Applying Scenario Based Design to actively involve citizens of a

Climate-Proof City

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April 13th, 2018
Scenario Based Product Design
Industrial Design Engineering

UNIVERSITY OF TWENTE.

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April 13th, 2018
Scenario Based Product Design - Group 5
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Preface

Dear reader,

For the past 2,5 months, we have been working hard to find solutions for heavy rainfall, which could be applied on private property. Following our research, we developed three product concepts. This report will explain the results of our research, our design approach, our motivation for this approach and our reflection on the general approach and specific parts of the design approach. We hope you enjoy reading our report!

Best regards,

Tom, Sanne, Merle, Sven and Yanick
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Contents

Abstract

In the analysis phase the first step was to conduct desk research. This research consisted of a problem definition, stakeholder analysis, market research, and context analysis. It was also planned to conduct an interview with the municipality or the case provider and to conduct a survey with potential users. It was decided not to conduct an interview with the case provider since it was possible to get a few answers about the case in general via mail. However, an interview with the municipality should still be conducted. Since it was not possible to get in contact with the municipality, the interview could not have been conducted. It was tried to fill the missing information with additional desk research. Anyhow, not all of the information could be found.

The survey was conducted successfully and served, amongst others, as a basis for creating in-depth persona's in the next phase of the project. Also insight was gained into the current situation of house owners, like how they handle flooding, and what their wishes and their needs are.
The outcome of the analysis phase is a first range of wishes and requirements.

During the design phase, needs persona's were created and their needs, goals, and wishes were identified. It was also brainstormed for possible functions that might fulfill a certain needs persona goals and needs. Furthermore, possible problem scenarios were created which gave insight into a variety of possible problems of a future product and thus resulted in a extensive list of requirements.

Moreover, in-depth persona's were created based on the empirical data obtained through the survey. For each in-depth persona a character driven scenario was written. In the beginning it was stated that these character driven scenarios would be daily scenarios of the persona's. However, it was decided to write scenarios in which it is raining heavily since this is the period when the product should fulfill its main function, that is, prevent damage through flooding.
These scenarios served as input for the Magical Bits session which was the following step in this phase. The Magical Bits session was executed amongst the design team and it resulted in a range of different ideas for possible functionalities.
The outcome of the design phase are, again, a range of requirements, as well as a whole list of ideas for possible functions for a future product.

During the co-design phase, a CUTA-session and an MRP-session. In the beginning, it was planned to conduct these two sessions separately from each other, however, regarding the available time for the project and due to struggles with planning these sessions it was decided to conduct the parallel. Because of planning difficulties also a smaller amount of people took place in the co-design session than initially planned.
The possible problem scenarios from the earlier phase served as a base for the co-design sessions. The results gave less input than expected, but valuable insight was gained in the thinking process of people. The outcome of the co-design phase are three concepts, each focusing on a different solution to the initial problem.

During the evaluation phase the concepts are compared to the requirements, they are rated on how well they are suitable for each character driven scenario from the design phase, and they are validated by a few respondents based on a range of criteria.
The outcome of this phase is an overview of the advantages and disadvantages of each concepts and recommendations for possible improvements for a further iteration step.

Samenvatting

In de analysefase was literatuuronderzoek de eerste stap. Dit bestond uit een probleemdefinitie, belanghebbendenonderzoek, marktonderzoek en contextanalyse. Verder was het de bedoeling om een interview te houden met de gemeente of de opdrachtgever, en om een enquête te houden met potentiële gebruikers. Uiteindelijk is besloten om geen interview te houden met de opdrachtgever omdat het mogelijk was om antwoorden over de casus te verkrijgen per e-mail. De insteek was echter nog steeds om een interview te houden met de gemeente. Helaas is dit niet gelukt, omdat we uiteindelijk geen contact hebben kunnen leggen met de gemeente. We hebben geprobeerd dit gemis te compenseren met aanvullend literatuuronderzoek. Dit heeft een deel, maar niet al van onze vragen beantwoord.

De enquête is succesvol uitgevoerd en diende onder andere als de basis voor het creëren van realistische persona's in de ontwerpfase. Uit de enquête konden nuttige inzichten worden onttrokken met betrekking tot de huidige situatie van huiseigenaren. Hierbij kan gedacht worden aan hoe omgegaan wordt met overstroming, en het in kaart brengen van hun wensen en behoeften. De uitkomst van de analysefase was een eerste inventarisatie van eisen en wensen.

Tijdens de ontwerpfase zijn zgn. *needs persona's* gecreëerd, waarbij hun behoeftes, doelen en wensen in kaart zijn gebracht. Ook is gebrainstormd naar mogelijke functies die de doelen en behoeftes van specifieke needs persona's zouden kunnen ondersteunen. Verder zijn possible problem scenarios gecreëerd, die inzicht gaven in een variëteit aan mogelijke problemen van een dergelijk toekomstig product. Daaruit volgde een uitgebreid eisenprogramma.

Daarnaast zijn realistische persona's gecreëerd op basis van de data uit de enquête. Voor elk van deze persona's is een scenario geschreven. Aanvankelijk was het de bedoeling dat voor deze persona's scenario's uit het dagelijks leven van deze persoon zouden worden geschreven. Er is echter voor gekozen om scenario's te schrijven waarin het zwaar regent, aangezien dit de periode is waarin de producten hun hoofdfunctie moeten uitvoeren - het voorkomen van schade door overstroming, danwel het (mede)voorkomen van overstroming. Deze scenario's zijn gebruikt als input voor de Magical Bits sessie, de volgende stap in de ontwerpfase. De Magical Bits sessie is uitgevoerd in het ontwerpteam en resulteerde in een aantal ideeën voor functionaliteit. De uitkomsten van de ontwerpfase waren wederom een aantal eisen, en daarnaast een lijst vol ideeën voor mogelijke productfuncties voor een toekomstig product.

Tijdens de co-designfase zijn een CUTA-sessie en een MRP-sessie uitgevoerd. In het begin was het de bedoeling om de sessies na elkaar uit te voeren. Echter, in verband met de beperkte beschikbare tijd voor het project, en daarop volgende planningproblemen is besloten om de sessies parallel uit te voeren. Deze problemen in de planning hebben er ook toe geleid dat er minder mensen meededen aan de co-designsessies dan beoogd.

De possible problem scenario's uit de ontwerpfase zijn gebruikt als de basis voor de co-designsessies. De resultaten gaven minder input dan verwacht, maar gaven niettemin inzicht in het denkproces van de deelnemers. Na synthese kwamen uit de co-designfase drie concepten, die elk met een andere invalshoek het probleem benaderen.

Gedurende de evaluatiefase zijn de concepten geëvalueerd aan de hand van de eisenlijst, is bekeken per realistisch persona hoe geschikt elk concept is, en zijn middels een enquête de concepten beoordeeld door potentiële gebruikers. De uitkomst van deze fase is een overzicht van de voor- en nadelen van elk concept, en aanbevelingen voor mogelijke verbeteringen in een volgende interatieslag.

Definitions

CUTA	*Current-use task analysis.*
Homeowner	*A person who owns the home he/she resides in.*
MRP	*Miniature roleplaying.*
Resident	*A person who lives somewhere permanently or on a long-term basis.*
SBPD	*Scenario-based product design.*

About the climate-proof city
SBPD-approach

1

Introduction

1 Introduction

1.1 About the climate-proof city

Global climate change is evident. This is expressed by weather that is gradually increasing in intensity, from mild winters and summers to higher peaks in temperature, heavier rainfall and extensive periods of drought. As a result, more and more Dutch citizens experience local flooding of urban areas. These areas are often not designed to handle these weather conditions. Therefore, spatial adaptation is essential to improve the water robustness of the areas.

The spatial adaptation approach of the Deltaprogramme focuses on large-scale urban (re)development, from neighborhoods upwards. Consequently, new housing projects often include water storage solutions, allowing homeowners to be able to temporarily store water on their plots. These storage solutions act as a buffer in case of heavy rainfall, preventing local flooding and other problems caused by heavy rainfall. To facilitate the water storage, new products are needed for citizens. There are several products on the market already, but these are not widely adopted. Questions the industry currently has are:

1. What are homeowners willing to do on their plots to create temporary water storages?

2. What kind of products would homeowners be looking for to create temporary water storages?

Within this research case, the focus will lay on the second question, but the first question is taken into account as well. The end goal is a selection of user wishes and concepts translating these wishes into product ideas.

1.2 SBPD-approach

The approach for this design process is built upon a combination of various SBPD methods presented during the SBPD course.

1.2.1 General structure

Section 1.1 sets the end goal for the project to be a selection of user wishes, concepts and product ideas. To reach this goal, the design process has been set up according to *Figure 1*. It consists of four phases: analysis, design, co-design and evaluation. In the following sections, these phases will be explained.

1.2.2 Analysis phase

The first step of the analysis phase involves desk research. It consists of problem definition, stakeholder analysis, market research, and context analysis. Based upon the desk research results, an interview with the municipality of Enschede was requested, and a survey with potential users conducted. The interview would serve to get an insight into the needs of the municipality. Would they like to invest in the project? And what actions do they currently perform against flooding? The survey results lay the foundation for the in-depth personas, and aid to gain insight into the current situation. It should answer questions such as: what do people currently do against flooding? And what functions would they like a flooding preventing product to have?

The main outcome of the analysis phase is an overview of the market, containing valuable insights into the wishes of homeowners. Other results are technical and functional requirements for the product and current situation descriptions.

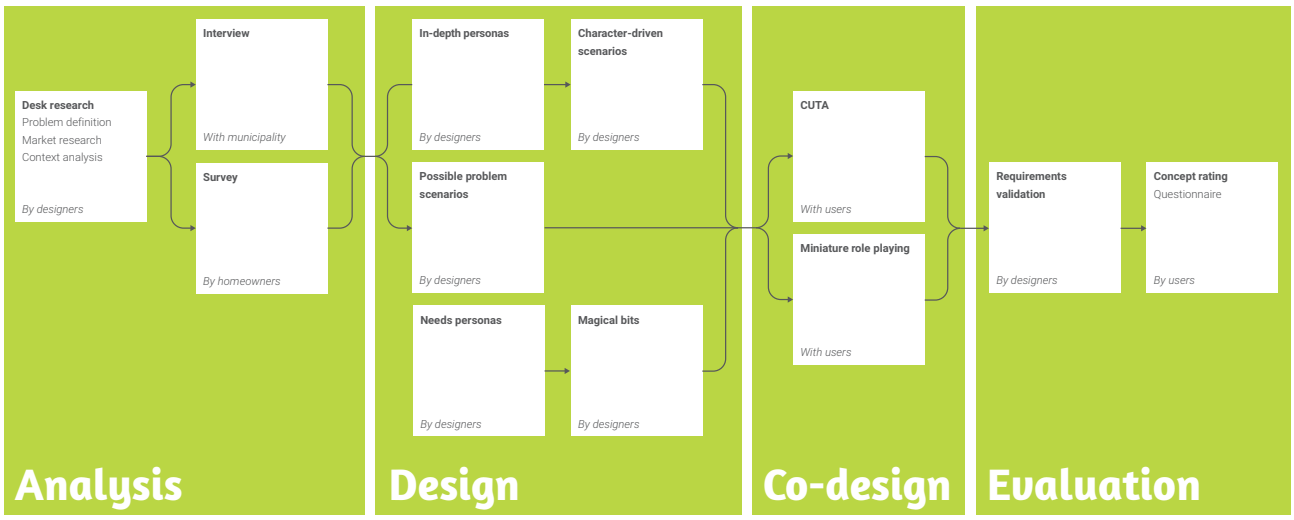


Figure 1. *This project required the creation of a scenario based design process. This figure shows the various activities within the design phases of the design process, and explains who are involved in at which design activity.*

Throughout the analysis phase, the users are actively involved to generate empirical data used as input for the outcome of the analysis phase.

1.2.3 Design phase

During the design phase needs personas are created and their needs are identified. This is done as inspiration so that it is thought about the extremes. For example: What functions would an influencer like to have in a product against flooding?

Next, for ideation the tool 'Magical Bits' is used. This tool is very easy to implement into the project and it might help to think outside the box and generate innovative ideas.

As a next step, character driven scenarios are created based on the personas made during the analysis phase. The purpose of these scenarios is to gain insight into the needs, goals, and wishes of the personas. These scenarios will be daily use scenarios to see how people can and would use the device in their daily lives. For example: Which functions could be added to implement the device into the users daily live and needs? The medium of expression are textual descriptions, and the source of inspiration are the designer's ideas and analysis.

1.2.4 Co-design phase

Afterwards, possible problem scenarios as edge case scenarios are created which are then being used for a roleplaying session and a CUTA session. The purpose of these scenarios is to communicate possible problems to the user to find out how they would handle in such a situation. The medium of expression in this case are textual descriptions and maybe storyboards and the source of inspiration are the designer's ideas and analysis.

As already mentioned, a CUTA-session with potential users is then conducted based on current use scenarios as well as on possible future scenarios. Moreover, an MRP-session is conducted with potential users. The outcome of the design phase are several concepts for a product against flooding.

1.2.5 Evaluation phase

As evaluation, the concepts are compared to program of requirements and might be adjusted to meet all of the requirements. Next, a questionnaire is conducted in which the potential buyers of the product (homeowners) rate the different concepts. Finally, the outcome should be a verified concept of or recommendations for a product against flooding for homeowners.

During this phase of the project, only the homeowners are involved and not all of the users since they are the ones who would be buying the product.

1.2.6 Benefits, risks and limitations

The benefits of the approach is that in each phase the stakeholders are concerned to make sure that the needs of them are covered. Moreover, the approach is based on the needs, wishes, and emotions of the users instead of only focusing on the (technical) main function of preventing flooding.

However, there are also some limitations. First of all, only a limited amount of time is available for the project and because of this, the project is only a limited iterative process. Probably more iterations would be better for the given case. Also, the project does have some bottlenecks. Firstly, the availability of stakeholders, especially the municipality, might be a problem. Furthermore, the stakeholders must be willing to participate.

Another problem might be the scheduling of the different participatory design sessions.

A more general bottleneck is that the given case may be solved with a solely technical solution. Cases which focus more on the feeling or on the interactions with the users are easier to implement in scenarios because less imagination is needed. With this case it is expected that with scenarios the interaction and feelings will be implemented, but is does require a lot of imagination.

Introduction
Desk Research
Survey
Interview with municipality
Conclusion

2

Analysis phase

2 Analysis Phase

2.1 Introduction

In the beginning of the project, desk research was executed in order insight into the subject. This research included a problem definition, a market research, a context analysis, and a stakeholder analysis. Afterwards, a survey was executed and it was investigated what the needs of the municipality are, what they currently do against flooding, what the problematic areas are and why these particular areas are more problematic than others.

2.2 Desk Research

In the following paragraphs the different analyses are presented. First, the problem definition is stated, then our stakeholders are investigated. Consequently, the results of the market research are shown and finally, the context analysis is presented.

2.2.1 Problem definition

Around the world things are changing. Not only does humanity influence global warming but also the infrastructure. Countries are filled with buildings, large cities or roads. Both of these changes influence the problems the Netherlands is currently experiencing with heavy rainfall. Firstly, the change in climate is the origin of the sudden large amount of heavy rainfall in the Netherlands. On average at least 24 millimeters of rain falls in one day, five times per year[1]. This is not only enough water to flood a basement but also influence a cities infrastructure with road flooding.

To cope with these problems, the infrastructure of towns and cities have to be changed. This could be done through multiple options; temporary water storage, changing the drainage throughout the whole city and guiding the water elsewhere during heavy rainfall. The Deltaprogramme spatial adaption is looking into making urban areas more water robust, meaning that a strategy of temporary water storages is being developed[2].

This report focuses on the possibilities of water storage for home owners, giving them their own solution for the problems they encounter. These solutions can be made for new housing projects, but might also benefit current homeowners experiencing problems with heavy rainfall. The scope of the project is set to the Netherlands and individual solutions that can be put on private property, not excluding the possibility of creating a community.

The objective for this report is to find a solution which reduces the problems caused by heavy rain in the Netherlands. This solution is placed somewhere around the house of an individual.

2.2.2 Stakeholder analysis

Figure 2 shows the primary stakeholders identified for this problem.

Primary

Homeowner (End-user)

The person living in the house, either alone or with other people. However, the house is not necessarily owned by this person. Therefore we use the term homeowner instead of house owner. The needs of this stakeholder are the main focus point of the project and will be investigated thoroughly during its runtime. This person often is the one to decide whether or not to buy the product.

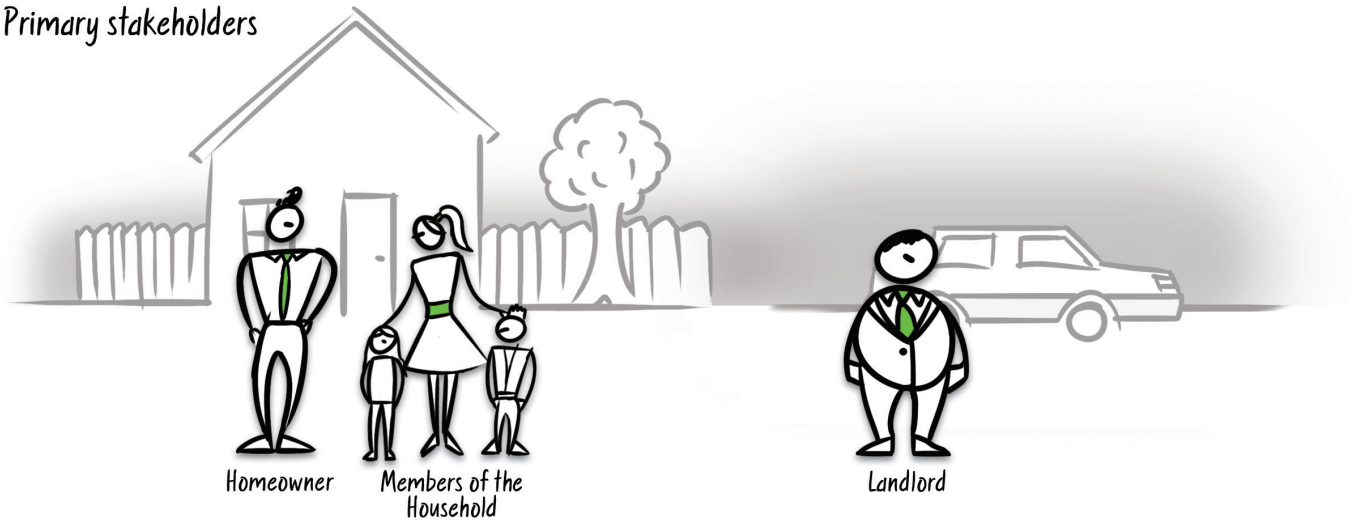


Figure 2. *The primary stakeholders are as illustrated above.*

Members of the household
These are people that share a house with the homeowner. They might have a voice in the procedure of acquiring the product, but they are not the final decision maker.

