use of a fixed, rather than a flexible budget as mentioned above.
5) The cumulative reporting of the effects of the selection in the tool, with special attention given to the effect on the attribute Superfluous water as mentioned above.
6) The use of subsidies to include privately operated measures in the allocation of a public budget. Including measures that would be privately owned/operated was desirable as this allows to measure the willingness of citizens to actively participate in USWM themselves. However, private investments cannot be considered in an experiment on how to spent a public budget. As the municipality already offers subsidies for green roods, this same approach was used to frame the rain tanks and façade gardens as subsidised measures.

3.5 FOLLOW-UP SURVEY

In addition to the task of selecting the advised configuration of USWM-measures, the respondents are also asked to answer some additional questions in a survey that was included in the online PVE-tool. The follow-up survey was designed with four objectives in mind. This section discusses how these objectives were translated into the composition of the survey. The survey itself is presented in appendix IV. The objectives of the survey are:

1) To gather input on the qualitative motivations of the respondents for selecting the measures in their configuration.
2) To gather input to assess the quality of the representation of the population of The Hague in the sample group.
3) To collect data on factors that are expected to influence respondents' choice behaviour.
4) To receive an evaluation the PVE-method and participatory decision-making in general.

To achieve the **first** objective, the respondents were asked to supply a qualitative motivation for selecting each of the measures they had just advised the municipality to implement. This qualitative assessment is a standard integration of the PVE-tool. As such, the tool was able to tailor these questions to show only questions regarding the measures that were included in the configuration that selected by the respondents. The questions were asked after completion of the experiment itself, so respondents didn't have the opportunity to re-adjust their selection afterwards.

The **second** objective required personal questions to be included in the survey, as no information on the respondents was known in advance. It was chosen to ask basic demographic characteristics like age, income, work situation, level of education, household composition and gender. Additionally, the respondents were asked to supply their postal codes and were asked to supply their email address in case they wanted to be updated on the developments of this research.

The **third** objective was achieved through asking the respondents, in addition to the demographic characteristics, whether they have a car and whether they live in an owner-occupied or rented dwelling. These questions are particularly interesting, because they are expected to have a strong relation with people's choice behaviour. For example, one of the attributes in the PVE-design is the number of parking spaces that should be sacrificed to allow for the measure to be implemented. It is assumed that whether people have a car themselves, could affect their willingness to sacrifice parking places for USWM-measures. Similarly, owner occupied have shown to be more involved in

the development of their neighbourhood, because they have a direct interest in the implementation of projects in the area as they might affect the property value of their dwellings (Kleinhans, 2013). For example, a subsidy for a façade garden might be less interesting for a renting-resident than for an owner occupier.

Lastly, a brief evaluation of the PVE-method is asked from the respondents to achieve objective four. They received multiple choice questions regarding the need for participatory decision-making in general and their perception of the capabilities of citizens to make well-informed decisions on public investments. Additionally, open questions are used to ask citizens to mention how they expect the results will be used by the municipality, what they liked about the PVE-method and what they would like to see differently about the PVE-method.

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Chapter 4:

Results of the PVE-experiment on USWM in the case study of The Hague

OUTLINE OF CHAPTER 4

This chapter presents the results from the PVE-experiment on USWM in The Hague and discusses the implications from these results for the applicability of the PVE-method in USWM decision-making. Section 4.1 starts with providing the descriptive statistics of the PVE-experiment. Section 4.2 discusses the quantitative results of the experiment. Section 4.3 focuses on the qualitative motivations supplied by respondents. Lastly, section 4.4 addresses how respondents evaluate the PVE-method.

4.1 DESCRIPTIVE STATISTICS

4.1.1 RESPONSE RATIO

Sessions	Quantity
Active	524
Finished	149
Delegated	0

On July 2nd 2018 exactly 5000 inhabitants of the municipality of The Hague received a letter (see appendix 1) in which they were invited to participate in this PVE-experiment. The numbers on the response ratio presented in this paragraph were downloaded on August 14st 2018. In the six weeks respondents could participate, the website of the PVE-experiment was visited 673 times. Those 673 visits, resulted in 149 fully completed experiments. Thus, the 5000 invitations resulted in a 3,0% successful response ratio (=149/5000). Out of the 149 registered completed experiments, two sessions had to be discarded because they were used for verification and validation purposes. Additionally, a completed registration does not mean that the respondents completed all the tasks properly. The session was labelled *finished* if the respondent ended-up on the last page of the experiment. Some respondents did end-up there, without supplying any response to the qualitative motivations of their selection and/or the survey. Since all but one of the 147 completed sessions did however meet the set requirements of a valid response (provided a configuration of selected measures, session time should not be unrealistically short, email-addresses should not overlap and no postal codes should be overrepresented) 146 sessions were included in the final data set. The dataset used for the analysis in this thesis was exported from the website on August 14th 2018. Missing values are treated differently per variable in this dataset. Therefore, it could be that some results show different sample sizes.

4.1.1.1 Received emails

Out of the 5000 targeted respondents, ten emails were received on the account supplied in the letter. Six of those reported an error in finding the correct website. The majority of those errors were resolved by using the https://bewonderzoek.nl - link, rather than the www.bewonderzoek.nl – link. This problem is probably related to security settings in the browsers that were used. One respondent that ran into this problem, opted-out anyway because of "*a lack of knowledge on the topic".* One respondent had other problems with the website and decided not to pursue participation in this experiment any longer, after various attempts of solving the problem had failed. This respondent did supply thoughts regarding USWM in a brief interview over the phone, however these responses were not considered in the current analysis. Two people send an email to say they would not participate. One was not interested in participating and wanted to tell, *"so you could invite someone*

else to participate". The other decided not to participate after reading the introduction, because *"it is not justified to say that extreme rain showers are the result of climate change, without any scientific substantiation."* One email was only to ask in the third week whether participation was still possible, this person did indeed complete the experiment afterwards. The last email was a request for assistance in completing the PVE, because this person could not operate a computer properly, yet wanted to participate. A meeting with this person was held on August 1st 2018 to assist in completing the PVE-experiment.

4.1.1.2 Validating responses

Unfortunately, due to the new European privacy regulation, it was not possible to retrieve the IP-addresses of the respondents, which makes the validation of the responses of the responses a bit more difficult. As it is possible, to complete the experiment multiple times as a person, a check on mis-use of this functionality is needed. As mentioned in section 4.1.1 four criteria are used to validate the response.

1) a configuration of selected measures had to be provided
2) the session time should not be unrealistically short
3) email-addresses should not overlap
4) no postal codes should be overrepresented in the sample
5)

The first criterium was met by all the finished responses. One respondent showed an odd configuration consisting of only 31 green roofs, yet that is a valid configuration that resulted from a 40-minute session, in which all follow-up questions were answered as well. As such, there was no need to exclude this response. Moreover, multiple people showed to select larger amounts of the green roof measure.

The session time was tracked by the PVE-tool. This allowed to see the interval times in between every action a respondent took on the website. For now, only the total session time is considered in the assessment of the validity of the response. A summary of the grouped session times of the respondents is presented in figure 4.1-a. The average session time was 24 minutes, even though three respondents took up to about 1,5-2 hours to complete the experiment. Four respondents commented it took long to complete the experiment, see section 4.4.6. Two completed the experiment in 24, 39 and 40 minutes, which explains their perception of a long experiment. One replied the experiment took too long, even though that respondent had a session time of only six minutes.

Out of the 146 responses, 84 supplied their email-address for future contact. No double entries of email addresses were found. It is not a very solid check for fraudulent use of the website, as

someone who would have bad intentions would probably be so wise not to supply the same email address. However, is does filter for people who wanted to update previous responses. Anyway, no reasons were found to exclude any cases.

Lastly, the postal codes were checked for overrepresentation. No double entries of postal codes were found when the full postal codes (incl. letters were assessed). Some overlap of numbers in the postcode did occur, but nothing exceptional. Only 16 entries did not supply their postal code. No entries were excluded on basis of the postal code. The 146 cases are considered valid. If more data would have been gathered, it could be argued that only fully completed cases should be included in the data set. Within this research, such exclusion criterium is not applied to maintain a sufficient level of response. The exclusion of cases on basis of missing values was decided upon per question.

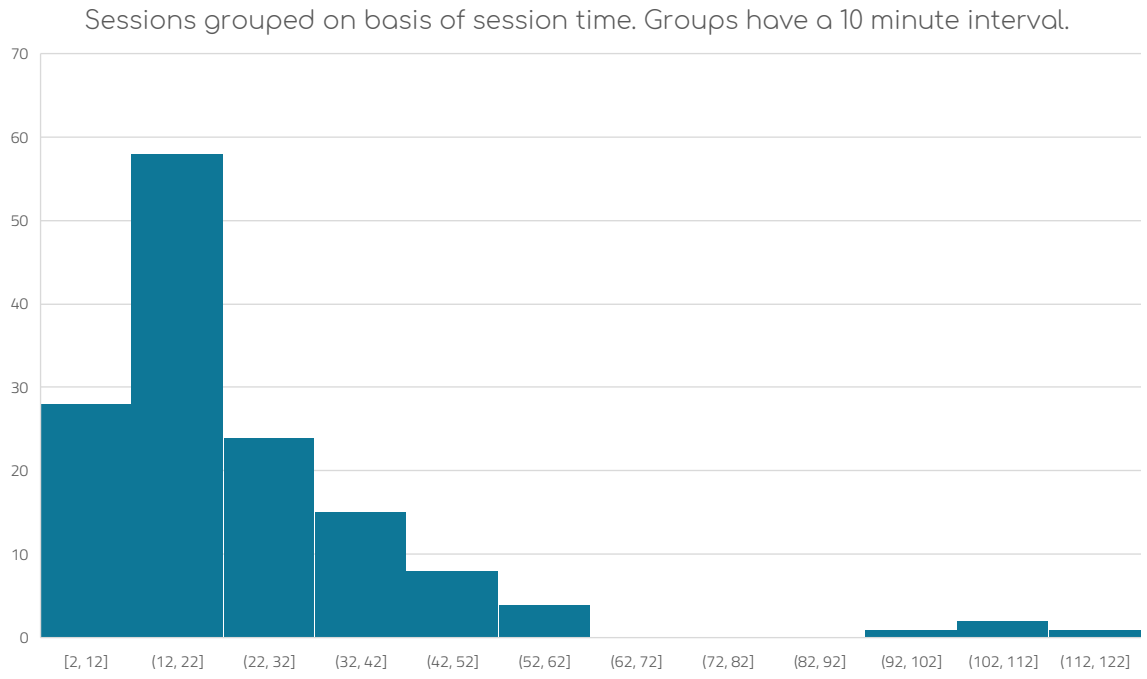

Figure 4.1-a: Sessions times of completed responses in the PVE-experiment. Average session time (n=146) is 24 minutes.

4.1.2 Validation of sample with population data

The objective of participatory research is to include the preferences of citizens in decision-making processes. Particularly, if the participation is aimed at understanding the desires of a specific target group, it is crucial to test whether the sample of the experiment properly represents the targeted population. This section describes the analysis of how well the sample of respondents in the PVE-

experiments represents the entire population of inhabitants of the municipality of The Hague. This analysis is performed by comparing demographic statistics gathered in the PVE, with statistics on the population of the municipality of The Hague. These statistics are derived from the Den Haag Buurtmonitor (Gemeente Den Haag, n.d.).

4.1.2.1 Age

The first demographic characteristics that is used to validate the sample as a valid representation of the population in The Hague is age. In the PVE, respondents were asked to provide their year of birth. Over 86% (n=127/139) of the respondents provided this information. Figure 4.1-b shows the proportional representation of the age groups in both the sample group and the actual population. The years of birth were coded in order to match the grouping applied in the Buurtmonitor data. Three conclusions follow result from the analysis:

1) Only inhabitants of 18+ were eligible to be selected in the random sampling of addresses. Despite not being able to address respondents personally, indeed no underaged respondents completed the experiment. The age limit was set at 18, as this is also the age at which Dutch inhabitants become eligible to vote in elections.
2) The distribution shows that the age-group of 45-64 years is overrepresented in the sample group. Even though the distribution in general seems to follow the distribution of age groups in the population quite well, the data also provides grounds to assume that younger inhabitants (<45) do not participate as much as older inhabitants (45+). Potentially given in by the fact that people in this older age group have more time to participate than young parents or career starters in their 20's and 30's. An analysis with narrower boundaries of each age group would be needed to test this hypothesis. In figure 7.2-b an overview of the age of all the respondents in the PVE. These results show indeed that only 8 respondents under the age of thirty have completed the PVE and that the average age of the respondents is rather high at almost 52 years old.
3) The assumption that elderly people might be underrepresented in the sample group, because the experiment is hosted online, is only partially true. Indeed, there is only one respondent in the category 80+yrs . However, this groups also represents just a small share in the actual population of The Hague. The age group op 65-79yrs is well represented, if not slightly overrepresented in the sample group.

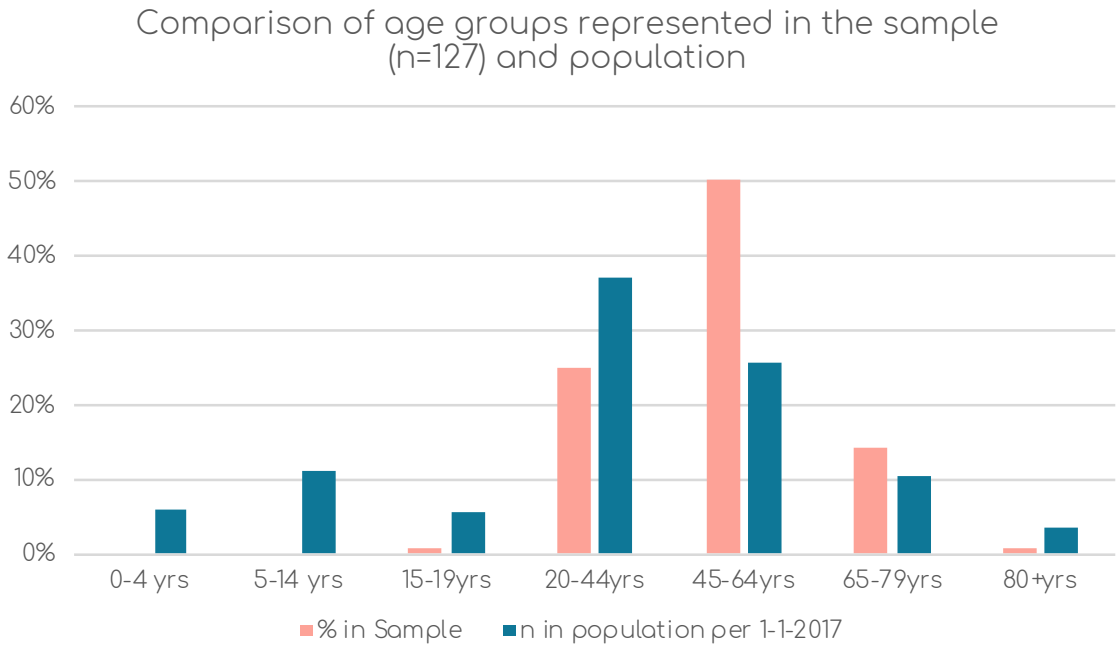

Figure 4. 1-b: Comparison of age group representation in both sample and population data.

The age distribution within the sample group is also reported individually in figure 4.1-c. This distribution shows that the remarkable result that the one respondent in de 80+ category said to be 103 years old. Other than this unexpected outlier, the distribution illustrates that particularly people <30 years old are underrepresented in the sample group. The average age of the sample group is therefore rather high at 51,7%. Based on the results, it is concluded that the PVE does allow for the inclusion of representatives from all age-groups in the participatory research. However, further research is needed to validate the underrepresentation of young adults.

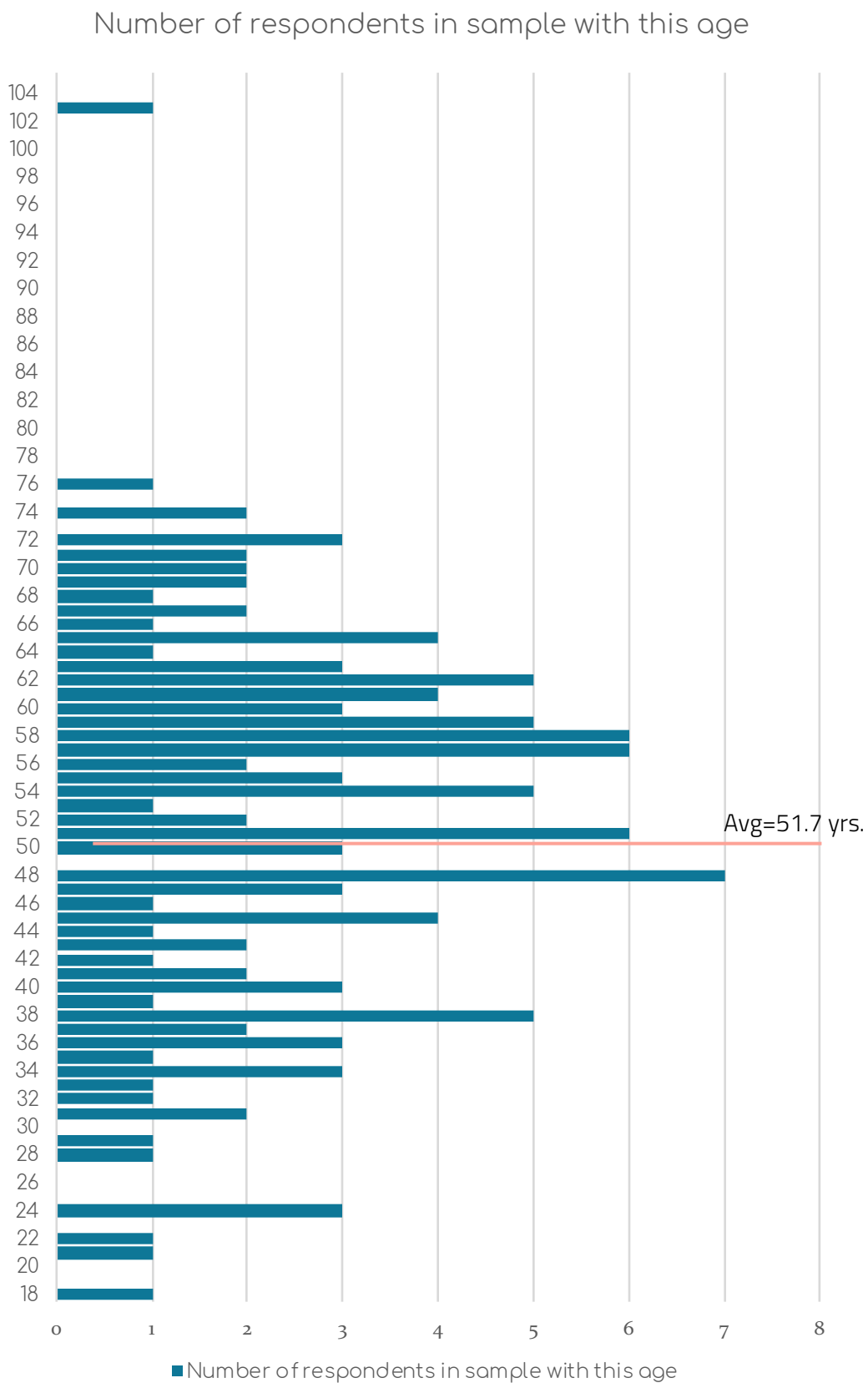

Figure 4. 1-c: Number of respondents with a specific age in sample.

4.1.2.2 Income

To be able to compare the income of respondents with the distribution of income in the population, some recoding had to be performed. In the Buurtmonitor a distinction is made between three income categories: low, medium and high. The answer categories offered in the PVE were split in four monetary and one other category, Therefore, the responses in the PVE had to be recoded. Since only information is provided on the lower and upper boundaries of the income, the responses could not be recoded into exactly similar bandwidths. Thus, for pragmatic reasons the answer categories were translated in to low, medium and high classes, based on the distribution supplied in table 4.1-a.

Table 4.1-a: Recoding structure for income groups

	Bandwidth in PVE	Recoded into Buurtmonitor category	Bandwidth in Buurtmonitor
Cat 1	< €20.000 a year	Low	<€25.700
Cat 2	€20.000-50.000 a year	Medium	€25.700-€47.900
Cat 3	€50.000-80.000 a year	High	>€47.900
Cat 4	>€80.000 a year		
Cat 5	Prefer not to supply this info	n.a.	n.a.

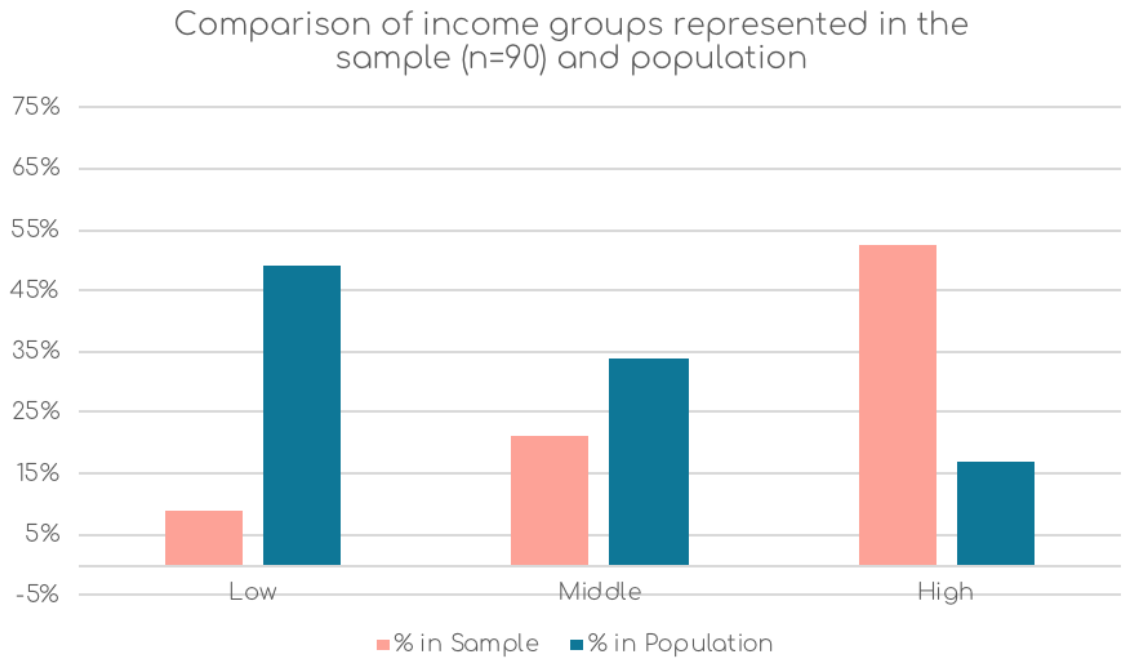

Figure 4.1-d: Comparison of income groups represented in the sample (n=90) and the population in The Hague.

The results of the analysis are presented in figure 4.1-d. There is a clear mismatch between the income groups present in the sample data and present within the population of residents in the municipality of The Hague. Higher incomes are overrepresented in the sample data, while low-income groups are largely underrepresented. These results could support the assumption that young people might be less-involved with this participatory study than older people, as in general a persons' income increases as they get older, or could be a result of overrepresentation of higher-educated inhabitants in the sample group.

4.1.2.3 Education

The sample seems to consist of very well-educated respondents (see figure 4.1-e). The results are in line with the data on the income of the sample population, as higher educated people, generally have higher incomes. More importantly though, these results implicate that the sample might not be a valid representation of the population in The Hague. One feasible, yet alarming explanation for this overrepresentation of highly-educated peoples would be that the task given to respondents in the PVE might be too hard. The capacity of the human brain to process a maximum number of values at a time has already been mentioned in section 2.2.1. In section 3.1, the need for simplistic description of the measures and attributes was discussed in order to make the experiment and task comprehensible for all respondents. It could be, that despite these attempts, the PVE was still too complex for some people. This assumption is also shared by some of the respondents themselves, given some responses to the qualitative questions in the survey. For example, someone mentioned: "*I think this experiment might be too hard for some people*." Another respondent said: "*I do not know whether this matter can even be made any more simplistic, but I suspect that low-educated people drop out earlier. Perhaps a physical / practical version can help with this digital version. Their opinion is just as important!".* However, if indeed like this person said: "*many people would be put off by the large amount of data and variables of the various solutions"*, then the lower educated people should at least have visited the website to be confronted with the task-complexity. Unfortunately, no personal characteristics are collected in the uncompleted sessions on the website, and thus it cannot be checked whether the group of lower-educated people have indeed a higher drop-out rate on the website. Alternatively, lower-educated people either may not have a need to participate themselves, or they might have been put off by the topic or the style of the invitation letter. Since not enough information is available to draw any conclusions on that for now, further research is needed to examine what caused the underrepresented of lower-educated people, in order to make future samples better represent the actual society.

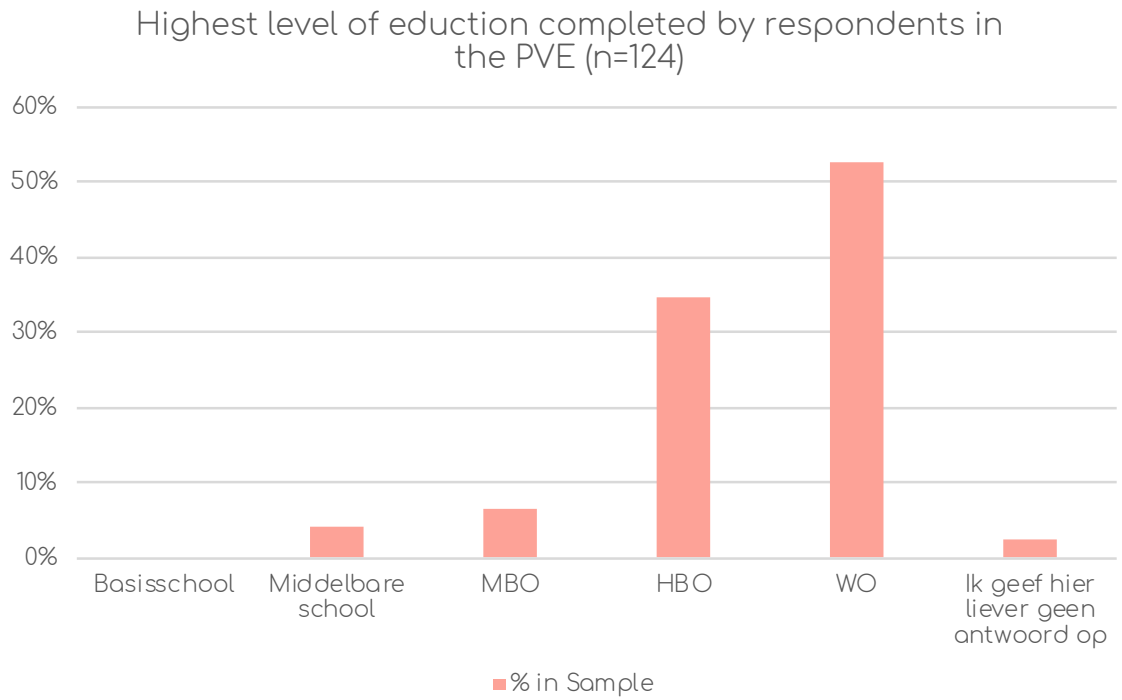

Figure 4.1-e: The highest level of education completed by respondents in the sample

4.1.2.4 Gender

The gender share in the experiment is slightly off from reality, as male respondents are highly overrepresented (63% male, 37% female, see figure 4.1-f). This overrepresentation of male respondents was also found in previous applications of the PVE (Mouter et al. (2018b) found 55% male vs. 45% female, and 56% male vs. 44% female in their two experiments). The fact this effect is seen in all three applications op the PVE, raises question as to why male respondents would be more inclined to participate than females. What affects the desire to participate and how is that different between male and female targeted respondents. Moreover, the first question that should be addressed is does it even make a difference? Would gender differences affect any choices made throughout the experiment? As a starting point for a more thorough analysis of the effects of gender on the response to the PVE, the (binary) selection of measures by both gender groups has been assessed.

A chi-square test of independence was performed to examine the relation between gender and the (non)selection of each measure (see section 4.2). No significant ($p<0.05$) relation between the measure selection and gender of the respondents was found. These results steer to the hypotheses that gender does not affect the response to a PVE-experiment. However, as the impact of gender on the response to other questions in the PVE-experiment has not been studied, it is too soon to accept this hypothesis.

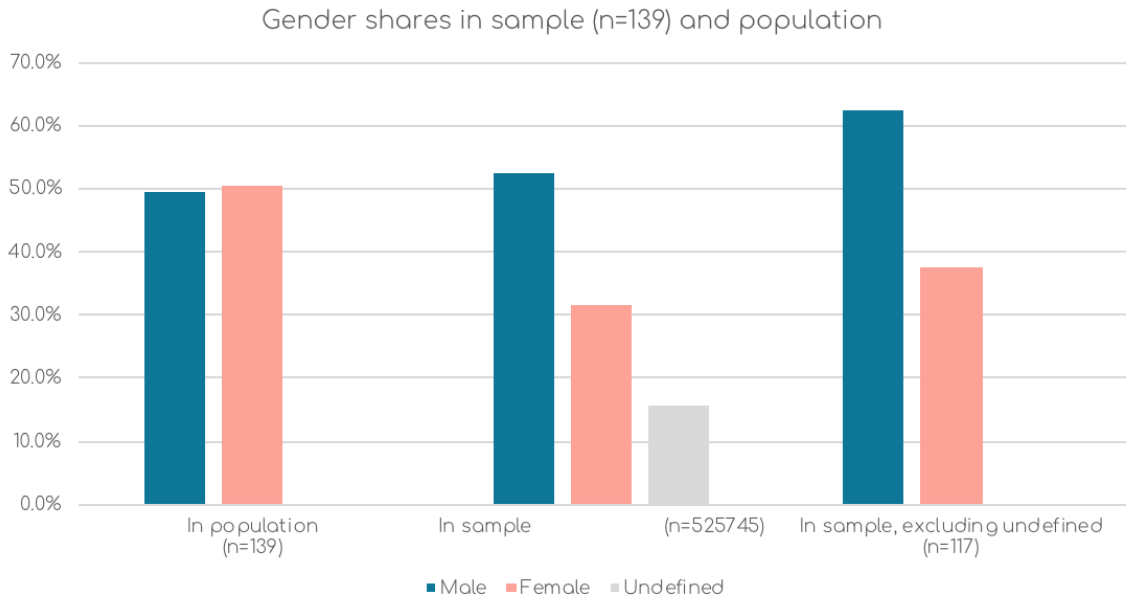

Figure 4.1-f: Gender shares in sample data and population

In figure 4.1-g the population pyramid for the sample group is presented. This diagram shows the distribution of gender and age within the population. The distribution of gender per age groups appears to be evenly spread, except for some more male respondents in the pensioners age groups.

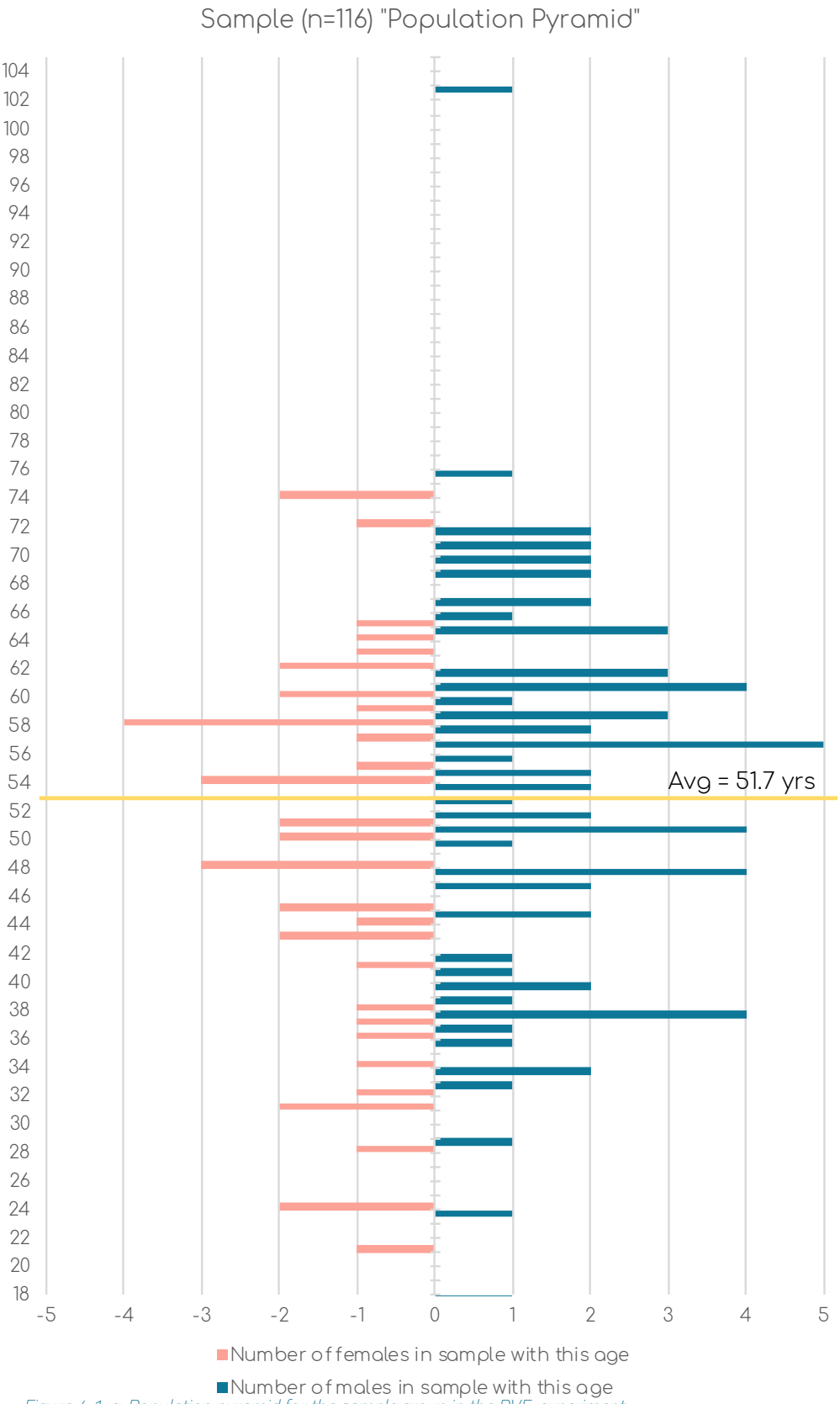

Figure 4. 1-g: Population pyramid for the sample group in the PVE-experiment

4.1.2.5 Household characteristics

Lastly, this section shows the statistics on car-ownership and tenure type. As discussed in section 3.6, the questions regarding car ownership and type of tenure are asked specifically to allow a comparison of the importance given by these groups to specific attributes. As the number of parking spots is one of the attributes, it is interesting to see whether any differences arise in the importance of that attribute for people that do and those that do not own a car. The tenure type is particularly interesting to compare with the importance given to subsidised measures.

