

Participatory Value Evaluation in Urban Storm Water Management

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Abstract

The Participatory Value Evaluation (PVE)-method was developed by Mouter, Koster, & 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 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 focuses on the topical societal challenge of managing superfluous storm water in the urban environment. The case study consisted of the application of a PVE-experiment to assess various measures for urban storm water management (USWM) and a follow-up survey to analyse how respondents evaluate the PVE-method. Out of 5000 targeted respondents, 146 completed experiments were derived. The results indicate that the PVE-method is evaluated positively by respondents and provides valuable insights into the qualitative motivations of respondents for selecting specific measures (effectiveness against superfluous storm water and more green space). It is concluded that 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 in the context of USWM decision-making is bounded by three limitations. Future research should focus on tackling these three barriers of the applicability of the PVE-method in the field of USWM: how to lower the threshold for participation to generate enough response to perform the econometric choice modelling, how to decrease the task-complexity for respondents and how to improve the representation of the municipal population in the sample group.

Keywords

Participatory Value Evaluation | Participatory Budgeting | Urban Storm Water Management | Willingness to Allocate | Participation

1 Introduction

Extreme rain events are expected to impose serious burdens on the urban environment (Koop & van Leeuwen, 2017). 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 suffering from storm water related damages increases (Dekker, Nootenboom, Locher, & Spekkers, 2016; Spekkers, Rözer, Thielen, ten Veldhuis, & Kreibich, 2017). USWM to date has resulted in sunk-costs in the existing sewerage infrastructure and large investments (in total Dutch municipalities spent 1.56 – 1.76 billion euros a year on urban water management in 2013 and 2014¹) have been allocated to the operation, maintenance and renewal of this infrastructure for the long future. If municipalities are to deviate from this “standard” measure for USWM, investments should be justifiable despite the sunk-costs in the sewerage infrastructure. The total utility (including the value of additional benefits) derived from other measures should be significant for that measure to become a viable alternative to the sewerage system. 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.

¹ 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.

Economic assessments of public goods

A key challenge in the economic evaluation of investments in public goods (like protection against superfluous storm water), is to successfully consider the social value of those goods and the positive/negative externalities of the investment. Ostrom & Ostrom (1971) discuss how the concept of public goods impacts public decision making. They introduce the viewpoint that public agencies can be seen as a means to “...provide public good and services responsive to the preferences of individuals in different social contexts” (Ostrom & Ostrom, 1971). However, the challenge remains to find the appropriate approach to define that preference and to use it in a decision-making process such that the decision will maximize the total utility of a public investment for society. Assessing investment opportunities for water infrastructure development is complicated, since 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.

A well-known and frequent applied method for the economic assessment of (public) investment opportunities is Social Cost Benefit Analysis (SCBA). Despite the widespread use of the SCBA by public authorities, the applicability of the SCBA as a means to assess investments with public funds has not been undisputed (i.a. Ackerman & Heinzerling, 2004; Alphonse,

Alfnes, & Sharma, 2014; Hauer, 1994; Jara-Díaz, 2007; Kelman, 1981; Mackie & Fowkes, 1999; Marglin, 1963; K Nyborg, 2000; Sagoff, 1988; Sunstein, 2005).

Mouter, Van Cranenburgh, & Van Wee (2016) argue that the foundations of the SCBA on consumer Willingness to Pay (WTP) is faulty, when applied to evaluations of investments with public funds. The main difficulty is that public goods and services are characterized as non-exclusive, non-market and incentivize free-rider behaviour. As a result, the consumer choices on which the WTP is estimated, might not reflect how individuals want public policies to change (Sen, 1985). When the preference for a certain public good or service is assessed by decision-makers, they should therefore not base these estimations on a consumers' Willingness to Pay, but on the preference of an individual in their role as a citizen (Mouter et al., 2017; Mouter & Universiteit, 2017)