Landlord
If the end-user lives in a rental home, the house is owned by a landlord. Often the person that lives in the home will need to discuss lasting changes to the house with the landlord. Therefore it is necessary to take into account the needs and wishes of this person as well.

Secondary
Municipality (Government)
The municipality wants a livable and thriving city. Since rainwater collection prevents flooding, the city takes advantage of the product. Governmental resources, for example, might prove useful in this case.

Neighbors
Just as the municipality, the neighbors want a livable environment and the possibility to pursue their own way of living. They do not want to be hindered or bothered by a product that their neighbor acquired. However, if the product prevents flooding and other water related trouble, the also benefit from the product.

2.2.3 Market research

When looking at the market of flood protecting products, it can be found that for homeowners there are basically only two categories to choose from: water tanks and water barriers. In *Appendix B* some of these products are described. Furthermore, there are also some general concepts for solutions for flood protection, which are especially meant to be applied for cities rather than homeowners.

To sum up the findings, there are many products available for homeowners to protect their houses against flooding. However, most of these products are barriers or tanks and do often not have additional functionalities but collecting water or preventing water from getting into the house. The products often are quite big and most of them have an unpleasant design. So there is a need for flood protecting products which offer additional and valuable functionalities to the user and which have a pleasant design.

For cities some interesting concepts are currently under development even though no 'perfect' solution could have been found yet.

2.2.4 Context analysis

People experience a varying degree of disturbances from heavy rainfall. One aspect herein is the places they live. According to the Unie van Waterschappen, the most problems occur in large urban areas and cities, due to **stonification** – an increased amount of brick and stone[3]. **Greenification** of urban areas is one of the ways municipalities and water boards want to reduce the risks of heavy rainfall and extended periods of drought.

Large urban areas that suffer from heavy rainfall, do so due to various causes. Extended periods of rain may overflow the maximum throughput of the cities' drainage system. Greenification could act as a buffer to carry water more gradually, compared to stone. Areas with lots of buildings in a small space have relatively much roof space. Water from roofs will usually enter the drainage system, possibly leading to overflow as well.

Reportedly, various areas in northern Enschede suffer from poor drainage, caused specifically by high ground water levels[4]. A closer look into these areas shows that they are built in a more spacious manner than the city center, with most houses having a small to medium size garden, ranging from approximately 80 to 800 square meters.

Analyzing satellite imagery of the areas lead to some interesting observations. On larger plots, most of the plot is grass-filled. The images of these areas show a small part of the garden dedicated to terraces and swimming pools, and quite some trees and bushes can be found as well. Medium size plots still have most of the land filled with grass. On the contrary, small plots are mostly terrace-filled, with plants often placed in pots instead of in the ground. In the city center, private garden spaces are rare. Instead, rooftop terraces are a common private outside place. Green areas in the city center are often public, instead of private.

Examining the various outside places, it seems that terrace sizes stay more or less the same, regardless of garden size. However, the larger the plot, the more space residents are willing to dedicate to grass, bushes and trees. Therefore, it might be sensible to create products suitable for terrace spaces. This would serve the largest amount of plots, as virtually all plots contain a terrace, and many plots do not have a grass field. Furthermore, the Unie van Waterschappen points out that stone and tiling are part of the problem[3]. Addressing terraces in the product range could potentially reduce the amount of rainwater causing overflows.

2.3 Survey

2.3.1 Expectations

It is expected that the results of the survey will validate the problem given in the case. Furthermore, the results are used as a basis for both the in-depth personas, character-driven scenarios and possible problem scenarios. The minimum amount of responds is set at 30. This is a viable amount of respondents within the amount of time available for the research, and it will provide a broad overview of various problem situations. As the team members are from different parts of the Netherlands and the parents are asked to fill in this survey it is expected that different problems will come up. Besides, with the different background it is unexpected for people to provide extremely out of the box ideas, but not impossible.

2.3.2 Preparations

The survey is built with the focus on five different subjects; questions about the person, questions about the living situation of the person, questions about the possible solution, questions about the current situation and whether they would

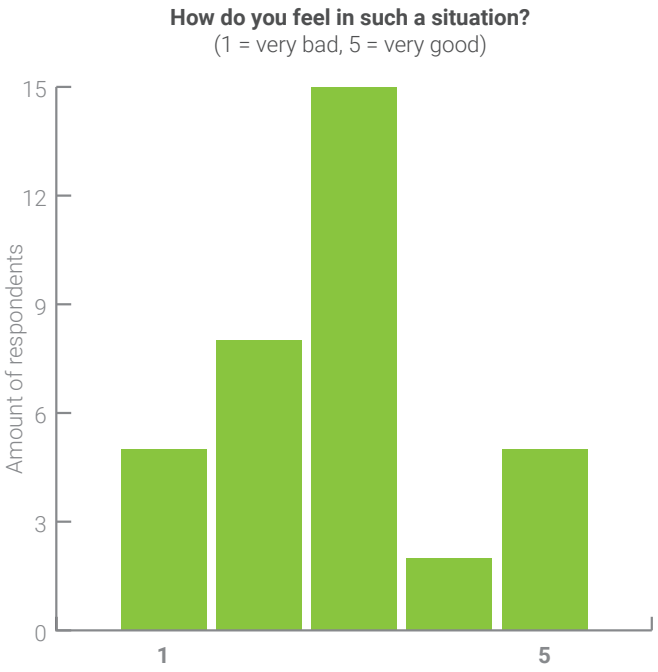


Figure 3. The question addresses the feelings of the respondents in case of heavy rainfall.

be willing to give their contact information for possible further questioning. The questions about the person and living situation are combined into a persona. The questions about the current situation and the possible solution can be used for creating and validating ideas and concepts. Besides, the questions about the current situation validate the problem that exists. The contact information may be used for approaching people for the co-design phase. The most interesting questions will be analysed but all the questions and their results can be found in *Appendix C*.

2.3.3 Result

35 people from all over the Netherlands answered our survey. On average, 79% of the people who answered the questionaire are having trouble with the heavy rainfall in the Netherlands. The feeling about the heavy rainfall is quite average, it is doable yet unpleasant, as can be deducted from *Figure 3*. However, the reaction to a possible solution is overwhelmingly positive, indicated by *Figure 4*. This shows that a solution will have a high chance of making it on the market and that the problem is big enough to solve.

The people who encounter problems showed that there are five main problems that occur: water getting inside the house and rises to an uncomfortable level, for example in the basement (1), streets are flooding, which in turn makes transportation hard or even impossible (2), gardens get flooded, negatively influencing the flora (3), roofs may leak or the gutter fills up, preventing rooftop water from flowing into the drainage system (4), and people get wet from the rain, which they find uncomfortable (5). Furthermore, some state that they do not feel safe in a storm

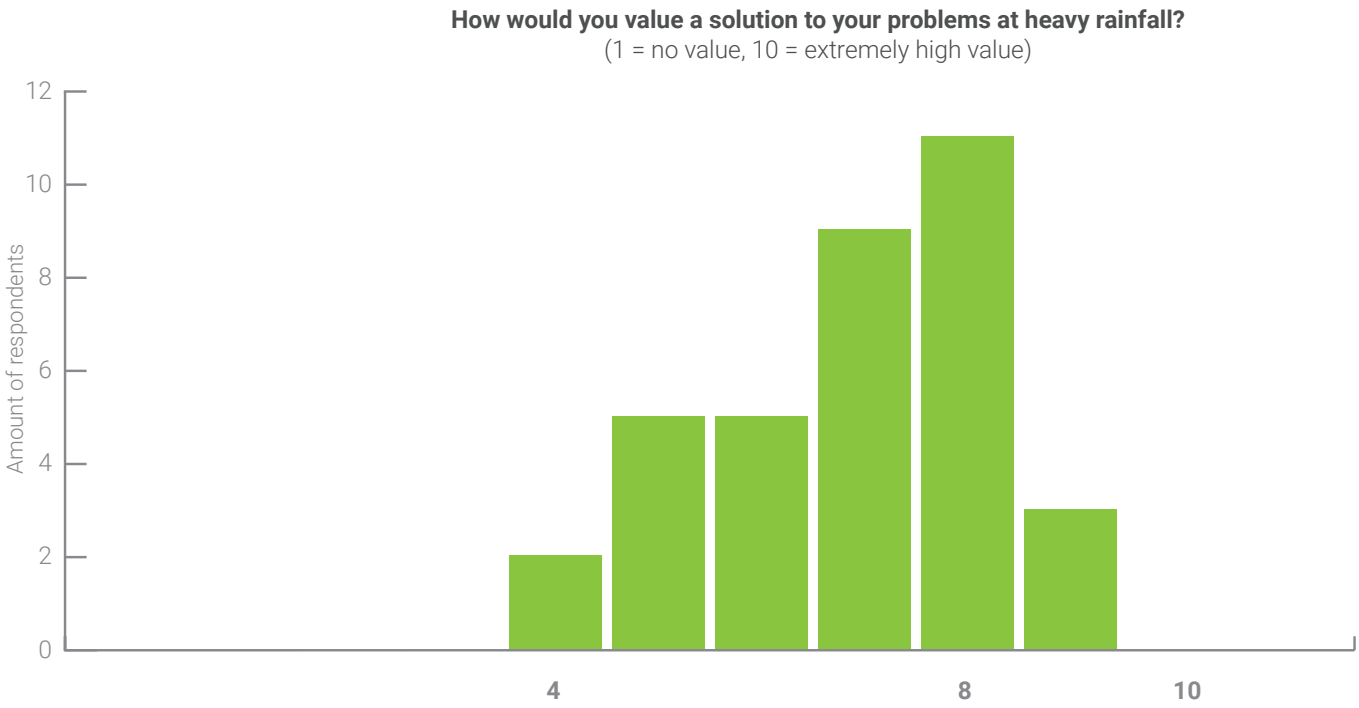


Figure 4. *People seem to value a solution to their problems at rainfall.*

with a heavy amount of rain, and others get sick. These five main problems can be evaluated in order to investigate a broad range of possible solutions.

Questions about the respondents' living situation, combined with their experiences with heavy rainfall yielded some interesting results:

83,0% of respondents living in non-dense neighbourhoods are affected by heavy rainfall.

70,6% of respondents living in dense neighbourhoods are affected by heavy rainfall.

77,8% of respondents living in city centres are affected by heavy rainfall.

54,5% of respondents with a basement are affected by heavy rainfall.

77,8% of respondentsliving on the ground floor are affected by heavy rainfall.

85,7% of respondents with a garden are affected by heavy rainfall.

These percentages show that all neighbourhoods have around the same amount of problems, yet two things were unexpected. First, the non-densly build neigbourhoods have more trouble with the rain than the densly build neighbourhoods or city centres. Urbanization is viewed as a source for the bigger flooding problems within neighbourhoofd, yet this survey does not agree with that. In the second line of percentages it is visible that people with basements do not have as many problems with rainfall, yet people with gardens suffer the most. This makes it the most important for the solution to fit in both ground floor and garden solutions and make solving the basement problems less necessary, yet still a wish.

Only 1 out of the 35 people wanted a non-permanent solution, while all the others wished for a permanent solution. For the permanent solution most people wished for using the littlest amount of space or integrating the solution within another object. When the product has a nice design, people are willing to provide more space for the solution especially in the garden.

Lastly a few wishes and requirements came up for the solution. The most important factors for the future solution according to the people are sustainability, the proof of it working, ease in use, quick use and environmental friendliness. With stating extra functions, a lot of people stated flushing the toilet, creating energy or using the collected water for dry periods. These functions and wishes will be implemented in ideas that are formed later on.

2.3.4 Reflection

The use of the survey has been found very useful. As expected it did not help with very innovative or out of the box ideas that we did not come up with ourselves, yet it gives a sufficient amount of information for the creation of personas and definitely gives further insight in the problem that other analysis methods

would not be able to give. Some questions in the survey got very different answers than expected and after some discussion it was found that the wording should have been different. For example the question about 'the permanent or non-permanent option' (literal translation: staying option vs non staying option) got 34 out of the 35 people choosing a permanent option. Yet using the word permanent might have caused for people to shy away from the permanent option. Therefore, it might be important for further implementations of surveys in the future to firstly talk with an outsider about the questions that are being asked and asking for their interpretation.

2.4 Interview with municipality

To get more insight in the problems connected to flooding and excessive rainfall the idea is to invite the municipality for an interview or conversation. The main goal of this interview will be to get insight in what the specific problems are and in which areas these problems occur most. Also it will be useful to get an idea about which things will and already have been done to fight flooding.

To arrange this meeting contacts from and connected to the municipality of Enschede have been contacted through several ways. For the meeting a short introduction of the project and a small list of questions are prepared. The goal is to create a natural conversation which will be steered to answering the questions. The questions prepared focus at what has been done, what are the problems, where do problems occur, what will be the ultimate solution and how will these projects be financed.

Unfortunately after several tries to contact the municipality through direct contacts and other people there was no response. At some point the choice has been made that there was insufficient time left to interview the municipality and incorporate the results into the project. As a result there are no results to be used as input, expected possible responses, views and inputs from the municipality will be written down to be used as input. From this design requirements will be created.

2.4.1 What has and will be done by the municipality

At this moment several different projects regarding climate management are in progress in Enschede. These climate projects are part of a bigger plan to keep the city sustainable. The targets of the climate management are aimed at limiting the negative impact created by climate change and creating opportunities out of them. Enschede wants to make sure the water related aspects of living in Enschede remain manageable. Also people need to be more aware about water usage and need to be more involved with the water supply of the city. Together with the water partners of the city they want to create a good water quality and supply for Enschede[5]. To realize this Enschede tries to disconnect the rainwater drainage from the sewers. To make people more aware they are creating areas where the water is visible for the citizens. At times of severe rain the water is collected in the green areas in the city and in the streams and canals.

In the city streams and Wadi's are built to control the water flow. Also a large water collection area called the Kristalbad has been built to naturally collect and filter the rainwater. Also test with green roofs made from plants have been done. In the near future a large water collection tank will be built under the Oldenzaalsetraat to collect excessive rainwater[6].

2.4.2 Our assumptions about what the municipality will think about the project:

The minimization of costs for both the municipality as well as the citizens will have a high priority. Also minimizing far-reaching construction or changing of existing infrastructure will be important. This also includes avoiding the need for permits and such.

Collective solutions and solutions contributing to the neighborhood and community will be important. It will also be important that every member of the community will have access to the solution in one or another way.

2.4.3 Finances

As there has been no meeting with the municipality it is difficult to get a number on how much money could be involved in this project from the municipality. To get a ballpark figure some desk research into the finances of the municipality of Enschede has been done and it has been found that there is approximately €230.000 per year available for the whole sustainability program of Enschede[5]. The climate control is one of seven subjects within this program meaning that there is not a lot of money directly available. Further information about the finances regarding climate control could not be found.

2.4.4 Problem areas

In Enschede there are several problem areas regarding water. These are Enschede-noord, Stadsveld, Pathmos, Bruggert and Cromhoffsbleek-Kotman. In Glanerbrug the areas Dolphia and Bentveld-Bultserve are problematic. These are areas that are already closely watched by the municipality and testing is done to finds solutions for the problems[4].

2.4.5 Requirements

Based on the assumptions made before some design requirements can be made for the project.

· The design has to be implemented without the need for permits or excessive alterations to existing infrastructure

· The design, when possible, has to be suitable for use as a collective solution.

· The design needs to be accessible to every member of the community.
· The design needs to contribute to the community in one or another way.

2.4.6 Reflection

In conclusion the approach to get information from the municipality that has been chooosen in the beginning of the project has failed. There was no response from any of the people that have been contacted. The result was that there was no data available as input for the project so this had to be supplemented by data from desk research.

In the future it would be useful to start with a desk research into what data is already available. At the same time there has to be a more active approach to get contact with the municipality and tries to find other contacts or methods to the data needed.
A thing to consider is what if the approach failed due to disappointing information from the municipality. If there had been a meeting but the municipality refuse to give insight in the data needed there would also be a problem as the design approach has been built around the assumption that there would be data available. The conclusion for this is that it is important to have a backup plan to continue the design process if some of the approaches chosen in the beginning prove to be of no good use.

2.5 Conclusion

At the start of the analysis phase, little was known about the problem at hand except for the information provided through the assignment brief. The goals of this phase were firstly to gain insight in the problem as seen by the municipality and secondly to as well be able to see the problem from the viewpoint of the designated end-user: the homeowner. Overall, the analysis phase gives an overview of the problem, its characteristics, possible solutions and its stakeholders. Most of the analyses were executed using desk research techniques. Valuable input for the project was generated by using a survey through which insight into homeowners' wishes, thoughts and characteristics was achieved. The result of the analysis phase is a rough set of wishes and requirements, to be found in *Table 1 to 6*. These were synthesized from the different analyses.

Table 1. *Requirements and wishes originating from the problem analysis.*

Nr.	Requirement
1	The provided solution should be on a private level.
2	The provided solution should be placed on residents' own property (around the house).
3	The provided solution should be a fitting solution for people in the Netherlands.
	Wish
4	The provided solution might create a community.

Table 2. *Requirements originating from the stakeholder analysis.*

Nr.	Requirement
5	The provided solution should not hinder the user in their own environment.
6	The provided solution should not hinder neighbours in their own environment.
7	The provided solution should be more effectively solving the problem of water difficulties than the current situation.

Table 3. *Wishes originating from the market analysis.*

Nr.	Wish
8	The provided solution should have a pleasant design for its visible parts.

Table 4. *Requirements originating from the context analysis.*

Nr.	Requirement
9	The solutions should be suitable for small and bigger urban areas.

Table 5. *Requirements originating from the survey.*

Nr.	Requirement
10	The provided solution should strive to prevent water from entering the user's house unintentionally.
11	The provided solution should be permanent.
12	The provided solution should strive to prevent streets and other public infrastructure from flooding.
13	Water should be reused purposefully by the provided solution.

Table 6. *Requirements originating from the interview.*

Nr.	Requirement
14	The design has to be implemented without the need for permits or excessive alterations to existing infrastructure.
15	The design, when possible, has to be suitable for use as a cooperative solution.
16	The design needs to be accessible for every member of the community.
17	The design needs to contribute to the community in one or another way.