CAR

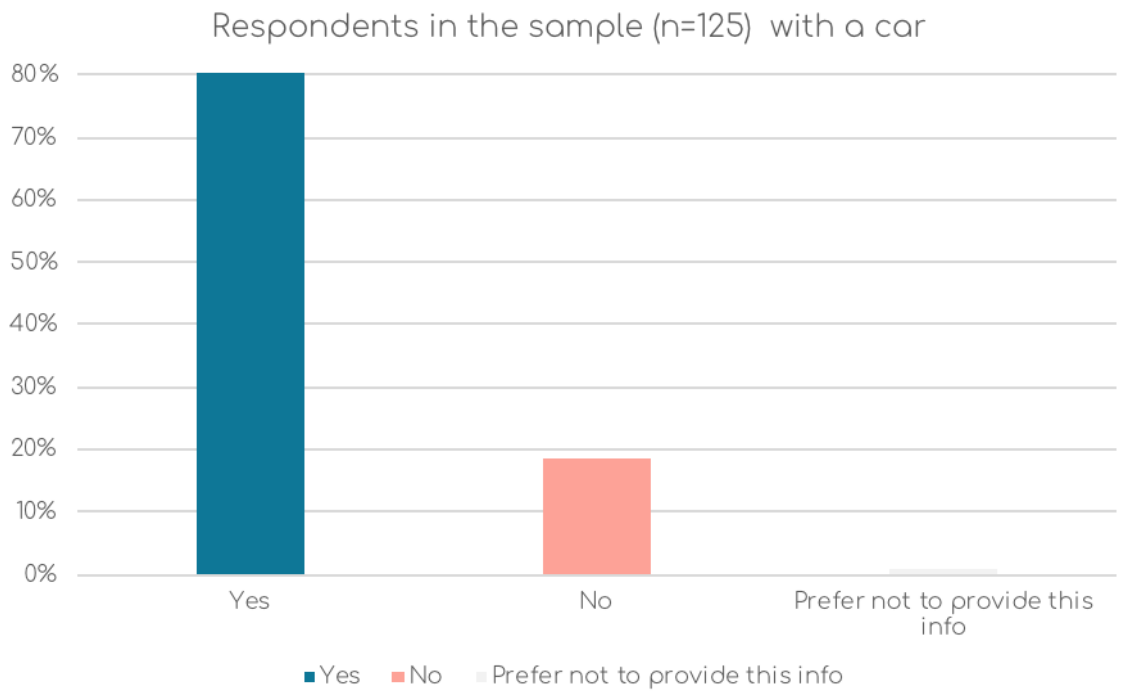

Figure 4.1-h: Car ownership within the sample group

The majority (80%) of the respondents stated to have a car (see figure 4.1-h). This number is high, if it is compared with the individual car ownership ratio (55%) according to the CBS (Kampert, Nijenhuis, Van der Spoel, & Molnár-in 't Veld, 2017). However, their analysis only considers privately owned cars, while the respondents in the PVE-experiment might also have answered "Yes" if they drive lease cars they do not own themselves. Additionally, the question in the PVE-experiment did not specify whether the question referred to having a car as individual or as a household (in NL, the ratio of households with a car is 80%). These results can therefore not be used to validate the representation of the population in the sample group. Yet, the main reason for including this question

is to be able to cross-check the ownership of a car, with the perceived utility of parking spaces (included as an attribute in the PVE-design). Unfortunately, the econometric choice modelling has not been performed within the scope of this thesis, however the data is available for use in future research.

Tenure

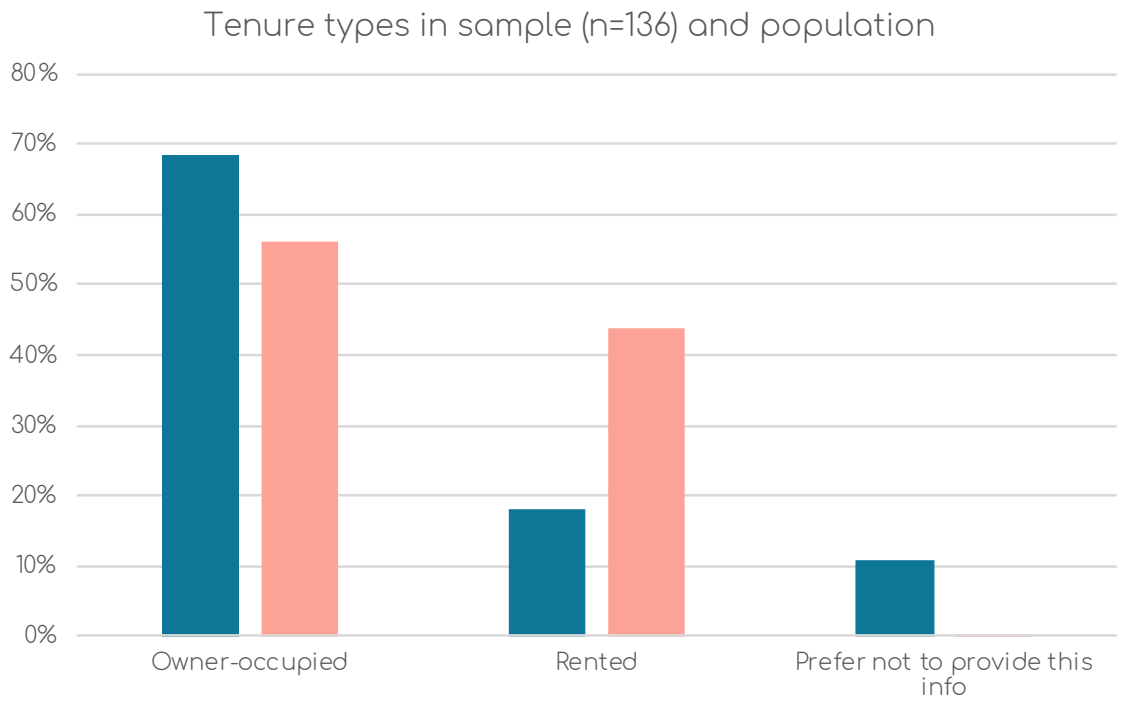

Figure 4.1-i: Tenure type within the sample group.

In the sample group, 68% of the respondents live in an owner-occupied dwelling, and 18% lives in a rented dwelling (see figure 4.1-i). Particularly, the share of respondents living in rented dwellings is low compared to the shares in the population (44%, Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2013). This supports the assumption that owner-occupiers are more concerned with the development of the neighbourhood, and could therefore also be related to the overrepresentation of people with a higher income. Further analysis should be performed to assess, whether indeed people with a higher income are more likely to participate as they have more direct (self-)interest, because they live in owner-occupied dwellings and thus the value of their property is affected by the developments in the neighbourhood.

4.1.3 Conclusions on representation of The Hague population in PVE

Based on the analysis of the descriptive statistics, it must be concluded that the sample is not a good representation of the society in the municipality of The Hague, because

1) Lower-educated people are strongly underrepresented.
2) Young people are slightly underrepresented
3) And, potentially as a result of the two points mentioned above, people with low-income were strongly underrepresented.

As no information is gathered on why people decided not to participate, it is hard to draw any hard conclusions on why these groups are not properly represented in the sample. Various assumptions have been mentioned throughout this chapter, that could be useful to keep in mind when setting up future PVE experiments for which a specific target group is approached. One generic conclusion can be drawn though: the threshold to participate should be lowered. Whether that is achieved best through simplifying the tool, by targeting respondents via a personally addressed email or by organizing better support during the actual completion of the experiment in webinars or group sessions, should be further evaluated in future research.

4.2 Quantitive results

The quantitative analysis of the responses consists of two types of analysis. The first is just a straightforward overview of the most-often selected measures. The second consists of the econometric choice modelling.

4.2.1 Frequencies

In figure 4.2-a, an overview of the selection of measures in the PVE-experiment is presented. The results show that Green strips (n=87) and Permeable paving (n=88) are selected the most. In section 4.3 the motivations for selecting these measures are be discussed. Particularly the water basement (n=22) was not favoured by the respondents, neither were the water square (n=30) and the elevated building (n=37). Interestingly to conclude form these results is that the three least favoured measures, do not provide any green space to the neighbourhood. Yet, the selection rate of the permeable paving shows that adding green space, is at least not the only determining factor for citizens' preferences.

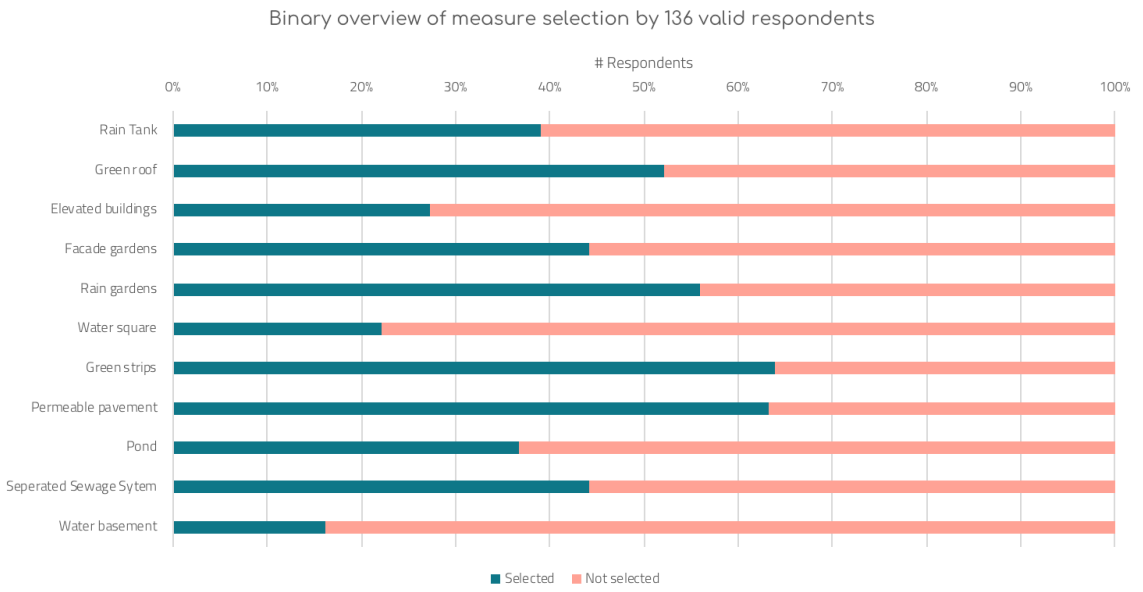

Figure 4.2-a: Overview of the binary selection frequency of each measure

Table 4.2-a presents the frequencies of the selection of measures (both binary and considering the amount of each measure selected. When the selected amount of each measures is considered as well, the water basement (sum=24) and the water square (sum=32) still are favoured the least. These are also two of the most expensive measures. The permeable pavement (x=370) is the most frequent selected-measure, followed by the green roofs (x=351) and the green strips (x=319). Again, the costs seemed to have played an important role here. The Rain gardens (n=76), were nearly as often selected as the green roofs (n=71), when considering the binary selection. In the cumulative selection, the rain gardens (x=150) were still forth in line, regarding popularity, yet the difference with the green roofs all of a sudden is 201 selections. The green roofs are much cheaper than the rain gardens (€51.500 versus €175.000 averaged). These results imply that the multiplier effect, particularly emphasises the related costs, but doesn't cause a shift to a different preference for measures.

Table 4.2-a: Frequency table of binary and cumulative selections of the measures in the PVE-experiment

	Rain Tank	Green roof	Elevated building	Facade garden	Rain garden	Water square	Green strips	Permeable pavement	Pond	Separated Sewer System	Water basement
Valid	136	136	136	136	136	136	136	136	136	136	136
Not selected	83	65	99	76	60	106	49	50	86	76	114
Selected	53	71	37	60	76	30	87	86	50	60	22
Missing	0	0	0	0	0	0	0	0	0	0	0
Mean	0.85	2.58	0.80	1.04	1.10	0.24	2.35	2.72	0.73	0.51	0.18
Standard mean error	0.136	0.387	0.149	0.132	0.12	0.039	0.306	0.303	0.106	0.057	0.036
Median	0.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00
Mode	0	0	0	0	0	0	0	0	0	0	0
Std. Deviation	1.586	4.511	1.733	1.542	1.405	0.459	3.564	3.531	1.238	0.667	0.420
Maximum	10	31	9	6	8	2	25	16	6	3	2
Sum	115	351	109	141	150	32	319	370	99	70	24

The binary selections can also be used to assess the impact of the various demographic characteristics on the stated preferences. For example, figure 4.2-b shows the difference in stated preference by gender. The figure shows what percentage of the total selection per gender (male: n=73, x=328 and female: n=44, x=208) was contributed by each measure (see also table 4.a-b). The absolute number cannot be compared, since more male respondents participated than female.

Table 4.2-b: Comparison of differences in measure selection between male and female respondents

	Rain Tank	Green roof	Elevated building	Facade garden	Rain garden	Water square	Green strips	Permeable pavement	Pond	Separated Sewer System	Water basement
♂	9%	12%	6%	9%	12%	5%	13%	15%	8%	8%	3%
♀	8%	11%	5%	11%	14%	5%	15%	13%	6%	11%	2%

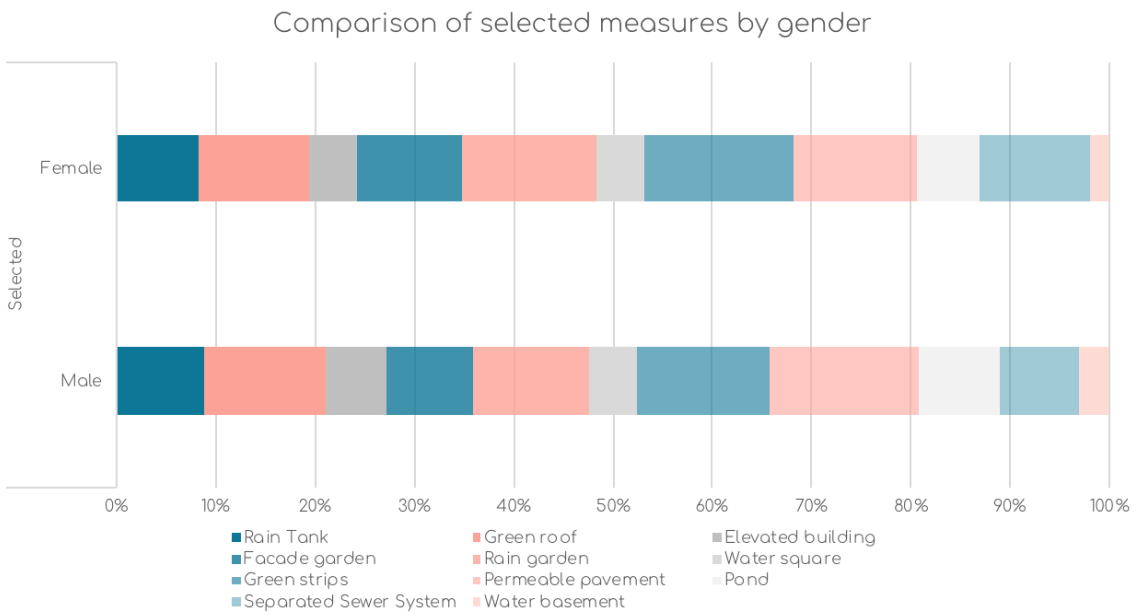

Figure 4.2-b: Binary selection of measures split by gender

Additionally, a chi-square test of independence was performed to analyse if male and female respondents (n=44, x=207) show different preferences for each measure. No significant ($p<0.05$) relation between the measure selection and gender of the respondents was found (see table 4.2-c).

Table 4.2-c: Asymptotic significance values of Chi-square analysis gender and measure selection

	Rain Tank	Green roof	Elevated building	Facade garden	Rain garden	Water square	Green strips	Permeable pavement	Pond	Separated Sewer System	Water basement
p-value	.857	.974	.567	.196	.079	.710	.175	.240	.839	.126	.583

4.2.2 Econometric choice modelling MDCEV

The MDCEV-model can be used to determine the utility of each measure and the related attributes. One condition that should be met to be able to perform such analysis, is that the PVE-design should provide different versions of the experiment to the respondents. In each version, some differences have been made in the height of the effect of the measure on each attribute. This way, the utility function can be used to determine how much change in the value of an attribute should be realised, to have respondents select a different measure. The number of versions was determined on basis of the expected response from the 5000 targeted respondents. Figure 4.2-c shows the actual responses obtained in the case study for each of the 26 versions. The number of responses on each of the versions is rather low to perform statistical analysis. Given the complexity of setting up the MDCEV model specifically for this PVE-experiment, with the outlook of insufficient data to draw any statistical conclusions, made that pursuing the econometric choice modelling of the results not feasible within the scope of this thesis. Hopefully, future research can provide the desired insights from the econometric choice modelling to assess its value to and applicability within decision-making on USWM.

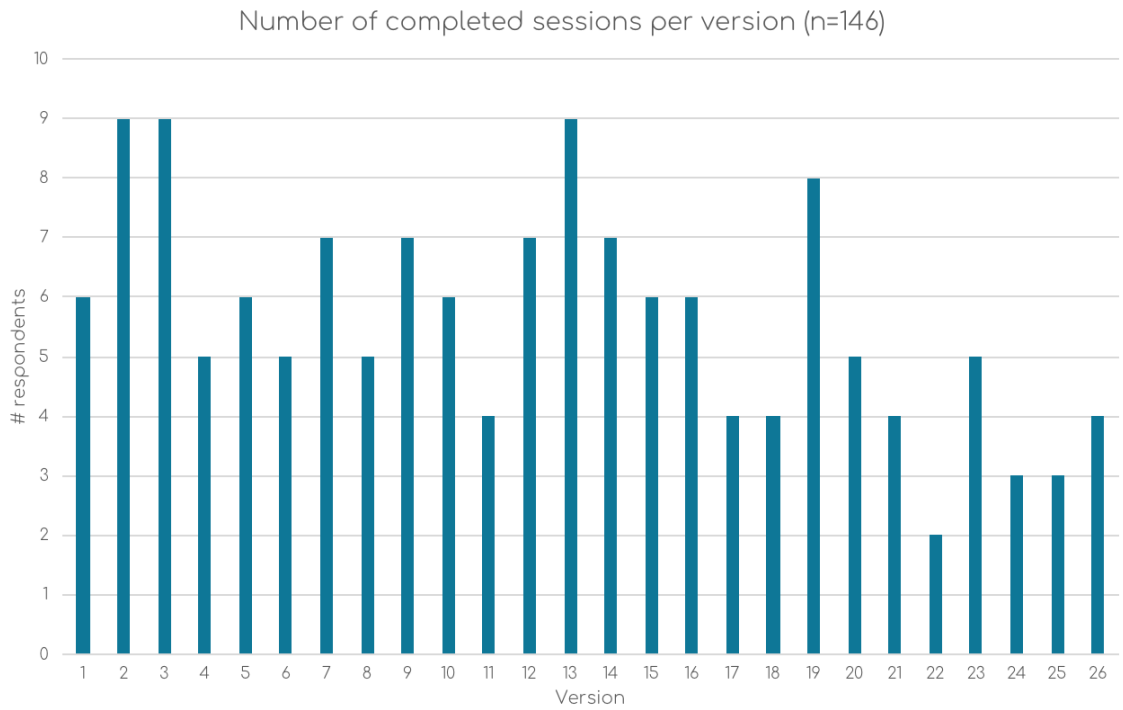

Figure 4.2-c: Number of times a PVE-session was completed for each of the versions.

4.3 QUALITATIVE RESULTS

This section elaborates on the results of the qualitative analysis in the PVE-experiment. In addition to the quantitative results presented in section 4.2.2, the qualitative responses provide a deeper understanding of respondents' choice behaviour. For this analysis, the qualitative responses have been recoded into groups of similar motivations for selecting a measure. Figure 4.3-a presents an overview of the most-frequently mentioned motivations, cumulated over all eleven measures. The results show that two motivations were most important to respondents in making their selection of measures: (1) that the solutions add green space to the environment and (2) that the measure is effective in preventing superfluous water. The importance of green space, was also apparent in the quantitative ranking of the measures discussed in section 4.2.2.

Some people aim to combine effectiveness with added green space:
[1] "*Double function: both better water drainage and pleasant to have more green in public space, especially along the street*"
[2] "*Effective, and increases the amount of green space*"

Others refer to the multiple benefits of green space for the (spatial) environment. The amount of green space is often mentioned in combination with spatial betterments, biodiversity and improved looks of the area:
[3] "*The main cause is the buildings, as they result in too little green space. Let us therefore work on the cause and bring back more green again. Use the natural system. Moreover, research has shown that in a green environment people feel safer, that a green environment has a positive effect on health, that it helps to improve air quality and brings more biodiversity (e.g. for the benefit of pollinators such as bees). In short, by putting more green in neighbourhoods, we hit several birds with one stone!* "
[4] "*Increases green space, good for mood and fun for children playing in the street as compensation for all that alloy on the other side*"
[5] *"The space in the city on roofs is currently hardly used for water collection, while this is one of the easiest ways to catch water and (partially) hold it. Besides that, it looks even nicer."*

And some people state to be willing to actively contribute to maintaining that green space:
[6] *"Holding water and using it for more green, just at the front of houses where it is now often stony. Also asks for participation by residents for maintenance and it looks nice."*
[7] *"Increase the amount of green in an urban environment. Resident participation."*
Some repsondents just want simple and effective measures against superfluous water:
[8] *"System that, once installed, does not require much maintenance but is effective."*
[9] *"Simple and effective"*

Only 32 times respondents apparently considered costs to be important.

Three answer categories related to the space a measure requires might seem to overlap, but have different implications. The does not/hardly affect the number of parking spots reflect the respondents (n=22) that were concerned the number of parking spaces would decrease.
[10] *"looks nice and doesn't decrease the number of parking places"*
Other respondents (n=13) appreciated measures for the fact that do not require additional space, regardless of whether that affects the number of parking places or other types of land-use
[11] *"Green solution that looks nice as well. No loss of space*. "
Five respondents selected measures specifically because those lead to less parking spaces
[12] *"Aim at car sharing, take cars and parking places out of the city, add more trees and infiltration points in it…"*

Even though the question was what motivation respondents had for selecting a specific measure, some respondents (n=31) did not provide their motivations, but set conditions for the implementation of that measure. These conditions varied from urging to think about the effects of weeds on the functioning of permeable pavement
[13] *"We need to consider how to deal with weeds on this pavement, otherwise you create a slippery surface and weed problem again."*
to specifying in which spatial environments these measures should be applied
[14] *"Only on parking spaces"* or *"Only if it is a newly built neighbourhood"*
to sending a message to the public authority
[15] *"we already have this in Wateringse Veld, but I think I am the only one who knows: Communicate, Communicate, Communicate!!".*

Another interesting result is that only eight times self-interest was mentioned as a motivation for respondents to select a measure. It is likely that this is (at least partially) due to the absence of location details for each of the measures. The implication of these results can be two-sided. On one hand, it supports the objective of the PVE to allow for budget allocation in the public interest, rather than stating preferences from a personal gain perspective, and the objective of this PVE-experiment in The Hague specifically to find the most desirable solutions, without being restricted by any location specific circumstances. On the other hand, it might also be due to a lack of perceived consequential effects of the selection in the PVE-experiment. This would be more harmful as previous studies have shown that the quality of the response decreases with a decrease in (perceived) consequential effects of the choice respondents make (McFadden & Train, 2017).
In appendix VII, the motivations for each individual measure are discussed in more detail.

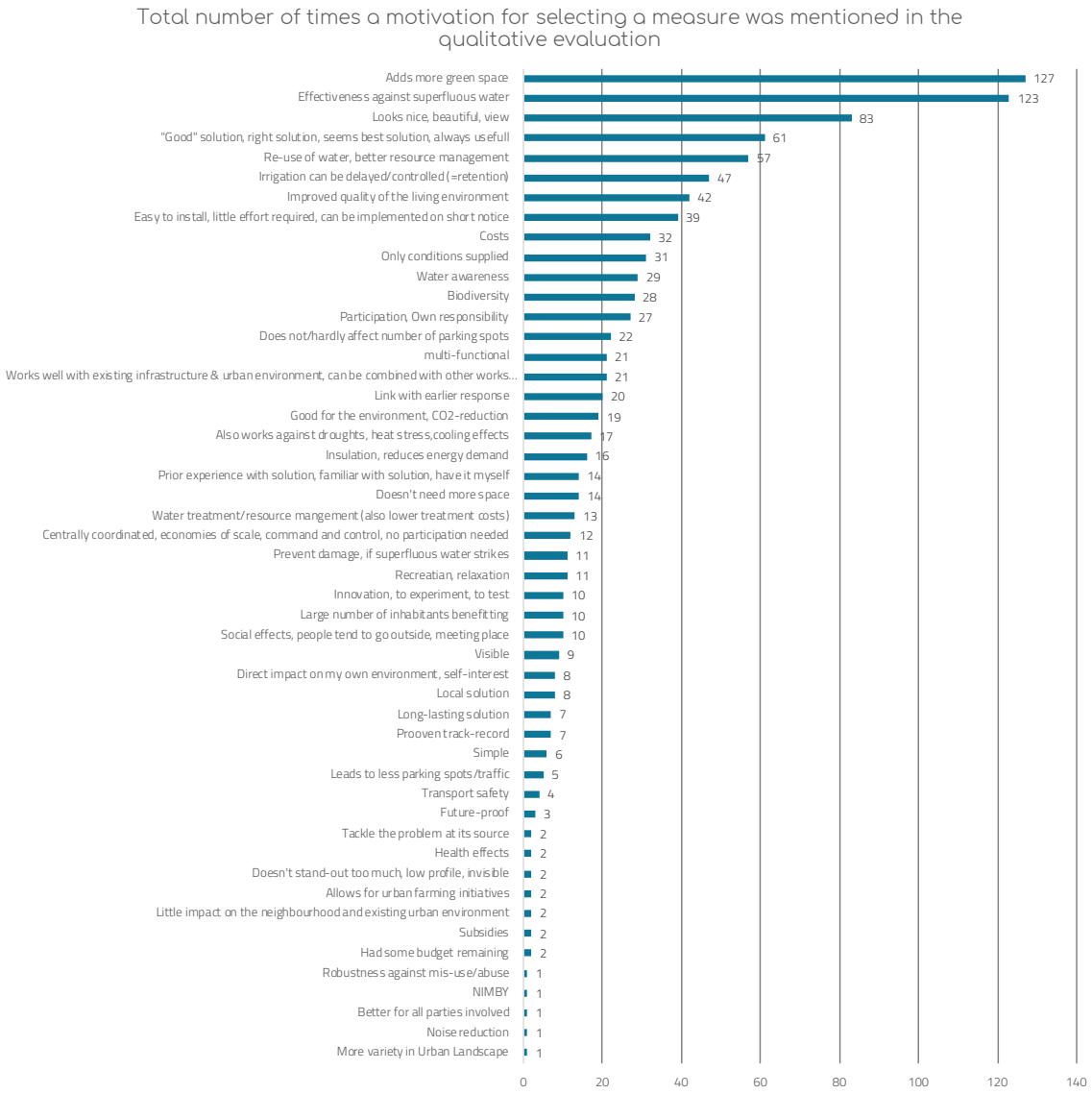

Figure 4.3-a: The total number of times these categories were mentioned as motivations for selecting specific measures[3]

[3] *The Link-with-earlier-response-category represents motivations that consisted of a reference to a response given on an earlier question (e.g. "see above"). Because the order of questioning differed, dependent on the order in which measures were selected, it could not be concluded with certainty to which other answer the respondents referred. Therefore, these responses are not categorized according to the references, but reported as a separate category.*

4.4 EVALUATION OF THE PVE-METHOD

In the qualitative survey, respondents were asked to evaluate the PVE-method. The results that follow from this evaluation are discussed in this section.

4.4.1 IS PARTICIPATION OF CITIZENS IN DECISION-MAKING DESIRABLE

First of all, it is interesting to know whether participation is considered important at all. Of course, the respondents of this experiment were expected to be in favour of participation (hence they would not participate if they felt it was useless). Indeed, the responses show that over 80% of the respondents considers citizen participation in decision making on public investments important (see figure 4.4-a and table 4.4.-a). Similar scores (80-85 %) were found by Mouter et al. (2018b). They asked whether their participants agreed to the statement that "*it is good that the municipality involves citizens in this process*".

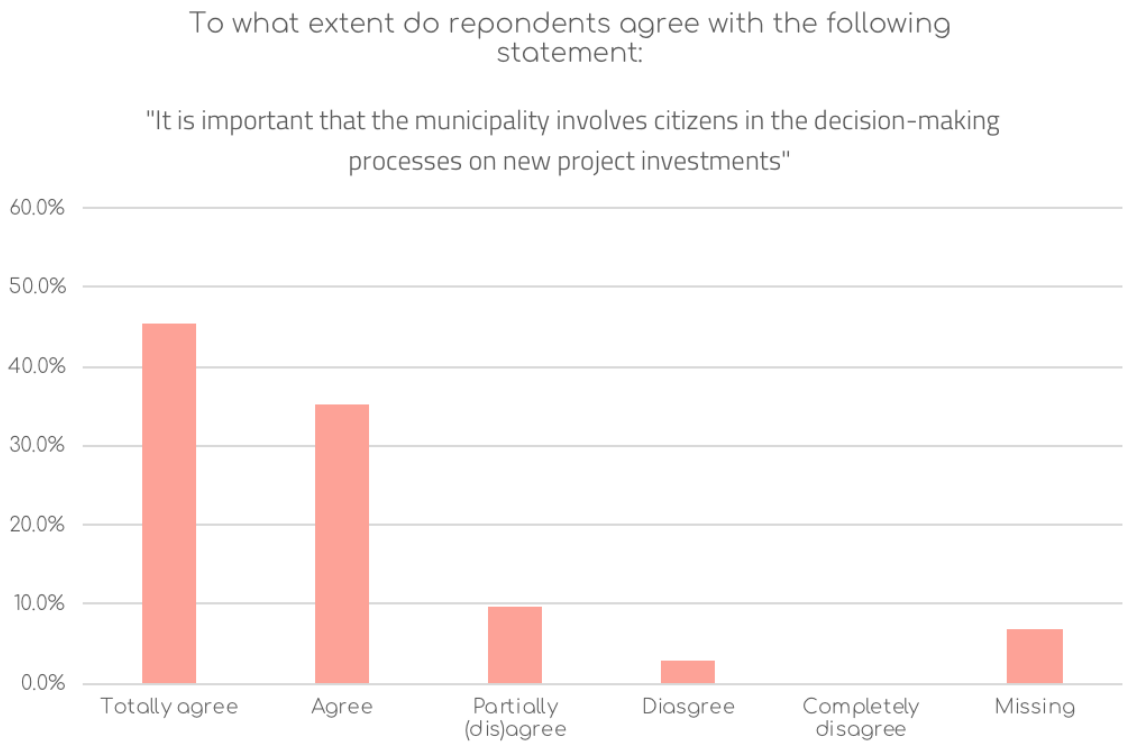

Figure 4.4-a: Response on the statement: involving citizens in the decision-making processes on public investments through participatory research is important

Table 4.4-a: Response on the statement: involving citizens in the decision-making processes on public investment through participatory research is important

	Frequency	Percentage
Totally agree	51	35,2%
Agree	66	45,5%
Partially (dis)agree	14	9,7%
Disagree	4	2,8%
Completely disagree	0	0,0%
-	10	6,9%

In addition to the multiple-choice questions as used by Mouter et al. (2018b) and in this thesis, the respondents in the case study of The Hague were also asked to motivate why they consider participation important (see figure 4.4.-b). The main motivations that were supplied on why participation of stakeholders is needed are:

1) The participation generates support for decision-making
2) The citizens are the end-user of the "decision"
3) The participation can enhance knowledge sharing as citizens have important (practical) input on the actual situation
4) Participation creates awareness on the issue (of superfluous storm water).

The motivations of the respondents in the case study show similarities to the three main motives public authorities have for initiating participatory decision-making processes. Klijn and Koppenjan (2000) identified the following benefits that participatory decision-making could have for local authorities.

1) Creating support and minimising the potential resistance of groups that might oppose a policy, by involving them in the process of decision-making.
2) Improving quality of the decision through the knowledge exchange between the municipality and the local stakeholders on preferences, problems, location specific restrictions or opportunities etc.
3) Improving local democracy. It is an attempt to bridge the gap between public authorities, citizens and other local stakeholders.

Out of the 146 respondents, 39 mentioned to benefit of generating support for the decision-making through the involvement of stakeholders in the decision-making process.

[1] "*The municipality is there for the residents, I understand that the final decision lies with the municipality. But they get more support when they involve the residents."*
[2] "*If you draw residents well into this story and tell them that the municipality must do something, but that it can also provide benefits, people want to think along. If you do not take them with you, resistance will arise."*
[3] "*Good for thinking along because it affects the quality of life in the neighbourhood and involving the residents. also ensures support and sense of involvement.*"
[4] "*Without support, a multitude of time and money will be spent in the follow-up process to allow the measure to be implemented."*

Respondents (n=32) claim that citizens should be involved because they are the end-users of the outcome of the decisions. They argue citizens are impacted the most and should therefore have the chance to provide their opinion on the impact on their living environment.

[5] *"The municipality does this for the residents. If they ultimately have nothing to do with it, they will only complain and that is what you ultimately do not want as a municipality and as a resident. A plan without a say, will definitely be grumbled about."*
[6] *"It affects all citizens and their future in a liveable city."*
[7] *"The residents live in the municipality and it is community money."*
[8] *"Based on the principle that the municipality is there for the residents. Furthermore, there are always conflicting interests involved. For the support of the measures it is essential that a transparent weighing of interests takes place."*

The reasoning that residents are the actual end-users is also used in combination with the argumentation that citizens have valuable information on the local situation, that might not be available to the policy makers (n=18). Participation could enhance knowledge sharing, which would help to make better decisions.

[9] *"Because the municipality certainly has good ideas, but the problem is affecting the citizens, who know where the shoe pinches. Together we can solve the problem."*

[10] *"Local democracy is perhaps the most important one, here real choices can be made that influence the daily life of the residents."*
[11] *"Cross-pollination of good ideas, residents are inclined to think long-term and know the neighbourhood better than the municipality (civil servants)"*
[12] *"Residents have good insight into the local situation. Significant information about the environment can be missed on the drawing board."*

According to fourteen respondents the development of (water)awareness among citizens through participatory processes, can create an incentive for citizens to make an effort in tackling the problems themselves as well.