A different approach to determining the social desirability of a set of alternatives (Broadway & 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 underlying principle of participatory budgeting is that citizens are asked to help allocate the public (tax) 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 (see also Barak & Katz (2015) on assessing stream restoration in Israel). Mouter, Koster, Dekker, & Borst (2018) elaborate extensively on the concept of WTA as an alternative to WTP and its embeddedness in economic theory. Participatory budgeting is also a means for inclusive decision-making. The involvement of stakeholders (e.g. citizens) in the process of decision-making is expected to help generate support for decisions, to improve the quality of the decisions and to enhance local democracy by bridging the gap between public authorities and inhabitants (Klijn & Koppenjan, 2000)

From an economic theory point of view, participatory budgeting provides a more appropriate 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 (Mouter et al., 2017). Therefore, Mouter et al., (2017) have developed a participatory budgeting tool, the Participatory Value Evaluation (PVE) to tackle those downsides.

Participatory Value Evaluation

Whereas traditional participation is organized through workshops and 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 assess the utility that is derived 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.

The theoretical advantages of this approach have been discussed in further detail in the work of Mouter, Koster, Dekker, & Borst (2018a, 2018b). However, the empirical evidence of the applicability of this method in public decision-making is very limited, as the method has so far only been applied in two case studies: a transport case study in Amsterdam and a Water Safety Study. The two earlier 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 needs to be assessed through the application of the PVE-method in a case study on the topical societal challenge of superfluous storm water in the urban environment.

Research objectives and scope

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 assessment based on a participatory budgeting approach with the PVE-method could help to steer future investments in climate adaptation and urban storm water management strategies, such that the highest value-for-money can be achieved. 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 considered²:

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

² 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 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

2 Methodology

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. 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.

The PVE-experiment is designed through an iterative process (see figure 1), consisting of

- 1) Scoping and framing the experiment
- 2) Selecting and characterising measures
- 3) Selecting and characterising attributes
- 4) Developing the qualitative survey
- 5) Developing the online tool.

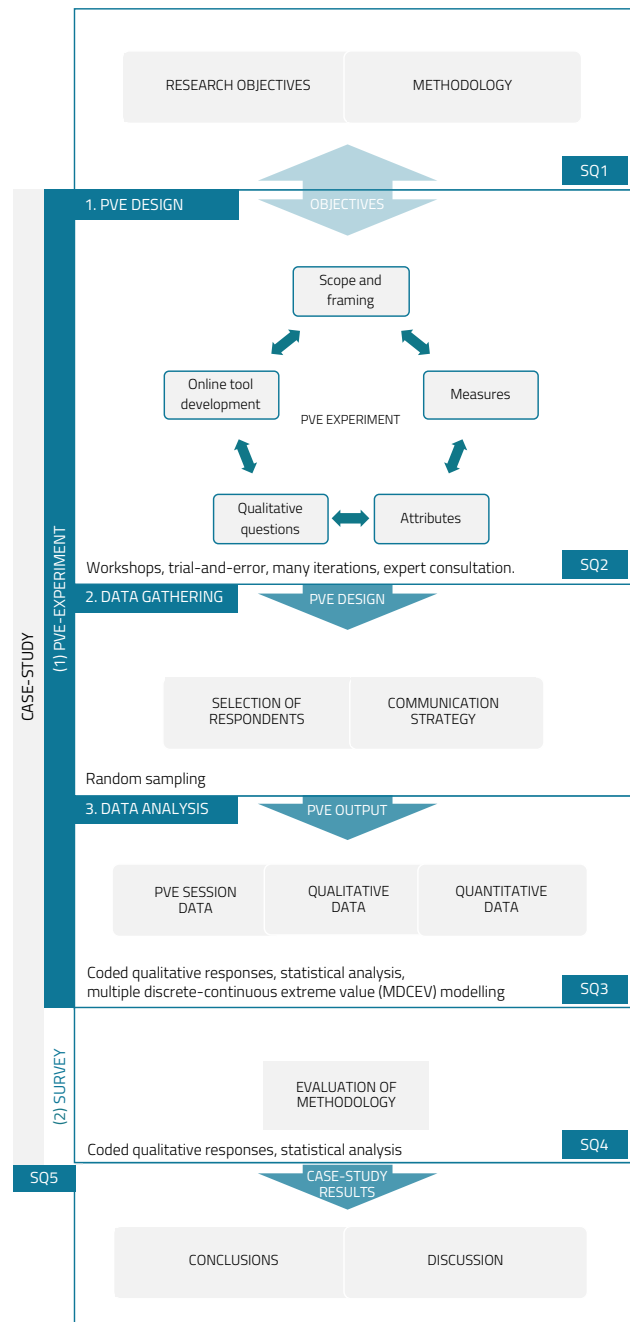


Figure a: Visualisation of the methodological framework applied in this research.