In-depth personas
Character-driven scenarios
Possible problem scenarios
Needs personas
Magical bits

3

Design phase

3 Design phase

3.1 Introduction

During the Design phase the main goal was to develop as many ideas as possible. To achieve this goal, firstly, in-depth personas were created based on the empirical data obtained through the survey in the Analysis phase. Then, character driven scenarios were written in which the protagonists are the in-depth personas. As a next step, possible problem scenarios were investigated. Next, a Magical Bits session was executed. The Magical Bits session aimed to brainstorm about possible functions of a future product. Lastly, needs personas were developed for each 'need' as presented during the lectures. For each needs persona a range of ideas were created for functions that a future product should have in order to fulfill the needs personas' needs.

In the following the preparations, expectations, and the results of each theme are presented. At first, the in-depth personas and their corresponding character driven scenarios

3.2 In-depth personas & character-driven scenarios

3.2.1 Preparation

In depth personas were created based on the results of the survey. The various answers from the survey were grouped and the individual persons were merged into a total of five personas. The groups of people who were merged for the personas and their corresponding scenarios are given the names **Yellow**, **Green**, **Grey**, **Blue**, and **Red**.

Group Yellow are people which mainly suffer from flooded streets due to heavy rain. The Green group are house owners with a garden. The next group, group Grey, are people whose main problem when it is raining is that they get wet when they are outside. Group Blue are people who have only few to no problems with rain, so people who sometimes suffer from various problems due to heavy rainfall. The last group, group Red, are people who mainly suffer from a leaking roof.

3.2.2 Expectations

The underlying goal of the in-depth personas and the character driven scenarios was for the designers to be able to empathize with the audience they are designing for and to be able to think of which problems might occur due to heavy rain but also due to the product. As stated earlier, the purpose was also to gain insight into the needs, goals, and wishes of the personas who are representing the future users of the product to be designed. The scenarios are written instead of drawn, because it reduces the amount of time necessary, and it allows for a higher level of detail.

3.2.3 Results

The persona created for group Yellow is a 49 years old single woman, Erna. In her character driven scenario the problem is that water is seeping into the hallway of her house whenever a car is passing by.

For group Green, the persona Lydia was created. Lydia is 52 and she is married and has three children. In her scenario the problem is that she has a flooded basement.

Group Grey was merged into Marieke, a 21 year old student. Marieke does not often suffer from rain, but in this particular scenario the basement of her apartment is slightly flooded and the roof is leaking.

The persona created for group Blue is Frits, who is 49 years old, and married with two children. In his scenario the street and his house are flooded and water seeps into the house through the walls.

The full descriptions of the in-depth personas and the full character driven scenarios can be found in *Appendix D* and *E* respectively.

3.2.4 Conclusion

The goal to gain insight into the needs, goals, and wishes of the personas and to be able to empathize with them is reached at this phase of the design process. However, it is important to always refer back to the personas when a design decision is made and to reflect whether a certain product or product function fit into these needs, goals, and wishes and into the described character driven scenario. Besides, a range of requirements and ideas for the future concepts were attained. The requirements can be found in *Appendix I*.

3.2.5 Reflection

One remark is also that in the beginning of the project it was stated that the character driven scenarios will be daily use scenarios to see how people can and would use the device in their daily lives to find out which functions could be added to implement the device into the users daily live and needs. However, the scenarios as described in this paragraph are not usual daily live routines but descriptions of the daily routine while it is raining heavily. The decision not to make common day scenarios has been made because the main function of the product is to be able to help the user in a situation of flooding/ heavy rain. Additional functionalities must be investigated later when the main functionality is clear. At this stage of the project it was especially necessary to formulate the main struggles of the users and to understand their needs, goals, and wishes in order to be able to create a valuable design with additional functionalities later on.

3.3 Possible problem scenarios

3.3.1 Expectations

The possible problem scenarios should form different extreme scenarios that can be used for both the role playing session and CUTA session. Besides, these scenarios communicate big edge case problems. It is expected that the possible problem scenarios will give us not only scenarios but also some requirements that take away dangers or problems immediately when designing especially concerning human factors. A written form is chosen because in this case, drawings would not be of additional value, but would cost more time than written scenarios.

3.3.2 Preparation

To properly make some problem scenarios a brainstorm session with the design team is organised. Extremes, such as death, storms, tsunamis and children are discussed with the focus on probable mistakes or faults with the design. From these scenarios some requirements are gathered.

3.3.3 Results

Due to a extremely large amount of rain multiple streets and gardens are flooding, the water level is rising and can reach until the electrical circuit of the product. The water damages the product and its electrical circuit. The product does not perform the way it should be and only makes matters worse.

The requirements gathered from this problem are:
The electrical circuits should either be; closed off for water, high enough for the water levels not to reach the electrical circuit or inside a house or shed.

The owner of the house and/or climate proof city solution is on a holiday while the weather back home is horrible. The water levels are rising and cause damage to both gardens and houses. Luckily the owner has his climate proof city solution. The only problem is, he is not home or does not have a proper connection with the solution to turn it on. Due to this his garden is still overflowing.

The requirements gathered from this problem are:
The solution should provide an automatic option for days which are not spend at home or should always provide an automatic solution.

It is a stormy day in the Netherlands with wind speeds up to 140 km/h. Trees are breaking and people are flying across 'de Dam'. All the broken branches and flying roof tiles are not only destroying houses and bringing people in danger, it also hits the climate proof city solution. The solution is now spreading the water instead of collecting it. Some parts of the solution are flying around town now as well.

The requirements gathered from this problem are:
The solution should withstand storms and possible damages following the storm
The solution should stay in place in a storm

Tineke loved the idea of recycling rainwater and bought the climate proof city solution. This solution collects the rainwater which can than be filtered and be drunken or it can be used to flush the toilet and clean the house. One day a little mouse finds his way into the climate proof city solution and drowns in the collected water. This does not only give a horrible smell it also makes the water unuseable. Tineke wants to find out what makes the water this horrible blueish colour and tries to open the climate

proof city solution, but she cannot get in.

The requirements gathered from this problem are:
· The solution should be closed off to animals and other species.
· The solution should provide access to the user in case of product failure.
· The user should be notified about any problems with the water.

The children of Henny are playing in the garden. One of them trips and breaks a wire that is in the ground. This wire is part of the climate proof city solution. Not knowing that the wire is broken they continue their game of football. They run around and kick the ball in all directions, it hits the doors and walls, but also the climate proof city solution. It ruins their ball because of the sharp edges. One of the children goes and checks what happened and cuts his fingers in the process of checking where the sharp edges were.

The requirements gathered from this problem are:
· The solution must not be in the way of normal human behaviour
· The solution must not have any sharp edges
· The solution must not provide any danger to the users or their children, friends or visitors.

It is a beautiful fall day, with orange leaves all over the ground. Yesterday it was raining a lot and the climate proof city solution made sure there were no problems in the house or garden of Lily. However, all the leaves are collecting in the water and on top of the collection system, making it impossible for the solution to collect new water and disperse the old water. Besides it makes the collected water disgusting.

The requirements gathered from this problem are:
· The solution should filter garbase, leaves or any other objects from the water
· The solution should work in all seasons
· The solution should always have an opening for collecting water and/or should be able to remove objects from that opening

Kim is moving to another city and invested in a climate proof city solution about a year ago. In this year it did not rain a lot and Kim is dissapointed that she paid a price but did not achieve the value she wanted.

The requirements gathered from this problem are:
· The solution should be able to move with the user
· The price of the solution should be partially paid by government or municipality
· The price value comparisson should also be right when there are not many days of heavy rain, for example also with days of little rainfall.
· The solution should be modular or fit in many housing situations

During the cold, hard winters in the Netherlands the temperature can drop to -10 degrees Celcius. With such low temperatures, water inside pipes could freeze up and block all water flow. When the climate proof city solution has piping, it could occur that the whole product will not work properly when storing frozen water.

The requirements gathered from this problem are:
· The solution must work with temperatures between -20 and 40 degrees Celsius
· Piping cannot freeze

Lodewijck and his neighbours have a interesting relationship. Both pretend to like eachother, yet they definitely do not. Lodewijck just installed his new climate proof city solution and his neighbour Gijsbertus is coming to look at what it is. He notes that the size of it is ridiculous and now it blocks his sun, he finishes his point with a joke about his fake tan. Lodewijck knows his neighbour Gijsbertus definitly dislikes his climate proof city solution, and Lodewijck will hear much more whining from his neighbour if he does not change anything.

The requirements gathered from this problem are:
· The solution must stay within municipality guidelines
· The solution must not infiltrate the comfort of others
· The solution must not be an irritation in the eye for the user and others.

3.3.4 Reflection

The possible problem scenarios provided a good basis for both requirements about safety and ensuring that the solution works. With creating the scenarios, it took a while to get started and think creatively, but after a few minutes the group really got going and came up with very interesting point of views. These scenarios did not feel very useful as a basis for the CUTA and roleplaying sessions since these sessions focused more on the regular use, instead of the extreme edge case scenarios covered in this technique. However, it is expected that these requirements provide enough basis for the safety measures that the extreme scenarios are not possible anymore.

3.4 Needs personas

Instead of creating representative, typical user personas and scenarios right away. The design phase of this project started with the creation of several so called needs personas. These personas describe people who each embody a certain human need. These needs are: *bodily wellbeing, idealism, influence, autonomy, mastery, popularity, safety, connectedness, self-realization and stimulation*. This approach of using needs

Table 7. Overview of each scenario and their corresponding Magical Bit

Scenario	Technology	Feature	Example	Function	Magical Bits
YELLOW water seeping into hallways	Water confine-ment	Block water	prevent water from seeping into hallway	Block	Barrier
GREEN Flooded basement	Home infra-structure	Collect water	Prevent rain from reaching basement windows	Collect	Bucket
GREY: Leaking roof, flooded basement	Home infra-structure	Relocate water	Divert water from roof to allocated space	Divert	Tube
BLUE: flooded streets and houses, water seeping into the house through the walls	Public infra-structure	Facilitate accessibility	Keep street accessible and clean	Soak water	Mop

personas shows similarities with using for example extreme characters. By stretching the personalities of these personas into only one direction, the characteristics with regard to the product to be designed become clearer because they show less nuance. In the context of the project, they were carried out to create inspiration for requirements and product-ideas, which probably are not so realistic, but could spark newer, more realistic ideas that would otherwise be overlooked.

Two needs per person were assigned to the people in the group to be developed. These finished personas were in a later session presented to the other group members and provided incentive for a brainstorm in which ideas for a system for homeowners to prevent problems due to heavy rainfall were brought to the table and written down.

Of course these needs personas almost never represent any real user. However, using this approach is useful in a number of different ways. First of all, the start of any creative project, especially when concerning a broad field and a hardly narrowed down assignment, is difficult. Besides that, this particular project also involves getting insight in possible users and their lives. Therefore the designers should get into the habit of getting into the minds of these people. A method where not the context, target group or the product is leading the scenarios, but where they are restricted by very specific user characteristics imagined as people helps identifying possible thoughts and actions of users that might not be directly thought of by the designers as typical end-users. Provided that the designers are able *"to get into the minds"* of such people, using needs personas is a relatively quick way to come up with non-typical ideas (such as the product being also a water feature for a model train setup), however most of them are not directly useful and would need further iteration. But they can definitely function as so-called triggers for further idea generation.

3.5 Magical bits

Magical Bits is a brainstorming method for experiencing a product before it is conceptualized. For this, the main function of a future product must be known. This function is then represented by a familiar object sharing that function, the so-called Magical Bit. Participants of a Magical Bit session are usually the designers and it is also recommended to let stakeholders also participate. The participants are given a non-functional model of the Magical Bit, they are told what they could possibly do with it in terms of the main function and are asked to describe what they would use the product for in different situations. This method is used in order to be able to brainstorm freely and to overcome solution-oriented thinking.

3.5.1 Approach

The starting point for the Magical Bits session were the character driven scenarios. Based on each scenario, the technology, the feature, an example case, the function, and the corresponding Magical Bit were determined as shown in *Table 7*.

In the first scenario, the water flushes over the doorsteps and seeps into the hallways of houses. The corresponding technology here is water confinement with the feature to block water. An example would be preventing water from seeping into the hallway. The function is thus 'block' and the chosen Magical Bit is a magical barrier.

The problem of the next scenario is that the basement is flooded the technology is home infrastructure with the feature to collect water. A suited example is to prevent rain from reaching the windows of the basement. The function is 'collect' and the Magical Bit is a magical bucket.

For the next scenario, the technology is, again, home infrastructure but this time with the feature to relocate water. An example would be to divert water from the roof to an allocated space. The corresponding Magical bit is a magical tube.
The last scenario has the technology public infrastructure and the feature to facilitate accessibility. An example is to keep the street accessible and clean. The function is 'soak water' and the Magical Bit is a magical mop.

After the Magical Bits were determined, each of them were constructed from aluminum foil. Then, for each Magical Bit it was brainstormed for ideas for possible functions of a future product by acting out various cases.

3.5.2 Results

The result of the Magical Bits session are a range of ideas for functions that the future product might have. These ideas are listed below categorized per scenario/Magical Bit.

Yellow - Magical barrier *(Figure 6)*

· Garden fence closes to become a flood barrier
· If the fence is to high so that the water can flow through underneath
  · *Inflatable unit under the fence*
  · *Potentially with small holes so that the water can slowly flow through the fence*
· Fence adapts to objects passing by (cars which make waves)
· Powered by waves
· Fence closes automatically when needed

Green - Magical bucket

· Whole room/ceiling can automatically form into a bucket
· All things are vacumized so that the water cannot reach them
· Scoop dirt out of rain drain and collect it
· Use basement as tank
· Water filter to make drinking water out of rain water

Grey - Magical tube

· Intense *'vacuum cleaner'* which sucks in the water around a biking person
· Tube of bicycle is used as motor so that it becomes a water powered bicycle.
· Tube through the whole street so that the water flows through.
  · *Water stays preserved but street is still accessible and usable*

Blue - Magical mop *(Figure 5)*

· A mop which dries walls and simultaneously paints water stains.
· Remedy and prevent water stains
· Possible to use the mop in an angle of 90° to reach each part of the wall
· Mop unit beneath the door; water cannot enter because it is soaked
· Rain drain cleaning appliance with integrated trash bag
· Automatic umbrella that soaks water
· Automatic *'vacuum cleaner'* unit which swipes automatically
· Automatic rain drain *'vacuum cleaner'*

3.5.3 Conclusion

Magical Bits is a very handy method when designers are stuck while brainstorming. It was expected that some ideas will be generated of which a few might be useful, however, much more ideas came up then initially expected - even though some of these ideas are not that realistic or relevant.

The method is especially useful to get into a conservation about possible functions of the future product and to think further than the most obvious functionalities. One remark might be that it would have been more handy and useful to implement this method right at the beginning of the design phase when the designers do not have any clue what possible function the future product might have. This way the brainstorming would even be broader and more intuitively.

3.7 Conclusion

The design phase has yielded a wide range of ideas and input for the design of the final idea. Starting with the needs personas, a list of possible product functions has been created based on the various personas that were written. Each of these personas described a very different type of person triggering inspiration for possible product functions. Next in-depth personas were created based on results of the conducted survey. By grouping similar responses different in depth persona's each with their own specific problems could be created. These persona's yielded valuable insight in potential problems and use situations of products during excessive rainfall. Based on both types of scenario's props for a Magical Bits session were prepared. The magical bits session yielded a wide variety of different product ideas and usage situations. The full list of these ideas can be found in *Appendix J*. This list was filtered to get an overview of ideas which had potential. Based on input from both the analysis phase and the design phase three main themes were created based on the list of ideas. These themes are: Water recycling, Water collection and Water diversion/preventing flooding.

Water recycling focuses on finding ways to collect and re-use excessive rainwater for different purposes. These purposes can be generating energy, household jobs like cleaning, flushing toilets, feeding and washing pets, washing cars or bikes, watering the garden, etcetera.

Water collection focuses purely on finding ways to effectively collect excessive rainwater when needed and store it until the drainage systems of the city are capable of handling all the water again.

Water diversion/prevention of flooding focuses on creating solutions to protect houses or property against any problems that might occur during excessive rainfall. Solutions relevant to this theme are for example the diversion of water to other safe places, evacuation of people and properties, barricade the water stream, etcetera.

In conclusion the final result of the design phase are three themes that can be used as a basis for concept generation in the next phase of the project.

Figure 5. *Magical mops.*

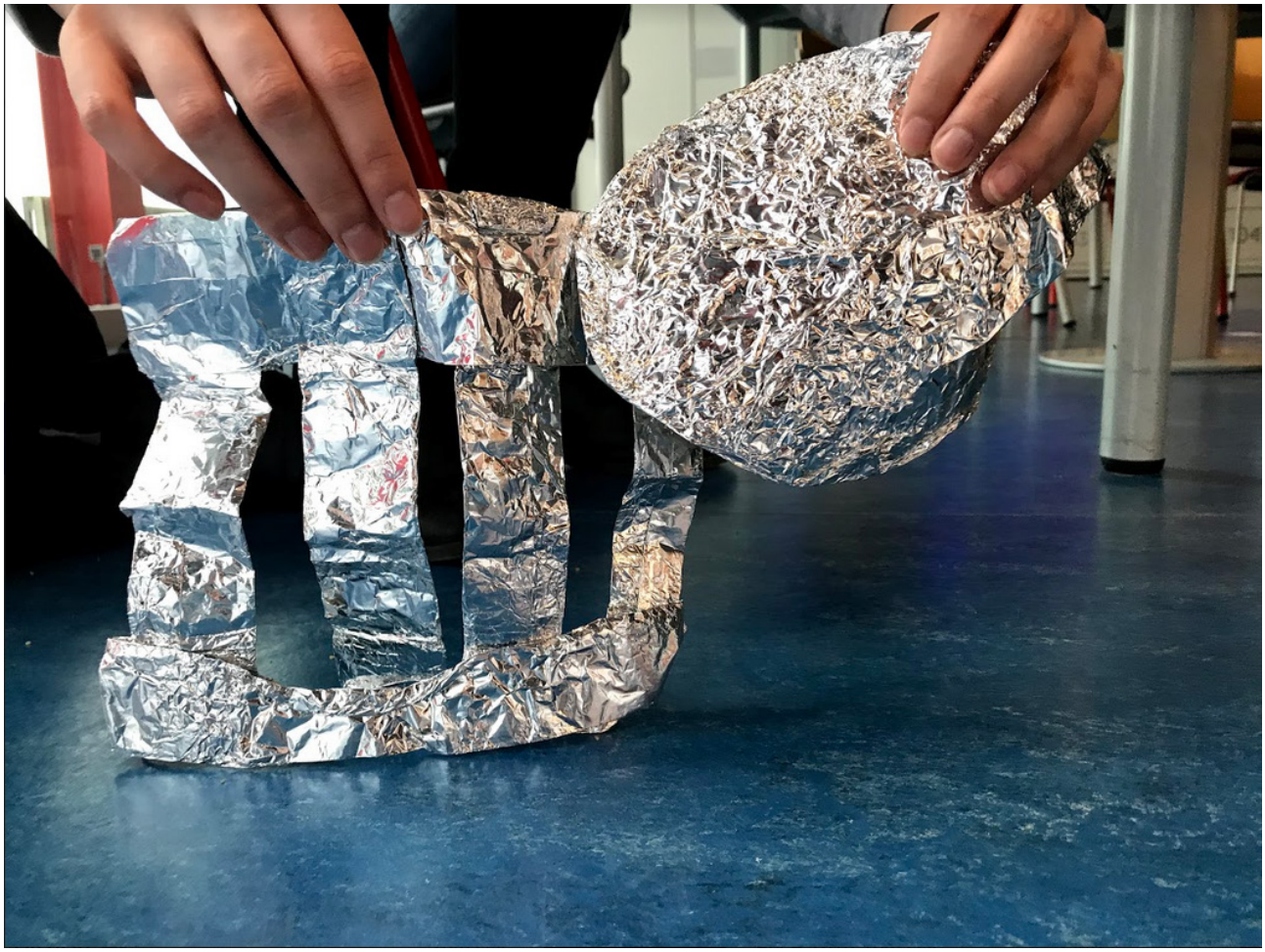


Figure 6. *Magical barriers.*

Co-design session setup
CUTA
Miniature role playing

4

Co-design phase

4

Co-design phase

4.1 Introduction

The starting point for the co-design phase is the range of ideas for future product concepts from the design phase. Based on these ideas, as well as on the character driven scenarios and the possible problem scenarios, a co-design session was planned. The co-design session consisted of a CUTA-session and an MRP-session. In this chapter, the preparation, the expectations and the results of these sessions are described. The result of the synthesis following the co-design phase are three different product concepts, which will be presented in the final section of this chapter.