[13] *"Inhabitants can also do a lot (less paving), involvement in investments raises awareness and with that (hopefully) willingness to do something itself to reduce the (general) costs. Really worry about the situation in the old district Statenkwartier"*
[14] *"Water problems affect all of us. From now on, we are conscious of our own influence on climate change and the impact of our behaviour on our environment."*
[15] *"Participation always works better than top-down policy. In addition, people also see their own responsibility instead of expecting that all their problems have to be resolved."*

In addition to the motivations of people who consider participation to be important, figure 4.4-b also presents motivations of respondents who are more conservative when it comes to the importance of participation or don't agree with the statement. The main motivation mentioned by those respondents (n=7) is that the municipal council has been elected to take those decision on what is best for society.

[16] "*I elected a city council, so they can do good for the city*"
[17] "*Not everyone is equally involved. It can take a lot of time, and not everyone has that. My fear is that older people in particular determine what the neighbourhood looks like. They have time to go to residents' evenings / afternoons. The city council has already been elected by the citizens."*
[18] "*All kinds of opinions of people who do not have the appropriate knowledge lead to nothing. Good technological or spatial interventions need to be worked out by people who understand it and then explain it to residents."*

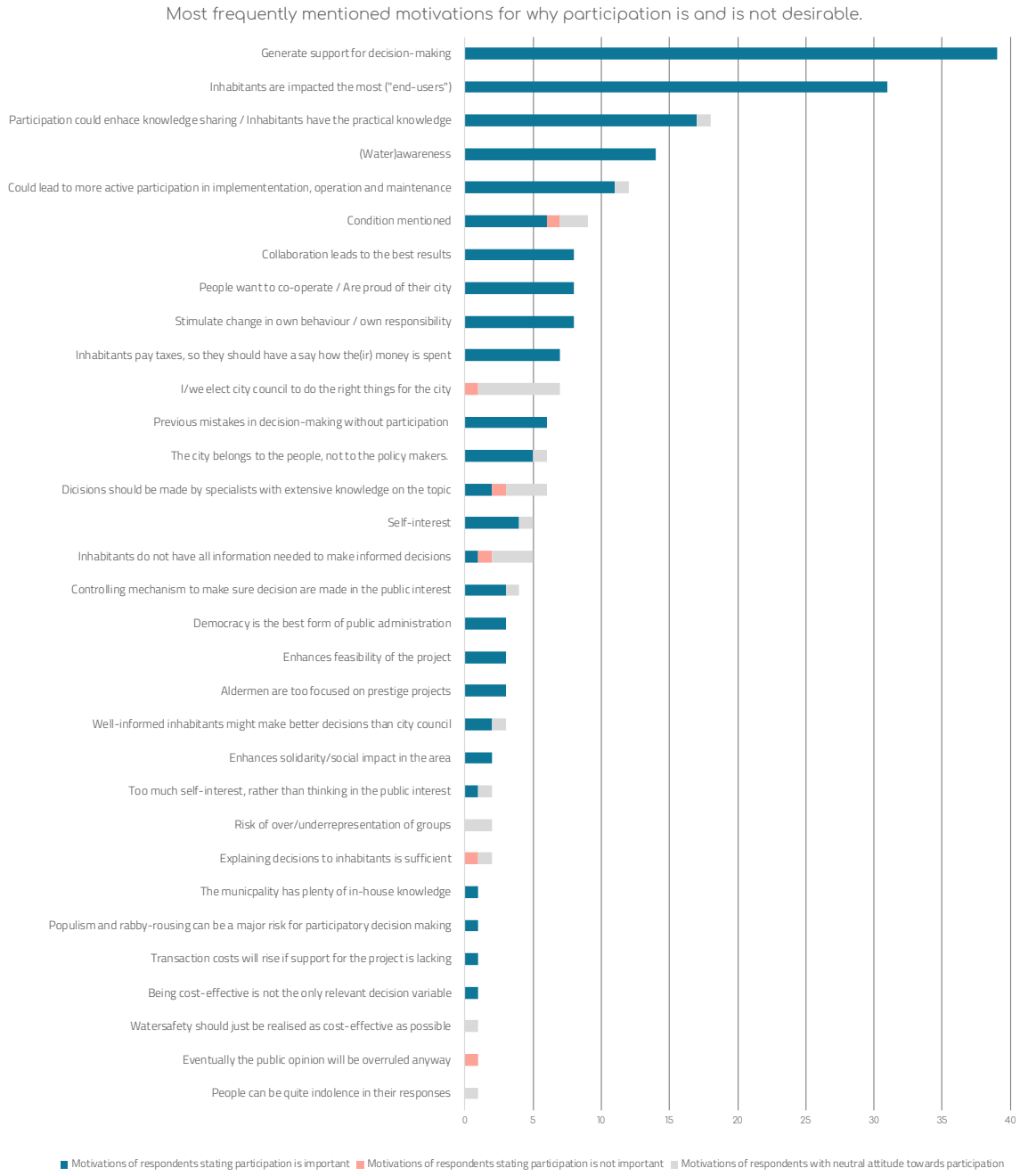

Figure 4.4-b: Motivations for why participation is considered important

4.4.2 Capability of citizens to take role of public authority

The results on the statement "citizens have sufficient knowledge to advice the municipality on the allocation of public funds" show that 50% of the respondents neither agree or disagree (see figure 4.4-c). The share of respondents that agree with this statement, is only marginally bigger than the group opposing this statement. This is an interesting insight, as even though respondents state that citizen participation is important, they do not believe that citizens actually have the capacity to advise the municipal authority. This has strong implications for the way the results of participatory processes should be handled by municipal authorities, as apparently the citizens indirectly state that the results of a participatory process cannot be blindly followed in the actual decision-making, as the expertise is missing within the population of citizens.

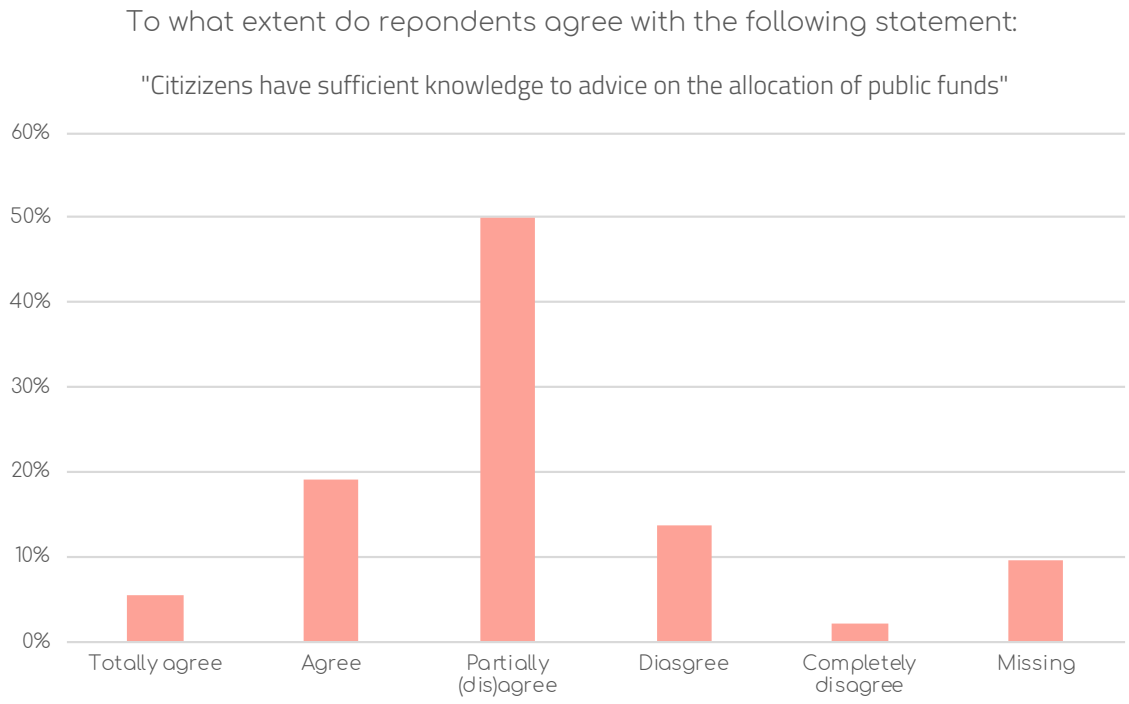

Figure 4.4-c: Response on the extent to which citizens have the capacity to decide upon public investment opportunities

4.4.3 Assessment of own capability to advice on USWM

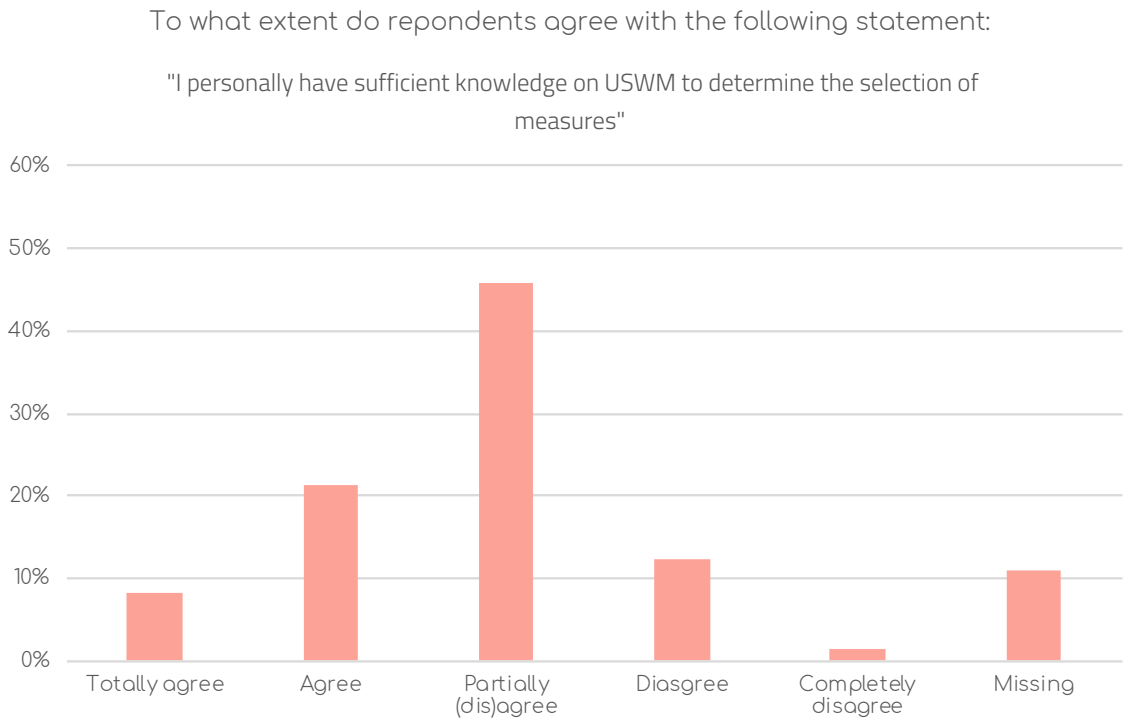

Figure 4.4-d: De distribution of respondents (not) agreeing to the statement that they believe to have sufficient knowledge on USWM to advice on which measures to select.

The response to the question whether respondents feel they have sufficient knowledge on the topic of USWM follows a similar distribution as the answer to the question whether residents have the capacity to take decisions on public investment opportunities (see figure 4.4-d). Interesting in this debate is also the perspective of (Knüppe & Pahl-Wostl, 2011) who argue people struggle to interpret risk as limitations of water management policies, as we are so used to the success of the water management systems. His reasoning implies that participation on risk-related investments might better not be based on participatory processes.

4.4.4 What expectations do respondents have regarding the use of the PVE-results in the actual decision making in The Hague

On the question what expectations the respondents have regarding the use of the results of the PVE-experiment, the majority states that is expected that these results will be considered as input for future decision-making (see figure 4.4-e).

[1] "*I expect the municipality considers their own expertise to be leading in choosing the right measures. This research can be used by the municipality to opt for the popular measure where several solutions lead to the same result.*"
[2] "*If the results give a clear picture, I would advise to include this in the decision-making process. Also, nice if the overall results are communicated to the participants / invitees for the survey."*
[3] "*Include in the considerations for taking a decision of sufficient working and accepted measures for the medium term."*

The importance of open communication regarding the outcome of this research and transparency in the eventual decision-making process are considered important. The importance of transparency throughout the decision-making process was also mentioned by respondents in their argumentations for why participation of citizens is important in general.

[4] "*take results seriously, but above all provide direct feedback of the way in which the results of this research have been dealt with towards the participants of this research*"
[5] *"Inform residents of the results and then include this in the decision-making process."*

Some respondents state not to expect anything will be done with the results, even though some do hope they are wrong.

[6] *"I hope they take it into account, but I do not know if I can expect that."*
[7] *"Nothing"*

The meaning of "doing nothing" remains a bit ambiguous, as is shown by quote 8.
[8] *"Nothing. Discuss, evaluate, report and make presentations."*

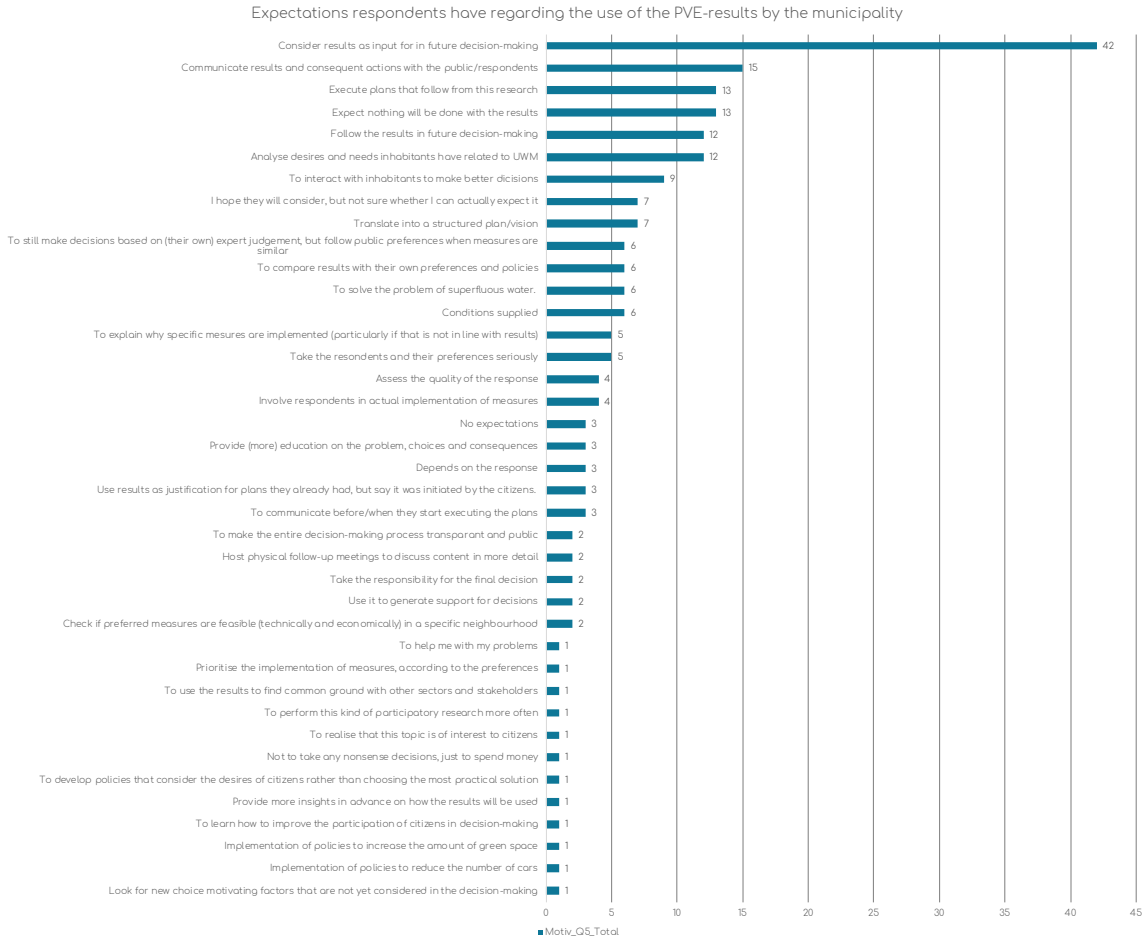

Figure 4.4-e: Expectations respondents have regarding the way the results of this research will be used

The responses that indicate respondents don't expect any action to be taken on the results, shows mistrust exists between citizens and the municipality. The use of participatory decision-making can either be a way of bridging this gap (if applied properly), or widen the gap if the communication around the application of the participatory study is insufficient. Expectation management and open communication is essential to exploiting the potential of the PVE-process. This importance is emphasized by the larger number of respondents who have stated to consider being informed as one of the most important follow-up actions.

4.4.5 What respondents liked about the PVE-method

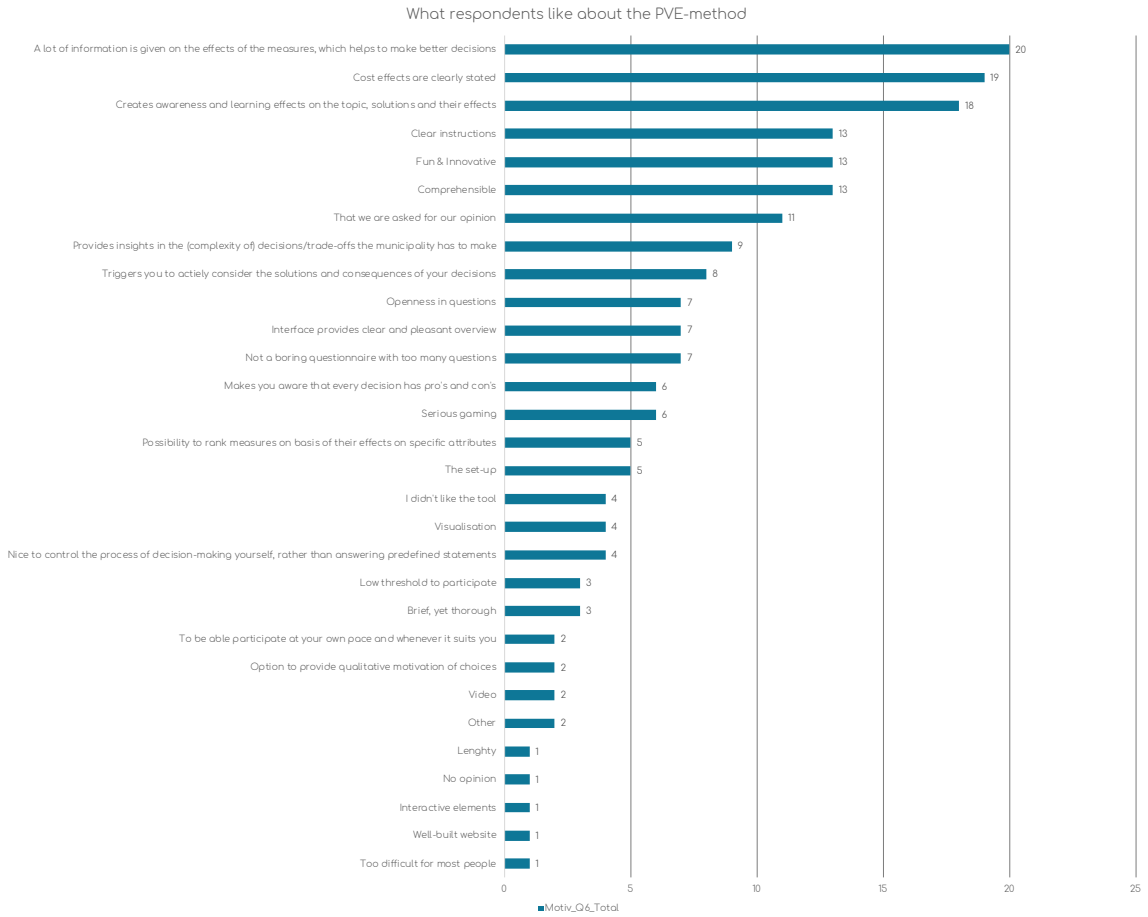

Figure 4.4-f: Response on the question what respondents liked about the PVE-method

The most frequently mentioned benefits of the PVE-method are that it provides a lot of information to the respondents, which not only helps to make better informed decisions, but also creates a learning effect that respondents state to appreciate (see figure 4.4-f). Similarly, the awareness that is created on the problem of superfluous storm water and the potential means to resolve those problems is highly valued by the respondents. Shreve & Kelman (2014) have stated this as "*the process of thinking about alternatives is already valuable, regardless of the result.*" Even if the preferences of the citizens are not implemented in the end, the knowledge sharing, mutual understanding and awareness that is created during the process already add value to the decision-making process. In the same line of reasoning, a rather large group has stated that just the fact that they are asked for their opinion is a major benefit of the PVE-method. Other frequently mentioned benefits of the PVE-method are the clearly presented cost-effects, instructions and the fun means of participating in a research.

4.4.6 What respondents like to see changed on PVE-method

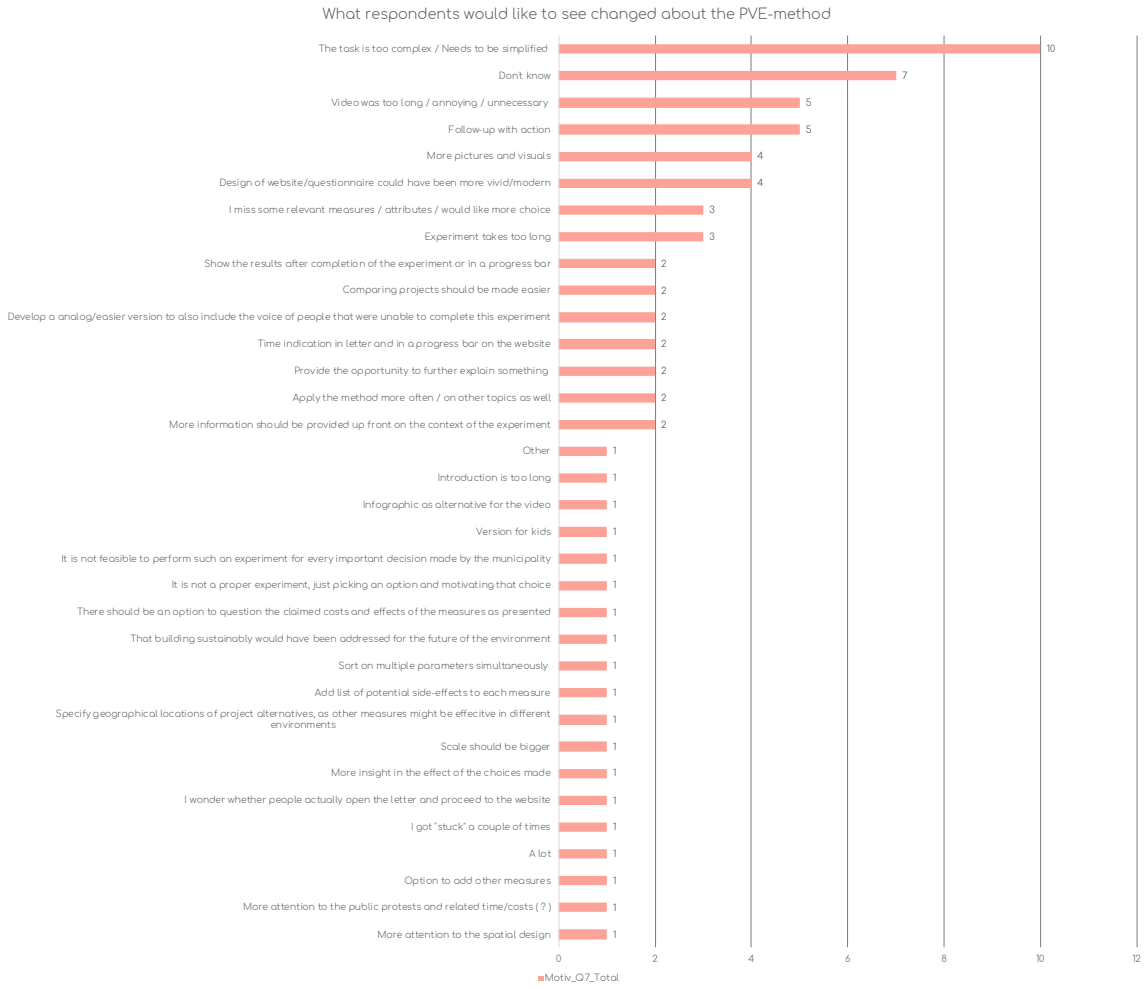

Figure 4.4-g: Suggestions for improvement of the PVE-method

The main critique on the PVE-method is that the task is too complex (see figure 4.4-g), according to 10 respondents. Interestingly though, the vast majority of the respondents who have stated this, mentioned the task would be too complex for "my neighbours" of "other residents". Hardly any response concerned the fact that the respondent found the task too complex for his/herself. The evaluation of the PVE-method also shows a need for a visually more attractive lay-out of the PVE-website. Even though not one respondent said to dislike the used visualisation of the measures, some requests for pictures of what the solution would look like were made. In setting-up the PVE-experiment, the choice not to include pictures was made to be able to exclude possible effects of associations related to the quality of the picture, as it would not be possible to capture pictures of every measure in similar contexts (e.g. Whether the picture is taken in sunny or rainy weather could influence the perception of the measure). Using rendered 3d-sketches would be an alternative to

the use of pictures, yet more expensive and time-consuming, means to show the envisioned look and feel of the measures in a controlled and consistent way. These renders should be used in addition to the visualisations showing the more technical functioning of the measures, rather than replace them. The interface of the website though, could benefit from a more vivid and dynamic interface. The results also indicate that hardly any substantial downsides of the PVE-method are addressed by the respondents. Other than the observation that the task might have been too complex for some respondents, all other suggestions for improvements that can easily be implemented. Together with the results discussed in section 4.4.6, it is concluded that respondents positively evaluate the PVE-method as a tool for participatory decision-making.

4.4.7 Remarks after completion of the PVE-experiment

The only substantial implication that is derived from the final remarks of the respondents, is that there is a clear desire to be updated on the results of the experiment (see figure 4.4-h). And 3 people enjoyed participating through the PVE.

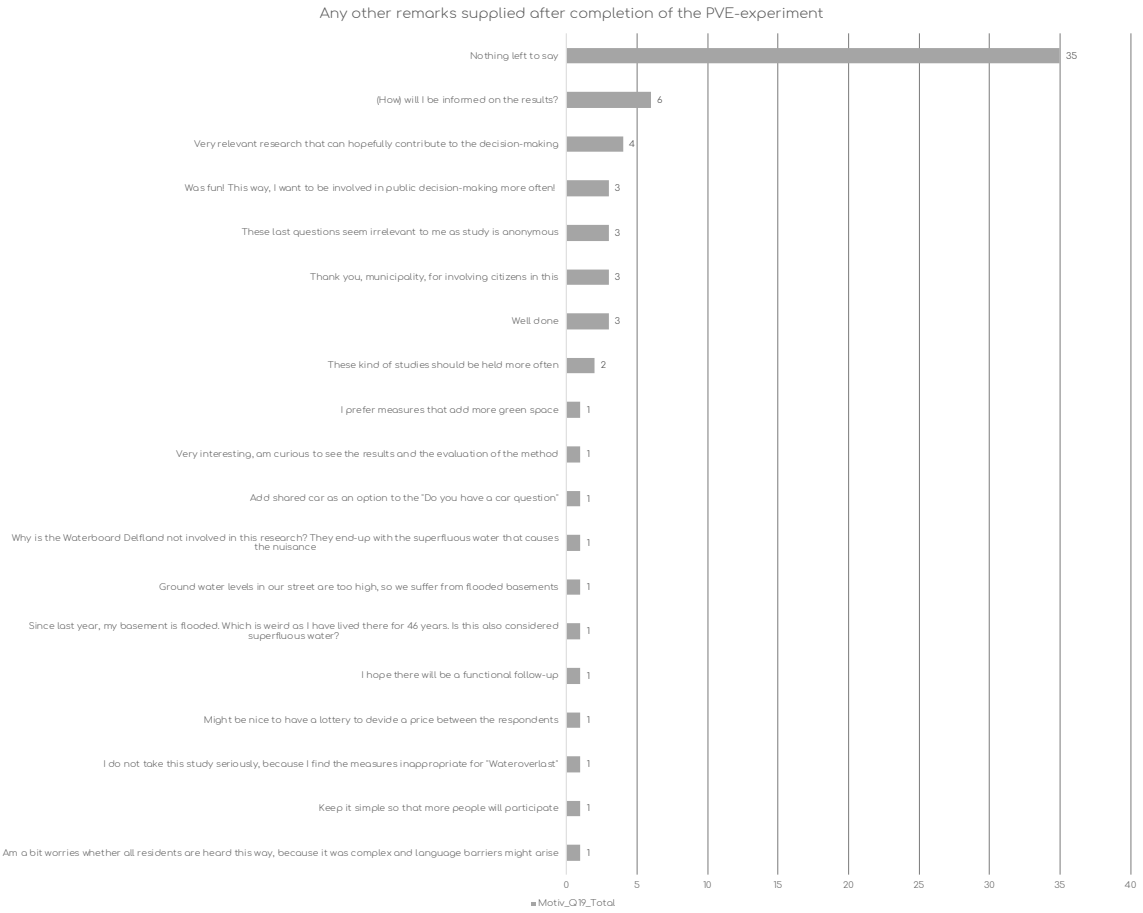

Figure 4.4-h: Remarks after completion of the PVE

4.5 ROLE OF THE PVE-RESULTS IN DECISION-MAKING PROCESS

The results of the PVE-experiment provide input for the decision-making on USWM. The specific combination of the type of results and the context of the experiment determine how the results can be used in the decision-making processes. To determine the role of the PVE-results in municipal decision-making processes, first the level of participation that is established through the PVE-experiment is determined. Arnstein (1969) introduced the concept of the participation ladder to consider the level of involvement of citizens in the decision-making process. For the assessment of level of participation that is established through the PVE-experiment on USWM in the Hague, the participation ladder of Edelenbos (2000) is used. In his doctoral thesis, Edelenbos (2000) tailored the Arnstein ladder to define five levels of citizen participation in Dutch decision-making processes (see table 4.5-a.

Table 4.5-a: Explanation of levels of participation in Edelenbos (2000) cited from Edelenbos & Klijn (2006)

	Explanation of the levels of participation in participation ladder (Edelenbos, 2000) cited from Edelenbos and Klijn (2006) page 21-22
Informing	to a large degree, politics and administration determine the agenda for decision-making and inform those involved. They will not use the opportunity to invite interested actors to provide input in policy development
Consulting	to a large degree, politics and administration determine the agenda, but regard those involved as a useful discussion partner in the development of policy. Politics does not, however, commit to the results of these discussions
Advising	in principle politics and administration determine the agenda but give those involved the opportunity to raise problems and formulate solutions. These involved actors play a full-fledged role in the development of policy. Politics is committed to the results in principle but may deviate (if substantiated with arguments) from them in the final decision-making
Co-producing	together politics, administration and those involved determine a problem agenda in which they search for solutions together. Politics is committed to these solutions with regard to the final decision-making, after having tested this outcome in terms of a priori conditions
Co-deciding	politics and administration leave the development and decision- making of policy to those involved and the civil service provides an advising role. Politics simply accepts the outcomes. Results of the process have an immediate binding force

The PVE-experiment aimed at defining the optimal configuration of USWM measures in an unspecified neighbourhood in The Hague. As the possible measures are predefined in the PVE and the municipality does not commit to adhere to the results of the PVE-experiment in the actual policy implementation, the level of participation would be best categorized as *consulting*. The input is used to gather input for the development of new climate adaptation policies. Due to the possibility to also add qualitative responses in the PVE, the citizens do have some opportunity to raise problems and formulate alternative solutions that the municipality might not have had considered themselves (see *advising*). Moreover, some misalignment on the level of participation that is achieved through the application of the PVE-method is apparent in the responses in the PVE-experiment. Most respondents (n=40), indeed expect the level of participation related to the PVE-method to be *consulting* or *advising,* as is indicated by the following quotes:

[1] *"I expect that the municipality will consider their own expertise to be leading in the deciding upon the most suitable measures. This research can be used by the municipality to opt for the popular measure where several solutions lead to the same result."*
[2] "*I expect that the results are taken as an advice. After all, an advice does not have to be followed, but should be considered in the decision-making.*
[3] "*Consider (as an advice) in the decision-making process. Motivate where and why other choices are made that do not align with the preferences from citizens that follow from the PVE-experiment."*

Other respondents (n=3) consider the results of the PBG to be more or less binding for the municipality (*co-producing* and/or *co-deciding*). The expectations this group of respondents have regarding the follow-up on the results of the PVE-experiment can be characterized by these quotes:

[4] *"I consider the research as a kind of referenda, which means that the municipality should weigh the results of the PVE-experiment heavily in their final decision-making."*
[5] *"that the municipality looks at the choices that are made, why THOSE decisions are made by the inhabitants and that the municipality follows that line of reason."*

One respondent acknowledged the importance of stating the level of participation that is envisioned with the experiment up-front, as this could prevent misperceptions regarding the wat the results are used in the final decision-making.

"[6] *"It would be useful that this {what the municipality will do with the results of the PVE} would be communicated up-front to prevent disappointments. What level of the participation ladder is aimed for? It seems to be the top level now, but that is not clear and moreover this could be endangering for the decision-making process."*

The lack of results of econometric choice modelling does not affect the level of participation, only the variety of insights that can be considered by the municipality. The level of participation does not shift, as the level of binding-commitment to the results is independent of the type of results that are obtained. In a PVE-experiment that is based on real-life project proposals, the level of participation might shift more towards *advising*, as it is less likely that the municipality would still pursue a project that doesn't have the support of the society. The PVE-method in its current form does not aim involve citizens throughout the entire decision-making process from identifying problems to actual implementation of the measures. Instead the citizens advise on which solutions to implement, within the given policy agenda (budget) set by the public authority.

Besides the level of participation in the decision-making process, the type of results that are obtained through a PVE-experiment also affects in which stages of decision-making the results can play a role. Many frameworks on public decision-making exists. For this thesis, the recent framework of Howlett, McConnell, & Perl (2017) is used, which integrates two widely applied frameworks; the different stages in policy development (E.H. Klijn & Teisman, 1991; Timmermans, 2001) and the policy streams of (Kingdon, 1984) (see figure 4.5-a). The PVE-method as a configuration tool is particularly useful to provide input for the policy formulation stage. The econometric choice modelling is more important in a configuration PVE-experiment, than in a PVE-experiment with the task of making a binary selection of real-life project proposals in a referenda-style study (Koster, personal communication March 19, 2018). That is because the configuration tool aims to contribute to the development of new visions and policies, and thus the desired results are input for a program of requirements. In the development of a new vision, the key task for the municipality is to determine the pillars on which the vision is based. Such pillars would be to focus on the development of green space in the neighbourhood and to reduce the number of parking spots. A vision is not based on the roll-out of one specific measure, as the feasibility of that measure might be different on various geographical locations. In the use of the PVE-method for the binary selection of real-life project proposals, the econometric choice modelling is less crucial, as in those cases the PVE can also be considered as a referendum on whether a project/measure should be realised or not (decision-making). The econometric choice modelling would then only be valuable to make the economic assessment of the total utility of the project as a justification of the investments in that project. The

application of the PVE-method with binary selection of realistic projects, also shifts the role of the results more towards the later stages of decision-making. Additionally, the PVE can play a role in merging political, policy and problem streams into policy windows. The more interaction takes places between these streams, the more likely it is a window of opportunity occurs. Respondents indicated how valuable it is that citizens can help to identify local problems through the PVE, to align those problems with existing or new solutions and to create a more collective awareness for action.