The content was generated through literature study, workshops, trial and error, and expert consultation.

The respondents of the PVE-experiment were selected through random sampling of postal codes from adult (18+) inhabitants of the municipality of the Hague. Participation was on a voluntary basis and completely anonymous. The 5000 invitation letters resulted in 146 completed PVE-experiments (3% success rate). These 146 completed sessions on the online PVE-tool generated four sorts of data:

- 6) demographic characteristics of the respondents
- 7) quantitative data on the configuration of USWM-measures the respondents had selected within the budget constraint
- 8) qualitative motivations of the respondents for selecting the measures they included in their portfolio
- 9) the evaluation of the PVE-method by respondents in the form of answers to the integrated follow-up survey.

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.

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. The same technique was used to analyse the qualitative responses to the survey.

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).

3 PVE application in case study

This section will discuss both the set-up of the PVE-experiment and the results that were obtained from the actual application of the PVE-experiment in the case study of The Hague.

Set up of the PVE-experiment

The context of the case study is USWM in The Hague. This specific context allows for the assessment of the applicability of the PVE in a different sector and at a different

policy level. A geographically undefined neighbourhood is chosen as the scope for the case study in The Hague. 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 municipality of The Hague.
- 3) Household size: 2.2 people per household

The set-up of the case study for the field of USWM was different from the set-up of earlier PVE-experiment on the following 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.

In the PVE-experiment for this case study 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 these measures on eight PVE-experiment in this case study also allowed respondents to 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 showcase of the PVE-experiment for the case study of The Hague can be found via <https://bewonderzoek.nl>.

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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.

Case study results

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 (=143/5000). Out of the 149 registered completed experiments, three sessions had to be discarded because they were used for verification and validation purposes.

Since all but one of the 149 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) 145 were sessions included in the final data set.

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 identified, 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.

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. 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."*

The results on the motivation for selecting specific measures show 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.

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 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."*

In contrast to the multi-functional approach, some 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"*

Many respondents apparently considered costs to be less important, than the benefits that would be derived from a measure. In appendix VII, the motivations for each individual measure are discussed in more detail.

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. 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 for follow-up among citizens 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"*).

On a more positive note, the PVE-method has proven not only to be a means for municipalities to gather input, but simultaneously provides the public authorities a way to create awareness and explain the effects of different measures. 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 and 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 Conclusions

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. The assessment of the PVE as a means to better align USWM policies with citizen 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.

Drivers of PVE-applicability 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), creates an understanding of the complexity of public budget allocation (which enhances support for decisions) and 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).

[2] The PVE-method allowed 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) provided insights in the preferences of citizens through the ratio by which each measure was selected. (3) The survey after completion of the PVE allowed for the supply of input on specific knowledge needs.

[3] Even though the response ratio 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 showed to appreciate the fact that they were 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.

[7] Despite a fear of underrepresentation of older age group because of the digital form of the PVE-experiment, most age-groups were properly represented in the sample group. The option to check the representation of the population in the sample statistically, prevents the unjustified extrapolation of responses from only a small group of

respondents or false interpretation of index numbers.

[8] Setting-up the PVE-design was a bit of 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 ill-defined. However, once these issues were resolved, the PVE-method allowed for customization 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.

Barriers of PVE-applicability 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 voluntarily 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 (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.

6. Discussion and future work

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.

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.

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. Future research is needed to determine whether the composition of the sample groups is significantly different in various methods of public participation.

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 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 than have been performed in this study. The survey also 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. Or what the relation is between the other demographic statistics and the stated preferences, motivations and perception regarding the PVE-method.

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