4.2 CUTA

4.2.1 Expectations

Within the design it is important to implement the users thought and wishes, therefore CUTA has been added to the project. With the CUTA session it is expected to get more insight in the thinking process of potential users and an external view on the problem. With CUTA it becomes visible how the participant would act in certain situations, together with the miniuature roleplaying this can form a base for generation of ideas, evaluation of ideas and validation of ideas. Lastly, it is expected that the user will have a lot of space to fill in the blanks to get creativity flowing. This will help moreso with the generation than evaluation and validation, but can be extremely helpfull.

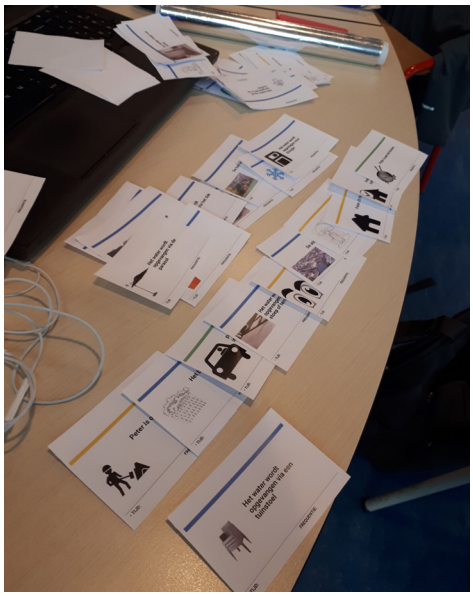
4.2.2 Preparations

To prepare the CUTA a planning and the CUTA cards have been made. The cards are based on the cards presented to us in the lecture, small cards with technology driven, non-technology driven, and non-object based. Peter and Shannon are used as the male and female character on the cards for distinct appearance and possible identification. On the cards are a lot of locations and objects that can help the participant shape his own ideas. For example, cards are filled with activities such as work, transportation in multiple manners, or collecting the water in different ways. The participants can completely make their own stories, also by adding their own cards.

The planning for this part of the project is made and will be altered in between sessions. The whole CUTA session should take about 45 minutes to an hour. Within this session an introduction of 10 minutes is held, the introduction should let the participant know what the problem is and what we will be doing today. After that all the cards will come on the table and the participant gets 10 minutes to choose the cards he or she will be using, the 10 minutes are chosen because of the large number of cards. After that the participant places the cards in sequence on the table, which can also be placed side-by-side, this will take around 5 to 10 minutes. The last task is to fill in the duration and frequency on the cards and possibly make their own cards, this will take 5 minutes. At the end of the session a small discussion will be held to check what the participant means with all their choices, this will take 5 to 10 minutes.

4.2.3 Results

Three sessions have been held, all of which were held in the exact same way since no changes were found necessary from any of the first two participants. The participants had different ages and backgrounds in order to get different insights, yet this did not work out the way we expected it to turn out. Two of the three participants had nearly the same outcome for their CUTA session and did not add any other cards without the guides



Cuta session.

telling them.

All of the participants understood the difference between certain cards and that choosing certain problems or solutions were important instead of using them all. The average story began with it beginning to rain and a person being at their work. After that a certain type of transportation was used to get home, with the statement of the person being later than normal (filling in a longer duration). Then two of the three participants choose the flooding garden problem and one choose the leaking roof. The solution for the leaking roof was putting buckets down in combination with pumping it onto the street, while the participants with the flooding garden wanted the water to be collected with terrastiles and pumped directly into the sewer. All three participants had different recycle uses for the water; one uses the water for a fountain, another for their plants in combination with drought and the last participants choose creating green energy.

4.2.4 Reflection

Using CUTA in the co-design phase went fine, yet the results were not as expected. Because of the background of the participants it is expected that the results were less creative as found in the lectures. What was surprising is that they were also not as elaborate, because the participants were not as confident in what they were doing. This could have been because of not using techniques for the participants to get more creative and confident in what they were doing. Using CUTA for idea generation, validation and evaluation was also difficult, because as said in the results, the differences were minor. What helped was the discussion at the end, where asking questions got us further information for the intentions of the participant and either the generation, validation or evaluation could be done there. It is known that with the CUTA cards this should have been possible, but to get the optimal result some things have to change in the planning.

4.3 Miniature role playing

4.3.1 Expectations

The design phase resulted into a collection of ideas. In the MRP-session, the goal was to test what ideas projected users find useful and would want to use. This is done by presenting participants with various situations, having them think of ways to cope with the situations, providing them with the designers' ideas and letting the participants act out how they might deal with the situations if they had access to the solutions following the designers' ideas. The expectation was that participants would speak more freely and openly and might also come up with some creative ideas, following the playful nature of some of the used means of communication, like Lego.

4.3.2 Preparations

As MRP-sessions can become lengthy, a rigid time schedule was prepared:

On-site preparation – 15 min
Introduction – 5 min
Warm-up (optional) – 10 min
Share designers' ideas – 5 min
Roleplaying various scenarios – 30 min
Evaluation – 5 min

The actual role playing part of the session consisted of playing out three situations: heavy rainfall, catching rain and using water usefully. With MRP, people can 'hide' behind a representation of themselves, allowing them to speak more freely. To take full advantage of this, part of the setup was to include multiple form factors of expression. Participants were supplied with pens and paper, a pre-made plan of a house and a large box of Lego's, allowing them to choose the means of expression they feel most comfortable with. To further increase participant comfort, the session was held at the participants' home.

4.3.3 Results

The original intention was to have two MRP-sessions, a session with a validation and generation component, and a session with a validation and evaluation component. Unfortunately, limited time led to the execution of only one session, with 2 participants (not living in the same house). Participants were asked to choose a visual means of communication they felt comfortable with (e.g. pen and paper, Lego, among others). They chose Lego, and were asked to create a representation of their home and work location. At first, they did not really understand why they were doing what they were doing. However, after some more explanation, the setup of the session became clearer. Once they finished building, it was time for the first assignment.

"Play out what a regular day in your life looks like"

A familiar scenario came about, showing steps such as waking

up, showering, making breakfast, driving to work, working, lunch break, working, going home, cooking dinner, watching some tv and going to bed. Participants were asked to go through this scenario again. Halfway through the scenario, the situation of heavy rainfall was introduced. When asking participants how they would react to this situation, their reaction was abstemious. “There’s nothing we can do about stopping this rain anyway, so I would just continue working and see what’s happened when I get home”, one participant said. They would go through the scenario again, and were asked to think about ways to catch rain and to do something with the water. Besides the most common applications (flushing the toilet, filtering it and using it to shower), no inside domestic applications were mentioned. However, outside applications were more popular. A reservoir to water plants in periods of droughts was especially liked by the participants. Unfortunately, at this point in the session, time was almost over, so the session had to end. One last notion a spectator (and civil engineer) had, was that he believed that large-scale solutions would be a better way to solve the problem than small private solutions, which implies that solutions should be easily producible on a large scale, or perhaps modular, to truly have an effect.

4.3.4 Reflection

MRP takes a lot of time to do properly and efficiently. In our case, the session was held on-site. This has advantages and disadvantages. One of the advantages is that people will often feel more comfortable in a familiar environments, thus they will probably speak more freely. Also, visiting the home of a participant provides designers with additional context and improves the designers’ conception of the potential users. A disadvantage of organizing the session on-site may be that the boundary conditions for every session are different, because the environment changes every time. This can be controlled by bringing more of the attributes yourself, however, this has some logistical implications and might also reduce the comfortable feeling people have from doing the session in their own space. For generative sessions it does not have to be a problem, but for validation, consistency will be more important. Furthermore, performing a session in people’s homes has a negative impact on the time efficiency of the sessions, due to additional preparation and traveling time. This problem could be overcome by organizing one day with multiple sessions at a neighborhood center instead. This would still provide the familiar environment to the participants, with reduced preparation and travel time. Another finding from the session is that it takes some effort to have participants take the method seriously. In our case, the main cause might be that the chosen material, Lego, has too much of a playful connotation to the participants. The fun of building with Lego may have interfered with how serious the participants take the method. This may be overcome by using more dedicated, case-specific materials. However, this is only viable for larger scale MRP-sessions due to the extensive amount of preparatory work needed. Larger scale MRP-sessions do have the advantage that they provide more insights, and provide a broader basis to base design decisions on.
All in all, the method seems to be useful for generation and validation, but the amount of preparatory work makes it unsuitable for projects with limited time available. For medium to large scale projects with more time available, MRP looks to be a useful method for user involvement, which can be tailored towards various goals and projects.

4.4 Concepts

Based upon the design phase and the participartory sessions, various ideas were proposed, of which 3 ideas were turned into concept designs.

4.4.1 Concept protection (Figure 7)

This concept focuses on protection of gardens and property from excessive rainfall. The idea is that the system responds automatically when needed. The goal of the system will be to divert the rainwater away from the homes of the owners.

The system can be implemented in several ways but the main concept is an inflatable flood barrier embedded into the bottom of a garden fence. Once the system detects a flood the it will inflate the barriers blocking the water from the streets from getting into the garden and potentially flood the house.
A second way to implement this concept into the garden is to create paths that can be used to divert and drain water away from the garden. Throughout the garden inflatable barriers will be incorporated within garden decoration or furniture at tactically chosen positions. When needed these barriers will form a drain and divert the excessive water in the garden away from the house towards a location that can handle the water or and temporary water storage tank. This second solution can be especially useful for gardens with large patio’s or paved surfaces as these types of gardens do not drain water efficiently.

Both these implementations of the idea can be incorporated to function fully autonomously and respond to the outdoor conditions in a smart way giving home owners the peace of mind that their property is safe. Examples of smart responses can be, as mentioned earlier, automatic deployment, but also adjusting to waves created by passing vehicles and such.

When the system is not needed it will be fully deflated and incorporated within the garden furniture and decorations.

4.4.2 Concept Stepping Stone (Figure 2)

The concept basically consists of an underground water reservoir. The core idea of this concept is that the stored water can be used for green purposes. Think for example of flushing

Figure 7. *Concept Protection.*

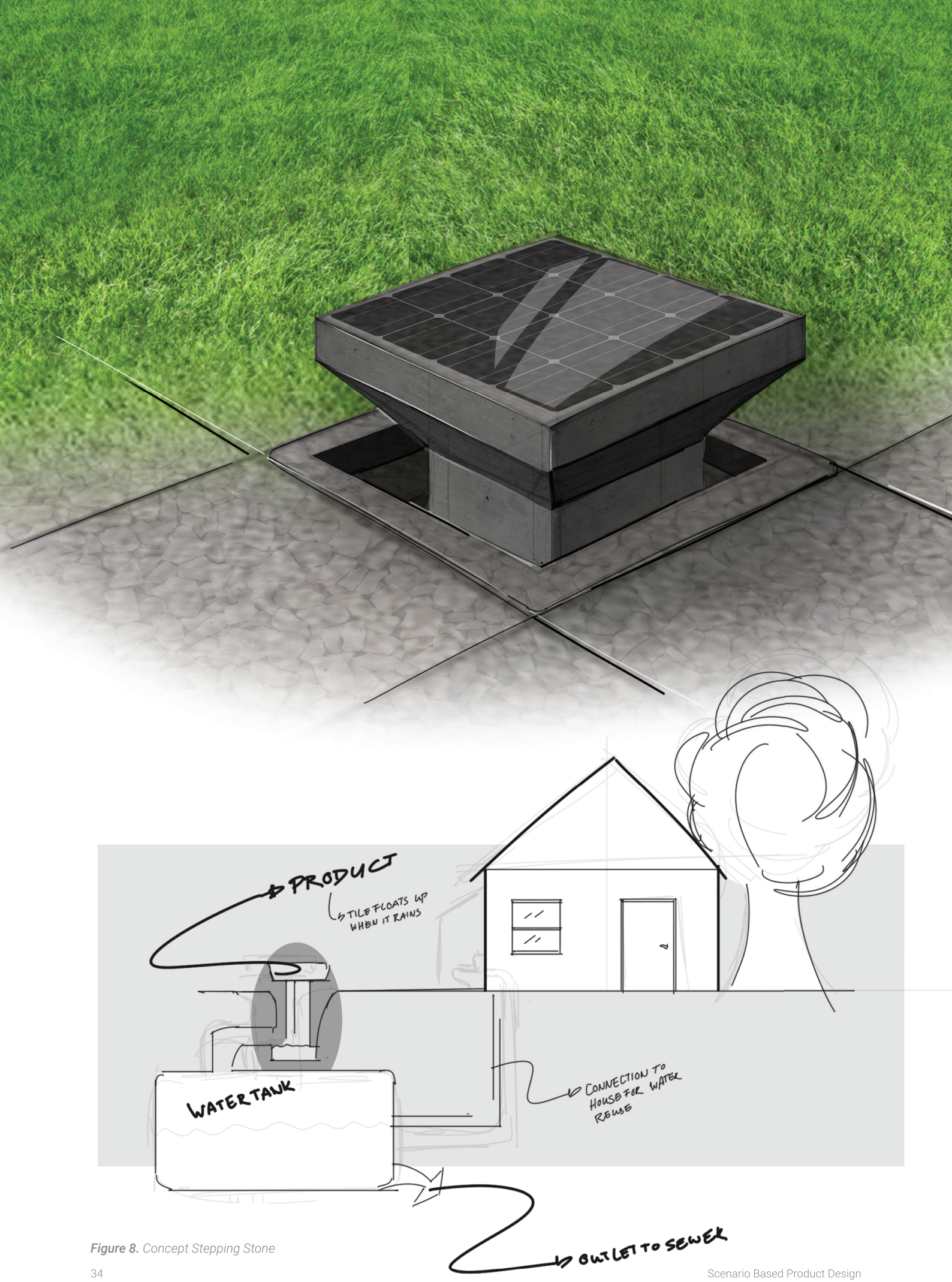


Figure 8. *Concept Stepping Stone*

the toilet or generating small amounts of electricity. The excess water will slowly be distributed to the sewage system of the city over a larger stretch of time. In this way the system will not overloaded.

The product for the user should not take up too much garden space. Most of it will be underground. The visible part of the product, the part that can be seen in the garden, takes the shape of a garden tile with a solar panel embedded in it.

When it rains, the water level below the tile rises and lifts the tile up. This shows people that the product works, that it is actively solving their problem and at the same time allows more water to be absorbed and stored in the storage tank underneath.

Multiple tiles can be arranged in patterns across the garden. When all active and floating on water, the difference in water level might even evoke a suggestion of waves. Although the garden will not be flooded with water, but the tiles suggest that it might have been without the product.

4.4.3 Concept Garden Blox *(Figure 3)*
In this day and age, people increasingly experience pressure from various sources such as work and social media. Following this trend, people more and more have a need for some place to get some rest and relax. Being surrounded by nature helps people relax, and the soothing sounds of flowing water will certainly calm anyone down, especially when lying in a comfortable position. Garden Blox provides all this, and much more, in a modular setup tailored to the need of the users.

Garden Blox are modules of one square meter which can have various functions. The example configuration shows a fountain Bloc, a chaise longue and a plants Bloc. However, there are many more possibilities. Garden Blox could be used for growing vegetables, various ways of seating could be created, a fireplace or barbecue Bloc, or a grand statue Bloc as a centrepiece.

But it does not stop here. Not only do the modular Garden Blox form a personal, tailored conversation piece for gardens of any size, but they also help the local community at periods of heavy rainfall. Below every Bloc is the possibility of creating a water reservoir, which will help reduce the load on the sewage system during periods of heavy rainfall. Due to the large surface areas of the Blox, they could potentially store vast amounts of water. For example: below the blox in the example configuration, in case of a reservoir depth of just 1 meter, the Blox are able to store up to approximately 5500 litres of water, a number which could be even higher in gardens with more Blox or a higher reservoir depth. The Garden Blox act as a buffer in case of heavy rainfall, after which the water can be used for various applications. For instance, stored water might be used to water the plants in the garden, or for decoration through fountain Blox. These are just two of the many possibilities to reuse the stored water.

All in all, Garden Blox serve a twofold purpose. On the one hand, they are a convenient and flexible solution for anyone wanting to add some functionality to their gardens, be it relaxation, gardening or decoration. On the other hand, the water storage space below the Blox serve a community purpose by reducing the load on the local sewage system in case of heavy rainfall, thus reducing risks of streets overflowing. Furthermore, the reservoir adds convenience through water reuse for various applications.

4.5 Conclusion
In this phase participatory design techniques have been used to generate input for concept generation. Based on results from the previous phases a CUTA session and a Miniature Role Playing session have been done. The results of both these sessions were less useful than expected. The results lacked creative input and ideas from the participants. The result of this was that there were no new design requirements for the concept generation directly from these sessions. The sessions did however give valuable insight in the thinking process of people.

Next, based on the results of previous sessions and the CUTA and Miniature Role Playing, three concepts were created. These concepts are based on the themes mentioned in the conclusion of the Design phase. All three concepts focus on a different solution to the problem. These concepts will be used in the next phase to evaluate which one is the most fitting solution and ultimately to decide if the design approach chosen to create the concepts was successful.