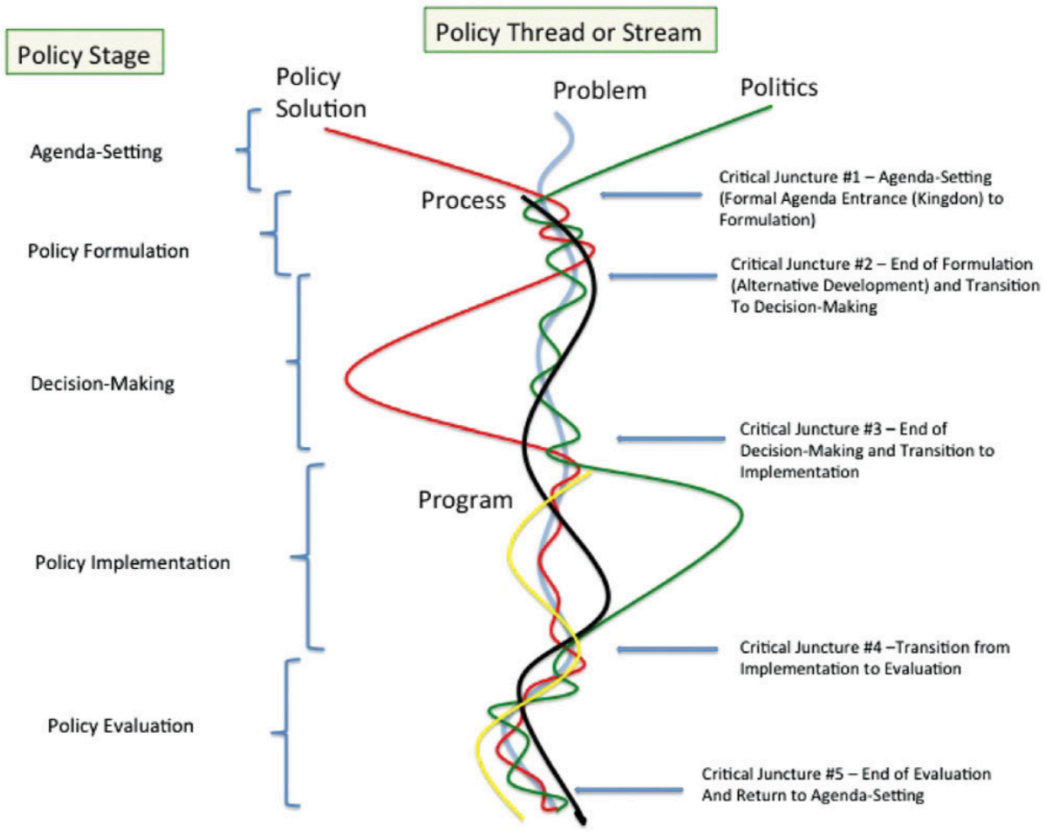

Figure 4.5-a: Howlett et al. (2016) combined the "policy streams" of Kingdon (2011), with the policy stages derived from the cycled approach by Klijn and Teisman (1991) and Timmermans (2001) in to this five stream political decision making model.

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Chapter 5:

Conclusions

OUTLINE OF CHAPTER 5

This chapter presents the conclusions of this master thesis. At first, the main research question of this thesis is answered in section 5.1. Sections 5.2-5.6 discuss the answers to the five sub questions of this research respectively. As such, section 5.2 concludes on the methodological steps to be taken in the application of the PVE-method. In section 5.3 the design of the PVE-experiment in the case study of The Hague is evaluated, while section 5.4 discusses how the results of that case study can be used in the decision-making processes on USWM. Section 5.5 provides some concluding remarks related to the evaluation of the PVE-method by the respondents. Lastly, section 5.6 presents the practical lessons learned from applying the PVE-method in the case study of The Hague.

5.1 GENERAL CONCLUSION

To what extent is the PVE-method as a participatory research tool applicable in USWM decision-making processes to improve the alignment of public policies with citizens' preferences in The Hague?

The PVE-method is well-applicable as a means to improve the alignment of public policies with citizens' preferences in the field of USWM. However, the applicability of the method is limited by some characteristics of the method itself and the context of USWM decision-making. The level of participation that is currently achieved with a PVE-method is consulting or potentially advising. The applicability of the PVE-method as a tool for binding co-producing of co-deciding is still too limited and at least for now undesirable. The assessment of the PVE as a means to better align USWM policies with citizens' preferences in the case study of The Hague resulted in a set of drivers and barriers for the applicability of the PVE-method in the context of USMW at a municipal level.

5.1.1 DRIVERS OF THE APPLICABILITY OF THE PVE IN USWM

1) Citizens showed great interest in the PVE-method because it provides background information on the measures (which supports a change in own behaviour), it helps to create an understanding of the complexity of public budget allocation (which enhances support for decisions) and it provides a clear overview of the costs related to a measure (which is important for a viable economic assessment of the utility citizens derive from the measures in the PVE). If citizens feel they gain something from participating in a PVE-experiment they will be more willing to participate in future studies. Without support for the PVE-method among citizens, the large-scale application of the method would be challenging.
2) The PVE-method allows for the collection of different types of input on the preferences of citizen through just one experiment. (1) The qualitative data provided a deeper understanding of the perception of citizens and the specific motivation for stated choices. (2) The quantitative data (even though the econometric choice modelling could not be applied) can provide insights in the preferences of citizens through the ratio by which each measure is selected. (3) The survey after completion of the PVE allows for the gathering of input on specific knowledge needs.
3) Even though the response ratio of this case study was lower than expected, the PVE-method still provided insights in the individual preferences of 149 inhabitants (3% of the 5000 targeted respondents) for the allocation of the public budget for USWM. Insights in this amount of individual preferences would not have been generated through a town-hall meeting or face-to-face citizen consultation.

4) Citizens seem to appreciate the fact that they are given the opportunity to state their preferences and in general considered the PVE-tool a pleasant and fun means to convey that preference.
5) Citizen participation is considered important by 80% of the respondents (who are obviously biased, as those who not consider participation important are less likely to participate in the experiment) and only a small percentage of the respondents stated to have insufficient knowledge on budget allocation or USWM to advice the municipality.
6) Despite a fear of underrepresentation of older age group because of the digital form of the PVE-experiment, most age-groups (except 18-30yrs old) were properly represented in the sample group. The underrepresentation of the younger citizens is not related to the digital tool of the PVE-experiment, but has to do with their willingness or time to participate.
7) Setting-up the PVE-design was a lengthy process, because a clear guideline for the application of the PVE-method was lacking and the objectives of the PVE-experiment in the case study were not clearly defined. However, once these issues were resolved, the PVE-method allowed for customisation of the tool, such that it could be tailored to the case of USWM. Particularly, the multi-faceted approach to USWM made it possible to include a fair set of trade-offs in the PVE-design.

5.1.2 Barriers for the applicability of the PVE in USWM

1) Targeting respondents is challenging at municipal level, yet crucial for the applicability of the PVE. By random sampling inhabitants and asking them to voluntary participate in the experiment via impersonal invitations via paper mail doesn't provide the amount of response needed to perform the econometric choice modelling.
2) The current set-up of the PVE-experiment on USWM is too complex. Respondents (n=10) indicated concerns regarding the task complexity. Additionally, the overrepresentation of well-educated people could be an indication of the complexity of the task for respondents.
3) The applicability of the results in the experiment are dependent on how well the sample group represents the population of The Hague. Well-educated people are overrepresented in the sample group, as well as higher-income groups and male respondents. In the case study, the results of the PVE case study can therefore not be interpreted as the preference of the entire society in The Hague.

5.2 METHODOLOGICAL STEPS FOR APPLYING A PVE-EXPERIMENT

This thesis provides a stepwise approach for setting up a PVE-experiment that can be used for future application of the PVE-method (see section 2.3). This approach turned out to work well for this case study. However, this approach is not validated in other research and thus does not provide any guarantees that it will lead to a successful set-up of a PVE-study in other cases. The approach for setting up a PVE-experiment requires a finish-to-start planning for the phases PVE Design, Data Gathering and Data Analysis. Particularly the PVE Design phase is characterised by an iterative process of (1) selecting and characterising measures, (2) selecting and characterising attributes, (3) setting up survey for follow up questions, (4) developing the website for the PVE-tool and (5) framing the case study and task for the respondents (see figure 5.2-a). This iterative process can be made more effective by having a clear and singular objective with the PVE-experiment and by hosting workshops and test sessions on the PVE-design to arrive at a well-balanced and dedicated PVE-experiment.

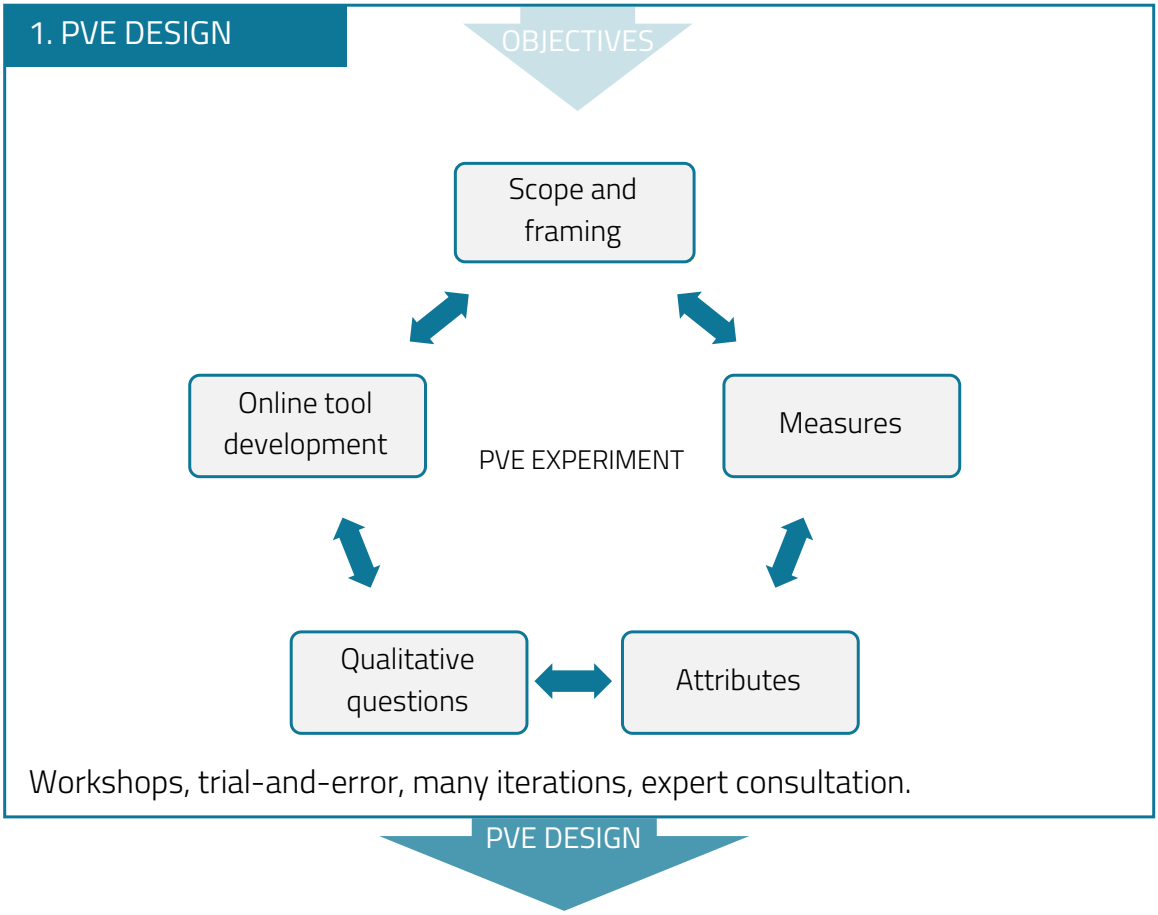

Figure 5.2-a: Steps in setting up the PVE-experiment

5.3 DESIGN OF THE PVE-EXPERIMENT IN THE CASE STUDY

The requirements for the design of the PVE-experiment were identified in workshop. Some adjustments to the tool were needed to tailor the PVE-experiment to the context of USWM in The Hague and to the requirement that were identified in the workshops, literature study and expert consultation. In order to adapt the PVE-method to the specific context of USWM, the design of the PVE-experiment in the case study was fundamentally different from the design of the PVE in previous applications of the PVE on six points:

1) The use of the PVE as a configuration tool, which required the tool to be adjusted with the possibility to select a multitude of each measure.
2) The absence of the option to delegate the task to an expert.
3) The use of an undefined project location, instead of real-life project plans with a designated geographical location
4) The use of a fixed, rather than a flexible budget
5) The cumulative reporting of the effects of the selection in the tool, with special attention given to the effect on the attribute Superfluous water.
6) The use of subsidies to include privately operated measures in the allocation of a public budget.

Even though the calculations of the effects of the measures were highly simplified, the PVE-design resulted in realistic trade-offs between attributes in USWM decision-making. Particularly the representation of the effects of the measures on the risk of superfluous storm water was somewhat unrealistic as a result of the simplifications. These simplifications were needed, because the occurrence of superfluous water events is dependent on many (technical) variables, is dynamic over time and is dependent on the specific configuration of measures. As the current set-up of the PVE-method does not allow for dynamic calculations of the total effects of the selected measures, because of limitations to the online tool, the risk reducing effect of the measures had to be simplified to a static representation. As probabilities are hard for respondents to assess without any references, the representation also needed to be adjusted into a unit that was easy to be assessed and allowed to show to what extent the combination of measures as a whole contributed to achieving the goal in the experiment (solving the problem of superfluous water). Therefore, the risk reducing effect of the measures was reported as the [number of days that superfluous water would be prevented by implementing the measure].

5.4 RELEVANCE OF THE RESULTS FROM THE PVE-EXPERIMENT FOR DECISION-MAKING PROCESSES ON USWM

The qualitative results showed that whether a solution adds green space is almost considered equally important as whether the measures reduces the risk of superfluous storm water (mentioned as motivation for selecting a measure 114 and 116 times in total respectively). The quantitative results on whether a respondent has selected a measure or not, showed that *permeable paving* and *green strips* are preferred by citizens. The *Raised building, water square* and *water basement* clearly were least favoured by citizens. The latter emphasizes the demand for green space to be added to the project area. The response to the PVE-experiment was insufficient to perform the econometric choice modelling. As a result, no insights are obtained regarding the total utility of the various measures and the effects of the attribute levels on that utility.

Thus, the results that are obtained in the PVE-experiment provide input for early stages (policy formulation and decision-making) of the municipal decision-making process. The qualitative data partially compensates for the lack of econometric choice modelling to determine the value of each attribute. The level of participation that is currently achieved with a PVE-method is consulting or potentially advising. The applicability of the PVE-method as a tool for binding co-producing of co-deciding is still too limited as (1) the representation of the population in the sample group is inadequate, (2) not all possible decision-variables can be included in one PVE-experiment, (3) a majority of the respondents indicate that they do not expect the results to be followed blindly, but expect the results to be considered in future policies, while experts remain in charge of the final decision and (4) because maturity of the PVE-tool and the applicability of the PVE-method are not (yet) sufficiently validated in multiple studies. Additionally, PVE-methods enhance knowledge sharing and communication between municipality and citizens and can as such function as a bridge between political, policy and problem streams in decision-making. Yet, the PVE-method in its current form is meant to derive the preference of citizens for a pre-defined problem and set of alternatives, rather than to ask citizens to put their own problems or alternatives on the agenda.

5.5 EVALUATION OF THE PVE-METHOD BY RESPONDENTS

The evaluation of the PVE-method showed a need for a visually more attractive lay-out of the PVE-website. The use of a more sophisticated interface could help to reduce the complexity of the PVE, which has been stated to be the biggest downside of this method. Additionally, alternative means to provide instructions on the use of the online tool should be explored, as the video was mentioned to be a source of irritation by a small group of respondents. Furthermore, various respondents

explicitly stated that the follow-up on the PVE-experiment is crucial to them and considered this to be part of the experiment. This shows the challenge in managing expectations, but particularly emphasizes the need for clear and open communication on the objectives with an experiment and on the use of the outcome of the study. Even though the demand among citizens for follow-up is high, some respondents do not have high expectations as to whether the municipality will provide that desired follow-up (*"I hope the municipality will do a lot with the results, but to be honest, I don't expect they will. Sorry").* Therefore, the municipal authority should consider what follow-up action will be taken and how this follow-up is communicated to the respondents. If the citizens perceive no follow-up action was taken on the results of the PVE-experiment, the mistrust of citizens will increase, rather than that support for the decision-making is generated and citizens will become less inclined to participate in future participatory processes.

On a more positive note, the PVE-method has proven not only to be a means for municipalities to gather input on the preferences of its citizens for specific measures and attributes, but simultaneously provides the public authorities a way to create awareness and explain the effects of different measures on the attributes. The PVE-experiment can thus be used to stimulate two-sided communication and information exchange between municipalities and its citizens. Creating awareness is important to generate support for decision-making as well as to incentivize citizens to actively contribute to USWM themselves. Apparently, citizens themselves also perceive this knowledge effect to be a benefit of the PVE-method. Additionally, citizens state to appreciate the fact that their opinion seems to matter, which is also supported by the response to the question whether participation of citizens in decision-making processes is important. Various respondents have also explicitly mentioned to consider the PVE-method a fun a comprehensible means to organize that participation. To use the words of one respondent to summarize these benefits: "*More fun, "more active", more visual than a regular survey. Educational! Informs on the possible measures, their pros and cons, costs and trade-offs. Good for perception and opinion.*"

5.6 PRACTICAL LESSONS LEARNED FROM APPLYING THE PVE IN USWM

LL1: Stating clear objectives for a PVE-experiment are key to be able to arrive at a PVE-design that can provide the targeted results.

LL2: Limit the scope of the PVE. Rather perform multiple different experiments to reach the objectives, than trying to put too much in one PVE-design.

LL3: Workshops are very effective for both diverging on possible measures and attributes to include in the PVE-design, as well as to converge towards the final selection of measures and attributes to be included in the experiment.

LL4: Use simple and clear sentences in the framing of the PVE-experiment, such that all respondents in the targeted response group can understand. Leave out technical descriptions of attributes and measures. Use language that is easy to understand and relates back to the respondent's own environment. Consider setting up the PVE-experiment in multiple languages if that is necessary to obtain a representative share of the population in the sample group.

LL5: Collaboration with other parties can impose risks on your planning, but often enhances the quality of the research. For example, the collaboration with the municipality of The Hague provided fruitful insights in the workshop, as well as that the response ratio was probably increased by sending the invitation letters (see Appendix I) on behalf of both the Municipality and the researchers. Similarly, the PVE- tool would not have been as good without the external support from SplicedGene, but it came at the price of a large delay in the planning of this research.

LL6: Being pragmatic is needed now and then. Not every single detail can be modelled to perfection. Always reconsider if going in depth adds to the objectives set out for that element in the research.

LL7: Test, Test, Test. The only way to get a true feeling on the task complexity, the trade-offs, ambiguities and potential flaws in the PVE-design is to test the experiment. Testing the design as a researcher yourself is important, but particularly valuable feedback is derived from tests with persons that do not have any affiliation with the research or the topic at hand.

LL8: Put effort in making clear visualisations, as they help respondents to better understand the situation.

LL9: The video is considered important, yet also seems not to be preferred as instruction method by some respondents. Consider using different means to instruct on the use of the website, like a little tour of the interface etc.

Chapter 6:

Discussion and future research

OUTLINE OF CHAPTER 6

This final chapter consist of a reflection on this master thesis study and an outlook towards future work in this field of research. Section 6.1 elaborates on the possibilities to deal with the limitations to the applicability of the PVE-method in the context of USWM that are identified in this research. Section 6.2 reflects upon the limitations of the study performed in this master thesis. Section 6.3 is dedicated to a more detailed discussion of the response ratio in the PVE-experiment from the case study. Lastly, section 6.4 ends with suggestions for future research on the PVE-method.

6.1 DEALING WITH LIMITATIONS TO THE APPLICABILITY OF THE PVE-METHOD

On basis of the input gathered in this thesis, the conclusion is drawn that the applicability of the PVE in the field of USWM is bounded by three limitations. Various approaches for dealing with those limitations are discussed below.

1) Targeting respondents is challenging at municipal level, yet crucial for the applicability of the PVE. By random sampling inhabitants and asking them to voluntary participate in the experiment via impersonal invitations via paper mail doesn't provide the number of respondents needed to perform the econometric choice modelling.

This limitation can be resolved in two ways in future PVE-experiments in USWM. Either respondents should be targeted differently, such that the threshold for participation decreases. For example, respondents might better be targeted via email or through panels of inhabitants who have stated to be willing to participate in research projects (like the Stadspanel in many large municipalities). Or other incentives for participation should be created, either monetary or through addressing location specific measures in the PVE-design. Future research on the effect of different approach strategies on the composition of the sample group in PVE-experiments specifically would help to understand better how a representative sample group can be generated at different levels (national, regional and local) of applying the PVE.
Or, the problem is resolved by solely using the PVE-method as a tool to collect basic statistics on consumer preferences (like the frequency tables in section 4.2) and insights in the qualitative motivations for those stated choices. Even without econometric choice modelling, the PVE-method can supply valuable input for municipal decision-making in line with citizens' preferences. For this specific type of application of the PVE-method, further research in the costs related to such experiment. It could be that the PVE-method is too sophisticated, and thus time, knowledge and capital-intensive that the same objectives could also be achieved through more simplistic methods. Or to use the suggestion from one of the respondents of the case study experiment:
"*Maybe a light-version of the PVE can be developed to allow for quick consultation of citizens' preferences*"

2) The current set-up of the PVE-experiment on USWM is too complex. Respondents (n=10) indicated concerns regarding the task complexity. Additionally, the overrepresentation of well-educated people could be an indication of the complexity of the task for respondents.

This complexity is partially inherent to the field of USWM. Defining the configuration of USWM is in essence a rather technical task. This complexity was also noted in the characterisation of the attribute "Superfluous water". The static representation of the effect of a measure on the risk of superfluous water was difficult and is therefore based on many assumptions and simplifications that do not reflect the real situation. The task complexity can be reduced by solely applying the PVE-method to evaluate projects (which encompass specific measures for USWM) binary, as was done in other PVE-experiments. The PVE-method is more comprehensible if only a selection of stand-alone projects is asked, rather than a configuration in which also the quantity of a measure can/should be selected. Additionally, it doesn't require the modelling of interaction effects of measures in different configurations.

Yet, this conclusion does not imply that the PVE-method cannot be used as a configuration tool at all. In less technical sectors, the configuration task might be very well possible, without becoming too complex. If the interface of the tool could be further developed and if the tool would allow for dynamic calculations of the total effects of the configuration on the attributes, the PVE-method might also be useful for configurations in more technical sectors. However, this would have serious implications for the choice modelling and calculation of the utility function, so further research would be needed to check the feasibility of such a dynamic PVE-configuration tool. A first step in this further research, would be to examine whether the assumption that *the option to select a multitude of each measure, does not lead to new insights in the utility of the measures* is true for the data gathered in this case study. This functionality was now included, because it was needed to allow for the configuration task to be realistic. Additionally, it was assumed that this addition to the PVE-method might be of added value as an indication of the relative importance (weight) given to that measure. However, the results of the case study raise questions as to whether the selected multitude might just solely be related to the costs of the measure. Probably, the MDCEV-model used to assess the "standard" PVE-experiment is still effective as a means to calculate the overall utility. The only difference would be that the number of alternatives increases exponentially, as every configuration should be treated as a different alternative providing the cumulative effect of the selected number of the measure on the attributes. The practical applicability of this method should be tested, as the list of alternatives might become too long, with too little data on each of the alternatives to draw any significant conclusions. Alternative choice modelling techniques should be evaluated as well, as the MCDEV method would probably not be applicable if the PVE-method is expanded to dynamically calculate the effects of a specific configuration, as the conditions for the binary selection no longer apply. Previous studies have indicated that binary modelling of portfolio data could lead to completely different results than if portfolio modelling was applied, as a result of poorly (too

negatively) estimated project intrinsic value. Therefore, one must be careful with applying potentially inappropriate modelling techniques to analyse the data (Koster, personal communication 29 august 2018). Further research should focus on finding the appropriate modelling methods.

3) The applicability of the results in the experiment are dependent on how well the sample group represents the population of The Hague. Well-educated people are overrepresented in the sample group, as well as higher-income groups and male respondents. In the case study, the results of the PVE case study can therefore not be interpreted as the preference of the entire society in The Hague.

It could be that over- or underrepresentation of specific groups in the sample, is related to the (lack of) desire of groups to participate in public decision-making in general and not related to the PVE-method specifically (e.g. Wittmayer (2016) also sees an overrepresentation of male participants with higher incomes in face-to-face participatory processes). Future research is needed to determine whether the composition of the sample groups is significantly different in various methods of public participation.

6.2 DISCUSSION ON RESEARCH

In addition to the discussion on how to overcome the limitations of the PVE-method, this research has raised some other points for discussion.

1) Two of the measures that were included in the PVE (Rain tanks and Rain gardens) concerned subsidies granted to the citizens themselves. The underlying assumptions was that this would be a means to assess the willingness of citizens to participate not only in the decision-making, but also in the actual implementation and maintenance of USWM measures. However, the qualitative responses indicate that one cannot conclude on basis of the quantitative data whether the respondents selected the measure because they want to actively contribute to storm water management, or because they see subsidies as a means to collect "free items" from the municipality.
2) In the design of PVE-experiment for the case study, it is not considered that some measures should actually be realized in specific combinations with other measures. For example, the water square needs to be connected to a discharge system, otherwise the water on the square will not drain in dry periods either. In fact, the measures in the PVE-design have different purposes in the chain of USWM. Some measures, solely provide retention capacity (e.g. rain tank), others (e.g. like the separated sewage system) provide discharge capacity

and some provide a combination of both retention and long-term storage capacity (e.g. rain garden). Thus, in reality, these measures would be linked with each other (e.g. a green roof would be connected to either a pond or the sewerage system or the water square would discharge into the sewerage system). Asking respondents to consider these connections in their configuration would make their task too technical and too complicated. In future studies, it might be worth considering to use "sales packages" with specific combinations of a retention and a discharge measure. In her research, Pak (2018) used an PVE-experiment that included sales packages of specific combinations of alternatives to transition towards gas-free neighbourhoods. Such set-up of the PVE-experiment could also be applicable in the field of USWM, by making sales packages that include combinations of means for water catchment, retention, transport, discharge, filtration and re-use.

3) Since the new EU regulation on data protection that was installed on the 25th of May 2018, it is no longer possible to retrieve respondents IP-addresses, unless explicit consent is asked. It was chosen not to ask this consent out of fear it would impose a serious burden on respondents' willingness to participate. As a result, limited options are available to control the fraudulent use of the PVE-tool. At this point, there is no limit to the number of entries respondents can make to the website and no means are available other than their stated response on date of birth, postal code and email address to check for multiple entries by the same respondent. Simultaneously, the session data is comprised because the researcher had to no option to use a designated version of the tool and as such, visits to the website by the researcher were also included in the session data reports. Improvement should be made to the PVE-tool, either through limiting the use of the tool to one session by asking a unique user code or by providing a dedicated personal link to each respondent.
4) The PVE-experiment generated data that could be used for many more analyses then have been performed in this study. The survey generated input on car ownership to assess whether these would affect their preferences for measures that impact the number of parking places, or data to assess the influence of the type of home-ownership on the response and the respondents' preference for subsidies specifically. A more thorough analysis on whether a respondents' gender affects the underlying motivations for selecting a measure can be performed. Or what the relation is between the other demographic statistics and the stated preferences, motivations and perception regarding the PVE-method can be studied. Additionally, there also seems to be some correlation between the selection of specific measures (based on a quick-scan in correlation matrix SPSS). The dataset has mostly been prepared for all those analyses already.

6.3 ADDITIONAL DISCUSSION ON THE RESPONSE RATIO

There is a slight bias is the number of visits as presented in section 4.1.1, as there was no designated version for the researcher to enter, without intervening with these statistics. As the researcher did pay quite a large number of visits to the website to showcase the method, to retrieve information or simply because of faulty navigation to the back-end of the website, the actual number of visits from potential respondents is estimated to be 10/15% lower. This has two effects:

1) The ratio of respondents who did visit the website and ended-up completing the experiment is at least higher than the 22,1% (=149/673) that is reported in the actual tracking of the website. Particularly if one considers the fact that if a respondent enters the link to explore if (s)he is interested to participate and decides to complete the experiment another time, the exploration of the website also counts as an active visit. Thus, even though no hard evidence is available, the high completion ratio of the visitors of the website implies that the online environment is sufficiently inviting and understandable for respondents to participate.
2) The ratio of people who received an invitation to participate and those who actually entered the link to visit the website is lower than the 13,5% (=673/5000) that is concluded on basis of the website tracking. This ratio is lower than expected, particularly considering that multiple visits from one person are counted as a unique session. Under the earlier substantiated assumption that people who do visit the website are likely to indeed complete the experiment (over 22%), the question arises why the number of visits to the website out of 5000 invitations is so low. This question is addressed in more detail in section 6.3.

The fact that the actual response turned out lower than was expected, might be explained by the specific circumstances under which the invitations to participate in the PVE-method were send. Five possible factors that may have caused the lower response ratio are discussed here in more detail.

1) In order to participate, the respondents had to enter the link provided in the letter on a suitable browser on a computer. Even though this seems like a minor action, it is assumed that this could be an important burden for people not to participate. If the person reading the letter was not sitting next to a computer, it is possible that the invitation would already be forgotten by the time the potential respondent did have a computer available. Unfortunately, due to privacy and anti-spam policies it was not possible to invite inhabitants to participate via email, so this was the best available way to approach respondents.

2) A second limitation caused by privacy regulations, was that only the addresses of the inhabitants could be provided and thus no names or other personal information. Because the targeted respondents were selected in a random sample, it did occur that one address received two anonymously addressed invitations to participate. Again, not the ideal situation, also because it is assumed that personally addressed letters would receive better response.
3) Thirdly, due to cost and time-restrictions it was not possible to send reminders. Some targeted respondents might have been willing to cooperate, but forgot about it or lost the letter unintentionally.
4) Forth, the invitations arrived in the beginning of July, which is a typical holiday period in the Netherlands. Even though respondents had four weeks to complete the experiment, it is assumed that the holiday period negatively influences the response ratio.

Despite this long-list of factors that presumably have played a role in the lower response ratio, no hard evidence for either of those explanations can be given. Therefore, this data neither proves nor refutes whether some not-replying targeted respondents might have no interest to participate. They may have felt it would take too much time (even though no time indication was mentioned), it could be that they had no interest in of knowledge of the topic, nor perceive any problems with superfluous water, they could have been on holidays et cetera. More PVE experiments should be held in order to be able to draw any conclusions on the willingness of respondents to participate in such participatory studies.

6.4 SUGGESTIONS FOR FUTURE RESEARCH

Some suggestions for future research have already been mentioned in the discussion of the limitations of the applicability of the PVE-method and this research. In addition to those suggestions, a great amount of future work can be done on the further assessment and development of the PVE-method. Based on the experiences in this research, the following topics are highly relevant and interesting to be studied in future research to further enhance the PVE-method as a public decision support tool.

1) A key point for future research is to study the communication around the application of a PVE-experiment. The results showed a clear need for follow-up among respondents of the PVE-method. In order to exploit the potential benefits of the PVE-method and to prevent the negative consequences of nothing being able to meet the demands of the citizens,

expectation management throughout the PVE-research is key to the success of the application of the PVE-method. Additionally, the implications of implementing different measures than were preferred by citizens, could hamper instead of generate support for decision-making. How should municipalities deal with the results of the PVE. Is it desirable to use the PVE-method for participation at the participation level of co-producing and co-deciding? Or should (experts within) the municipal authority always make the final decision?

2) In the current PVE-experiment, respondents are asked for a qualitative response as to why they have selected that specific measure. However, no questions are asked on why they did not select the other measures, while this might provide just as much or maybe even more valuable input on citizens' choice behaviour. As resistance against public-decisions is mainly generated out of people's dislike for a certain measure, it would be helpful to know which elements of a project could cause that resistance, such that actions can be taken to resolve those problems early if the measure would be implemented eventually.
3) Under the assumption that the applicability of the PVE-method will develop further to overcome (or deal with) its limitations, the PVE-method could develop into a frequently used tool in municipal decision-making. However, if participatory decision-making (in general) becomes the standard, challenges might arise in the availability of respondents. If almost every public investment decision would be based on a participatory process, the burden on citizens could increase drastically. It is not feasible to expect citizens to participate in a participatory research every week/fortnight/month. Moreover, the studies would become too dependent on a small group of inhabitants willing to participate on such regular basis. Therefore, the question asked in this experiment whether "Participation of citizens in public decision-making is important" is insufficient, as this implies that participation is important under all circumstances. In order to control the roll-out of participatory studies in a municipality, future research should address the conditions for applying participatory studies (and the PVE-method specifically) in greater detail. For example, for what kind of public decision is citizen participation desirable? What type of participatory methods should be applied in those cases? Whom should be invited to participate? Which studies have priority over others? These insights could eventually be combined in a structured overview to help municipal to organize their participatory decision-making processes effectively.
4) In addition to its application in citizen participation, the PVE-methods also has potential for other applications. For example, the PVE-method could be used to evaluate the preferences of experts, rather than citizens to align on the best applicable measures. Particularly in larger

organisations, like municipal authorities, the method could be a valuable means for aligning the different departments within the organisation.

5) The design of the PVE-experiment in this research, introduced the application of the PVE-method as a configuration tool, within a new context (USWM) and was the first application that reported a second attribute (Days with superfluous water) in addition to the budget constraint. Simultaneously, the PVE-design differed from previous applications regarding option like to delegate a decision, in the use of a dynamic budget. In order to determine the effects of each of these alterations, the changes should be made in studies with two sample groups, in which one alteration differ between the groups. Only then, the actual effect of the alterations can be determined.