Garden Blox

Modular outside furniture

The comfort of being outside with the needs of the future

Figure 9. *Concept Stepping Stone*

Requirements validation
Concept rating

5

Evaluation

5 Evaluation phase

5.1 Introduction

In this section, the three different concepts are evaluated. At first, a requirements validation was done. This consisted of rating how well a concept fulfills a certain requirement. Moreover, the concepts were rated on how well they serve as a solution for the problems in the character driven scenarios. Furthermore, the concepts were introduced to a few people and evaluated by them based on a range of criteria. The results of the Evaluation phase are a better insight into the advantages and disadvantages of each concept and recommendations for a further iteration process.

5.2 Requirements validation

To validate the concepts with the requirements all requirements gathered from the analysis phase and design phase are put in a list, which is placed in *Appendix I*. On the bottom of that list the in-depth personas are placed, for a validation of the consumer needs and requirements. All concepts get points from 1 up to 5 for each requirement, 1 meaning it does not suffice, 5 meaning it would suffice perfectly. Comparing all the concepts with the requirements shined a different light on the concepts and their positive and negative points.

Concept Protection is a strong solution for individuals, because it does not collect the water but sends it another way. This means that it would work for every individual that buys the product, that is where concept Protection gets higher points. However, on all requirements focussing on the strength within a community, multifunctionality and looks concept Protection scores much lower than the other two concepts.

Concept Stepping Stone is strong in its simplicity and reuse of the water. The solution can be used near a house or on the streets, however it scores lower on its modularity and resistance to all weather situations.

Concept Garden Blox scores highest on its modularity, while also being strong on looks and multifunctionality. However it does not create a community feeling nor is it cheap and thus available for loads of people.

Concept Stepping Stone and concept Garden Blox were clearly better concepts at the end of the requirement validation, both strong at their own points. The difference of only one point was eventually made by the combination of the concepts and the in-depth personas. Here the ease of the steppingstone, which could fit with in nearly every situation, got one point more than the Garden Blox, which stays a strong concept.

Additional clarification for some of the requirements:

10 - The provided solution should strive to prevent water from entering the user's house unintentionally & 12 - The provided solution should strive to prevent streets and other public infrastructure from flooding.

While concept protection is the base for keeping water out, concept Stepping Stone and concept Garden Blox focus on removing the water for a larger surface. However, this does not mean that these concepts keep the water outside of the owners house, they just keep the water levels lower.

20 - The solution should withstand storms and possible damages following storms.

All concepts have their strong and weak points in this matter. For example concept Protection might not be fixed to the ground properly when the ground is wet, while branches laying on top of the solution would have no influence to the workings. For concept Stepping Stone the story changes with its opening, possibly being a weak point when getting a branch stuck, while it would keep up extremely well with loads of wind or forces on top of the Stepping Stone. With concept Garden Blox, it depends on the module chosen. Staying with the name of the concept, the Garden Blox, a garden can quickly be damaged by strong storms, while other modules might be fine with a storm.

31 - The solution should be able to move with the user.
Concept Protection can be moved and altered to certain situations pretty easily because of the tubing, while both concept Stepping Stone and concept Garden Blox have areas that need to be dug out. This makes moving such concepts to a new house hard and therefore the concept has to be installed again if necessary.

42 - Yellow (Erna)
Erna is used to using the same technique as concept protection uses, that is why that would definitely suit her. It also finds a solution for the water that comes from the cars driving by. Concept garden blox has a lot of flowers and colour to it, making it beautiful in Erna's garden. Lastly, concept stepping stone would suit Erna because of the space it uses. Erna lives in the city centre and that makes space a very precious thing.

43 - Green (Lydia Jansen)
Lydia fits with every concept, she has a large garden so a lot of space for any of the concepts. She likes safety and all of these concepts give that to her while either not taking up more space or giving something back.

44 - Grey (Marieke)
Since Marieke does not have a garden she has no space in using any of the concepts, however concept protection may be used for her roof or keeping the water away from the front door.

45 - Red (Harm Smikkel)
Because Harm does not live on the ground floor both concept protection and concept garden blox will not work for him, even though he might find them interesting. However, concept stepping stone can be placed in the space that he uses to get to the front door. This will not fix his problem of having a leaking roof, but it will help the people around him.

46 - Blue (Frits Oudenaller)
Frits is an individualist, he takes care of his own stuff. That is why concept protection fits him. However the looks of concept protection does not fit the status he would like to have. With the more interesting and prominent looks of both the stepping stone and the garden blox Frits is very confident. Both these concepts have interesting aspects which he can show his friends, family and other visitors.

5.3 Concept rating
An evaluation survey has been conducted to evaluate the three created concepts. Respondents were asked to evaluate positives and negatives of every concept and to compare the concepts. This survey can be found in *Appendix K*.

From the results can be concluded that the concepts Stepping Stone and Garden Blox were rated considerably higher than the concept Protection. The main critique on the concept Protection was that the respondents did not see how and if the concept would be working. They also thought the solution would be too expensive compared to its functionality. Also the looks were not reviewed positively. The idea of diverting water did receive positive ratings.

Concepts Stepping Stone and Garden Blox received comparable ratings. The aspect of reusing water while being an attractive garden piece was the most likeable.
For the Stepping Stone concept, respondents were concerned about the costs of implementing a solar panel in the product. They were also unsure about the strength of the panels as they also function as a garden tile. Regarding the Garden Blox the concerns were related to the large size of the product. Some respondents disliked having a large object in their garden.

Overall, practicality, design and reusability of water seem to be the most important aspects to the respondents. From the results it did not become clear what respondents would want to spend on the concepts. The most important factors influencing costs seems to be on the product type, its functionalities and personal preferences, amongst other factors.

5.4 Conclusion
In this phase of the project, the concepts were validated based on the requirements, the suitability of the concepts for each in-depth persona, and the opinion of a few respondents.

As mentioned earlier, the concept Stepping Stone and Garden Blox score better than concept Protection in each kind of validation. Each concept, however, does have its own advantages and disadvantages. In a further iteration process it would be possible to improve the concepts in a few aspects. The advantages, disadvantages, and possible improvements are described in the following.

Concept Protection does not collect and reuse water but rather diverts the water and protects property from getting damaged.

This concept is the only one which is suitable for people who do not have any space around their house for a somewhat bigger product. Moreover, since it does not collect water, it is more suitable for people living on their own who do not really have a need for using redundant rainwater. This concept is also the only concept that prevents water from entering the user's house unintentionally. Because this solution is not fixed, it is possible for the user to move it and even to take it with him when he moves. Also, the product works in every season and fits many housing situations.

Since the product constantly stays in place, for instance the garden, it might hinder the user. Moreover, it is not really an aesthetically pleasant addition to the user's environment and because the redundant water is only diverted, the concept does not support prevention of streets and other public infrastructure from flooding. Furthermore, since the concept is not fixed to the ground it might move during a storm. Also,the product does not filter garbage, leaves or any other objects from the water and it does not have an opening for collecting water or provides options to keep the product opening free of obstructions. Lastly, the product does not have an added value when there is little to no rain since it neither decorates the environment nor makes use of the redundant water in a purposefully way.

In a further iteration step it would be possible to improve the looks of concept Protection and integrate a possibility to filter and also to collect the water. The last point is the main point why concept Protection scores lower than the other two concepts, since the overall problem of flooding is not improved by this solution.

Concept Stepping Stone is the solution which most effectively solves the problem of water difficulties than the current situation and it does also have a pleasant design. Furthermore, it does not hinder the user or the neighbours in their own environment. The provided solution is permanent and strives to prevent streets and other public infrastructure from flooding. Moreover, the product filters garbage, leaves or any other objects from the water. Since the product is fixed, it stays in place during a storm.

A disadvantage might be that the product does not really prevent water from entering the user's house unintentionally. The product is not completely closed off for any animals or other species, so that it might be possible for them to get stuck in it. Also, the product does not really provide access to the user when something is wrong since it is mainly installed underground. Furthermore, the solution might not work in all seasons since when the water freezes, the stepping stones cannot move anymore. Because the solution is fixed it cannot easily be taken with the user when he moves. Lastly, the product only has little added value when there is little to no rainfall since all its functionalities depend on reusing rainwater.
In a further iteration step, it should be tried to make the product completely closed off for animals and it should be thought of a solution for providing access in case something does not work properly.

Concept Garden Blox is the concept with the most pleasant design and, moreover, it still has an added value when there is little to no rainfall. This solution more effectively solves the problem of water difficulties than the current situation and strives to prevent streets and other public infrastructure from flooding, just like the foregoing concept. The product is fixed and stays in place during a storm, it does not hinder the user or the neighbours in their own environment, and the product filters garbage, leaves or any other objects from the water. On the other hand, the provided solution does not prevent water from entering the user's house unintentionally and it does have sharp edges at which a child might hurt himself. Lastly, since the product is fixed it cannot easily be moved. In a further iteration step it might be possible to integrate more functionalities which more purposely make use of the water.

All in all, three concepts for flooding products were developed of which two score quite good when validating them using three different strategies. All of the concepts might be improved in a further iteration process. With regard on the available time for this project, it was not possible to make any iterations. However, concept Stepping Stone and concept Garden Blox already seem to be very suited for the initial problem.

6

Conclusion, reflection & recommendations

6

Conclusion, reflection & recommendations

6.1 Conclusion

In the Analysis phase the first step was to conduct desk research. This research consisted of a problem definition, a market research, and a context analysis. It was also planned to conduct an interview with the municipality or the case provider and to conduct a survey with potential users. It was decided not to conduct an interview with the case provider since it was possible to get a few answers about the case in general via mail. However, an interview with the municipality should still be conducted. Since it was not possible to get in contact with the municipality, the interview could not have been conducted. It was tried to fill the missing information with additional desk research. Anyhow, not all of the information could be found. The survey was conducted successfully and served, amongst others, as a basis for creating in-depth persona's in the next phase of the project. Also insight was gained into the current situation of house owners, like how they handle flooding, and what their wishes and their needs are.
The outcome of the analysis phase is a first range of wishes and requirements.

During the Design phase, needs persona's were created and their needs, goals, and wished were identified. It was also brainstormed for possible functions that might fulfill a certain needs persona goals and needs. Furthermore, possible problem scenarios were created which gave insight into a variety of possible problems of a future product and thus resulted in a long list of requirements.

Moreover, in-depth persona's were created based on the empirical data obtained through the survey. For each in-depth persona a character driven scenario was written. In the beginning it was stated that these character driven scenarios would be daily scenarios of the persona's. However, it was decided to write scenarios in which it is raining heavily since this is the period when the product should fulfill its main function, that is, prevent damage through flooding.
These scenarios served as input for the Magical Bits session which was the following step in this phase. The Magical Bits session was executed amongst the design team and it resulted in a range of different ideas for possible functionalities.
The outcome of the Design phase are, again, a range of requirements, as well as a whole list of ideas for possible functions for a future product.

During the co-design phase, a CUTA-session and an MRP-session. In the beginning, it was planned to conduct these two sessions separately from each other, however, regarding the available time for the project and due to struggles with planning these sessions it was decided to conduct the parallel. Because of planning difficulties also a smaller amount of people took place in the co-design session than initially planned.
The possible problem scenarios from the earlier phase served as a base for the co-design sessions. The results gave less input than expected, but valuable insight was gained in the thinking process of people. The outcome of the co-design phase are three concepts, each focusing on a different solution to the initial problem.

During the evaluation phase the concepts are compared to the requirements, they are rated on how well they are suitable for each character driven scenario from the design phase, and they are validated by a few respondents based on a range of criteria.
The outcome of this phase is an overview of the advantages

and disadvantages of each concepts and recommendations for possible improvements for a further iteration step.

6.2 Reflection

Generally the use of Scenario Based Product Design was found difficult within this project. Within this reflection the story as to why this is and how this could be improved is told. To start off, the analysis phase went fairly well. The desk research went fine and some interesting information was found. This research formed a good base for both the interview and the survey. An open mind could be kept while still being informed. As for the survey it was found very helpful and interesting. Some participants had questions or remarks on the way questions were asked, but this could be fixed by checking the survey with a non-involved individual and then making it public. A whole other problem came up when trying to do the interview, since no contact with the municipality could be made. This problem came to existence because of multiple reasons, the main being not being able to get direct contact with anyone of importance, the second finding out too late that other options might be available. These options could be contacting other municipalities with our network or contact teachers earlier on. Another option, with a low chance of working, is to get an appointment at the municipality and try to contact the right person. The biggest change that should have been made is that other phases or parts of the projects are not as reliant on previous tasks, in this case being the interview. Before continuing to the next phase a week or two has passed by.

Then continuing on to the design phase, where a lot of persona's and scenarios were made. The needs persona's really helped with thinking outside of the box for people you would normally not design for. Making the needs persona's also went well. On the contrary the combination of the In-Depth persona's and character driven scenarios were not as successful. Thinking of new persona's based on real information gathered in the survey went well, yet that in combination with the character driven scenarios did not deliver any new types of information. What could have changed this is a problem that occurred more often in this project, giving a clear function to the design. Within certain scenarios the use of the solution was not implemented since these scenarios should have formed a base for the list of requirements. However that made the scenarios extremely standard and it did not require a lot of creativity to make things work. The last part of the design phase is the possible problem scenarios, which was found to be a very helpful tool. The possible problem scenarios gave a lot of information about how to remove both human and environmental mistakes from the design.

Within the co-design the same problem as stated for the character driven scenarios occurred. This problem is that there was no stated function yet as to which the participants could have added something. That is why with for example the CUTA-cards were still very broad and no generation was made possible. The MRP had the same problem, however both were found useful for the validation and evaluation parts. Another problem found in the co-design phase involved finding the right connections. Because no contact was made with the municipality and no target group became available from Pioneering own networks were contacted. Within these networks not everybody experienced the problems that are as big as they are in for example the north of Enschede.

The evaluation phase went well, looking at the overlapping opinions between the design team and non-designers feels very valuable. If looking at this process as the beginning of an iterative design process the evaluation can be extremely useful. The opinions of all people can be implemented and all the concepts can be made better by removing their bad points and focusing on their good aspects.

To conclude, as designers using Scenario Based Design Tools you are very dependent on people within a limited time frame, making planning extremely important. Within this project this went well but choices had to be made accordingly. Some participants within the Co-Design tools and survey might not have been the most suited people and were a bit outside of the main target group. However, they still delivered a good amount of information. It is expected that when contact has been made with the right people, such as a whole target group neighborhood, a lot more information can be gained. Lastly and most importantly, as said previously, a lot more iterations should have been made. Adding to the requirement list was not as necessary, while making the function clear could have brought better information from all the scenario based design tools. Because of this problem we think that this combination of tools works fine in a different scenario, with a clear function. That is why these tools work best with a redesign. The problem tackled in this case focuses on something that is unknown and abstract. All the practiced assignments in the lectures focused on objects or apps with a clear function on which additions could have been made and these assignments worked much better.

Finally, the whole process was very interesting. However, when looking back it could have been done better. With the changes that are elaborated upon in this reflection (and will be summarized in the recommendations) the use of this scenario based design method would be very useful compared to the conventional design method that is taught to students at the University of Twente. Because of the influence the user has on the design process, a more pleasurable design will be created that a designer would maybe not have thought of by him- or herself. The design process might not have taken as long but

iterating and testing with actual users afterwards might prove more difficult and time consuming as when the needs of the users are taken into account in a more direct way from the beginning of the project.

6.3 Recommendations

In the end several recommendations regarding the design process can be done. As mentioned in the different conclusions throughout the report a lot of things within the process were depending on results from other parts of the process. This can be seen in the In-depth and Possible problem scenarios as these were meant to be based on the results from the survey and the interview with the municipality. The recommendation for this is to create other plans to generate input for parts of the process. This can be for example using personal knowledge.

For future projects the key to success will be implementing more design iterations. This means that between the analysis phase and the design phase a key function of the product needs to be chosen. Next this function can be used to create all the different types of scenarios and the Magical Bits sessions. Both these sessions will take place at the same moment in the process and will not be depending on each others results. The results of these sessions will be used to create a new iteration to add more things to the concept and the functionality. After that the co-design sessions like CUTA and MRP can be held to further iterate, validate and evaluate the concept. These sessions can also be done parallel to each other. In the end parallel concept evaluation, concept rating and concept verification can be done to finalize the concepts. Having a specific function for the design will be key to successfully implement scenario based techniques.

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A

Appendices

Appendix overview

Appendix A - Problem definition
Appendix B - Market research
Appendix C - Survey
Appendix D - In-Depth personas
Appendix E - Character-driven scenarios
Appendix F - Needs personas
Appendix G - CUTA-cards
Appendix H - Miniature roleplaying session
Appendix I - Requirements validation
Appendix J - Ideas from design phase

Appendix A - Problem definition

Hoeveel water valt er?
60% van Nederland kan overstromen (onswater.nl / https://www.deltacommissaris.nl/deltaprogramma/gebieden-en-generieke-themas/veiligheid)
Maximale waterhoogte is rond de 5 meter

Waar valt het eigenlijk?
http://www.overstroomik.nl/overstroom-ik.html?adres=
Voornamelijk in steden en lager gelegen delen van het land. In de steden kan het niet wegstromen want bestrating.

Wat is de reden dat het valt?
- Klimaatverandering
- Opstuwing van de Noordzee door een storm (beïnvloed door stijging van de zeespiegel)
- Combinatie met een springtij of hoge waterstanden van de grote rivieren.
- Extreme regen
- Verstedelijking > Meer bebouwing en bestrating waardoor het overtollige water niet meer weg kan stromen: https://www.knmi.nl/kennis-en-datacentrum/achtergrond/hoe-vaak-komt-extreme-neerslag-zoals-op-28-juli-tegenwoordig-voor-en-is-dat-anders-dan-vroeger

Conclusie
In Nederland veel gebieden waar steeds regelmatiger overstromingen plaatsvinden, deze locaties kunnen tot 5 meter onderlopen. de overstromingen gebeuren het meeste in de stad ivm de ‘urbanization’. Om dit te verhelpen kunnen huiseigenaren tijdelijke wateropslagen plaatsen, maar wat maakt deze optie interessant voor eigenaren?

Appendix B - Market research

B1 - Introduction

As noted in the paragraph Market research on *page 15*, in the following various flood protection products cof the categories tanks and barriers are presented. Furthermore, some general solutions which could be applied by cities are mentioned.

B2 - Tanks

The most common type of collection tank is the regular water barrel connected to the water drainage pipes of homes, as shown in *Figure B1*. They come in various sizes depending on the environment and usage of the system. Sometimes the water collected by these systems can fulfill an extra function as for example using it to water plants in times of drought.