   Alternative approaches could have been used for the qualitative evaluation of the PVE-method. For example, a separate follow-up survey could be sent to all targeted respondents of the PVE-experiment. This survey could then also have functioned as a reminder to participate in the PVE-experiment or provided the opportunity to include an evaluation of the follow-up actions that would be taken (see point 1 of this section 6.4 on the importance of assessing the communication strategy around a PVE). Additionally, a separated (follow-up) survey could provide a more balanced view on the perception of citizens regarding participatory decision-making, as the current survey results are suffering from a major bias: only those people who participated in the experiment (as thus are likely to be in favour of participatory processes) were given the follow-up survey. Therefore, no insights were gathered on why other inhabitants did not participate and how they feel about the importance of participation in general.

   The separated survey was not chosen in this research for two reasons. First of all, there could be too much time between completing the PVE-experiment and filling out the follow-up survey, causing respondents to forget about their experiences with the PVE-experiment. More accurate responses on the positive and negative sides of the PVE would be obtained through a survey directly after completion of the PVE method. Secondly, a separate follow-up survey does not allow for any analyses of the relation between the perception regarding the PVE and the actual execution of the PVE-method. For example, if a respondent indicates in the separated follow-up survey that the experiment took too much time, it cannot be checked with their actual session-time. Still it would be valuable to perform a more longitudinal study, which includes follow-up surveys to determine the effects of the PVE-method as a tool to create awareness, to enhance the support for decisions and to see how respondents evaluate the follow-up by the municipality after completion of the PVE.

Additionally, a longitudinal approach consisting of multiple PVE-experiment would help to examine the effect of specific alterations in the PVE-design on the results generated from and the evaluation of the PVE-experiment.

Alternatively, the PVE-method and interface can also be evaluated through computer assisted personal interviewing (CAPI). In CAPI evaluations, a smaller group (ten to twenty persons) of the respondents perform the PVE-experiment under supervision of an interviewer, who can monitor the experiences of the respondents throughout the completion of the PVE-experiment.

To conclude, the extensive discussion on this research and the PVE-method should not to be mistaken for the fact that the PVE-method is not sufficiently developed to be applied on a large scale. Instead, all these suggestions for future research indicate how broad the potential of the PVE-method is and why it is interesting to further explore its opportunities through future research and applications of the PVE-method.

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Overview of appendices

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Appendix I: Letter to invite inhabitants to participate in the PVE-experiment

Delft, 31 juli 2018

Aan de bewoners van dit adres
«STRAAT_HUISNR»
«POSTCODE» «STAD»

Afz. Kieran Dartée
k.w.j.dartee@student.tudelft.nl

Betreft: Deelname Bewonersonderzoek 'Voorkomen Wateroverlast Den Haag'

Geachte inwoner van de gemeente Den Haag,

Wij nodigen u graag uit om deel te nemen aan het 'Bewonersonderzoek Wateroverlast Den Haag' van de TU Delft in samenwerking met de gemeente Den Haag. Steeds extremere regenbuien en sterke verstedelijking zorgen voor wateroverlast. Welke maatregelen genomen kunnen worden om die wateroverlast te voorkomen staat echter nog niet vast.

De gemeente Den Haag wil bij het zoeken naar oplossingen hiervoor graag weten wat de voorkeur van bewoners is. Op basis van de maatregelen die u en andere bewoners selecteren, krijgt de gemeente een duidelijk beeld van welke maatregelen inwoners het meest wenselijk en geschikt vinden.

Dit onderzoek bestaat niet uit een traditionele, langdradige vragenlijst, maar is een boeiende puzzel. U krijgt de kans om op de stoel van de gemeente te gaan zitten en aan te geven hoe u een gemeentelijk budget zou verdelen over verschillende maatregelen tegen wateroverlast. We stellen het zeer op prijs als u meewerkt aan dit onderzoek. Op die manier komen we samen tot de beste maatregelen die woonwijken in de toekomst waterbestendig maken en die naar voorkeur van bewoners zijn ingericht!

Via de volgende link komt u in de onderzoeksomgeving[1]:
WWW.BEWONDERZOEK.NL

Alvast bedankt voor uw medewerking namens de TU Delft en de gemeente Den Haag!

Met vriendelijke groet,

Kieran Dartée
Onderzoeker, TU Delft

[1] Het experiment werkt niet optimaal op de mobiele telefoon. U kunt het beste gebruik maken van een computer met standaard browserinstellingen (Google Chrome, Mozilla Firefox of Apple Safari).

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Appendix II: Content of the website

The following screenshots provide an indication of the different pages on the PVE-website. The complete tool can be experiences through https://bewonderzoek.nl. In appendix III, all textual content of the PVE is provided. The text on the website is in Dutch. An explanation of the content in English can be obtained via the author of this master thesis.

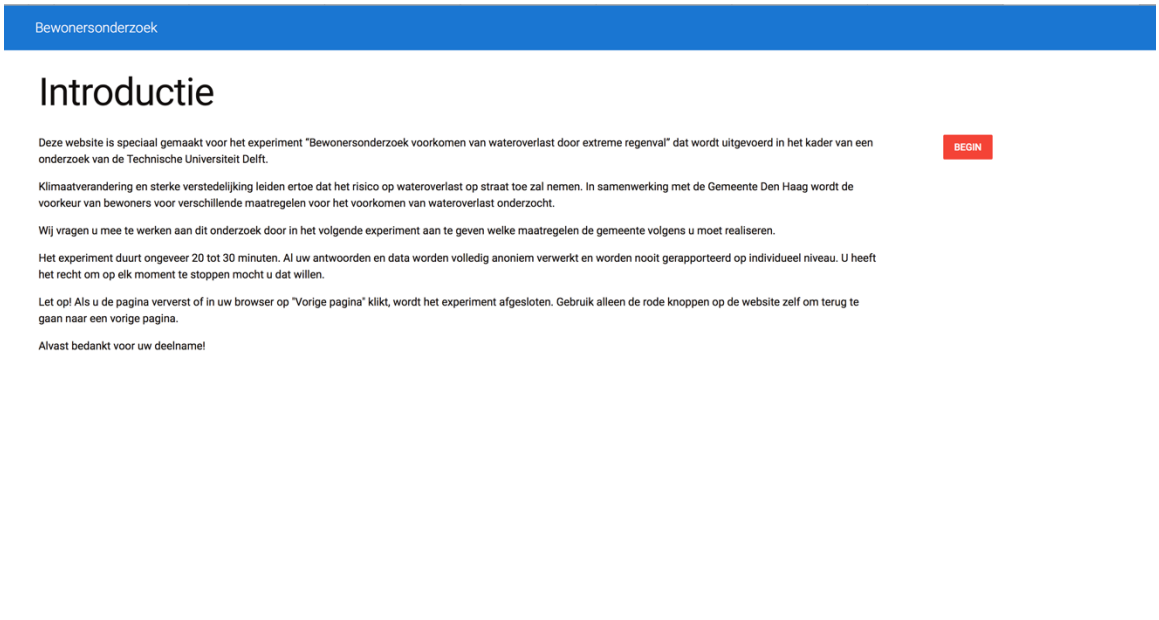


Figure App-a: Introduction page of the PVE-website

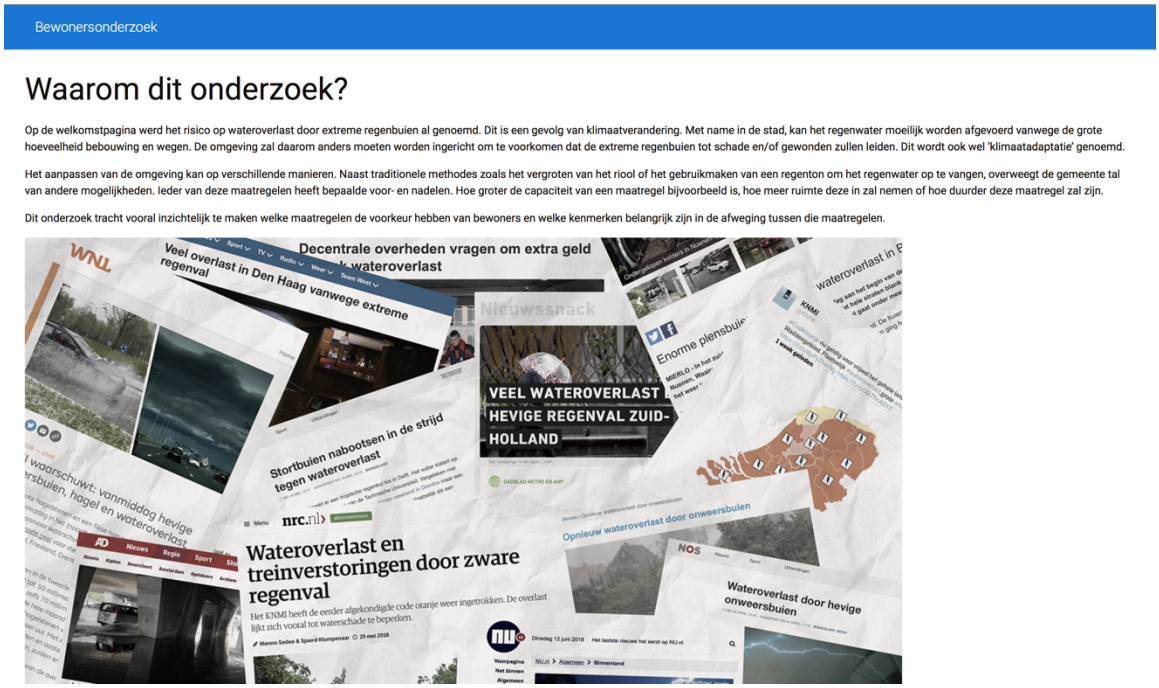


Figure App-b: Second page of the PVE-tool explaining the reason behind this research.

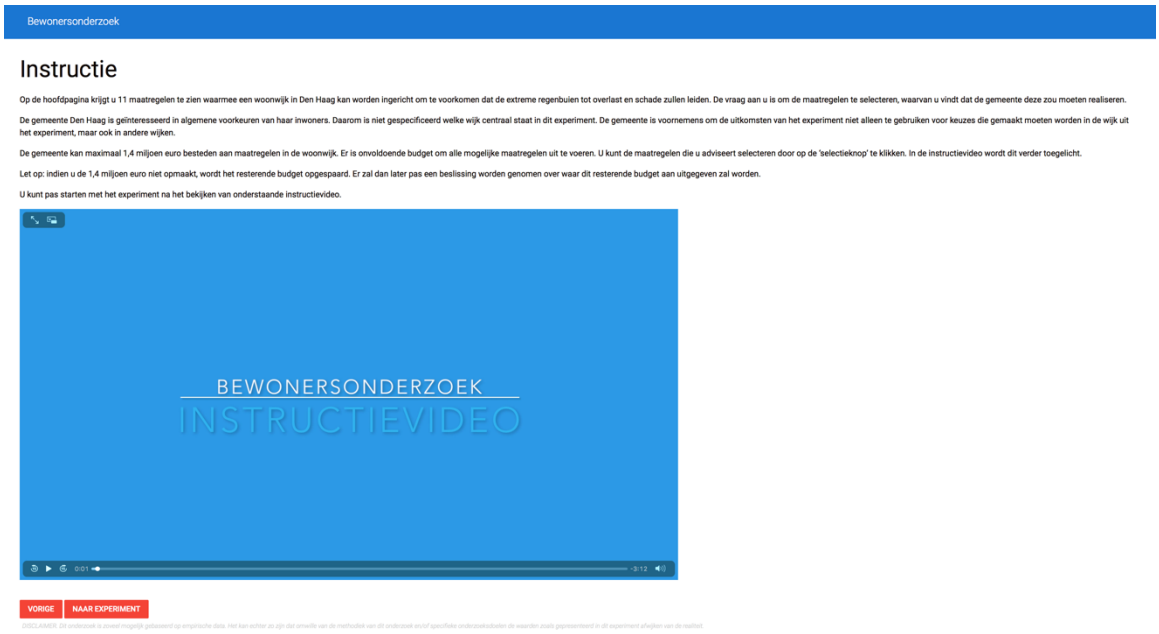


Figure App-c: Instruction page of the PVE-website

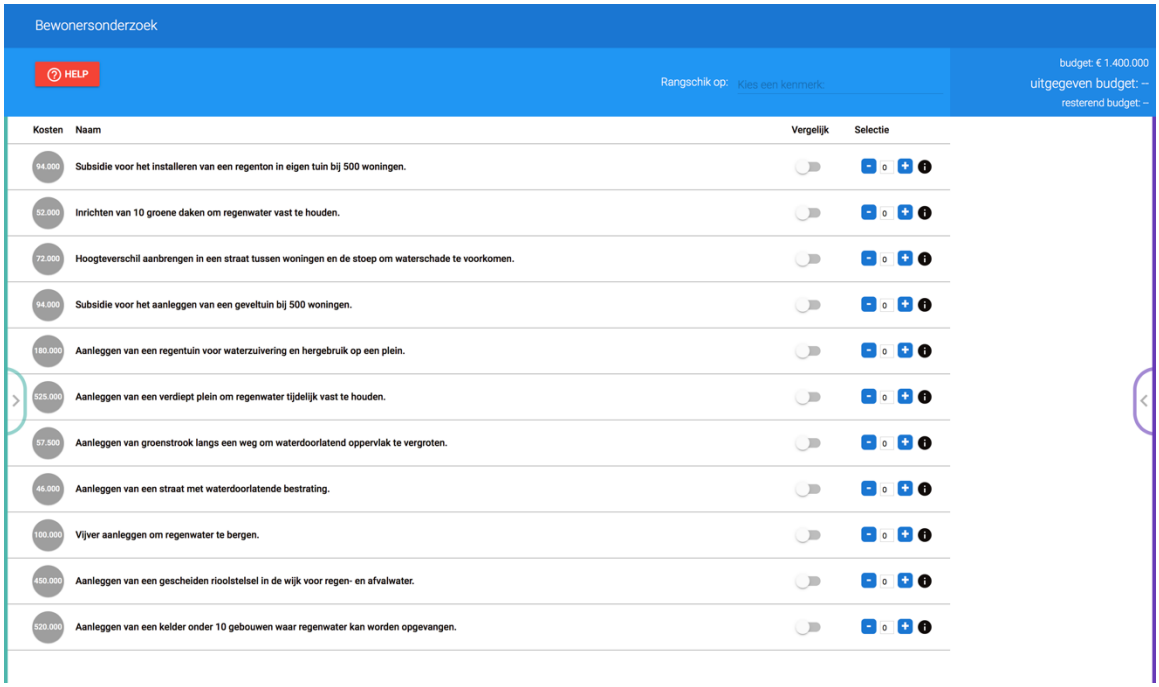
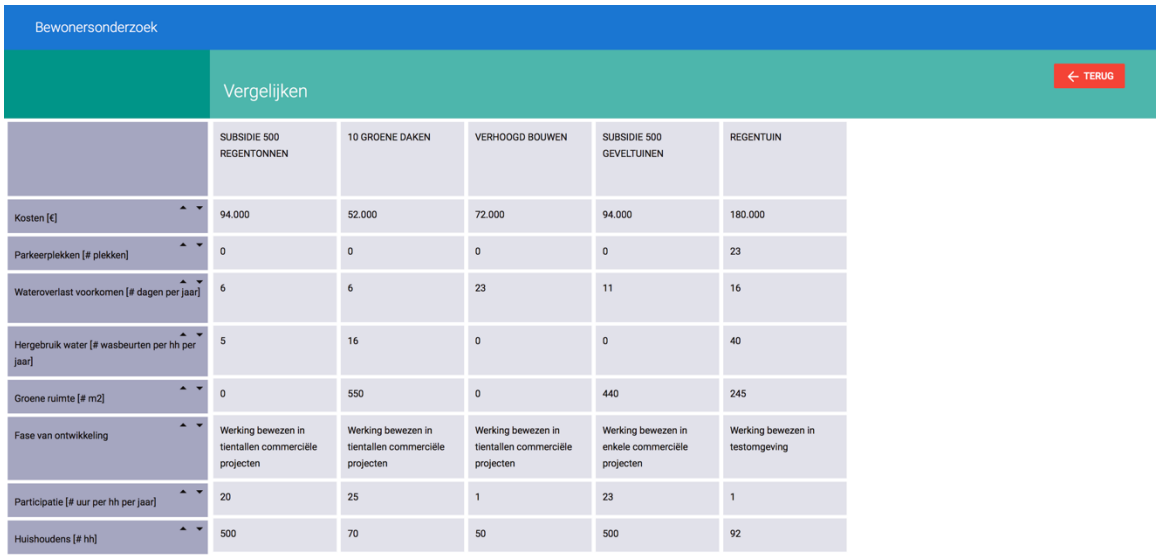


Figure App-d: Overview of the main page of the PVE-website showing all possible measures, the selection and comparison switches, and the remaining budget.



	SUBSIDIE 500 REGENTONNEN	10 GROENE DAKEN	VERHOOGD BOUWEN	SUBSIDIE 500 GEVELTUINEN	REGENTUIN
Kosten [€]	94.000	52.000	72.000	94.000	180.000
Parkeerplekken [# plekken]	0	0	0	0	23
Wateroverlast voorkomen [# dagen per jaar]	6	6	23	11	16
Hergebruik water [# wasbeurten per hh per jaar]	5	16	0	0	40
Groene ruimte [# m2]	0	550	0	440	245
Fase van ontwikkeling	Werking bewezen in tientallen commerciële projecten	Werking bewezen in tientallen commerciële projecten	Werking bewezen in tientallen commerciële projecten	Werking bewezen in enkele commerciële projecten	Werking bewezen in testomgeving
Participatie [# uur per hh per jaar]	20	25	1	23	1
Huishoudens [# hh]	500	70	50	500	92

Figure App-c: Comparison window to quickly compare the effects of the measures selected for comparison

Figure 6.4-d: Overview of the rain garden measure. Each of the measures as its own page showing the visualisations, a brief explanation of the measure and the effects of the measure on each of the attributes.

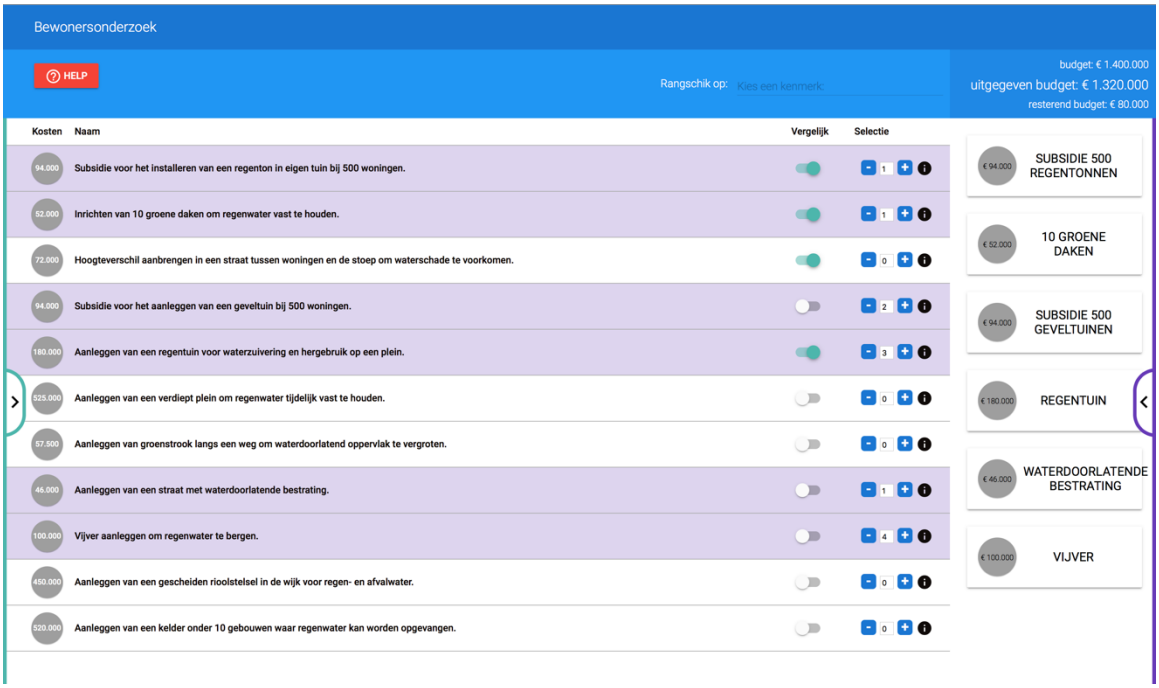


Figure 6.4-f: Overview of the main page indicating the selected measures and the remaining budget.

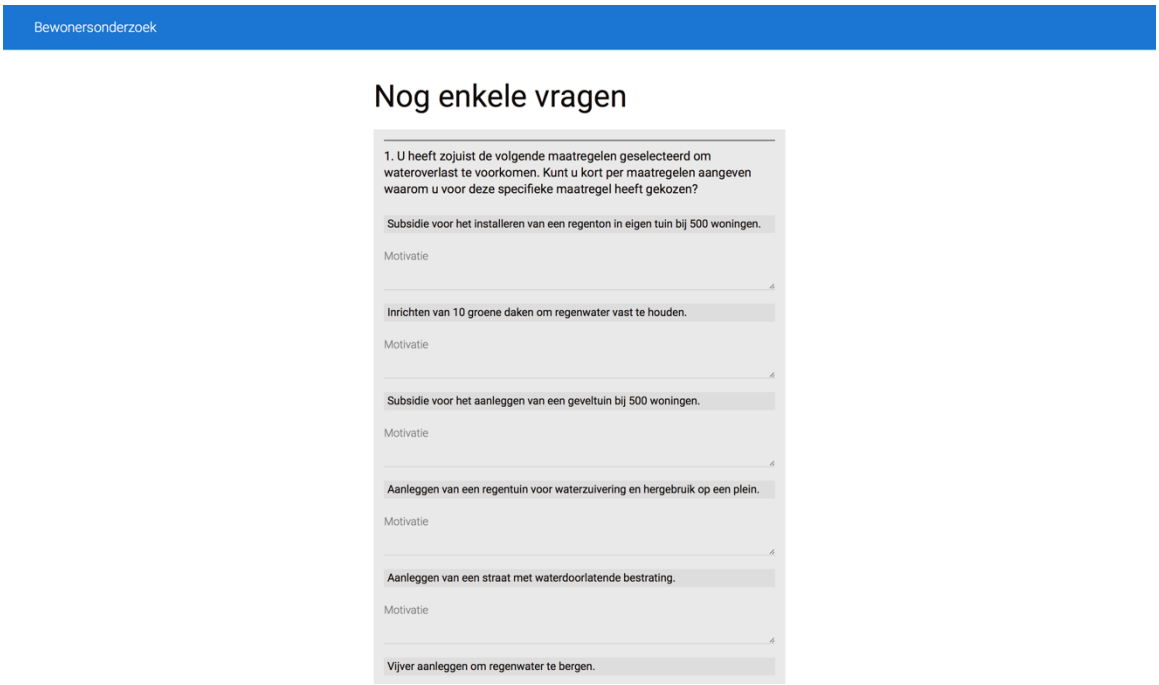


Figure App-e: Follow-up survey after completion of the PVE-experiment.

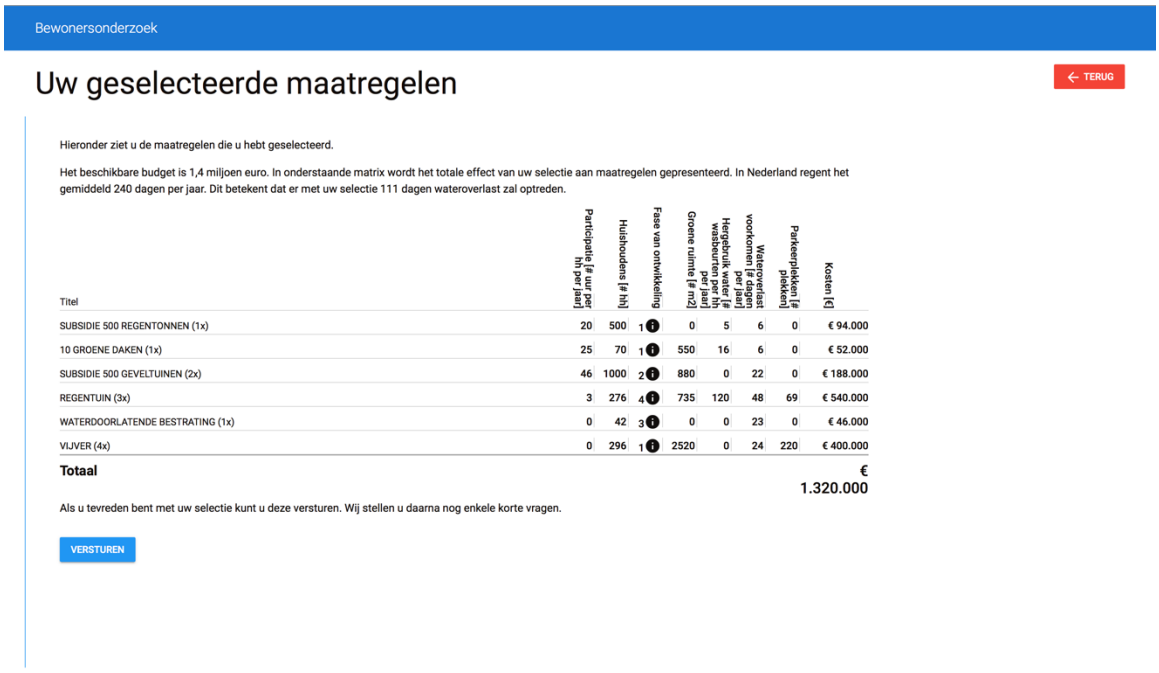


Figure App-g: Overview of the total effect of the selected combination of measures.

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Appendix III: Content website

This appendix presents the (Dutch) content of the PVE-experiment as was presented to the respondents.

INTRODUCTION AND INSTRUCTION OF THE PVE-TOOL

HOME PAGE:

WELKOM!

Deze website is speciaal gemaakt voor het experiment "Bewonersonderzoek voorkomen van wateroverlast door extreme regenval" dat wordt uitgevoerd in het kader van een onderzoek van de Technische Universiteit Delft.

Klimaatverandering en sterke verstedelijking leiden ertoe dat het risico op wateroverlast op straat toe zal nemen. In samenwerking met de Gemeente Den Haag wordt de voorkeur van bewoners voor verschillende maatregelen voor het voorkomen van wateroverlast onderzocht.

Wij vragen u mee te werken aan dit onderzoek door in het volgende experiment aan te geven welke maatregelen de gemeente volgens u moet realiseren.

Het experiment duurt ongeveer 20 tot 30 minuten. Al uw antwoorden en data worden volledig anoniem verwerkt en worden nooit gerapporteerd op individueel niveau. U heeft het recht om op elk moment te stoppen mocht u dat willen.

Alvast bedankt voor uw deelname!

WAAROM DIT ONDERZOEK?

Op de welkomstpagina werd het toenemende risico op wateroverlast door extreme regenbuien al genoemd. Dit is een gevolg van klimaatverandering. Met name in de stad, kan het regenwater moeilijk worden afgevoerd vanwege de grote hoeveelheid bebouwing en wegen. De omgeving zal daarom anders moeten worden ingericht om te voorkomen dat de extreme regenbuien tot schade en/of gewonden zullen leiden. Dit wordt ook wel 'klimaatadaptatie' genoemd.

Het aanpassen van de omgeving kan op verschillende manieren. Naast traditionele methodes zoals het vergroten van het riool of het gebruikmaken van een regenton om het regenwater op te vangen, overweegt de gemeente tal van andere mogelijkheden. Ieder van deze maatregelen heeft bepaalde voor- en nadelen. Hoe groter de capaciteit van een maatregel bijvoorbeeld is, hoe meer ruimte deze in zal nemen of hoe duurder deze maatregel zal zijn.

Dit onderzoek tracht vooral inzichtelijk te maken welke maatregelen de voorkeur hebben van bewoners en welke kenmerken belangrijk zijn in de afweging tussen die maatregelen.

INSTRUCTIE

Op de hoofdpagina krijgt u 11 maatregelen te zien waarmee een woonwijk in Den Haag kan worden ingericht om te voorkomen dat de extreme regenbuien tot overlast en schade zullen leiden. De vraag aan u is om de maatregelen te selecteren, waarvan u vindt dat de gemeente deze zou moeten realiseren.

De gemeente Den Haag is geïnteresseerd in algemene voorkeuren van haar inwoners. Daarom is niet gespecificeerd welke wijk centraal staat in dit experiment. De gemeente is voornemens om de uitkomsten van het experiment niet alleen te gebruiken voor keuzes die gemaakt moeten worden in de wijk uit het experiment, maar ook in andere wijken.

De gemeente kan maximaal 2,2 miljoen euro besteden aan maatregelen in de woonwijk. Er is onvoldoende budget om alle mogelijke maatregelen uit te voeren. U kunt de projecten die u adviseert selecteren door op de 'selectieknop' te klikken. In de instructievideo wordt dit verder toegelicht.

Let op: indien u de 2,2 miljoen euro niet opmaakt, wordt het resterende budget opgespaard. Er zal dan later pas een beslissing worden genomen over waar dit resterende budget aan uitgegeven zal worden.

[+video}

ATTRIBUTE DESCRIPTIONS PVE-EXPERIMENT

ATTR. 1: KOSTEN

Kosten in €.
[€]

De eenmalige financiële investering die nodig is om de maatregel te realiseren, waarbij rekening is gehouden met onderhoud- en beheerkosten over de looptijd van het gehele project. De kosten zijn de kosten voor de gemeente. Het gaat hier niet om uw eigen geld. De regenton zou bijvoorbeeld worden gerealiseerd door een subsidie vanuit de gemeente, waarmee bewoners een eigen regenton aan kunnen schaffen.

ATTR. 2: PARKEERPLEKKEN

Aantal parkeerplekken dat moeten worden weggehaald om de maatregel te kunnen realiseren.
[# Parkeerplekken]

Iedere maatregel neemt ruimte in beslag. Een bovengrondse oplossing kan ten koste gaan van andere manieren waarop die ruimte gebruikt kan worden. In sommige gevallen zal dit betekenen dat er parkeerplaatsen moeten verdwijnen om ruimte vrij te maken voor de maatregel.

ATTR. 3: WATER OP STRAAT

Het aantal dagen per jaar dat water op straat wordt voorkomen met de oplossing.
[# dagen / jaar voorkomen]

Door maatregelen te realiseren in de omgeving kan een bepaalde mate van regen per uur worden verwerkt. Op basis van neerslagdata en de capaciteit van de maatregelen kan een inschatting worden gemaakt van het aantal dagen waarop wateroverlast kan worden voorkomen door de betreffende maatregel te realiseren.

ATTR. 4: HERGEBRUIK VAN REGENWATER

Hoe vaak een huishouden per jaar de wasmachine kan draaien met het regenwater dat wordt hergebruikt.
[# wasbeurten / jaar /huishouden]

Sommige maatregelen maken het mogelijk dat het regenwater wordt opgevangen. Dit opgevangen water kan worden hergebruikt, bijvoorbeeld om de wasmachine te draaien, planten nat te houden of sportvelden te besproeien. Op deze manier kan er drinkwater worden bespaard.

ATTR. 5: GROENE RUIMTE

De hoeveelheid groene ruimte die wordt toegevoegd door het project.
[m^2]

Bij sommige maatregelen wordt groen-blauwe ruimte gerealiseerd. Groen-blauwe ruimte is de verzamelnaam voor gras, planten, bomen en water. De groen-blauwe ruimte heeft een betere water-afvoerende werking, biedt mogelijkheden voor recreatie (wandelingen, boek lezen, etc) en draagt bij aan het vergroten van de biodiversiteit (meer plant- en diersoorten).

ATTR. 6: BETROUWBAARHEID

De mate waarin de werking van de maatregel eerder bewezen is.
[Werking alleen nog theoretisch onderbouwd; Werking bewezen in testomgeving; Werking bewezen in grootschalige pilot; Werking bewezen in enkele commerciële projecten; Werking bewezen in tientallen commerciële projecten]

Als een maatregel zich eerder in andere projecten heeft bewezen, kan met grotere zekerheid worden gesteld dat deze maatregel doet wat ervan wordt verwacht. Nieuwe, innovatieve maatregelen hebben wellicht nog geen bewezen betrouwbaarheid, maar kunnen potentieel een wenselijker alternatief bieden voor bewezen maatregelen.

ATTR. 7: PARTICIPATIE

Aantal uren per jaar dat bewoners moeten besteden aan het onderhouden van de maatregel.
[# uur/ jaar / huishouden]

Bepaalde maatregelen vragen om een actieve rol van omwonenden. Dit betekent dat bewoners tijd zullen moeten besteden aan het beheer en onderhoud van de maatregel (denk aan het legen van de regenton, het snoeien van de geveltuin etc.). Neem aan dat de uren die hiervoor nodig zijn per maatregel, gelijkmatig zijn verdeeld over alle huishoudens in de wijk.

ATTR. 8: PROFITERENDE HUISHOUDENS

Het aantal huishoudens dat minder kans heeft op wateroverlast
[# huishoudens]

Het aantal huishoudens dat profiteert van de maatregel wordt bepaald op basis van de grootte van het gebied en het gemiddeld aantal huishoudens per vierkante meter.

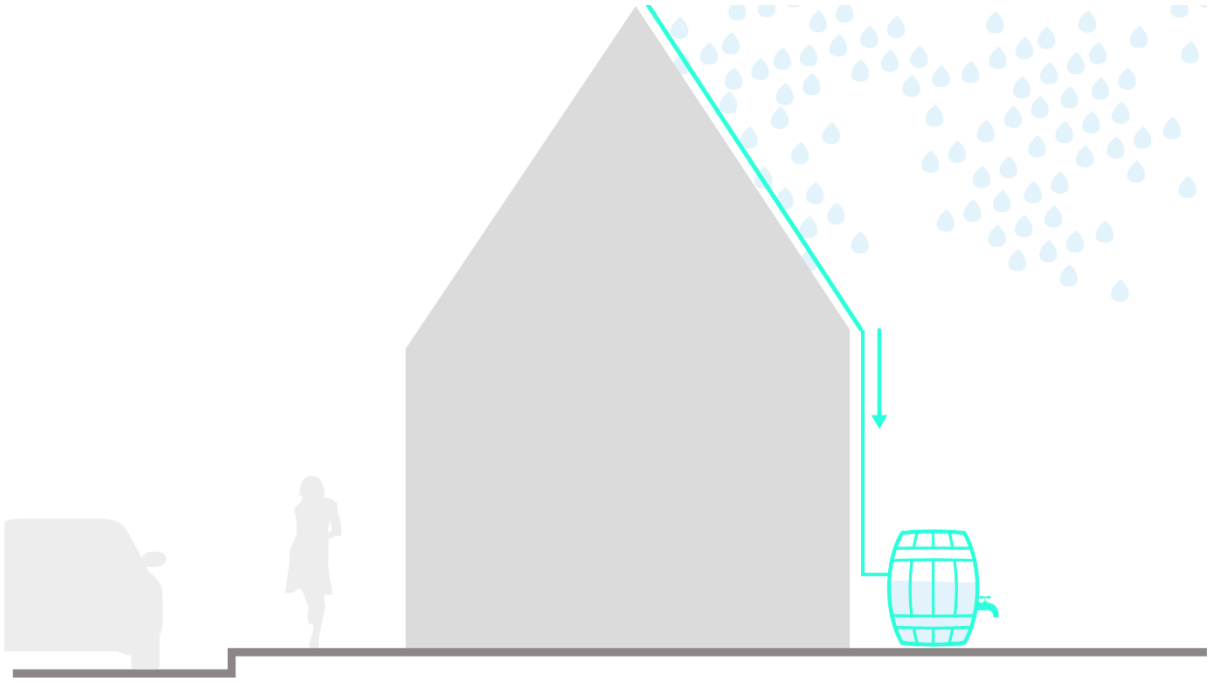
_____
_____

MEASURE DESCRIPTIONS PVE-EXPERIMENT

MAATREGEL 1: REGENTON

Subsidie voor het installeren van een regenton in eigen tuin.