Figure B1. *Regular water barrels*

The regular barrel tanks are however not that aesthetically pleasing to put in a garden so other water collection tanks exist in several forms. For example there are tanks implemented in architectural elements like walls of houses or garages as shown in *Figure B2*. The tanks can also provide a more decorative function as a garden fence or plant wall as shown in *Figure B3*.

Figure B2. *Architectural tanks*

Figure B3. *Garden fence tanks*

A non existing concept for a water collection system is the bench shown in *Figure B4*. This bench collects rainwater that can later be used to water plants. The biggest downside of this concept however is the fact that it only collects the rainwater that falls on the bench limiting the amount of water collected.

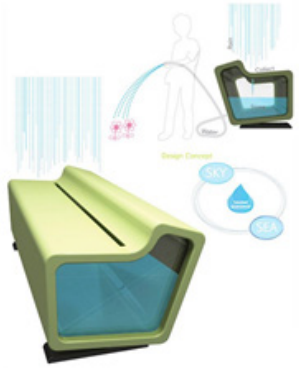


Figure B4. *Water collection bench*

The last tank system is the one shown in *Figure B5*. This system features a bag that can be placed inside the crawl space of a home meaning that it will be hidden from sight. This bag is connected to the drainage pipes of the house collecting all the rainwater that falls on the roof of the house.

B3 - Barriers

Next to water collecting products, there are also many water barriers available for homeowners to prevent flooding. One of them is the 'Water-Gate' self-inflating barrier (*Figure B6*). It is reusable and can be installed easily and quickly. The barrier is available in various lengths and heights. It is suited for flood control, creating reservoirs and dams, waterway diversions and for chemical spill containment.

Figure B5. *Water collection bags*

Figure B6. *Water-Gate barrier*

Two other barrier systems do work very similar to the Water-Gate, namely the flood barriers from Geodesign Barriers (*Figure B7*) and the EKO barrier system (*Figure B8*). The former are barriers which have a steel frame supporting aluminum sheets, waterproof plywood or wooden pallets. The latter consists of modular wooden floodwalls.

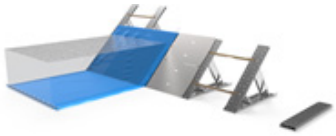


Figure B7. *Geodesign barrier*

Figure B8. *EKO barrier system*

The next barrier is the WIPP water-inflated flood protecting system (*Figure B9*). It is available in a variety of sized and the sizes can also be customized. For installation, the system is unrolled and inflated with any available water source.
There also are flood protection systems available, which are attached to the house. The first one is the Floodgate door guard (*Figure B10*) which consist of a telescoping frame covered by a rubber to creates a watertight seal against the doorway frame. It is very easy to install and fits 99% of domestic doorways.

Figure B9. *WIPP water-inflated system (left)*
Figure B10. *Floodgate door guard (right)*

The other system is the smart air bricks flood protecting system. This system consists of smart air bricks (*Figure B11*) which stop flood water from seeping into buildings. This solution is permanent and does only need to be installed once.

Figure B11. *Smart airbricks*

B4 - General solutions

When having a look at general solutions for flood prevention there are some concepts which might serve as inspiration for this project. The first concept is 'sponge city'. Such a city would be able to hold water, to clean it, and to drain it. Thus, the redundant water could be used for several purposes, as for instance, watering gardens and urban farms, replacing flush water in toilets, and maybe even processing it to be drinking water.

Also rooftop gardens are a great solution for absorbing water and they can be planted by homeowners, too.

Another solution might be an underground water tank as it is now being installed in Melbourne, Australia.

Appendix C - Survey

Respondent: 1

Vraag	Antwoord
Wat is uw woonplaats?	Doornspijk
In welke wijk in uw woonplaats woont u?	De Haere
Wat voor huis woont u in?	Koophuis
Heeft de woning een kelder?	Ja
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Bosachtig
Wat is uw huishoudelijk inkomen?	Boven modaal
Wat is uw leeftijd?	54
Wat is uw gezinssituatie?	Samenwonend zonder kinderen
Beschrijf kort globaal uw gemiddelde dag	Zorg voor 2 honden, huishouden
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Elke keer (ongeveer vijf keer per jaar)
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/uw tuin)?	In een gedeelte van de kelder blijft water staan
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Er valt zoveel regen dat het grondwaterpijl hoog blijft, dus duurt even voordat het water weg is
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	2
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Een alarm
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Éénmalig installeren, Aangetoond dat het werkt, Makkelijk in gebruik
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	7
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Energie opwekken of wc doorspoelen
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Wanneer het een mooi design is heb ik er meer ruimte voor over

Respondent: 2

Vraag	Antwoord
Wat is uw woonplaats?	IJmuiden
In welke wijk in uw woonplaats woont u?	Centrum
Wat voor huis woont u in?	Huurhuis
Heeft de woning een kelder?	Ja
Heeft de woning een ruimte op de begane grond?	Nee
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	58
Wat is uw gezinssituatie	Alleenstaand
Beschrijf kort globaal uw gemiddelde dag	Overdag werken 's avonds relaxen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer vier keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/uw tuin)?	Straten staan dan blank
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Je rijdt over straat auto's rijden door de plas en jij wordt dan drijfnat
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	1
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Thuis blijven of de bus pakken
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Duurzame oplossing, Makkelijk in gebruik
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	7
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Tuin water geven
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	het mag een passende oplossing hebben maar het mag niet veel kosten

Respondent: 3

Vraag	Antwoord
Wat is uw woonplaats?	Aalten
In welke wijk in uw woonplaats woont u?	Centrum
Wat voor huis woont u in?	Huurhuis
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Nee
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Modaal
Wat is uw leeftijd?	25
Wat is uw gezinssituatie	Samenwonend zonder kinderen
Beschrijf kort globaal uw gemiddelde dag	Werken van half acht tot vijf. 's avonds de deur uit voor een hobby of op de bank voor de tv
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Het regent soms wel hard. Maar ik heb er geen (over)last van.
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Niet
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	N.v.t.
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Goed de goten schoonhouden.
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Duurzame oplossing, Robuust design
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	8
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	WC of douchen. Beregenen van planten
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Als het onderdeel van de tuin maakt de ruimte niet uit

Respondent: 4

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Campus UT
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Ja
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Geheel bestraat
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	22
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Studeren, sporten, eten en slapen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Antwoord: 0 keer.
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Ik heb geen last van de regen.
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Nee, want ik heb geen last van de regen.
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	5
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Daar heb ik geen last van.
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Duurzame oplossing, Aangetoond dat het werkt, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	8
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Energie opwekken of wc doorspoelen
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Wanneer het een mooi design is heb ik er meer ruimte voor over

Respondent: 5

Vraag	Antwoord
Wat is uw woonplaats?	Hengelo
In welke wijk in uw woonplaats woont u?	Klein Driene
Wat voor huis woont u in?	Koophuis
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Patio
Wat is uw huishoudelijk inkomen?	Boven modaal
Wat is uw leeftijd?	52
Wat is uw gezinssituatie	Samenwonend met kinderen
Beschrijf kort globaal uw gemiddelde dag	Opstaan-werken-vrije tijd
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer één keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Straat overstroomt
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	De riolering kan al het regenwater niet verwerken, de straat staat blank en water stroomt op sommige plekken huizen binnen.
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Hier kan ik zelf weinig aan doen
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	-
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	9
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Energie opwekken en wc doorspoelen
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 6

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Campus
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Tegels en één struikje
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	19
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Studeren, sporten, chillen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	-
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Tuin
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Plassen worden zo geoot dat je er niet meer langs kunt lopen en het soms niet meer wegspoelt door de put
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Regenlaarzen aan doen
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Éénmalig installeren, Makkelijk in gebruik
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	6
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Wc doorspoelen, planten water geven, gewoon alles waarvoor water gerecycled kan worden
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Wanneer het een mooi design is heb ik er meer ruimte voor over

Respondent: 7

Vraag	Antwoord
Wat is uw woonplaats?	Zuidlaren
In welke wijk in uw woonplaats woont u?	Oude Tol
Wat voor huis woont u in?	Koophuis
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Terras bordes gras
Wat is uw huishoudelijk inkomen?	Boven modaal
Wat is uw leeftijd?	51
Wat is uw gezinssituatie	Samenwonend met kinderen
Beschrijf kort globaal uw gemiddelde dag	Opstaan eten werken hobby's
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer vier keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Niks
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Nee
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	5
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Heb ik niet
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Éénmalig installeren, Duurzame oplossing, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	9
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Dagelijks gebruik
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 8

Vraag	Antwoord
Wat is uw woonplaats?	Leiden
In welke wijk in uw woonplaats woont u?	Centrum
Wat voor huis woont u in?	Huurhuis
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Modaal
Wat is uw leeftijd?	24
Wat is uw gezinssituatie	Samenwonend zonder kinderen
Beschrijf kort globaal uw gemiddelde dag	Vroeg op, naar werk, koken, tv uurtje/eventjes terasje pakken, yoga en naar bed
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer één keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Modderige tuin
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Tuin een aantal dagen moeten vermijden om het gras niet te beschadigen
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Niks
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Duurzame oplossing, Onopvallend design, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	8
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Kraan water! Douche/wc/ wasmachine etc
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Geen, ik wil een geïntegreerde oplossing in bijvoorbeeld een meubel of de grond

Respondent: 9

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Campus
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Nee
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	20
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Overdag college en 's avonds chillen/sporten
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Nooit
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Geen last
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Nee
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Niet
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Éénmalig installeren, Duurzame oplossing, Onopvallend design
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	8
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Ja, wc doorspoelen
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Geen, ik wil een geïntegreerde oplossing in bijvoorbeeld een meubel of de grond

Respondent: 10

Vraag	Antwoord
Wat is uw woonplaats?	Leiden
In welke wijk in uw woonplaats woont u?	Geen idee
Wat voor huis woont u in?	Koophuis
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Nee
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	21
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Wakker worden, eten, af en toe werken, eten, tijd voor mezelf, slapen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer vier keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Ik word nat. De dakgoot overstroomt ook nog wel eens.
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Niet echt
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Goot leeghalen
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Éénmalig installeren, Aangetoond dat het werkt, Makkelijk in gebruik
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	5
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Ja recyclen van t water idk wat ik er mee kan
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 11

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Stadsveld
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Ja
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	80 m2 denk ik wel, veel gras, een betegeld stuk van de achterdeur naar een overdekt gedeelte naar de overdekte fietsen en de poort
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	21
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Sta op, ga naar de uni, kom thuis, eet, ga weer weg en kom laat thuis.
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer één keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Kelder staat blank. En het is gewoon slecht voor m'n humeur.
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Half jaar geleden? Verder geen details.
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	2
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Niet
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Éénmalig installeren, Duurzame oplossing, Aangetoond dat het werkt, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	5
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Ja recyclen van t water idk wat ik er mee kan
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 12

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Stadsveld
Wat voor huis woont u in?	Huurhuis
Heeft de woning een kelder?	Ja
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Groot, helft gras, helft tegels
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	22
Wat is uw gezinssituatie	Samenwonend zonder kinderen
Beschrijf kort globaal uw gemiddelde dag	Overdag colleges volgen of thuis studeren, in de avond thuis chillen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Nooit
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	-
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	-
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	-
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Éénmalig installeren, Goedkoopste oplossing, Duurzame oplossing, Aangetoond dat het werkt, Robuust design, Makkelijk in gebruik, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	6
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Wc doorspoelen, planten water geven
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Geen, ik wil een geïntegreerde oplossing in bijvoorbeeld een meubel of de grond

Respondent: 13

Vraag	Antwoord
Wat is uw woonplaats?	Leiden
In welke wijk in uw woonplaats woont u?	Tuinstadwijk
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	20
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Wakker worden, eten, studeren -> studieontwijkend gedrag, eten, slapen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer drie keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Lekkend dak
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Hels ongemak
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	1
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Het dak laten maken
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Éénmalig installeren, Duurzame oplossing, Onopvallend design, Makkelijk in gebruik, Veilig voor kinderen, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	7
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Duurzame opties als WC-water
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 14

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Centrum
Wat voor huis woont u in?	Huurhuis
Heeft de woning een kelder?	Ja
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	21
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Werken/college met in de avond vergaderingen of activiteiten
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Nooit
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Ik wordt er zelf vooral heel nat van
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Hevige regenval geen idee, nat worden gisterochtend onder de douche
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	2
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Even extra beter opletten als het gebeurt
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Aangetoond dat het werkt, Veilig voor kinderen
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	7
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Energie opwekken/wc doorspoelen en mogelijke andere "groene" functies
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Wanneer het een mooi design is heb ik er meer ruimte voor over

Respondent: 15

Vraag	Antwoord
Wat is uw woonplaats?	Utrecht
In welke wijk in uw woonplaats woont u?	Zuilen
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	21
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	School, werk, thuisstudie, afspreken met vrienden
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Elke keer (ongeveer vijf keer per jaar)
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Ik word nat
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Ik weet niet wat voor dag het precies was, maar ik moest heel veel doen en kwam overal te laat omdat ik niet de fiets kon pakken en dus afhankelijk was van het ov
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	1
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Ramen en deuren goed sluiten tegen lekkage
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Goedkoopste oplossing, Duurzame oplossing, Makkelijk in gebruik, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	5
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Zolang het duurzaam is
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 16

Vraag	Antwoord
Wat is uw woonplaats?	Bredevoort
In welke wijk in uw woonplaats woont u?	Centrum
Wat voor huis woont u in?	Koophuis
Heeft de woning een kelder?	Ja
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	100m2 bestraat; 35m2 bebouwd; 460m2 groen
Wat is uw huishoudelijk inkomen?	Boven modaal
Wat is uw leeftijd?	55
Wat is uw gezinssituatie	Samenwonend zonder kinderen
Beschrijf kort globaal uw gemiddelde dag	2u reizen 10 u werken 8 u slapen rest privé
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer twee keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Terras staat even blank
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Niet echt een probleem
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	4
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Genoeg tuin
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Éénmalig installeren, Duurzame oplossing, Aangetoond dat het werkt, Makkelijk in gebruik, Veilig voor kinderen, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	7
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Reservoir voor droge periode
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Geen, ik wil een geïntegreerde oplossing in bijvoorbeeld een meubel of de grond

Respondent: 17

Vraag	Antwoord
Wat is uw woonplaats?	Zeist
In welke wijk in uw woonplaats woont u?	Vollenhove
Wat voor huis woont u in?	Huurhuis
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Nee
Heeft uw woning een tuin?	Nee
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	n.v.t.
Wat is uw huishoudelijk inkomen?	Modaal
Wat is uw leeftijd?	28
Wat is uw gezinssituatie	Samenwonend zonder kinderen
Beschrijf kort globaal uw gemiddelde dag	Opstaan, aankleden enzo, ontbijten naar werk gaan, terug van werk komen, koken, eten, tv kijken, "bed klaar" maken, boek lezen, slapen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	geen idee
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	gras wordt sappig
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	ik nam een short-cut over het gras in plaats van de stoep en mn broekspijpen werden nat
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	2
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	niet
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Éénmalig installeren, Goedkoopste oplossing, Duurzame oplossing, Mooi design, Onopvallend design, Makkelijk in gebruik, Veilig voor kinderen, Klein formaat, Lichtgewicht, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	6
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	PS de waarde van de vorige vraag hangt af van de oplossing dus die telt niet mee. De extra functies zijn fijn zolang ze nuttig zijn en niet te veel ten koste gaan van iets anders.
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	ligt er aan

Respondent: 18

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Campus UT
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Tuin'. Betegeld stukje van ong. 3 bij 2,5 meter.
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	21
Wat is uw gezinssituatie	Alleenstaand
Beschrijf kort globaal uw gemiddelde dag	?? Thuis/College/Supermarkt/ Thuis/Vereniging ??
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer drie keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Overstroomde straten vooral; stationsplein (Enschede Centraal) is meestal het ergst.
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Een zeer groot drama: mijn sokken werden nat.
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Duurzame oplossing, Aangetoond dat het werkt
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	8
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Goede suggesties; hoewel misschien niet direct nodig denk ik hierbij direct aan irrigatie.
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing

Respondent: 19

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	campus
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Ja
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	23
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	wakker worden, ontbijten, dingen doen (verschilt per dag, studeren op uni of thuis werken of met mensen afspreken of chillen), lunchen, weer een dingen doen sessie (same), avondeten meestal thuis en in de avond vaak een activiteit buitenshuis of afspreken met mensen binnenshuis of alleen thuis chillen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Elke keer (ongeveer vijf keer per jaar)
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	de ingangen naar ons huis hebben dan zulke grote plassen dat je er niet door kan lopen, alleen fietsen.
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	
paar maanden geleden en was vet naar, want kon niet lopend mn huis verlaten zonder natte voeten te krijgen	
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	1
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	niet
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Goedkoopste oplossing, Duurzame oplossing, Makkelijk in gebruik
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	9
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	wc doorspoelen, energie opwekken, iets waardoor het nuttig is.
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing

Respondent: 20

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Campus
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Grasveldje met een boom en aan de zijkant wat bosjes. Verder ligt er een stenen pad waar je op kan lopen
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	22
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Lekker studeren, daarna eten met m'n huis en dan 's avonds iets doen (verschilt per dag wat, soms studeren, soms met vrienden zitten enzo)
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer twee keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Het gras is een beetje verzopen
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Het regende heel hard en er lag een laagje water op het gras
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Ik heb geen heftige overstromingen die ik hoef te voorkomen, dus niet.
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Éénmalig installeren, Onopvallend design
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	4
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	het water recyclen is wel goed
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 21

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Hogeland
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Tegels, geen planten. Meer een binnenplaats
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	22
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Slaap, studie, sport, sociaal, slaap
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer vier keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Straat en tuin staan blank
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Nee
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	5
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Rubberboot gekocht
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Goedkoopste oplossing, Aangetoond dat het werkt, Makkelijk in gebruik
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	7
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	wc doorspoelen
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 22

Vraag	Antwoord
Wat is uw woonplaats?	Schagen
In welke wijk in uw woonplaats woont u?	Schagen
Wat voor huis woont u in?	Koophuis
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Nee
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Heerllijk, bomen erin en planten
Wat is uw huishoudelijk inkomen?	Wil ik liever niet zeggen
Wat is uw leeftijd?	56
Wat is uw gezinssituatie	Samenwonend zonder kinderen
Beschrijf kort globaal uw gemiddelde dag	Opstaan, krant lezen, wandelen boodschappen, visite eten maken
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer twee keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Erg veel water
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Erg veel water, niet in huis maar laarzen aan!
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	4
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Baricaderen.
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Op afstand informatie te verkrijgen, Duurzame oplossing, Aangetoond dat het werkt, Makkelijk in gebruik, Veilig voor kinderen, Klein formaat
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	8
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Nvt
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Opslagruimte, in bijvoorbeeld een kast