De klassieke regenton is nog altijd een manier om regenwater van het dak van de woning op te vangen. Naast het voorkomen van wateroverlast, kan het water zo ook worden hergebruikt. De regenton is een maatregel die door bewoners zelf genomen dient te worden, maar die wel door de gemeente gestimuleerd kan worden. U kunt hier dus aangeven voor hoeveel regentonnen de gemeente in uw optiek subsidies uit zou moeten uitkeren aan bewoners, zodat de bewoners zelf met een regenton aan de slag kunnen.



Regenton

MAATREGEL 2: GROEN DAK

Inrichten van groene daken om regenwater vast te houden.

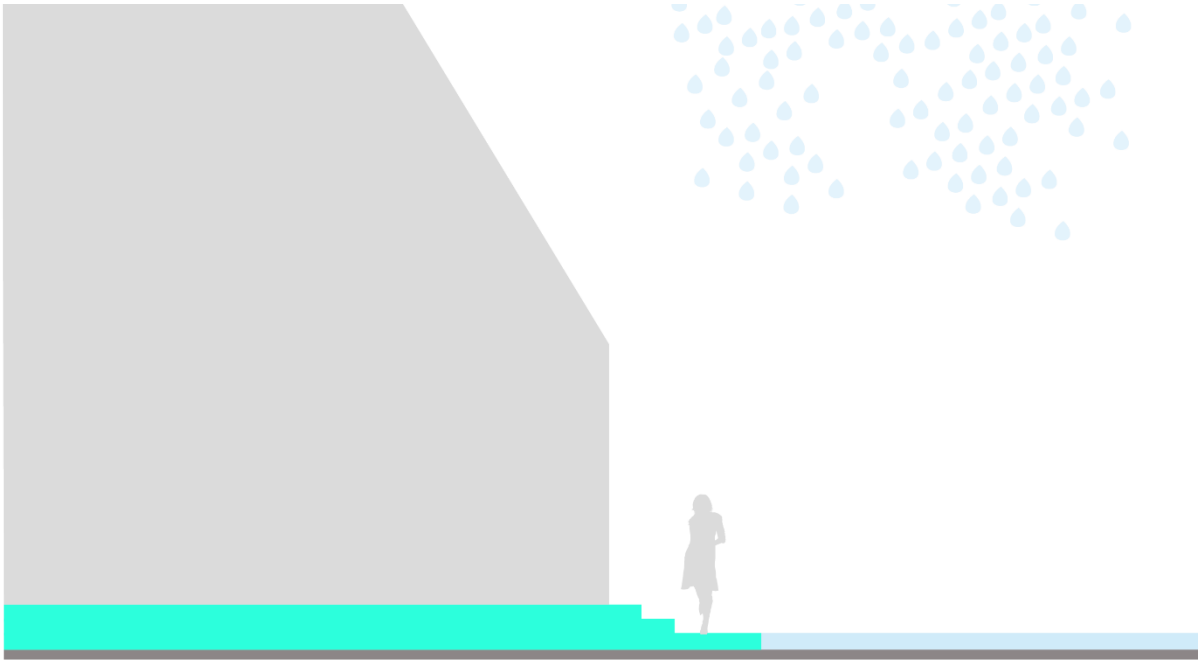
Op een groen dak wordt regenwater opgevangen en vervolgens op een later moment afgevoerd. Eventueel kan het water dat wordt opgevangen worden hergebruikt.

Groen-blauw dak

MAATREGEL 3: VERHOOGD BOUWEN

Verhoogd aanleggen van woningen ten opzichte van de straat.

Door een hoogteverschil tussen woningen en de straat te creëren, kan voorkomen worden dat ondergelopen straten schade aan woningen veroorzaken. Dit kan bijvoorbeeld door trottoirs aan te leggen, waardoor water op straat de woningen/gebouwen niet zal bereiken.

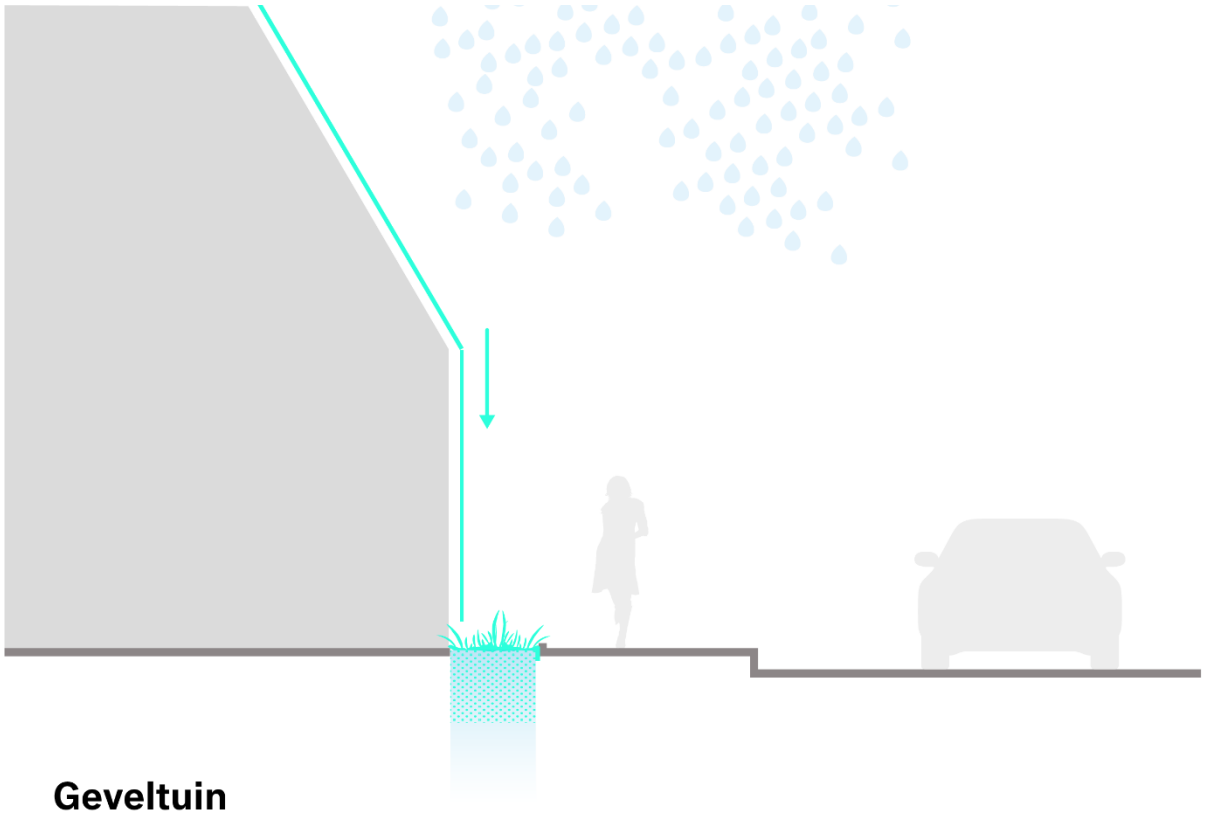


Verhoogd bouwen

MAATREGEL 4: GEVELTUIN

Subsidie voor het aanleggen van een geveltuin aan eigen woning.

Door voor de woning enkele tegels te vervangen door een geveltuin, kan het regenwater sneller worden afgevoerd. Op deze manier blijft er na een regenbui minder water op straat liggen. Geveltuinen dragen ook bij aan een groener straatbeeld. Het geveltuintje is eigendom van de eigenaar van de woning en dus is de eigenaar ook zelf verantwoordelijk voor het onderhoud. Het aanleggen van een geveltuin kan vanuit de gemeente worden gestimuleerd door subsidies uit te keren aan bewoners.

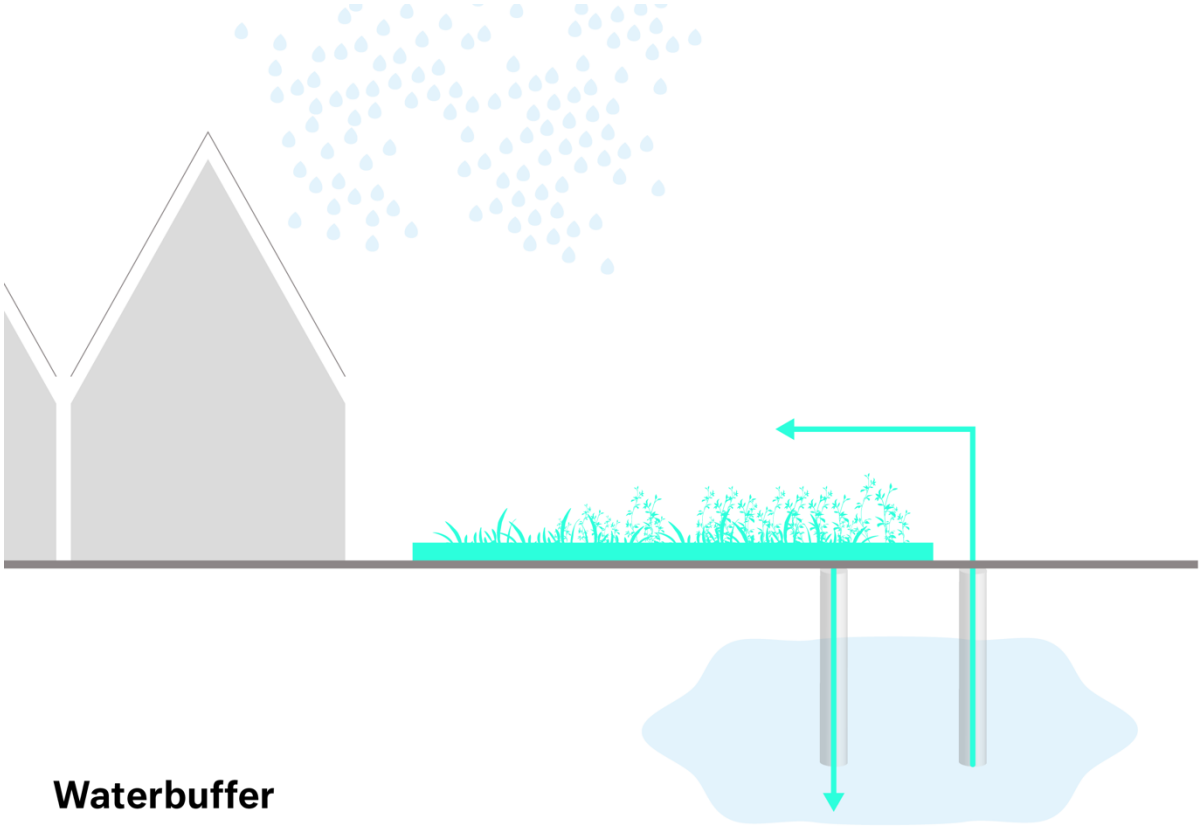


Geveltuin

MAATREGEL 5: WATERBUFFER

Aanleggen van regenwater systemen voor opslag, zuivering en hergebruik.

In plaats van afvoer via het riool, wordt door de waterbuffer het regenwater verdeeld en gezuiverd door planten om in een waterbel op 15 tot 50 meter diepte in de ondergrond te worden opgeslagen. In de zomer kan dit water weer hergebruikt worden door het uit de waterbel te halen. Zo blijft het regenwater in de wijk en wordt drinkwater bespaard. Door de waterbuffer wordt er meer groen in de wijk gecreëerd.

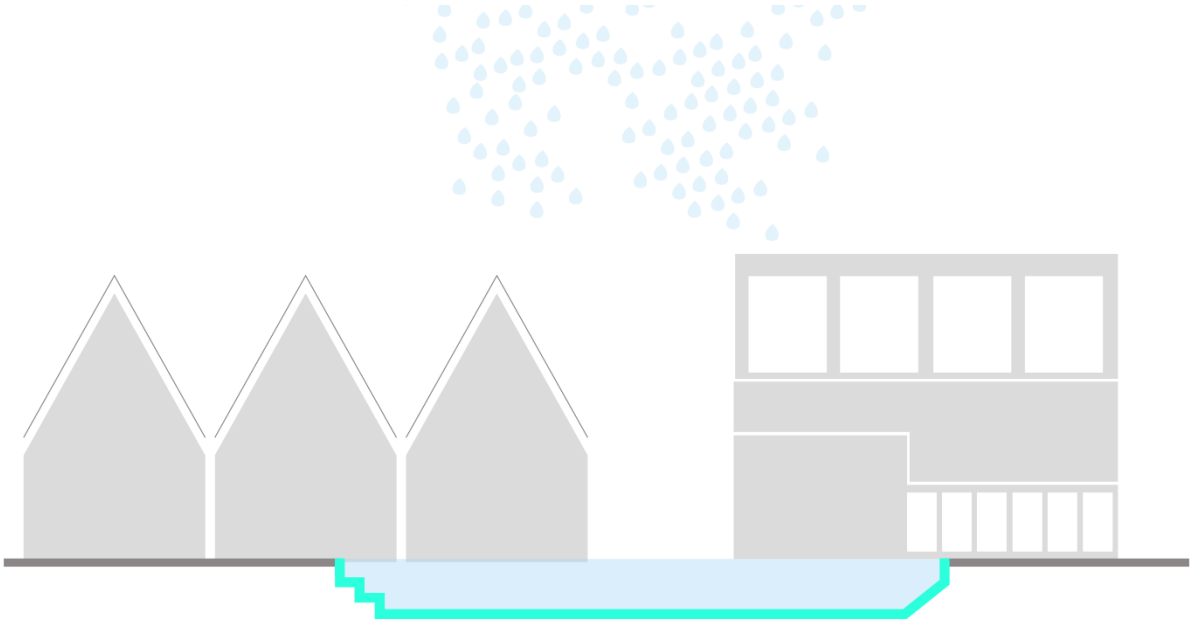


Waterbuffer

MAATREGEL 6: WATERBERGEND PLEIN

Aanleggen van een waterbergend plein om regenwater tijdelijk vast te houden.

Het plein wordt aangelegd als een kuil. Vervolgens wordt het plein dusdanig ingericht dat het regenwater op kan vangen in het geval van extreme regenval. Een waterplein is multifunctioneel. Bij droog weer wordt het plein gebruikt om te spelen of te sporten, terwijl bij zware regenbuien het plein onder water wordt gezet om het regenwater uit de wijk op te kunnen slaan. Dankzij de grote capaciteit van dit systeem kan regenwater uit een groot deel van de wijk worden opgevangen.

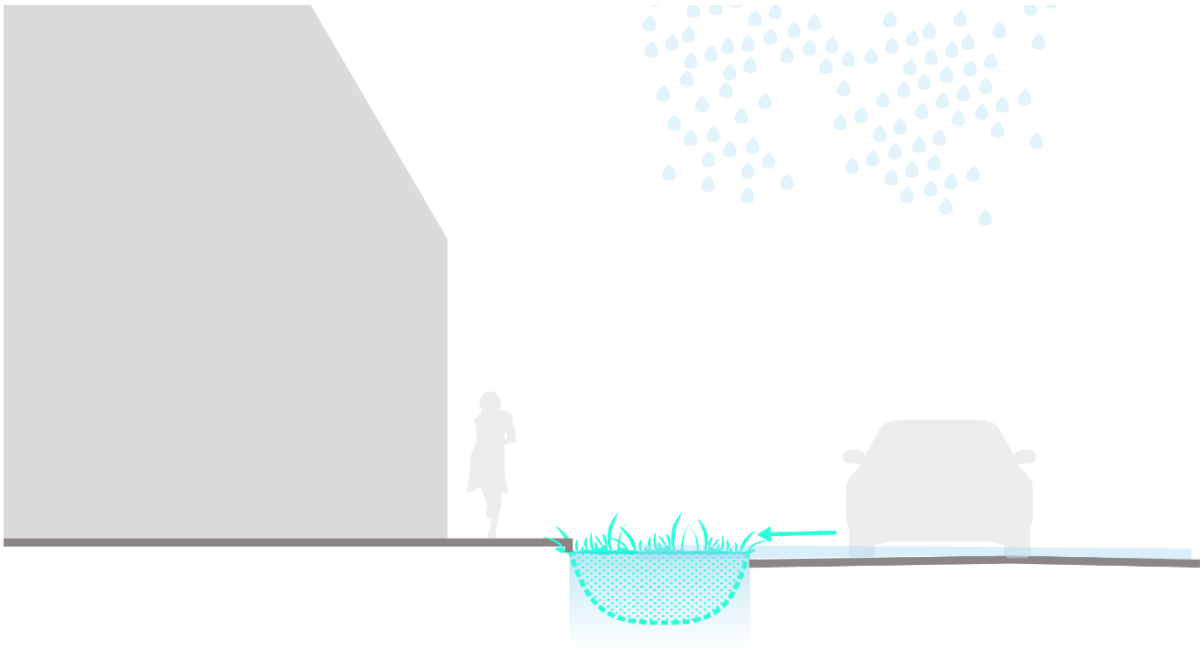


Waterbergend plein

MAATREGEL 7: GROENSTROOK

Aanleggen van groenstroken langs wegen om waterdoorlatend oppervlak te vergroten.

Door straten en trottoirs in te richten met groenstroken, kan het regenwater dat op naastgelegen wegen, trottoirs en parkeerplekken valt infiltreren naar de ondergrond. Het straatbeeld verandert ook, doordat de wijk een groenere uitstraling krijgt.

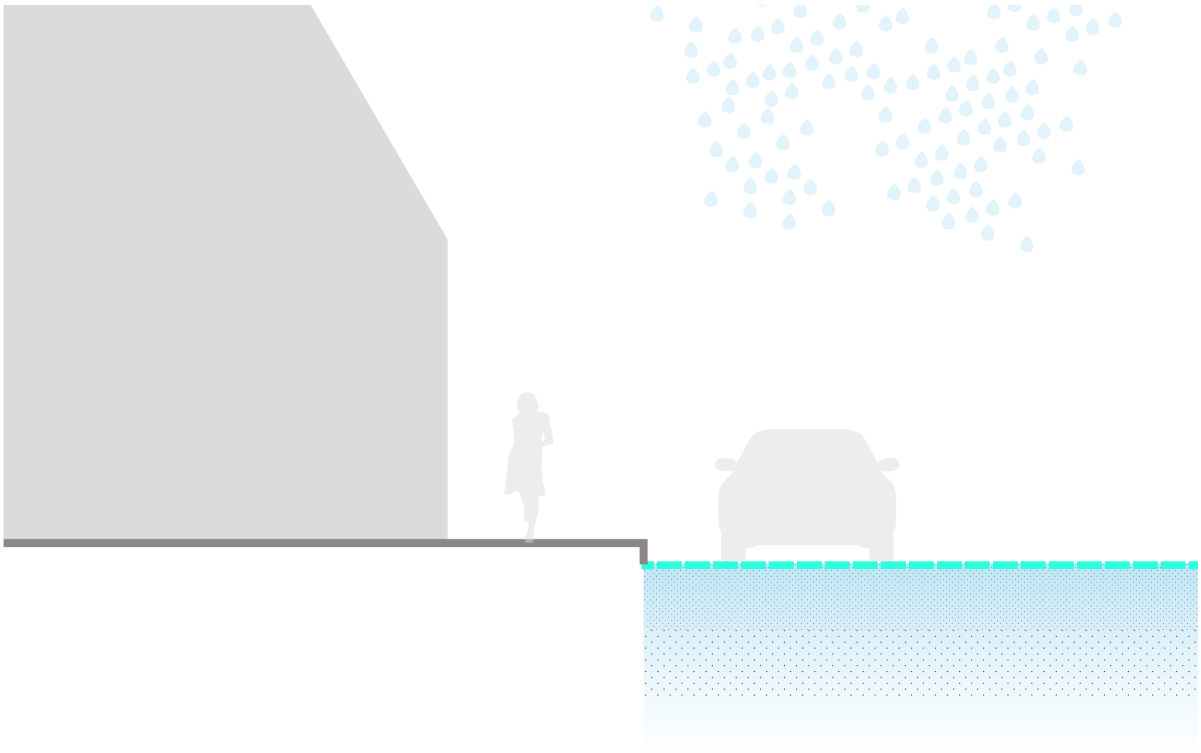


Groenstrook

MAATREGEL 8: WATERDOORLATENDE BESTRATING

Aanleggen van waterdoorlatende bestrating.

Op een weg of trottoir met normale bestrating blijft regenwater grotendeels liggen. Het water sijpelt hoogstens langs de kiertjes tussen de stenen. Door gebruik te maken van water-passerende bestrating kan het regenwater makkelijker door dit verharde oppervlak naar de ondergrond infiltreren. De bestrating wordt zodanig aangelegd, dat er geen risico bestaat dat fietsers in de ruimte tussen de klinkers blijven hangen.



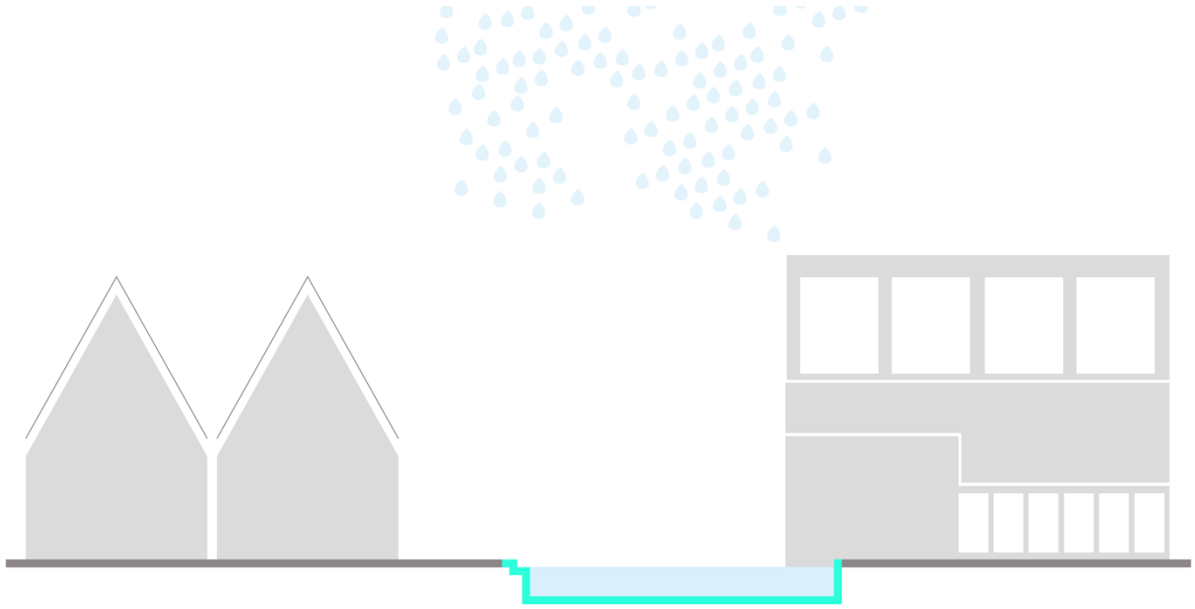
Waterdoorlatende bestrating

MAATREGEL 9: VIJVER

Een vijver aanleggen met voldoende capaciteit om regenwater te bergen.

Een vijver kan eenvoudig regenwater opvangen op een plek waar het niet tot schade kan leiden. In de zomer verdampt het water vanzelf en eventueel kan het water vanuit de vijver geleidelijk worden afgevoerd als de piekbuien voorbij zijn.

Het is tegenwoordig ook mogelijk om de waterstanden in een vijver te reguleren met automatische systemen. Het regenwater wordt dan alleen afgevoerd vlak voor een bui, zodat de vijver zo lang mogelijk gevuld blijft.

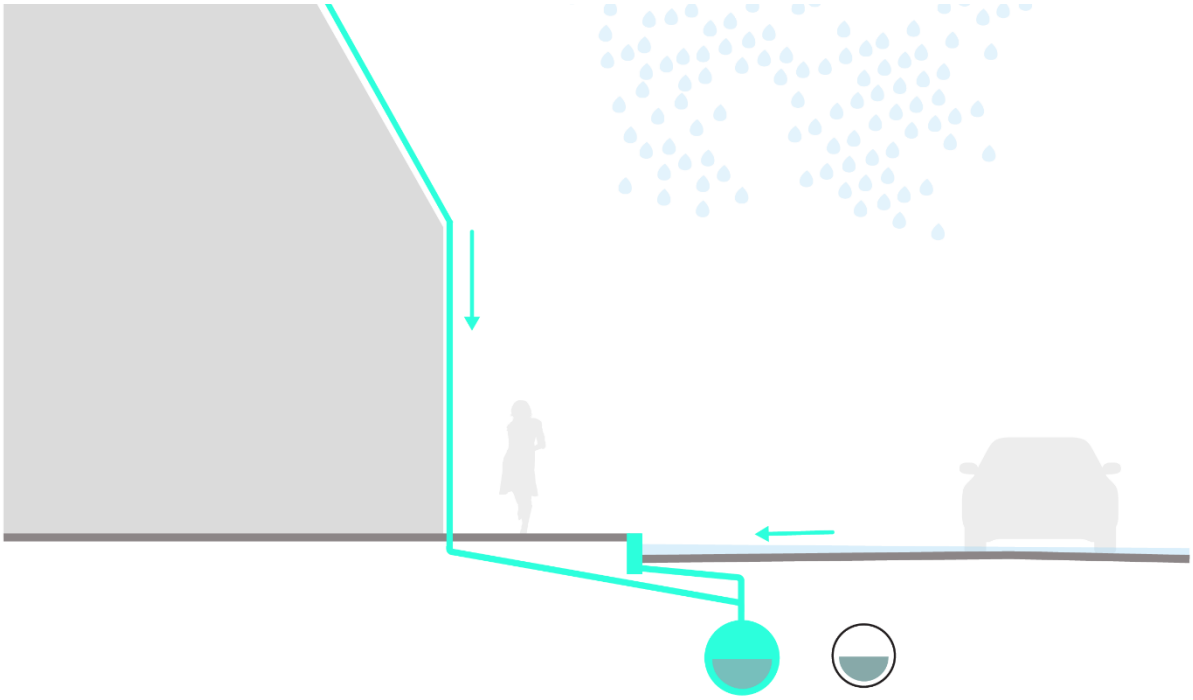


Vijver

MAATREGEL 10: GESCHEIDEN RIOOLSTELSEL

Aanleggen van een gescheiden rioolstelsel voor regen- en afvalwater.

Als de ruimte het toelaat, is het mogelijk om een apart stelsel aan te leggen voor de afvoer van regenwater zodat in de toekomst heftigere regenbuien kunnen worden verwerkt. Door het afvoerstelsel te scheiden van het riool voor afvalwater kunnen de kosten voor het zuiveren van het water bij de afvalwaterzuiveringen worden verminderd.



Gescheiden stelsel

MAATREGEL 11: WATERKELDER

Kelder aanleggen onder gebouwen waar regenwater kan worden opgevangen.

In een grote ondergrondse bak kan het water worden opgevangen om dit vervolgens later vertraagd af te voeren. Het voordeel van een dergelijke constructie is dat er boven deze kelder gewoon gebouwd kan worden. Het gaat hier niet over kelders onder uw eigen huis, maar over een grote kelder onder publieke gebouwen of pleinen.

Waterkelder

QUALITATIVE MOTIVATION FOR SELECTING MEASURES

[Only motivations were asked for those measures that were selected in the configuration of that respondent]

1. U heeft zojuist de volgende maatregelen geselecteerd om wateroverlast te voorkomen. Kunt u kort aangeven waarom u voor deze specifieke maatregel heeft gekozen?

a) Geselecteerde maatregel 1

b) Geselecteerde maatregel 2

c) Geselecteerde maatregel 3

d) Geselecteerde maatregel 4

e) Geselecteerde maatregel 5

_____
_____

FOLLOW-UP SURVEY TO EVALUATE PVE-METHOD

2. A. In hoeverre bent u het eens met de volgende stelling:
   "Het is belangrijk dat de gemeente haar inwoners betrekt bij besluitvorming over nieuwe projectinvesteringen."

☐ *Zeer eens* ☐ *Eens* ☐ *Ten dele (on)eens* ☐ *Oneens* ☐ *Zeer oneens* ☐ *Niet van toepassing*

   B. Waarom vindt u dit (on)belangrijk?

   _____
   _____
   _____
   _____

3. Wat verwacht u dat de gemeente met de resultaten van dit onderzoek doet?

   _____
   _____
   _____
   _____

4. In hoeverre vindt u in dat bewoners het vermogen hebben om beslissingen te nemen over de besteding van publiek geld?

☐ *Zeer eens* ☐ *Eens* ☐ *Ten dele (on)eens* ☐ *Oneens* ☐ *Zeer oneens* ☐ *Niet van toepassing*

5. In hoeverre vindt u dat u zelf voldoende inhoudelijke kennis heeft van het onderwerp om tot een selectie van maatregelen te komen?

☐ *Zeer eens* ☐ *Eens* ☐ *Ten dele (on)eens* ☐ *Oneens* ☐ *Zeer oneens* ☐ *Niet van toepassing*

6. Wat vond u prettig aan deze onderzoeksmethode?

_____
_____
_____
_____

7. Wat zou u graag anders zien aan dit onderzoek?

_____
_____
_____
_____

SURVEY PERSONAL CHARACTERISTICS

8. Wat is uw postcode?

   _ _ _ _ _ _

9. Wat is uw geboortejaar?

   _ _ _ _

10. Wat is uw geslacht?

    - ☐ *Man*
    - ☐ *Vrouw*
    - ☐ *Ik geef hier liever geen antwoord op*

11. Uit hoeveel personen bestaat uw huishouden?

    _ _

12. Heeft u een auto?

    - ☐ *Ja*
    - ☐ *Nee*
    - ☐ *Ik geef hier liever geen antwoord op*

13. Woont u in een koop- of huurwoning?

    - ☐ *Koop*
    - ☐ *Huur*
    - ☐ *Ik geef hier liever geen antwoord op*

14. Wat is de hoogste opleiding die u heeft genoten?

    - ☐ *Basisschool*
    - ☐ *Middelbare school*
    - ☐ *MBO*
    - ☐ *HBO*
    - ☐ *WO*
    - ☐ *Anders, namelijk* _

- ☐ *Ik geef hier liever geen antwoord op*

15. Hoeveel uur per week werkt u?

    - ☐ *>32 uur*
    - ☐ *16-32 uur*
    - ☐ *<16 uur*
    - ☐ *Ik heb momenteel geen baan, maar ben wel op zoek*
    - ☐ *Ik heb momenteel geen baan en ben ook niet op zoek*
    - ☐ *Met pensioen*
    - ☐ *Student*
    - ☐ *Arbeidsongeschikt*
    - ☐ *Anders, namelijk_____*
    - ☐ *Ik geef hier liever geen antwoord op*

16. *In welke categorie valt het gezamenlijke inkomen van uw huishouden?*
    - ☐ *<€20.000 per jaar*
    - ☐ *€20.000-50.000 per jaar*
    - ☐ *€50.000-80.000 per jaar*
    - ☐ *>€80.000 per jaar*
    - ☐ *Ik geef hier liever geen antwoord op*

17. Is er nog iets dat u kwijt wilt ten aanzien van dit onderzoek?

    _____
    _____
    _____
    _____

18. *Mogen wij uw emailadres om u eventueel in de toekomst te benaderen voor een vervolg op dit onderzoek?*

    _____

_____
_____

Appendix IV: Calculations used to determine the effect of the measures

The starting point for calculation the effects of the measures on the attributes, was do define the project area. The project area was defined with the characteristics shown in figure 0-a. The other input that was used, was actual weather data from a weather station of the KNMI in Voorschoten (https://www.knmi.nl/nederland-nu/klimatologie/daggegevens).

Table App-0-a: Characteristics of the project area used to calculate the effects of the measures

CHARACTERISTIC	VALUE
AREA NEIGHBOURHOOD	1000000m2
HOUSEHOLDS IN THE NEIGHBOURHOOD	2750 households
AVERAGE # OF PEOPLE PER HOUSEHOLD	2.2 persons
AVERAGE # OF HOUSEHOLD PER SQUARE METER	0.003 households
WATER USAGE PER WASHING CYCLE	0.055 m3
EXPECTED INCREASE IN PRECIPIATATION	5%
IMPERVEOUS SURFACE RATIO	50%
IMPERVEOUS SURFACE IN THE NEIGHBOURHOOD	

Table App-0-b: Cumulative yearly precipitation and evaporation in the defined neighbourhood area.

	TOTAL PRECIPITATION [mm]	TOTAL PRECIPITATION IN THE AREA [m3]	TOTALE EVAPORATION [mm]	TOTAL EVAPORATION IN THE AREA [m3]	WATER TO BE MANAGED AFTER EVAPORATION [m3]
2014	410.1	512625	249.3	311625	201000
2015	908.8	1136031	625.0	781250	354781
2016	836.1	1045094	635.0	793750	251344
2017	1076.6	1345719	643.1	803875	541844
2018	149.0	186219	49.5	61875	124344

For the calculation of the effect of the measures on reducing the risk of superfluous storm water, the daily precipitation data was used. Even though, the best way of modelling superfluous water would be to use hourly precipitation in order to show the effect of peak hours and compare that directly to the capacity on that moment, some simplification had to be made, which will be further discussed in the section on calculation the effect on preventing superfluous storm water. As some assumption in the calculation would have a bigger impact that would overrule the hourly input data anyway, the aggregated daily precipitation supplied by this KNMI weather station is considered to

be sufficient for the purpose of this research. For each measure, six input variables were entered. The value of this input variables was derived from literature or consultations with experts of the measures. In determining the effects, the size of the measures has been altered to generate a balanced set of alternatives. For example, one rain tank would not make a fair comparison with a water square. Therefore, the effects of the rain tank are measures for a subsidy for 500 rain tanks.

Table App-0-c: Input variables used to calculate the effects of the measures

INPUT VARIABLES	VALUE
COSTS	€
RE-USE OF WATER?	YES/NO
DOES IT AFFECT NUMBER OF PARKING SPACES?	YES/NO
CONNECTED # OF HOUSEHOLDS	# hh
SYSTEM (+MEASURE) SIZE	# m^2
GREEN SPACE	% of system size
TOTAL MAINTENANCE REQUIRED PER WEEK	# hours
RETENTION CAPACITY	# mm
MATURITY LEVEL	

Attribute 1 Costs

Input variable is also the value that is presented in the PVE-experiment. The input variable should therefore already consider the yearly operation costs, the yearly maintenance costs, the implementation costs and the life-time costs. The period over which the costs have been determined is 20 years.

Attribute 2 Parking spaces

If the input variable has stated that the system area of the measure cannot be used for parking, the number of parking spaces that would have to be taken out would is calculated as:

$$\#\ parking\ spaces = \frac{System\ size}{Size\ of\ a\ parking\ spot}$$

A parking spot in the Netherlands is approximately 11m2 (NEN-norm 2443). The attribute is framed as the number of parking spaces that would be removed. Since the measures do not have a designated project area, it is assumed that the number of parking spaces that would be removed is equal to the number of parking spaces that could have been realised on the system area.

Attribute 3 Superfluous water nuisance

The occurrence of superfluous water nuisance is assessed on a daily basis. However, to be able to determine the managing capacity of a measure, the hourly discharge of each measure is considered in the calculation as well. The managing capacity of the measure is dependent on its retention capacity ("the size of its storage facilities") and the discharge rate. The daily managing capacity is determined by summing the static retention capacity and the hourly discharge. An important limitation of this approach is that it is assumed, that the retention capacity will be fully available in the first hour of the next day. This effect is not very realistic, as it would for example assume that all rain tank is emptied at 00.00 am. As a result, the effect of the rain tank is represented too positively in the PVE-experiment.

$$Managing\ capacity\ per\ day_{measure\ x} = retention\ capacity + 24 * discharge\ rate$$

Consequently, the managing capacity is compared with the highest amount of precipitation on one day in 2017. The effect of the measure is calculated as the share of the maximum daily precipitation that is managed by the measure. This is calculated as follows:

$$Relative\ effect\ of\ measure = \frac{Managing\ capacity\ per\ day_{measure\ x}}{Max\ precipation\ per\ day} * 100\%$$

In order to present this affect in a way that is easy to understand for respondents, this relative effect has been translated into the relative effect on a yearly basis. If the measure can solve X% of the water in one day, it can also manage the water in X% of the days that it rains, that is, if the amount of precipitations would be equal every day. This is not the case in real life, but it is assumed as such in this research. We use the maximum amount of precipitation as the "norm" for what should be managed on a daily basis. In the Netherland, 240 out of the 365 days have rain. Which means that the effect of the measures on the number of days that water hindrance can be prevented is calculated as

$$Number\ of\ days\ superfluous\ water\ prevented = Relative\ effect\ of\ measure * 240$$

Attribute 4 Re-use

The calculation of the effect on the amount of water that can be re-used consists of several steps. First, the disconnected surface to the measure is determined. As the number of impacted people is entered as an input variable, we assume that the for every impacted household, the disconnected surface is expanded. The calculation of the disconnected surface is therefore as follows:

$$Disconnected\ surface = \frac{\#\ impacted\ households}{Average\ \#\ hh\ per\ square\ meter}$$

The disconnected surface can then be used to determine the amount of water could potentially be re-used by the measure. As the actual water flows and thus the disconnected surface is dependent on many variables (like the slope of the area, number of buildings, surface type, etc), it was chosen to assume that the entire neighbourhood has the same characteristics, such that the ratio's used in the calculation can be held the same. This results in the following formula to determine the amount of water per day that could potentially be re-used by the measure:

$$Water\ reuse\ potential_{\ measure\ x} = Disconnected\ surface * Total\ precipitation_{\ 2017} - Total\ evaporation_{2017}$$

Consequently, this potential is, if the measure allows for the re-use of storm water, distributed over the impacted households on a weekly basis, with a correction factor for the share of water that can be re-used. The storage facility of a measure might be full after some time (imagine not emptying a rain tank). Then no new water would be able to flow into the storage facility, cause superfluous water and thus this water would not be available for re-use either. In the calculation of the re-use potential, this effect is not considered, because it is assumed that the work that needs to be done to keep the capacity available is already represented in the attribute participation and thus that this work is actually done to exploit the potential re-use.

Attribute 5 Greenspace

The amount of greenspace added by the measure is entered as an input variable that represents the share of the system surface that consists of plant, flower, grass or water. The calculation is therefore straightforward:

$$Amount\ of\ greenspace = system\ size * green\ space\ ratio$$

Attribute 6 Maturity level of the measure

The maturity level is entered as an input variable. The levels of maturity reflect the Technology Readiness Level (TRL)-stages in product development.

Attribute 7 Participation needed

The participation needed per households is calculated by fairly distributing the amount of work that needs to be done to secure the working of the measure among the households.

$$participation\ per\ household = \frac{Total\ maintenance\ required\ per\ week * 52}{\#\ impacted\ households}$$

Attribute 8 Impacted households

The number of impacted households is entered as an input variable.

Adjusting the variables to min and max values

Eventually, the upper and lower bounds of the effects were determined. In this process. The range had to be large enough to see the effect of changes to that value on the actual choice behaviour. Therefore, some min/max values might represent values that are not likely to occur, yet would still be possible.

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Appendix V: Summary of workshop output

Getting a grasp of the trade-offs present in decision-making on climate-adaptation is easier in a setting in which discussions are held between stakeholders. Therefore, three workshops have been conducted which resulted in valuable insights in the key decision-variables for selecting specific measures. The first two workshops focused on defining the relevant attributes for the project commissioners: Field Factors and the Municipality of The Hague. The third workshop was part of the NAIAD-TKI research and thus focused less on the actual design of the PVE. However, since a wider variety of stakeholders was present and a real study has been analysed here, the workshop has been used for validation of the selected attributes.

WORKSHOP FIELD FACTORS

The first workshop was organised on January 12th 2018 in Delft. No list of pre-selected attributes was provided to the participants.

OBJECTIVES WORKSHOP 1

The objective of this workshop was defined as: "*To determine key decision variables (attributes) for decision-making on specific water management solutions for climate adaptation in an urban environment in the Netherlands.*" The workshop focused on defining and ranking attributes to be included in the PVE-experiment. The approach for this workshop was to start with defining the co-benefits of the Urban Water Buffer, a nature-based water management solution which is currently being developed by Field Factors and is being implemented in a pilot project in Rotterdam. Next, (co-)benefits provided by this measure, were compared with (co-)benefits of alternative solutions to create a full set of decision-making variables (attributes) related to urban water management. Consequently, the list of attributes was ranked on basis of three criteria:

1. Importance of the attribute in current decision-making processes
2. Potential importance in future decision-making processes
3. The relevance of the attribute to residents

PARTICIPANTS WORKSHOP 1

The two-hour workshop was held with the team of Field Factors, consisting of water management specialists, urban development consultants, architects and industrial and mechanical engineers.

Their role as commissioner of this research is mainly to advise on what information is important to them and why they think these attributes should be included in the PVE-design. In other words, the results from this workshop will be used for scoping the PVE-experiment. It will be important to verify that a fair balance of attributes in favour and not in favour of the UWB will be included in the final experimental design. Therefore, multiple workshops are included in this process towards the final design.

Results workshop 1

Throughout the process of ranking the attributes, the attributes showed to represent different hierarchy levels. In addition to the ranking on basis of the three criteria, one additional step was included in the process:

4. The attributes were grouped in order to deal with the differences in hierarchy level and limited distinctive character of the attributes

The workshop resulted in a selection of attributes at a comparable hierarchy level. A summary of the workshop results (the selection of attributes and the related grouping of the attributes) is presented in table 0-a. Three main conclusions that were drawn from the workshop will be discussed in more detail.

a) It is not possible to include all attributes in one PVE design, given the constraint discussed in section 2 of the main report. Grouping the attributes is not a solution for gathering insights on more attributes in one PVE-experiment. For example, one of the selected higher-level attributes was *Improvement in the Micro Climate*. This group also consisted of the lower level attributes *Air quality, Noise, Temperature, Wind* and *Smell* and the higher-level attributes *Health* and *Comfort* (see figure App-j). This grouping only has a nominal function within the PVE. If respondents would show to appreciate an improved micro climate in the PVE, it remains unclear whether they consider air quality, noise, temperature, wind or smell as most important for that microclimate. Particularly, if there is no clear specification of what is meant by an attribute and the specific causal relations between those attributes are unclear, no conclusion can be derived for attributes at higher/lower levels. For example, less noise could lead to a better micro climate, however, a better micro climate can also be achieved without a decrease of the noise levels. If insights in the role of the attributes *noise*

or *health* were desired, these should be included in the PVE-design as a separate attribute. The results of the PVE are limited to the specification of the attributes included in the design.

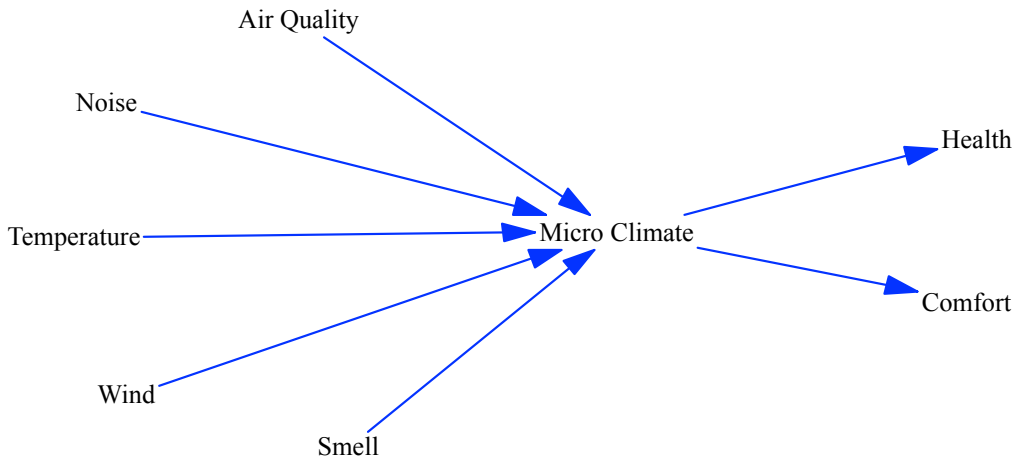

Figure App-j: Causal interaction of attributes related to the micro-climate

b) Using the PVE solely to assess the importance of co-benefits is not feasible, since no trade-offs would occur. It is utopian to think that a solution exists with only high score on co-benefits. This solution would either costs a lot of money, require a lot of space or be very unreliable. Without these trade-offs being present in the design, no useful results would be generated. Therefore, all decision-variables, and not just the benefits, should be addressed when defining a PVE-design.

c) A key trade-off that came forward in the workshop was that between the required space and money for a solution and what would come in return. Some, and particular nature-based, solutions might be more expensive or require more space, but will also provide the discussed co-benefits. The underlying policy questions here is whether water management should be sober and strictly functional, or whether a more integral regional development approach is desired.

Table App-d: Overview of the grouping of co-benefits in the Field Factors workshop.

Attribute	Lower level attributes
Costs	Maintenance costs, operational costs, initial investment, life-time
Reliability	Capacity to reduce risk of flooding, Capacity to reduce impact of flooding, Proven track-record, awareness of potential uncertainties
Required Space	Subsurface area, aboveground area
Adaptability	Flexibility, life-time, integration with other measures (for both similar and different problems), in(ter)dependence of other systems
Spatial Quality	Aesthetics, improved living environment, safety, recreational opportunities, multifunctional use of public space, green areas
Circularity	Circularity of building materials, circular use of harvested storm water
Improvement in Micro Climate	Quality of the living conditions, air quality, noise, smell, cooling effects, temperature regulation, wind reduction, comfort
Participation	Measures taken by residents themselves, participation in design, maintenance and operation of public facilities
Biodiversity	Flora and fauna
Water purification performance	Water quality

WORKSHOP MUNICIPALITY OF THE HAGUE AND WATER AUTHORITY DELFLAND

The one-and-a-half-hour workshop took place on February 8th 2018. In preparation of this second workshop, a pre-selection of attributes and measures was made on basis of literature and the workshop with Field Factors. This list formed the basis for discussion in the second workshop.

OBJECTIVES WORKSHOP 2

The second workshop had the objective *to discuss and adjust the pre-selection of attributes and to define possible measure on various locations in The Hague.*

Participants workshop 2

In this second work-shop, two representatives of the municipality of The Hague were present. The two participants from the municipality work in different departments. One is working on spatial development and sustainability, and the other is a specialist on the cities' sewerage system. Additionally, a representative of the Waterboard Delfland (on spatial plan development) was present, as well as one of the supervisors of this thesis, W. Kok from Field Factors.

Results Workshop 2

a) Suggestion to try a PVE with complying to the norm for water safety as the requirement, instead of staying within a budget, or combination of both}

b) Replacing the sewerage system is a targeted tax ("doelbelasting"). As such, providing integral solutions is not possible from a USWM perspective. The PVE-method could provide input whether this singular budget policy approach is still desirable.

c) The municipality has a particular interest in the acceptance of superfluous water and participation of citizens. These should therefore be included in the design of the PVE.

d) Furthermore, a brainstorm was held on potential locations and existing initiatives on USWM in The Hague that could be included in the PVE-design. However, due to time restrictions in the workshop, no conclusions were drawn regarding these locations.

WORKSHOP NAIAD-TKI

The third workshop was initiated from the H2020 research project NAIAD and the TKI project Urban Water Buffer (UWB). NAIAD is a research that envisions to internalise the Insurance Value of Natural Eco-system for disaster risk reduction. As such, emphasis is placed on the co-benefits of nature-based solution for water management. The Urban Water Buffer is a Dutch research program that assesses the potential of the applying the UWB-concept for retention and infiltration of storm water in the urban environment. In preparation of the workshop hosted by Field Factors on the 1st of March 2018, the long-list of co-benefits generated in the literature study and earlier workshops was tailored to the specific context of the UWB in Spangen.

Objectives workshop 3

The objectives of this workshop were to:

a) Identify and select the most-important co-benefits of the UWB in Spangen
b) Determine for three selected co-benefits which actions could be taken to exploit the potential co-benefits.
c) To identify indicators that could be used to assess the effectiveness of the actions for exploiting the co-benefits.

Participants workshop 3

The participants of this workshop were KWR (Water research institute), Wareco (civil engineering company focused on water and the subsurface), the municipality of Rotterdam, Water Utility Evides, Waterboard Delfland, Rijkswaterstaat, VPDelta, GEUS (Water research institute), TU Delft (supervisor Mouter) and Deltares.

Results Workshop 3

The workshop resulted in a (ranked) list of co-benefits of the UWB in Spangen. This list is reconsidered to determine whether these co-benefits should be included in the PVE-experiment. Additionally, the indicators that were defined to evaluate the effectiveness of the actions provided a starting point for defining indicators for the attributes in the PVE-experiment.

1) Lower Costs
2) Re-use of storm water
3) Raised water awareness
4) More green space
5) Cooling effects
6) Improvements in spatial quality
7) Improved (Ground)water quality
8) Decrease of costs (at) water treatment (plants)
9) Reduced risk of damage to building and infrastructure

In the workshop, actions and indicators were only defined for the three co-benefits that were ranked to be the most important.

Table App-e: Actions and indicators for co-benefit "Increasing water awareness"

Actie	Indicator
Making water visible by creating visible water elements	# users (interaction)
Use creative communication channels, such as coupons, moving packages, savings campaigns for vegetable gardens in local supermarkets	# coupons returned # new façade gardens
Conducting surveys before and after the realization of the project	#respondents
Organising lessons at primary schools and excursions with the water board	# children reached
Organise water festival / activities	# visitors per year
Attractive showcase	visitors # users of wifi network
Car-wash campaign with water from the buffer	# users

Table App-f: Actions and indicators for co-benefit "Spatial quality betterment"

Actie	Indicator
Define real estate values in the immediate vicinity before and after UWB	Real estate value
Encourage staying and active use of the square (sports and games) around the UWB installations.	Staying duration # users (current versus after UWB)
Increasing biodiversity (intrinsic value) by choosing native plant species. Measure the situation before and after the UWB.	# and species of flora and fauna

Table App-g: Actions and indicators for co-benefit "Improve (ground) water quality"

Actie	Indicator
Reducing overflow by increasing retention and infiltration capacity	m3 emergency overflow mm precipitation
Crates buffer as empty as possible as quickly as possible (properly setting of setpoints)	% filling level of crates of buffer time of water in the buffer
Infiltrate as much rainwater as possible	net supply of groundwater with high(er) quality water mm infiltrated precipitation
Appropriate treatment (no iron, low hardness, not biologically contaminated) Zero measurement and measurement after realization	% chemical composition of infiltration water dirt emission reduction
Maximising drainage to buffer by integrating development of Spangen Noord (promoting UWB among urban development and landscape architects)	taken into account in new plans yes / no m2 of connected surface now and in the future
Increase return flows (possibly to surface systems: flushing through canals)	rest m3 after delivery to Sparta
Integrate the spatial development Spangen Noord (promote with landsape architects and city council)	Is it integrated in the new plans yes/no?
Find clients/users	# meetings with potential end-users

Appendix VI: Qualitative motivations per measure

This section presents the motivations that were mentioned by the respondents for selecting a specific measure. In every figure, the number of times a motivation was mentioned for that specific measure is presented, as well as the number of times that motivations was provided for all 11 measures. This way, it can for example be seen that insulation was only mentioned as a motivation for selecting the green roofs (=16/16). For the most frequently mentioned motivations, some typical quotes are provided to indicate the perception of the respondents.

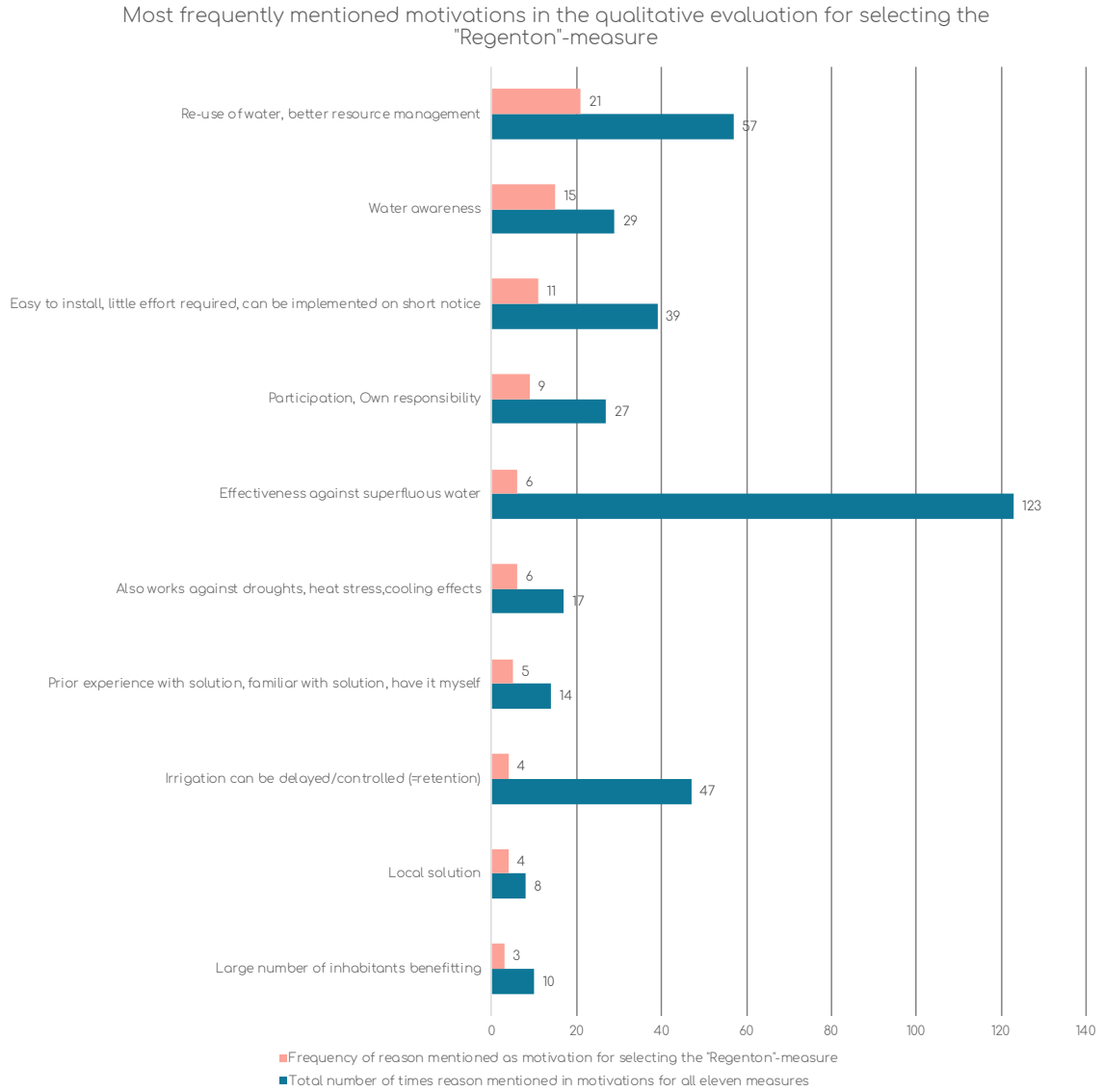

Figure App-k: Qualitative motivations for selecting the measure 1

Quotes on re-use of water:

"*A rain barrel can also be used to reuse the water when watering the plants during drier weather and it is then also possible to let the water slowly run into the ground.*"

"*We have two rain barrels at home. This is a simple measure, with a little effect. However, it also helps in the summer for water waste in dry periods. Easy for watering plants and cleaning things in the garden. Support is therefore easy to acquire.*"

"*Then there is also water in a dry time. Actually, water cellars should be made like in France, the citernes*"

Quotes on water awareness:

"*Opportunity for people to make a practical contribution themselves, which costs little effort; people become more involved in the entire issue of water discharge."*

"*A good example will make people follow: if residents know that a rain barrel can help, they will also buy rain barrels at their own expense and for their own costs, for example collectively to negotiate a discount.*"

Quotes on simplicity:

"*Simple measure that is possible for many people.*"

"*Easy to perform. Very visible.*"

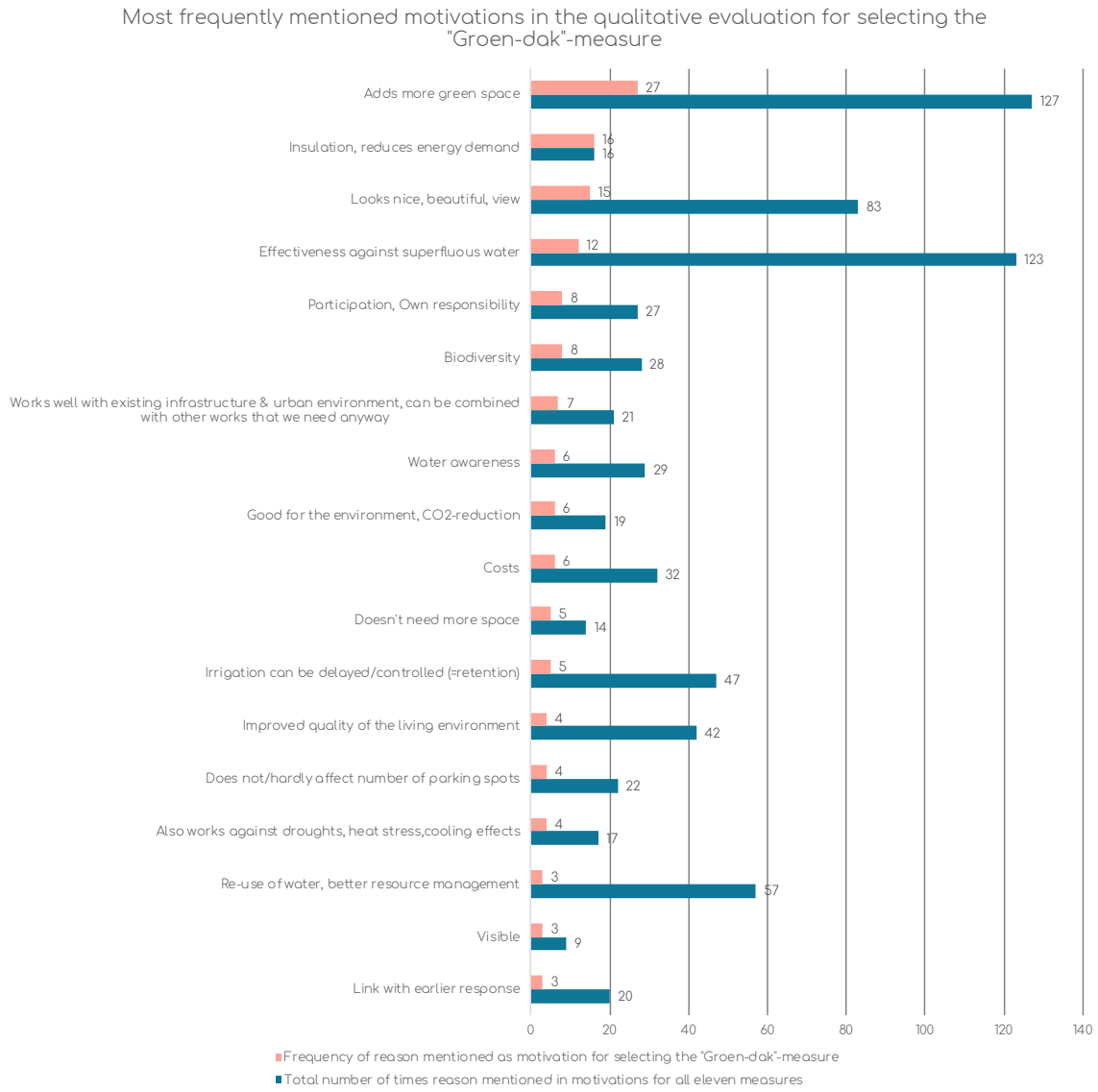

Figure App-k: Qualitative motivations for selecting the measure 2

<u>Quotes on more green space:</u>

"This creates a lot of green space, is not that expensive and does not cost parking spaces."

"It provides green space and the more visible green we have, the better it is."

<u>Quotes on insulation:</u>

"Green roofs have more advantages than holding rainwater. It is also insulating and provides more biodiversity. A plus-plus-plus measure. And if you do it in a visible place, it is also a much more beautiful sight than stones or bitumen."

"*There are many flat roofs in the city, it does not cost extra space, also provides good insulation and more nature in an urban environment. And the one that looks out on a flat roof has a better view. Also business parks would get a much friendlier look. I think that in the future the standard should be: flat roof = green roof*"

Quotes on insulation:

"*Is also beautiful to look at.*"

"*Looks nice, and probably spreads the drainage over time.*"

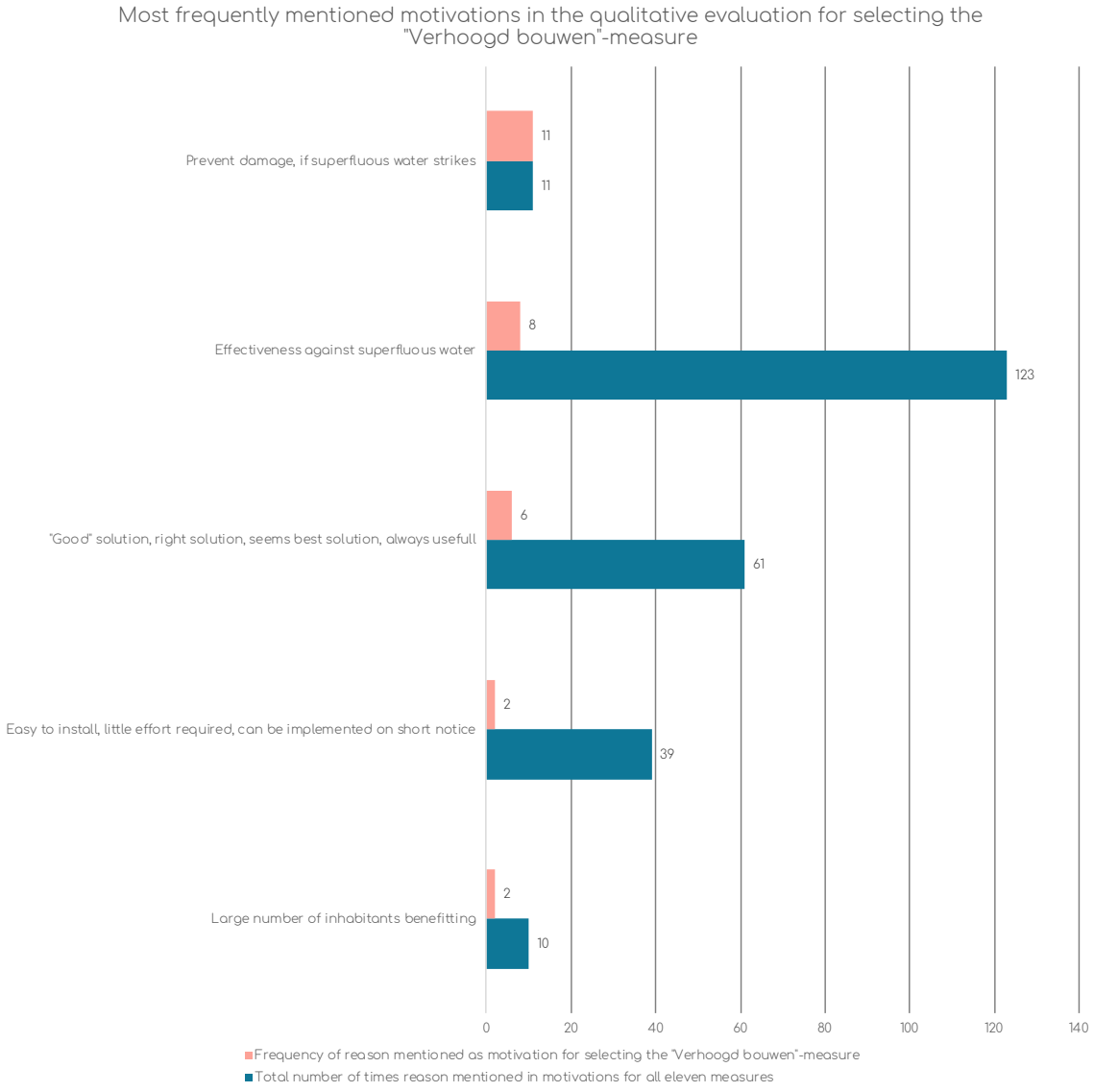

Figure App-I: Qualitative motivations for selecting the measure 3

Quotes on preventing damage:

"A lot of trouble can be prevented."

"Better than sandbags when the time comes."

"The water does not immediately enter the homes."

"Water damage is becoming more common. There is always a hassle about insurance afterwards. It prevents a lot of trouble."

Quotes on effectiveness:

"One of the most effective measures with effect for many households."

"Less trouble from underflow basements and better drainage from the sidewalk where no puddles remain on which the sand flushes under the stones."

"Seems a 'simple' but very effective solution."

Quotes on right solution

"Always useful. Pavement must still be built. Only then I would say."

"This measure is particularly useful in low-lying areas."

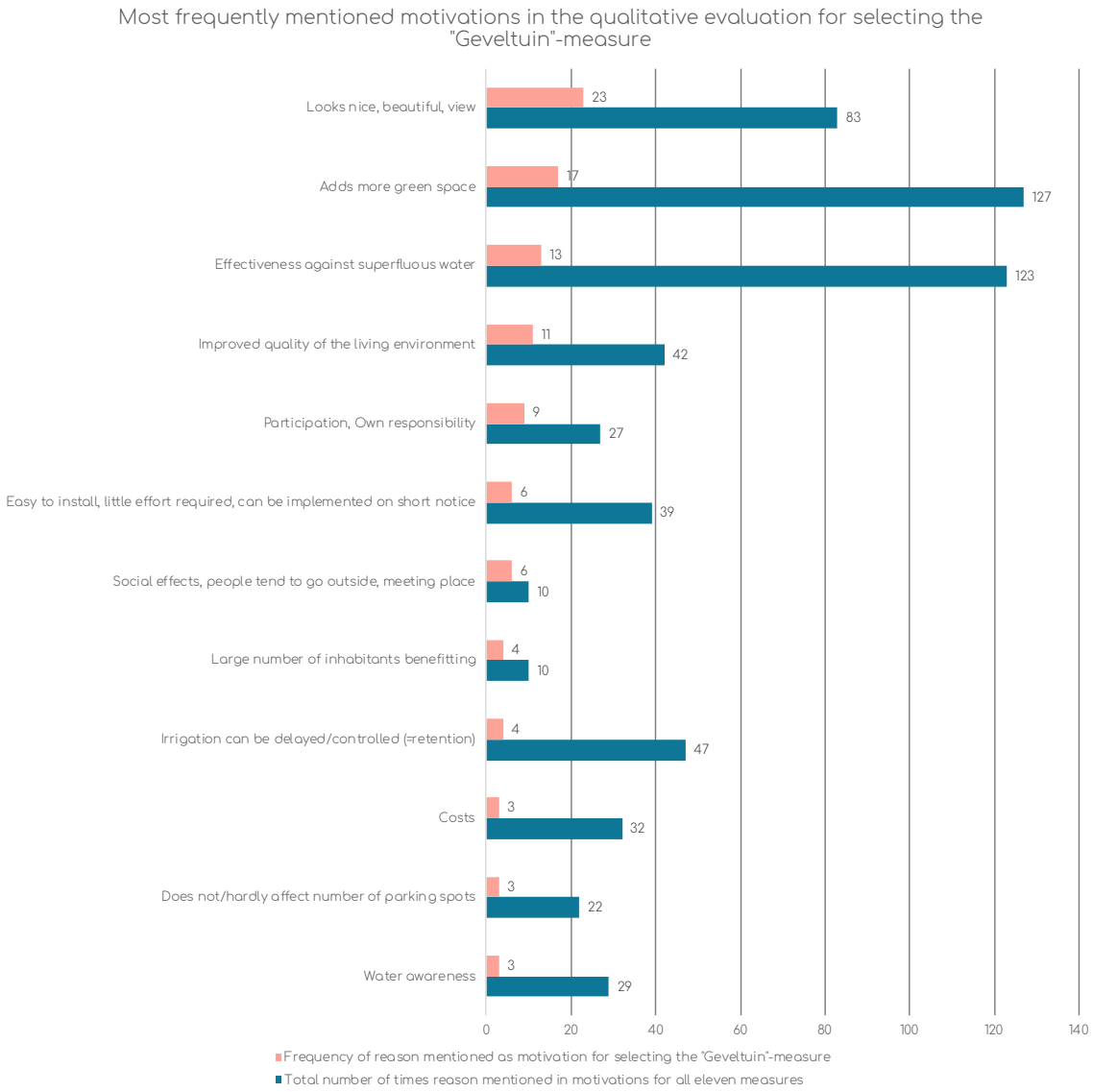

Figure App-m: Qualitative motivations for selecting the measure 4

Quotes on the looks:

"Besides retention capacity, it also improves the view of the neighbourhood."