Respondent: 23

Vraag	Antwoord
Wat is uw woonplaats?	Zuidlaren
In welke wijk in uw woonplaats woont u?	De Oude Tolweg
Wat voor huis woont u in?	Koophuis
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Grasveld, terrassen, tuinhuis, struiken en bomen, oprit
Wat is uw huishoudelijk inkomen?	Boven modaal
Wat is uw leeftijd?	52
Wat is uw gezinssituatie	Samenwonend met kinderen
Beschrijf kort globaal uw gemiddelde dag	Opstaan, overdag aan het werk (thuis of in het land), 's avonds vooral bestuurswerk of gewoon werk of uitoefenen hobbies of huiselijke werkzaamheden of relaxen
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer drie keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Geen last, op het terras kan best wat water komen maar dat is snel afgevoerd
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Bij heel veel regen vangt de wadi in de wijk het op
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	5
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Rekening houden dat water weg kan, dakgoten regelmatig checken
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Duurzame oplossing, Aangetoond dat het werkt, Milieuvriendelijk
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	8
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	WC doorspoelen, waterregulatie voor de tuin (bijv. sproeien), terugleveren aan waterleiding maatschappij, energie opwekken
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Zo min mogelijk ruimte

Respondent: 24

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Campus
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Nee
Heeft uw woning een tuin?	Nee
Wat is uw huishoudelijk inkomen?	Wil ik liever niet zeggen
Wat is uw leeftijd?	23
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	studeren / colleges op de UT, soms werken in Roombeek, sporten op de UT
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Ongeveer twee keer per jaar
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	ontprettig om dan op de fiets ergens heen te gaan; maar gezien ik op de bovenste verdieping woon heb ik er in mijn woonsituatie geen last van
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	niet van toepassing
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	niet van toepassing
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Éénmalig installeren, Duurzame oplossing, Robuust design
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	5
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	milieuvriendelijke opties (energie opwekken / wc doorspoelen)
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Opslagruimte, in bijvoorbeeld een kast

Respondent: 25

Vraag	Antwoord
Wat is uw woonplaats?	Enschede
In welke wijk in uw woonplaats woont u?	Matenweg
Wat voor huis woont u in?	Studentenwoning
Heeft de woning een kelder?	Nee
Heeft de woning een ruimte op de begane grond?	Ja
Heeft uw woning een tuin?	Ja
Indien u een tuin heeft, hoe ziet deze eruit? (korte beschrijving)	Vierkant. Veel steen. Grote trampoline. Een boom in de hoek.
Wat is uw huishoudelijk inkomen?	Onder modaal
Wat is uw leeftijd?	19
Wat is uw gezinssituatie	Studentenhuis/Samenwonend met vrienden
Beschrijf kort globaal uw gemiddelde dag	Ontbijten, studeren, sporten, series kijken
Volgens het KNMI krijgt "een willekeurige plaats in ons land [...] gemiddeld vijf keer per jaar een hoeveelheid regen van minstens 20 en 24 millimeter binnen een etmaal." Hoe vaak heeft u last van de heftige regen?	Elke keer (ongeveer vijf keer per jaar)
Waarvan heeft u last met de regen (bijvoorbeeld overstroomt de straat/uw huis/ uw tuin)?	Tuin loopt vol water
Kunt u de laatste keer dat u dit heeft meegemaakt beschrijven?	Waterig, veel regen. Geen idee meer welke maand
Hoe voelt u zich in de situaties? (1 (zeer goed) -5 (zeer slecht))	3
Hoe voorkomt u nu problemen met overstromingen door heftige regenval?	Niet
Wat vindt u het belangrijkst bij een toekomstig product? (Kies de drie opties die u het meest aanspreken)	Snel te gebruiken, Goedkoopste oplossing, Aangetoond dat het werkt
Welke waarde zou u geven aan een oplossing voor de problemen bij heftige regenval? (1 (laag) -10 (hoog))	4
Zijn er extra functies waarvoor u het opgevangen water zou willen gebruiken, denk aan energie opwekken, de wc doorspoelen of decoratie?	Nee
Wilt u een blijvende of een niet-blijvende oplossing?	Een blijvende oplossing
Hoeveel ruimte zou u beschikbaar stellen voor een blijvende oplossing?	Opslagruimte, in bijvoorbeeld een kast

Appendix D - In-depth personas

Persona Yellow

Personal introduction

Erna is a 49 years old woman. She is 1,84 meters tall and has a full figure, although it does not bother her or hinder her in her daily life. She has blond hair and green eyes. She likes to wear colourful clothes that she decorates with things like plastic flowers. She smells heavily of a certain kind of perfume.

She dropped out of school when she was younger. She was studying to be a nurse. With some detours, she eventually ended up in daycare for the mentally handicapped, which she has been doing now for almost six years. The daycare facility is located in a renovated farm building in a high-density neighborhood just outside the city centre of Enschede. She travels there four days a week by car from her house in Almelo.

At work she helps mentally handicapped people work. The company she works for takes on orders from other companies, like the packing of nuts for Zuivelhoeve, a food company from Twente, and helps the handicapped people do these jobs. The job is very demanding and requires giving constant attention to the clients, but Erna finds it very rewarding as well.

Inner needs and goals

Most of the times when Erna is home, she has visitors. Her sister in law visits a lot and they talk about everything over a cup of coffee. She wants people to feel appreciated and welcome, wherever they are. But she also wants the world to be more straightforward and direct. Whenever she feels like someone is doing something they should not be doing, she is not afraid to go up to them and tell them that it is in their own best interest to do something else.

Interpersonal desires

Erna values personal contact with a lot of people, but especially with people in her direct environment. Her colleagues, but mostly her family, her brother's family and her neighbours. She feels like it is important for people living so closely to each other to be able to rely on each other for support and a listening ear when necessary. It improves the living experience and makes for a safe and friendly living environment.

Professional ambitions

Her job is demanding but fulfilling. She leaves home in the morning at 7:30 and returns around 17:30 for four days a week. She already loves her job because she gets a lot of responsibilities and freedom to change the work environment for the better. Her ambition is to provide fun, personal care and well fitting jobs for her clients every day and in a safe environment.

Living situation

At home in Almelo, she lives with her husband a dog and two sons, both studying in different cities, but they come home often. Her husband works as a sales manager at a large company and is away from home a lot. She grew up in the same street as she is living in now, they bought the house to live closer to her brother and his family. The people in the street feel like close friends, although some closer than others. Most of them either grew up together with her or saw her grow up. Sometimes, when a new couple moves in down the street, they are welcomed very neighbourly by their neighbours, the people in the street value their relationships with the others. Every year, on new year's they gather all the people in one garden and have a small reception to celebrate. Erna often visits or get visited by her next door neighbour and they drink coffee together and talk. During the summer she often sits in her garden. Well, it is more a patio than a garden. She likes to have bright flowers wherever possible, but most of the garden is covered in tiles, which allows her to host barbecues when the weather allows it.

Persona Green

Personal introduction

The Jansen family consists of 5 people. Cornerstone of the family is Lydia (52). She is married to Peter (53), and mother of Tjibbe (16), Renske (15) and Fenne (12). They all live in a house from the 1930s, situated right outside the ring road in a middle to upper-class neighbourhood in Enschede. Lydia is a native Dutch white woman, just below average height (which seems to run in the family), a tad muscular, looking fit for her age. Her eyes have a rather insignificant grey colour, similar to the colour her hair had before she dyed it a deep black to cover it up. The -now dark- strands of hair are short, and fixed in place by some store brand hair wax; a convenient cut if you'd ask her. Lydia is a fierce woman with a strong opinion, and she does not stray away from communicating her viewpoints, which is a great quality for her, but also a major pitfall. It would be helpful to her if she would more often think before she says something. She is also quite pragmatic and practical, and likes to do things her own way.

The family is above middle class. This is mainly due to Peter, who works as a heart doctor in the nearby MST hospital. Peter and Lydia met at the gym, about 20 years ago. Lydia had been working there as a personal trainer from the moment she finished her studies (which was a turbulent time; she tried HBO sports education, but failed because of the high tempo. She succeeded with great results on MBO level 4 sports education). Peter, at the time, was a client of Lydia's. It was love at first sight.

Over time, the trainings became more and more personal, and they decided to live together. With their first child on the way, Lydia decided to reduce her work hours from 40 to 28, to have more time with the children (plural, because they were planning on having a few more) and to cope with the increased load of housekeeping. Currently, all three children go to middle school and are becoming a bit more self-sustaining. They all have their own weekly chores, leaving Lydia with a bit more time to herself. With the long hours Peter makes, Lydia will usually be the cook for dinner. However, during the weekends, the tables are turned, because Peter sure does love making some tasty meals. He usually borrows some recipes from a Jamie Oliver cooking book he once got for his birthday, but sometimes he tries to be creative, resulting in some half-decent creation he is very proud of. Every year, at the neighbourhood barbeque, Peter and Lydia form a great team doing catering. Lydia will make her signature salads, and Peter will stand behind the barbeque, grilling spare ribs and other slabs of meat.

Inner needs and goals

Over time, her ambitions have shifted from self-actualization towards wanting to have her children grow up well and successfully, whatever success may mean for them. She feels she has her own life together, and supporting her children is a main priority. She values honesty, and her attitude makes her tell her opinions as well, sometimes a bit too blunt. However, this is always with good intentions.

Interpersonal desires

Lydia can be strong and a bit harsh sometimes on the outside, but on the inside, she is quite caring, and every now and then she sure does need some love from others. As both her parents passed away and she does not have any siblings, this love and care mainly comes from Peter. He know exactly what to say at what moment, which certainly helps her through rough times.

Professional ambitions

Although it is not yet a realistic ambition, Lydia would love to have her own sports studio. Currently this is not doable, mainly because of the lack of time. She hopes that, if the children finally leave the house to study, she will have more time to dedicate to this project. She has started making some plans during some evening hours, where she already found out how feasible her plan is financially.

Average day

Her day starts early, she gets up at 06:30 for a half-an-hour run. Then she'll quickly shower, after which she wakes up her children to eat breakfast together. She waves her children goodbye as they cycle to school, and heads to her work at a local gym, where she works from 09:00 until 15:00 as a personal trainer. After work, she'll head to the supermarket to get ingredients for dinner and heads home, to do some work around the house, mainly involving laundry and cleaning. Around 17:00 she starts cooking dinner. They eat early because the children have their own hobbies they have to attend, which usually start around 19:00. With the children out of the house and Peter finally home from work, they usually sit on the couch to relax for about an hour. Afterwards, both Peter and Lydia will spend time at their various pastimes. Lydia might work on her personal gym project. The children usually return between 21:00 and 22:00 from their activities. Lydia promotes having enough sleep, and will go to bed around 22:30, in order to get enough sleep while waking up in time.

Living situation

The Jansen family lives in a spacious 1930s house right outside the ring road of Enschede. It is a free standing 5-bedroom house, with a monumental basement and a deep garden. Every child has their own bedroom, Peter and Lydia share a large bedroom. The additional bedroom is mainly used for storage purposes. The basement contains 2 crates of beer, some pottery, and empty bottles. Besides that, it is used for storage of barely-used objects that can handle the humidity; cardboard boxes wouldn't handle the high humidity. The garden is large and deep. They don't have enough time to do all gardening themselves, so they have a gardener come around every now and then.

Persona Grey

Personal introduction

Marieke is a 21 years old woman. She has a normal posture with a height of 1.70 meters and a weight of about 60kg. She has a slender face with some freckles here and there. Her eyes are green-grey and she has long brown hair. Her skin is quite pale with rosy undertones.

She needs to wear glasses for reading but not in her regular daily life. Marieke is a student at the University of Twente in Enschede, the Netherlands. She studies Psychology in her second year. She grew up in Groningen together with her parents and her two siblings Timo and Lisanne. She is the youngest of the children since Timo is 27 years old and Lisanne is 24 years old. Both her parents as well as Marieke herself are Dutch.

She grew up as being a Christian, but she never really believed in a higher being and became Atheist when she was 15. She thinks that politics is important but she is not actively involved in any political party. Her political stance is green-left.

Next to her studies, Marieke works as a waitress in a Pizza restaurant twice a week. Furthermore, she plays volleyball

and goes to spinning classes once to twice a week. She has a small friend group with which she meets about once a week depending on the schedule of herself and her friends.

Marieke does not have a boyfriend, nor did she ever really had one. She is not very interested in a relationship right now because she wants to focus on herself. She is not very outgoing, but she is not an introvert either. When she does not know people she tends to be very quiet in the beginning but rather than being shy she is very observant.

When Marieke is not studying, sporting or meeting friends, she likes to read and to make Sudoku quizzes. She likes intellectual challenges since she is quite intelligent with an IQ of 120.

Inner needs and goals

Right now Marieke's goal is to enjoy her live as a student and getting her Bachelor's degree. She is not a person who plans their live years in advance though she would like to have a family and being married someday. She would prefer living in the West of the Netherlands, maybe in Rotterdam or Den Haag.

Interpersonal desires

Marieke really enjoys being around people most of the times. She does only have a handful of good friends since to her it is very important to be close with your friends and be able to talk with them about anything. She had made bad experiences in the past, at times when she was attending High school, with people who she were friends with. Since then she does not want superficial relations in her life. Also, she does not like to go to big parties and talk to people she doesn't know all night long. Rather, she wants to be with her friends and spend time with them.

Professional ambitions

Marieke would like to be a psychologist at an addiction clinic. She would especially like to work with younger people and help them recovering. She is planning to do an internship in the summer holidays at such a clinic to get an impression of the work there.

Marieke would also not exclude that she might stay at home for one or two years when having a baby, but she definitely does not want to be a stay at home mum for long.

Average day of the user

In the morning Marieke usually gets up between 7.30 and 8.30 depending on when her first lecture starts. After showering, having some breakfast and getting ready she rides her bike to the University where she attends lectures. She lives in the city center of Enschede. Usually, Marieke has lecture till 12.30 and then she has a lunchbreak in which she meets with her friends or gets some homework done if necessary. Then, at 13.45 she normally has a lecture again. At 17.30 her classes are finished and she goes sporting or rides home. When she goes sporting, she usually rides home afterwards, which is at about 19.30. At home, Marieke eats dinner with her two housemates, Frida and Lena. Afterwards, she studies, reads, or meets her friends. At 23 pm she normally goes to bed.

Living situation

Marieke lives in an apartment with two other female students. Both of her housemates study Biomedical Engineering at the same University as Marieke. They eat dinner together nearly every day and once in a while they hang out with each other. In the weekends they often watch films together or they go shopping or have a coffee together. They are all quite close, even though the age gap is quite significant since Marieke's housemates are 25 and 26 years old. Marieke enjoys living with the two girls and really likes that she can hang out with them if she likes to but that she can also take time for herself.

Scenario Red

Personal introduction

In the centre of Utrecht lives a 21 year old man named Harm Smikkel. Harm is originally from Valkenburg where he lived together with his little brother and his parents for the first 18 years of his life. His father is originally from France and his mother is from the Netherlands, therefore Harm is raised bilingually. Harm is a strong, muscular guy, which happens to also love some chicken nuggets from time to time, making him around 90kg. He is seen as a handsome man in his neighbourhood with his beautiful dark hair and brown eyes in combination with his lighter skin with yellow undertones, all traits he got from his father's side of the family. The appearance of Harm can differ from very casual in joggers and a cap to a chique guy. When passing him on the street Harm is seen as a nice and approachable guy, with him walking behind you on the street late at night, you won't be scared.

Harm studies pharmaceutical sciences where he just obtained his bachelor's degree. On the side he works in the kitchen of different restaurants as a sous-chef. His speciality is tasting the food. Harm was raised very leniently, he got to discover a lot in his early youth and has a good relationship with his parents, he often goes and visits them on the weekends. In his student home he lives with four of his best mates. Together they like to spend time drinking beers, taking long walks on the beach and gaming. All of them have been friends since high school, where they spend their time in the exact same ways. Harm also liked to spend time with his girlfriend, with whom he also likes to take long walks on the beach. With Harms knowledge in the kitchen he knows that for love and friendship a good meal is the basis.

With his friends he used to eat a lot of 'Epic meal time' themed meals which have now changed to healthier versions with the same amount of bacon.

Socially Harm has a good life, he goes to a lot of student activities and small festivals with his girlfriend and friends. He always jokes that his future goal is to make some good drugs with his profession, yet his real life goal is to stay alive. Harm gets frustrated when something goes wrong or he loses a game, which is funny for all bystanders. All other times except right before exams and when someone unexpectedly changes his music, his attitude towards life is very positive, filled with happiness and hope. With his high IQ and a lot of abilities he is sure to change something in this world.

Inner needs and goals

Currently Harm is enjoying his student life and he tries to focus on enjoying it as much as possible. His future feels very secure with his girlfriend since they have been together for more than 8 years. Deep inside Harm always wanted to have children and dreams of taking care of his own little boys while his girlfriend works. He feels best when he is taken care of and therefore he is in need of validation and care from either his friends, family or girlfriend.

Interpersonal desires

Harm enjoys his personal time, but also in in need of validation and care. That is why he has a group of very close friends who all know how to handle Harm. However, conversations with Harm mostly stay superficial because he is scared to open up and behave anything less than manly. Only his girlfriend gets to see his true self.

Professional ambitions

Harm would like to have a short road to success in order to raise his future children. He wants to work as someone who creates new medicine in a hospital and he prefers the LUMC in Leiden. He will be doing multiple internships to really get a look into his future job and which roles he wants to fulfill.

Average day of the user

Harm often likes to sleep in until 10:30 AM when he does not have morning lectures. The first 15 minutes of his day are spend on his phone, looking at all his social media accounts. After that he rushes into the bathroom to take a shower and empty his intestines. After his shower he dresses himself in to whatever is appropriate to wear that day and goes to the kitchen. He makes his breakfast which mostly consists of bacon, eggs, milk, juice and coffee. While is egg is cooking he goes outside to take a morning cigarette and a breath of fresh air. He then eats his breakfast slowly, because food is not meant to be stuffed into someones mouth. After leaving his plate in the sink for his roommates to clean up he goes downstairs and grabs his bike to go to his lecture. When he arrives a little late he spends his lecture time taking notes and wandering off looking at his phone. When lunch starts he gets something from the cafeteria or the nearest supermarket, because he does not have time in the morning to make his own lunch. He spends his lunchtime with some of his classmates. After lunch he gets a quick smoke before he goes to his tutorial lecture. This lecture Harm tends to lose focus and spends more time playing games on his phone than actually practicing. When his lecture is over he goes home where he waits for dinner with some snacks. Together with his flatmates he plays some Call of Duty, even when dinner is ready. In the evening Harm studies and at 10PM the XBox is turned on again to play some latest games. At 2 AM he goes to bed.