"Is also good for the looks of the area."

"Better street view through this affordable measure, which also works well against heat stress"

Quotes on green space:

"Effective and emhances pleasant an green living space."

"Increases amount of green, is good for the mood/vibe and fun for children playing in the street as compensation for all that on the other side."

"It gives a greener picture of the city. Especially suitable for older residential areas or neighbourhoods where the houses do not have a front garden."

Quotes on effectiveness against superfluous storm water

"Looks nice for the street view and works well for the water runoff."
"Holding water and using it for more green, just at the front of houses where it is now often stony. Also asks for participation by residents for maintenance and it looks nice."
"The data indicated this has a relatively good effect on preventing superfluous storm water."

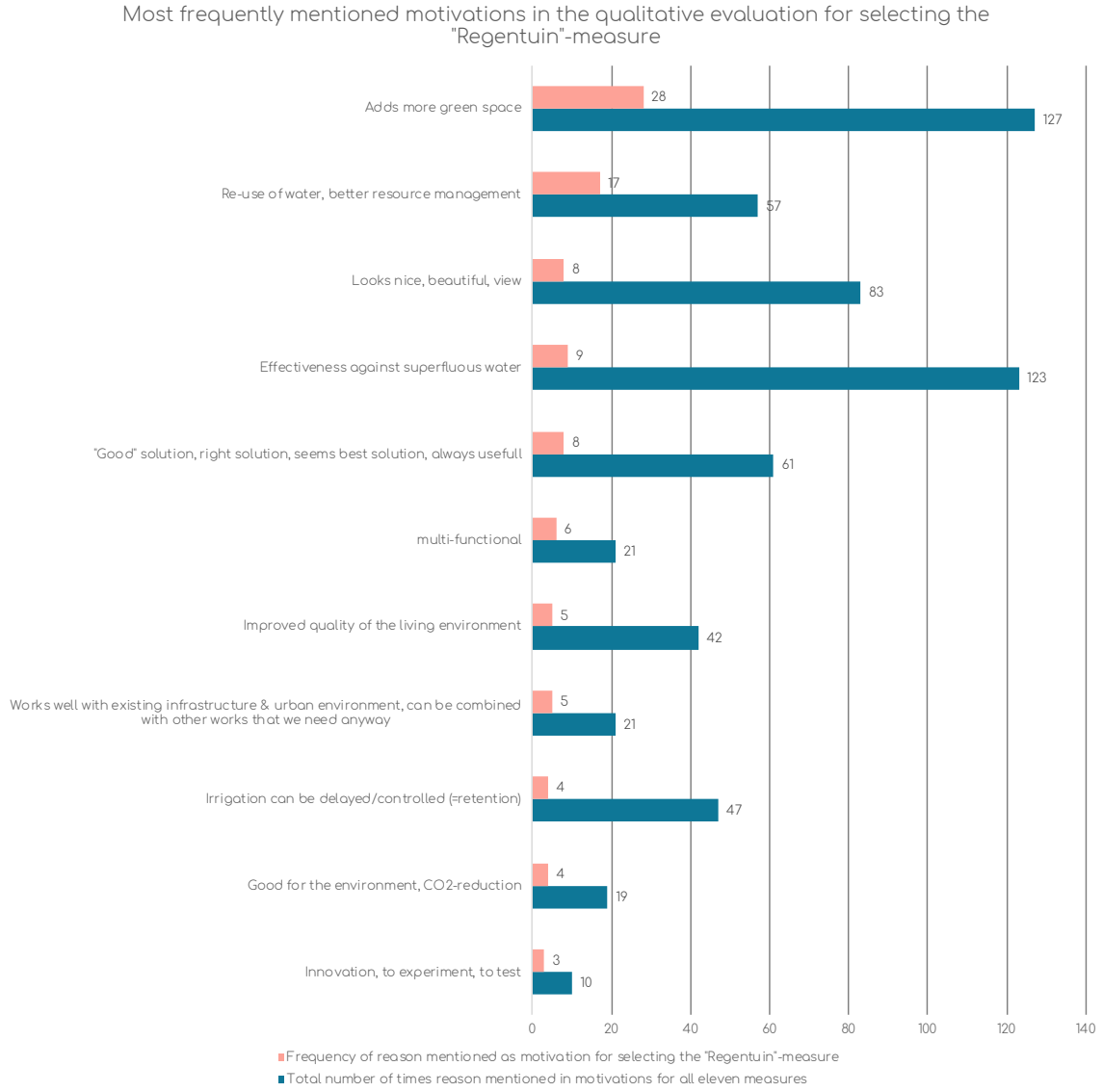

Figure App-n Qualitative motivations for selecting the measure 5

Quotes on green space

"Adds green space and is effective against superfluous water"
"Both because of more green and ability to re-use the water."

Quotes on re-use of storm water

"Especially the reuse of the water in this option appealed to me."
"Mainly the recycling has the advantage here. Double function."

Quotes on the looks and view of the measure

"Nice plan. I also think that subsidies should as much as possible go to technical inventions and / or to interventions in the public space. Rain barrels and yellow gardens etc. are beautiful, but they can be bought by people at their own expense. The eye wants something too. Green is important in a neighbourhood."
"Seems to be picturesque to me"

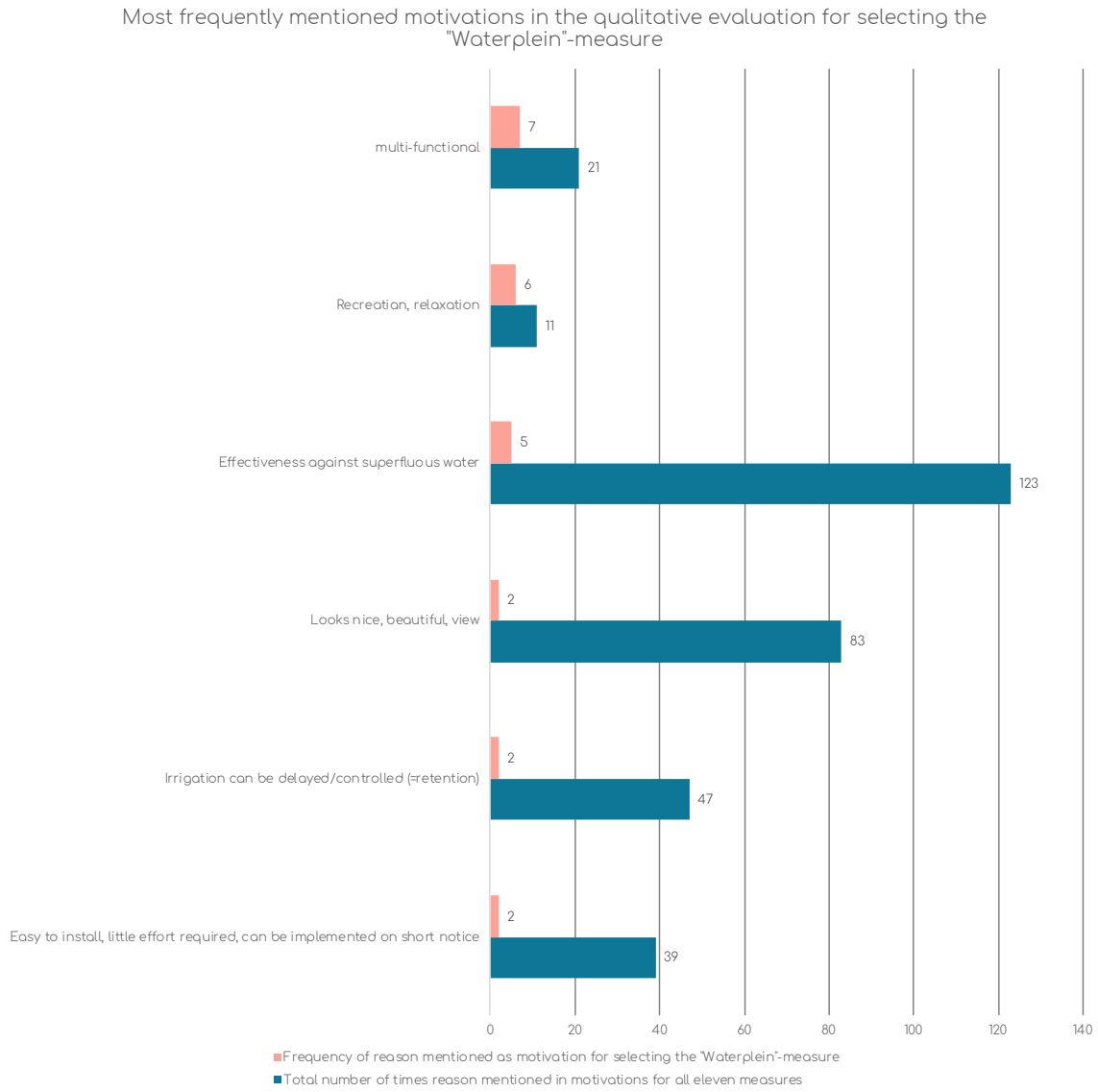

Figure App-o: Qualitative motivations for selecting the measure 6

Quotes on multi-functionality

"Urban development is interesting, there will be no traffic, will probably provide all kinds of outdoor games, if it is smartly furnished, people will probably sunbathe, a place to meet in the neighbourhood"

"Such squares are great fun, put a playground and skatepark on please"

Quotes on recreation

"Plein gives children room to play, because it cannot be a parking space if the whole thing is full when there is a huge downpour. "

"Combination play-recreation opportunities and temporary relief"

Quotes on effectiveness against storm water

"To prevent flooding in cellars and houses."

"Large buffering capacity."

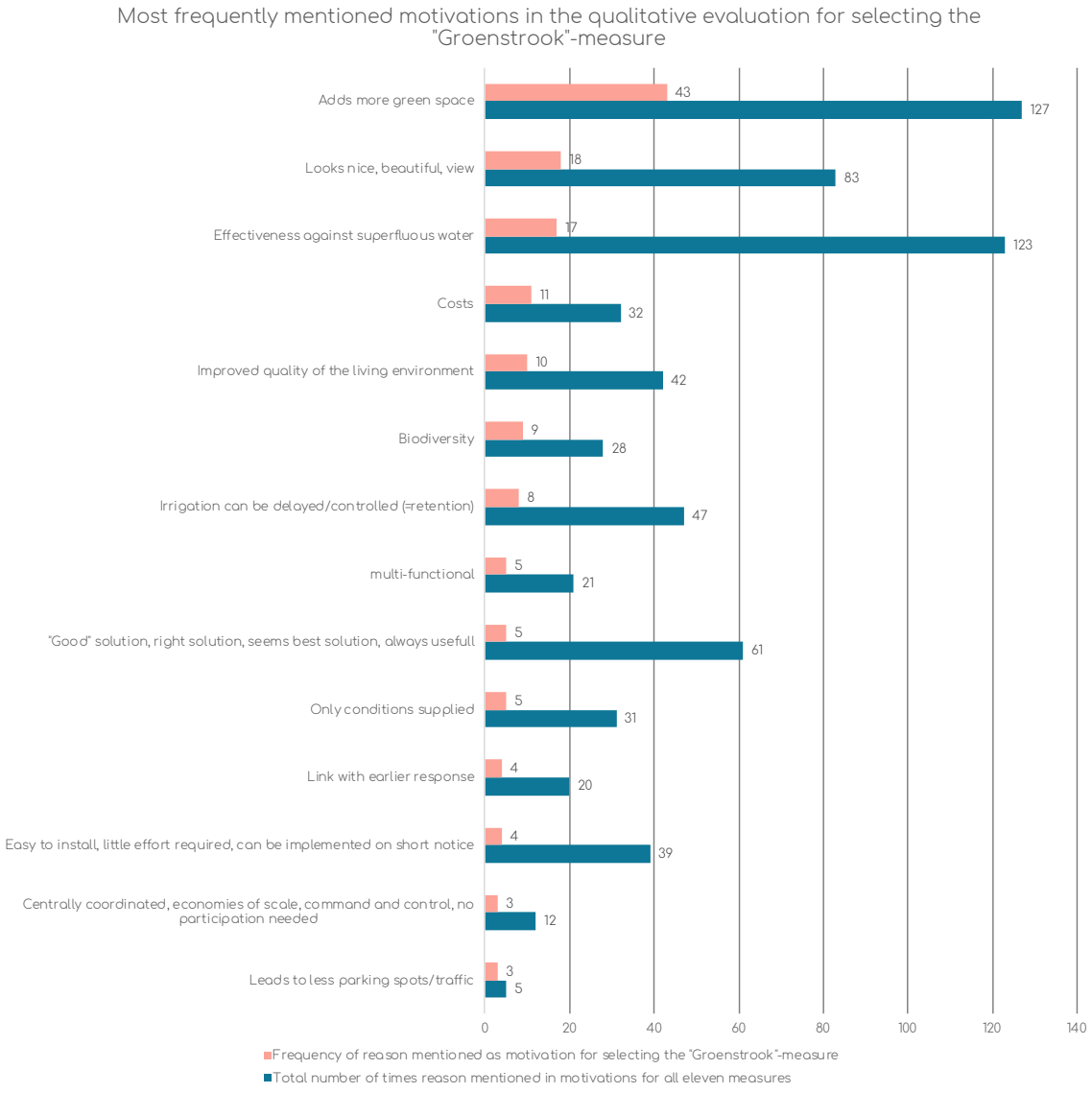

Figure App-p: Qualitative motivations for selecting the measure 7

Quotes on green space

"This measure is the most cost-effective and also provides a lot of green space. This measure should therefore be given priority where applicable. Because this measure does cost parking space, it will mainly be applicable in the suburbs where more space is available, there is more parking than in the city centre."

"Adds green space and it effective against superfluous water."

"Green in a neighborhood is better than nothing and is relatively cheap."

Quotes on the view/looks

"Besides water storage also improvement view in the neighbourhood. "

"Greening provides a friendly cityscape, with additional benefits such as water collection / permeability."

"Simple and cheap solution, which also looks good and is easy to implement."

Quotes on effectiveness against storm water

"Works well against superfluous water and adds more green space."

"More green that can absorb water from the street."

"Green strips are efficient and can look nice even while the effect is large."

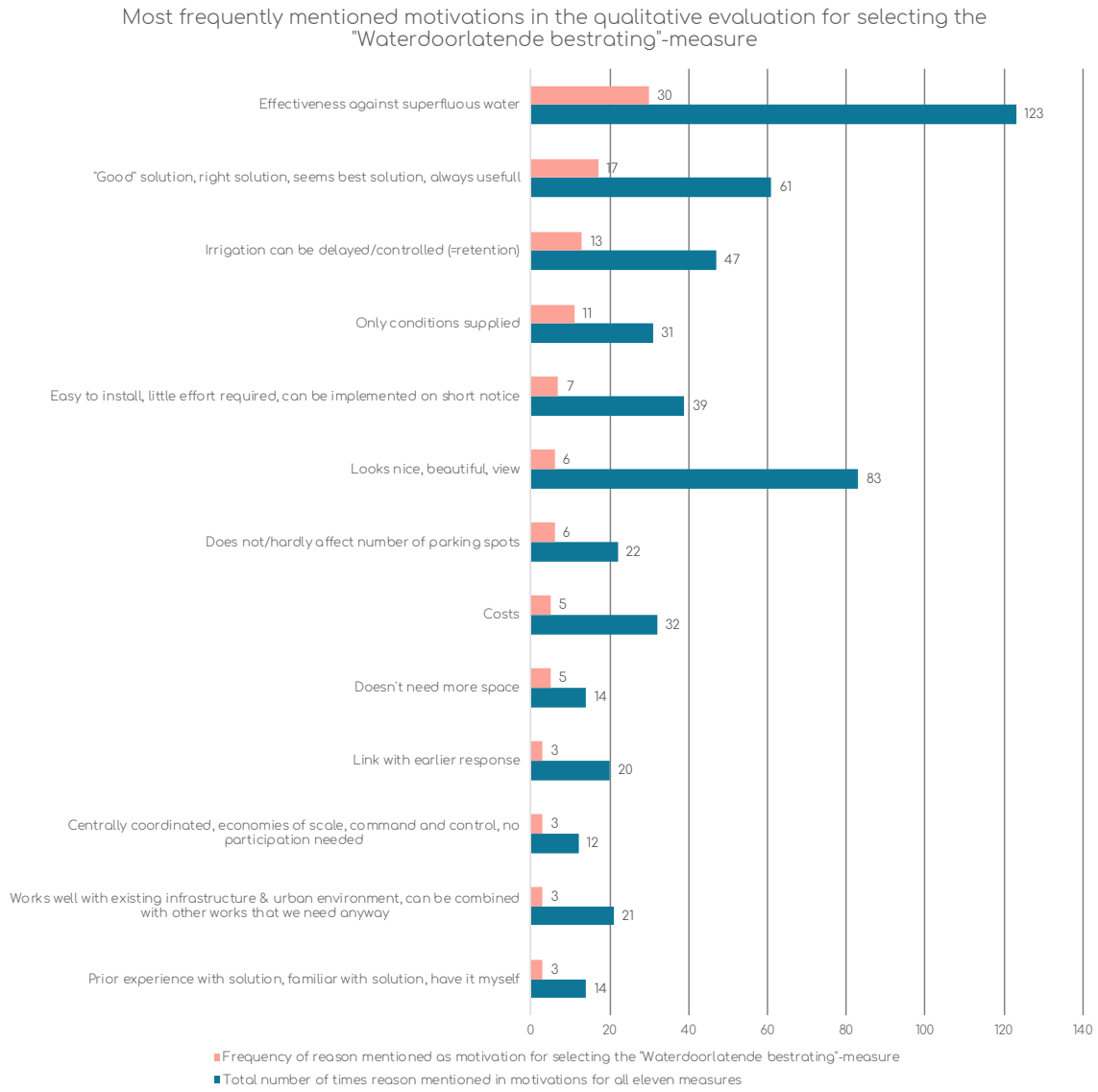

Figure App-q: Qualitative motivations for selecting the measure B

Quotes on effectiveness against superfluous storm water:

"Cost-effective measure to reduce days with superfluous water to 0."

"Effective against superfluous water."

"This helps in particular to keep the roads / carriageways / sidewalks free of water and thus limits pluvial flooding."

Quotes on being "a good solution"

"Water permeable paving is better for all parties, so that no water remains on the street, is very important."

"Great solution to prevent superfluous storm water."

"A good solution for the water that stays on the road so that it splashes less when you ride."

Quotes on retention capacity

"I find a more natural solution than closing everything up completely. This way the water can be better drained and stored."

"Does not require more space and allows water to infiltrate in the soil. With the right pavement choice, it can also look nicer than asphalt, especially in residential areas. Perhaps also possible for combi with grass, e.g. Parking places? '

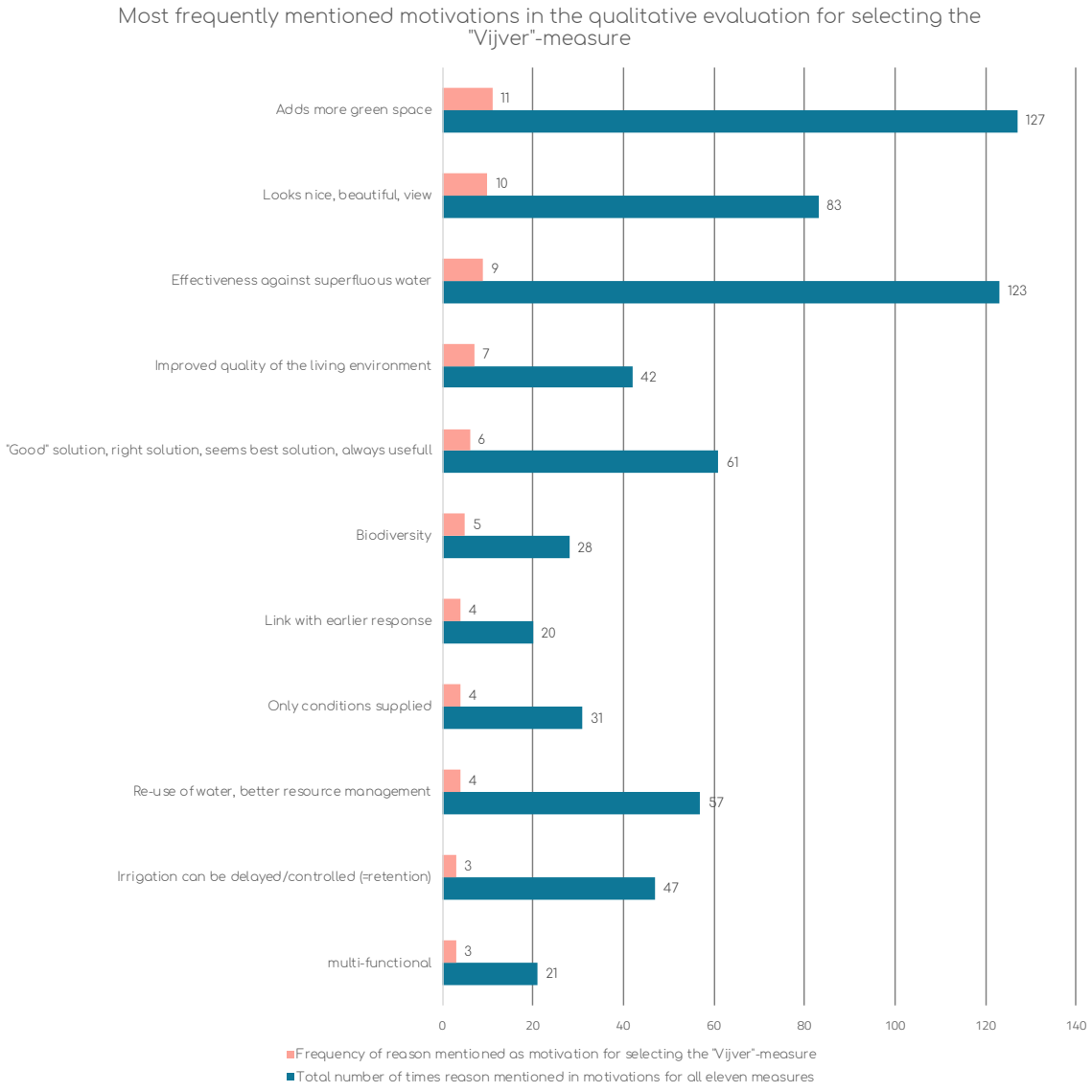

Figure App-r: Qualitative motivations for selecting the measure 9

Quotes on adding more green space:

"This solution also contributes to a beautiful environment, especially if the right planting also takes place."
"Pond is also a little extra 'nature'.."
"This measure is often the simplest and then you can plant the pond so that they are natural and can contain more fish which is good for the Amphibians, because now there are ponds where every year the plants are mowed from the soil rigorously and that has a negative effect on the entire biotope. Because the municipality often goes too easy due to a lack of ability/knowledge."

Quotes on the look/view

"Good for the looks of the neighbourhood."

"Relatively cheap, big effect, positive side effect street scene (green)"

"A pond looks beautiful and in for example a park it can also bring people together."

Quotes on effectiveness against superfluous storm water

"Serves two goals: looks nice and prevents superfluous storm water."
"Same as above: effective and enlarged the green spaces in the city."
"Seems to me of the proposed ideas a suitable idea for the neighborhood with reasonable impact."

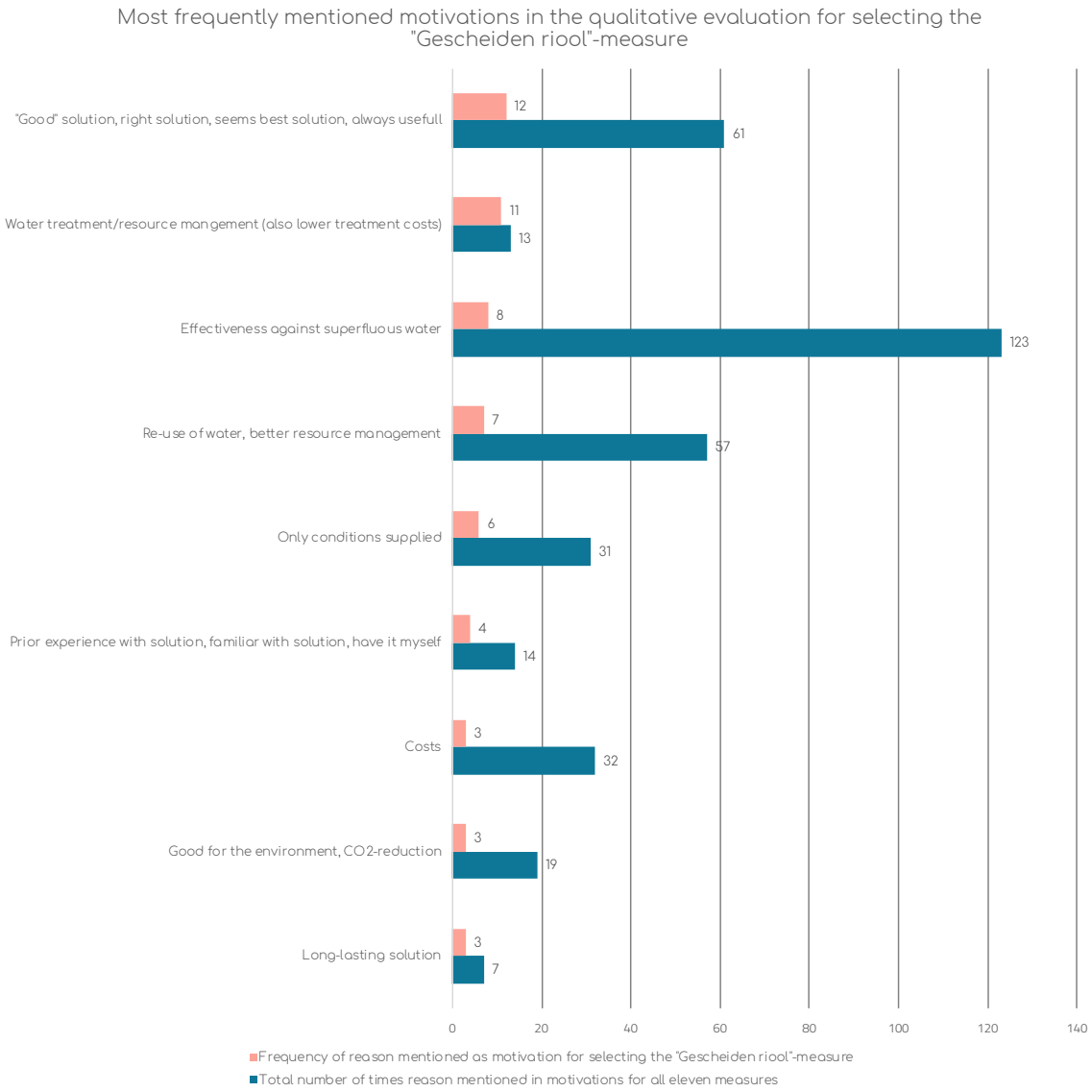

Figure App-s: Qualitative motivations for selecting the measure 10

Quotes on being "the right solution":

"In any case, a good first step towards greywater and it prevents overflow."

"As a result, the sewer will be less loaded and there is less chance that a pipe will jump."

"Preferably as much as possible of course, but it is expensive and not that simple."

Quotes on water treatment / resource management

"Better purification."

"This will probably also save energy in water treatment plants."

"It is a shame that we now mix rain water with waste water."

Quotes on effectiveness against superfluous storm water

"Great effect, limited impact on residents, so no expected resistance."

"The most effective means, with a continuous result. The other options give no effect at all in days compared to the costs and the existing resources."

"Relatively high number of days of water collection and little to no parking space."

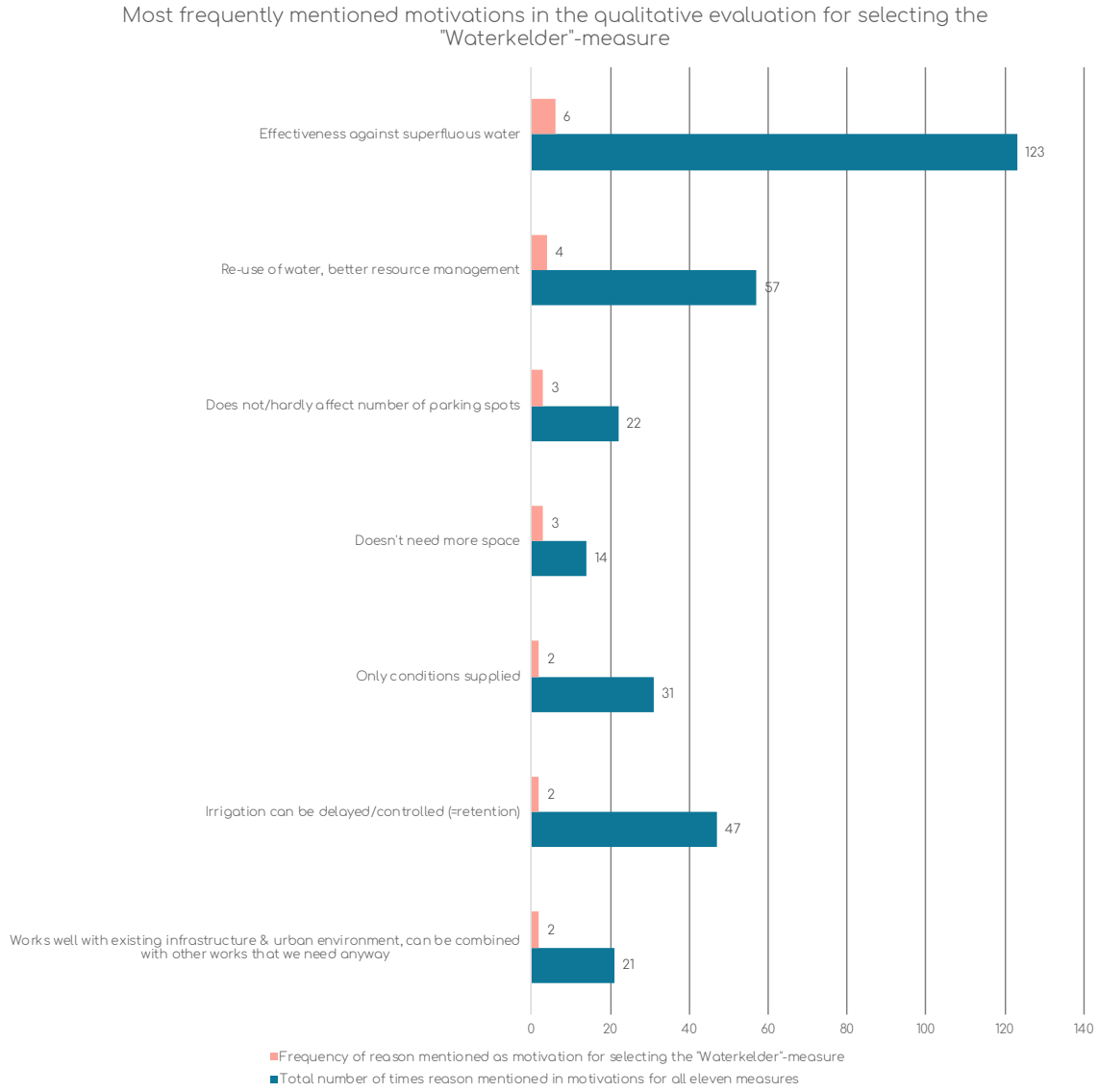

Figure App-t: Qualitative motivations for selecting the measure 11

Quotes on effectiveness against storm water:

"Draining excess water, does not require any extra land-use."
"Quick discharge."
"Storage in case of emergency."

Quotes on the re-use of water

"Possibly this water can be reused under these buildings for giving water to plants within the building. Or it can even be used for an x number of toilets."
"This allows water to be reused and used in times of drought. This way water can be reused and used in times of droughts"

Quotes on hardly affect parking spots

"It does not affect the number of parking places."

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Appendix VII: Matrix that summarizes the effects of the measures on the attributes

The table below summarises what the effect is of the measures on the attributes in the PVE. In the PVE-method, various versions are used to be able to analyse how changes in (the magnitude of) the effect of a measure impacts respondents choice behaviour. The MIN and MAX values represent the boundaries of the effects of the measure. Values outside of the boundaries are not expected to be realistic. The version data of the 26 versions was selected trough sampling values within the boundaries. The sampling was done on basis of heuristic design of particular combinations. The data presented in each of the 26 versions is available upon request.

Table App-h: Version data that was used in the PVE-experiment. The table shows the upper and lower boundaries of the effects of the measures on each attribute.

		KOSTEN		PARKEERPLEKKEN		WATER OVERLAST		HERGEBRUIK		GROENE RUIMTE		ONTWIKKELINGFASE		PARTICIPATIE		HUISHOUDENS	
		[€]		[# plekken dat verdwijnt]		[dagen wateroverlast per jaar dat wordt voorkomen door de maatregel]		[# keer dat een hh wasmachine kan draaien per week]		[m2]		[1;2;3;4;5]		[# uur werk per huishouden per jaar]		[# huishoudens dat baat heeft bij de maatregel]	
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
MAATREGEL 1	REGENTON	€ 80,000	€ 110,000	0	0	2	6	0	6	0	0	1	1	16	26	500	500
MAATREGEL 2	GROEN DAK	€ 33,000	€ 70,000	0	0	3	7	0	17	300	600	1	3	6	26	10	80
MAATREGEL 3	VERHOOGD BOUWEN	€ 40,000	€ 80,000	0	0	19	24	0	0	0	0	1	1	0	2	30	75
MAATREGEL 4	GEVELTUIN	€ 75,000	€ 100,000	0	50	8	12	0	0	375	590	1	2	20	40	500	500
MAATREGEL 5	REGENTUIN MET ONDEGRONDSE OPSLAG	€ 150,000	€ 200,000	0	23	15	19	40	45	150	250	1	5	0	2	60	100
MAATREGEL 6	VERDIEPT PLEIN	€ 465,000	€ 600,000	37	59	18	23	0	0	0	0	1	3	0	2	60	100
MAATREGEL 7	GROENSTROOK	€ 35,000	€ 65,000	11	23	17	22	0	0	125	250	1	1	0	12	35	75
MAATREGEL 8	WATERDOORLATENDE BESTRATING	€ 45,000	€ 80,000	0	0	22	30	0	0	0	0	2	3	0	0	35	75
MAATREGEL 9	VIJVER	€ 70,000	€ 100,000	45	64	4	6	0	0	500	700	1	1	0	0	60	100
MAATREGEL 10	GESCHEIDEN RIOOL	€ 375,000	€ 450,000	0	0	28	34	0	0	0	0	1	2	0	0	90	130
MAATREGEL 11	WATERKELDER	€ 400,000	€ 525,000	0	0	3	5	0	0	0	0	1	2	0	3	30	60