Living situation

Harm lives in a nice student house in the centre of Utrecht. Together they have the second, third and top floor of the building. The apartment was bought by one of the parents and can be rented by the group of friends. On the second floor (for them the lowest floor) two of the guys have their rooms, Daan and Jasper. One of the rooms is used as a dining place, the other is used as the living room. On the other side of the hallway are the toilet and the kitchen with access to the balcony, which has a beautiful layer of fake grass. On the third floor two other rooms are located, the room of Harm and the room of one of the other guys, Dominic. On the top floor the last guy, Peter, has his room and the bathroom is there. The top floor has a slanted roof, making standing in the shower pretty hard. All guys are around the same age, making living together a breeze.

Scenario Blue

Personal introduction

Frits Oudenaller is a middle aged man of 49 years old. Frits is a typically Dutch-built person. He is tall, around 1,88 meter, and has a put posture. Frits has dark blonde hair which is starting to go grey a little. His eyes are blue and his skin is average white. Frits has a beginning bald spot and his nose is slightly crooked. Both parents of Frits grew up in a small village in Drenthe called Drouwenerzand. This is also where they first met. After finishing school the parents of Frits moved in together in Groningen. This is also where Frits was born and raised. They did not live in the centre of the city but in the more rural outskirts of the city. Frits got all the space he needed to play and to develop himself.

Frits finished his VWO to go study the bachelor course business school at the Rijksuniversiteit Groningen. This is also where he met his wife Ellen. During the final stages of his bachelor Frits came in touch with a business consultancy firm. Here he did his graduation assignment and started his career after. Frits worked at this firm for a few years before starting his own consultancy

company with a few colleagues. As Frits has always been interested in new technologies and products they he started a company focussed on consulting businesses in choosing which products or technologies to market next. Being in this business means that Frits constantly needs to educate himself with technologies, products and trends. It took some time but once the company had had a few successes it started to become a healthy company. This meant Frits and Ellen could afford to buy a new house in the town Haren. A town close to Groningen. Here Frits and Ellen started a family, they got a son and a daughter who now are 21 and 18 years old.

As the average resident of Haren Frits earned a decent amount of money. Frits is well embedded within the community. He does a lot of volunteering work at the hockey club where both his kids and Frits himself are playing. His homelife is very well arranged and the kids are getting ready to finish school and move out. In his free time Frits likes to play hockey with his team or tennis with his wife. From time to time he likes to drink a glass of whiskey and smoke a cigar while reading magazines about tech and product design.
Overall Frits is a very positive human being with a bright look st his life. He is more an introvert than an extrovert and he appreciates his free time. His political stance is right voting for the VVD for years.

Inner needs and goals

Frits really focuses on the now but does like to arrange things for the future as his retirement is coming closer every year. He wants to provide for his family and allow his children to grow up and learn without any worries. He likes to provide a fun environment for his friends and he wants people to like him and hang out with him. For the future he would like to arrange things so he and his wife can have a worry free future.

Interpersonal desires

As Frits has his own company together with a few colleagues he is, together with these colleagues, responsible for a few families. This makes his job demanding and sometimes stressful. Frits needs his wife to be supportive and he needs to have someone to speak to. He does not like to talk to his children about issues regarding his work.

Professional ambitions

Frits already has a relatively well performing company. His ambition is to make the company grow enough to create a basis for a worry free future. This means that he has to work hard the coming periods until this goal is achieved. After that he would like to work a little less and slowly hand over the responsibilities and ultimately the company to a newer generation of employees.

Average day of the user

Getting up for work at different times depending on where he needs to go. Starting the day with a shower, breakfast and a newspaper before getting in the car to get to his appointments all over the country or at the office in Groningen. He works till around 5 every day and after that he goes home. When he works in Groningen he is home within 15 minutes. After work he eats dinner with the family and then goes to read and answer a few last emails before relaxing on the couch or going for a game of hockey or tennis. At the end of the day Frits rads the news on his phone and sometimes he reads a book. He usually goes to bed at around 23:30.

Living situation

A large free standing home in Haren with a garden next to a forest. The house is a old farmhouse renovated to a modern home. He lives with his wife and his daughter. His son lives by himself in a student house in Groningen. They live relatively close to their families. In their street they have a few friends but most of them live a few streets away. This are their friends from the hockey and tennis club.
When the weather allows it they can sit outside in the garden and enjoy the peace and quietness of the forest. When its cold or bad weather they can sit in their large living room by the fireplace or veranda.

Appendix E - Character-driven scenarios

Scenario Yellow

prrrrrrrrrriiii! The alarm on the phone breaks the silence. Erna opens her eyes and looks at the phone: 6:30, time to get up. She turns off the alarm and lies back down. Besides her, her husband takes a deep breath and turns back around. Erna swings her legs out of bed, she notices it seems to become more difficult as she is getting older. She stumbles to the bathroom to find her robe and puts it on, then she heads downstairs. The dog is excited to see her, she raises her eyebrows and pets the dog quickly before letting him go outside to pee. In the meanwhile, Erna gets the newspaper from the doormat.

After breakfast, reading the paper and scrolling through Facebook for a while. She takes a shower, gets dressed and rides the car to work. She is working until 15:00 today. The radio at work tells her that a storm is traveling over the area later that afternoon. When she drives home at 15:10, it does not take long before she is stuck in traffic. Some trees have fallen over and are now lying across the road. It takes her until 16:30 to get home. The rain is already pouring down at that time. She noticed that the water drainage in the street is having difficulties coping with the amount of water and that large puddles are forming on the streets. It does not take long before the water is more than 10 centimeters deep and covering all the street. It gets closer to the people's doorsteps.

Lots of neighbours are gathering in the street, they carry umbrellas and wear raincoats. A few of the men that have come home early from work take positions at the entrances to the street to block the way for cars. Because, whenever a car is passing through the street, creating waves, the water flushes over the doorsteps and wets peoples hallways. One woman, who works as a police officer, blocks the road with her service vehicle. In the meanwhile, the other women gather in front of the lowest positioned houses with towels and mops to help mop up the mess inside. No one is too preoccupied to help.

After an hour, the rain stops and after another hour, the water level is lowered to a point where cars can safely pass again. One neighbour files a complaint to the municipality.

Scenario Green

"Tjibbe, Renske, wake up! You have to go to school!", Lydia shouts to her oldest two children. Why is it so hard for adolescents to get out of bed? It's already 8 o'clock, after all. Of course, she already finished her morning run and woke up Fenne, her youngest child. Peter is long gone to work already. Lydia looks out the window and sees some rather dark clouds. Seems like some bad weather will be coming soon. Enschede is notorious for its heavy rainfall, and it looks like today will be such a day. Of course, she is not worried about the children ("They are not made up of sugar"). No. She is worried about the basement. She would love to have a swimming pool in the future, but the basement definitely is not the right place to put it. Last year, Peter invested in a rain-proof solution for the basement window. Water used to leak from the sides of the window into the basement, so he sealed it off with silicon filler. It has not rained this heavy ever since, so she really hopes the window will hold up. Just a few minutes after the children left for school, a ton of heavy rain falls down. She does not have time for this! Hoping Peters solution will work, she heads to the gym to work anyway. While working, she really can't stop thinking about the possible damage the water might do. In her lunch break, she quickly heads home to check on her basement, but it is too late. Peters solution didn't work, the water still reached the basement, perhaps through some other cracks or seams. She curses as she can't find where the water comes from. Realizing that she really can't do anything about it at this point, she returns to the gym. Her lunch break is almost over anyway. She calls a local water pump exploiter for an appointment to dry out the basement. Her insurance does not want to cover this, so that's a bill she'll have to pay herself. If only there was a solution that would enable her to actually use her basement without water pouring in at every rainfall, it would save her a great hassle and quite some money as well.

Scenario Grey

Marieke gets up at 8 am and sees that it is raining very heavy in Enschede today. She instantly is in a bad mood because she has lecture today and has to go there by bike. After having breakfast and showering Marieke picks up her bicycle from the basement of her apartment and rides to the University. When she arrives there, she is completely wet. She has lecture till 4pm today. The whole day she is freezing because of her wet clothes. She is probably going to have a cold the next days.

After the lectures are over, Marieke would normally have a spinning class today but she decides not to go because she is not feeling that well and also needs to do some grocery shopping today. So instead of going to the gym, Marieke rides her bike to a supermarket which is on her way home. It is still raining and when she gets to the supermarket she is, again, completely wet. She buys some food to cook dinner for her and her housemates and rides home.

At home, Marieke wants to put her bicycle into the basement but the basement is flooded. So, she leaves her bicycle in front of the house and goes upstairs to her apartment which is on the top floor of the building. When she gets into the apartment, she hears one of her housemates, Lena, calling with someone. She

seems to be very nerved. Her other housemate, Frida, welcomes her and tells her that the roof is leaking in the living room and that Lena is talking to the caretaker of the building right now. The roof has never been leaking before, but also it has never been this rainy before since Marieke lives in the apartment. After Lena is finished talking to the caretaker, she explains to Marieke and Frida that he cannot make it today but that he will take care of it as soon as possible. The girls put a bucket under the spot where the roof is leaking and Marieke cooks dinner. The girls then eat together and talk about their days. Marieke tells her housemates that she has been freezing all day and that she is probably getting sick and Frida makes tea for her so that she will feel better. While hanging out, the girls need to empty the bucket every now and then. At 10 pm, Marieke goes to bed and agrees with Lena and Frida that she will empty the bucket in about four hours. So, at 2 am Marieke gets up to empty the bucket. The bucket is not completely full yet since it is raining a little less now. She is very tired and regrets to have taken an apartment on the top floor.

Scenario Red

Harm wakes up from his deep sleep with a mysterious ticking noise. This very rhythmic ticking irritates him extremely, but he is not awake enough to get out of bed. He messages his housemates about who is ticking or what is happening. His housemates send him crazy gifs and tell him to get out of his bed himself. While he contemplates whether it is worth getting out of bed for this, he checks the news. He sees that last night was the biggest storm in the last 5 years, which explains why cycling back from the bar last night felt like cycling on a treadmill. He decides to get out of bed and when he enters the hallway he sees buckets everywhere. The only thing that comes to mind are curse words at this point in time. Harm goes to the kitchen where he makes his breakfast and thinks about what he has to do to solve this. He calls his mother and asks what she would normally do. His mother tells him that she will call someone who will take care of this and that he should just go back to bed, it is only 9AM. When Harm moves back upstairs, zigzagging through all the bucket from which he does not even know how his roommates got them, he gets a call from his mother. He is supposed to wait for the plumber which will arrive in about four hours, meaning he could still sleep a few hours before he has to wake up. When Harm lays back in bed his roommate Dominic knocks on his door. Water is leaking through the roof inside his room, waking him up. Dominic is wondering why Harm is going back to sleep and demands help. Together they empty buckets and try to get things fixed with the student solution, ductape. When the plumber finally arrives Dominic and Harm show everything that is wrong. Large brown spots have formed on the walls and ceilings and the plumber goes to work. He fixes the leakage and leaves behind the bill. The boys are left with the stains on the wall and all the filled-up buckets. They carefully carry all the buckets to the bathroom to empty them there and leave the mess for the three others to clean up. They celebrate their hard work with a beer, until Harms mother calls. She asked how everything went and tells them that they should take care of the bills themselves or should ask the homeowner, which is Daan's father. To not make things awkward they decide to pay the bill themselves, even though it is very expensive.

Scenario Blue

It is 7 in the morning and the alarm goes. Frits gets out of bed after snoozing his alarm several times. He checks his phone and sees a notification about a weather alarm in his area. It says "torrential rains expected in the afternoon". Frits lives in a renovated farmhouse. As this renovation has been finished only a few years ago Frits does not worry a lot about the expected rain. Frits goes on to take a shower and have breakfast while reading his newspaper. When he is finished he jumps in the car at 7:45. He has an appointment at a company in Amersfoort at 9:30. It is starting to drizzle lightly. Just before Amersfoort it is starting to rain more causing a small traffic jam. Slightly stressed Frits arrives two minutes before his appointment. At 13:00 Frits is finished and he gets ready to drive back to the office in Groningen. At this point the severe rains have started and traffic is terrible. It takes Frits three hours to get back. At the office the parking lot is covered in a layer of water. The office remains dry as the doorstep is high enough for now. Frits steps out of the car, the water is high enough to get his socks wet. Frits is not too excited about this but continues his workday until his wife calls. The house is flooding. Due to the weather conditions of the past few weeks the ground is saturated overloading the drainage and flooding the streets and the houses. This is unexpected as they live in an area with a lot of nature. Also some water seems to be seeping into the house through the walls. Frits rushes home to help his wife and daughter with blocking the doors to prevent more water entering the house. At this point the rain is starting to stop and the water level starts to lower a bit. Once it is dry Frits gets a ladder to check why there was water seeping through the walls. He discovers some of the gutters are clogged with leaves from the forest behind his house causing them to overflow and flood into the house. He starts clearing the gutters to allow the remaining water to run away. Together with his wife he goes on to clean the rest of the house. They intend to watch the gutters more closely in the future to prevent the gutters to flood again. For the flooding in the neighborhood they need to find a solution and try to contact the municipality for solutions.

Appendix H - Needs personas

Need: Bodily wellbeing

Personal description

Name: Laura
Age: 35
Profession: Psychologist
Relationship status: Married
Children: 2
Pets: one dog
Hobbies: Running, boxing, yoga, fitness
Political stance: Green, conservative
Favorite meal: Quinoa salad with Mediterranean chicken breast
Specific traits: Sporty, stubborn, ambitious, patient, kind

Say and do

Laura is a very active person. She gets up in the morning at 6 am, drinks a smoothie and goes for a run. She always takes her dog, Dug, with her. When she comes back home, she get ready, wakes up her husband, her daughter (7 years old), and her son (5 years old) and makes them a healthy breakfast and a lunch pack. In the meantime, her husband gets ready and also dresses the children. The whole family then enjoys breakfast together which mostly are fruits, yoghurt, and some nuts and grains. Then she takes the children to school and kindergarten and goes to work. She works as psychologist in a private psychology practice together with 3 other psychologists. In the lunchbreak she eats her homemade salad. After work she goes to the fitness studio to work out for about an hour. Every other day she has a yoga class, once a week she goes to a boxing class, and the rest of the week she trains on her own in the studio. After her workout she goes home and cooks for the family. The whole family then has dinner together. After dinner the family usually plays one or two games together and then the children go to bed. When the children are asleep, Laura talks with her husband or reads. At 10 pm she usually goes to bed to get full eight hours of sleep.

Think and feel

Laura needs to take care of her body in order to feel good. When she did not do sports for a day or eats unhealthy, she feels guilty and uncomfortable. This is why she sports twice a day: in the morning she feels very energized when coming back from a run and in the evening she needs the sports to relief herself from the stress of her work day.

When eating healthy, she feels clean and happy. She also really enjoys cooking and trying out new food.
Furthermore, it is very important for her that her children eat well and that they are healthy and active. In the weekends, the family often goes on trips: they go hiking, camping, or canoeing. She wants to teach her children that it is important to eat fresh cooked meals and to be active to have a happy soul.
Laura usually keeps track of her nutrients by documenting her meals with an app. She also wears a sports watch that measures her heartbeat to keep track on her health.

Need: Idealism

Personal description

Name: Freek
Age: 68
Profession: Retired
Relationship status: Married
Children: 3
Pets: A cat
Hobbies: Gardening, watching documentaries, walking, reading
Political stance: Far-left
Favorite meal: South-east Asian food
Specific traits: Passionate, understanding, sometimes intrusive in conversations

Say and do

Freek is retired, but he is not someone to stay at home sitting in a chair all day. He likes to go outside. His garden is neatly maintained and is full of colour during the summer. He has a garden shed on which he put solar panels last year. He watches

documentaries and reads books about sustainability and green alternatives. Since his vacation to Asia five years ago, he only buys clothes that aren't produced by cheap child labour and from environmental friendly companies. He often shows his wife, children and grandchildren what they can do themselves and hopes that they will do so. He is also a volunteer for a left-wing political party, he hands out flyers and passionately tells people why they should not hesitate to help others in society, since everybody deserves a good life and he is prepared to sacrifice some of his own luxuries for it.

Think and feel

Freek is worried about the world. He knows that industrialization and globalization are problems and that society and the planet suffer from it. He also thinks that the best way forward is to inspire people to change their own lives. He often feels overwhelmed by how slowly people seem to get how big of a problem this is. Much of his frustrations come from the way politics work. He would like for it to be faster, since the problems at hand require fast decision-making, but often certain discussions last forever and problems never seem to be solved quickly. He would like to see the world become a green, loving place where everybody is able to live life happily and in good health. He feels that he needs to convince people that this is the ideal world and acts accordingly.

Need: Influence

Personal description

Name: Marc Flaton
Age: 30
Profession: Youtuber
Relationship status: engaged
Children: 0
Pets: A German Shepherd
Hobbies: Golf, boats, fitness, cooking
Political stance: Left-wing
Favorite meal: Curried quinoa with roasted cauliflower and green asparagus
Specific traits: Postive, well-bespoken, health freak

Say and do

Marc is busy everyday keeping up with his 'five videos a week'-schedule for his YouTube channel 'MotivationMindNSoul'. He gets up every day at 6 AM to start his day with a jog with his dog Philipe. After that he has porridge for breakfast while he checks all the reactions on his latest video and posts a tweet about how we should see every new day as a new opportunity to thrive. At 8AM his video of the day comes online. His videos are about positivity towards life and others, where he tries to focus on influencing people's behaviour. Throughout the whole day he spends some time reacting to the comments and trying to convert people to his lifestyle in a positive way. Some days consist of meet and greets or motivational speeches, others of touring the country for his book tour, all of this while keeping his followers up to date. He tries to fill his time with his loved ones, who are often involved in his job. At 11 PM he goes to sleep after his Kamila tea.

Think and feel

Focusing on having a positive influence on everybody can be stressful, but since this is the life goal of Marc it also keeps him going. He gets support from his fiancé and family in everything he does. Everything he does is focused on influencing others. When he sees that this worked out he is the happiest person he could be.

Need: Autonomy

Personal description

Name: Philipe van der Steenwijck
Age: 45
Profession: Entrepreneur in the robot vacuum cleaner business
Relationship status: Single
Children: Twins, Philip jr. and Megan (15), both attending middle school
Pets: 0
Hobbies: Model trains, programming and going out for dinner

Political stance: Right-wing
Favorite meal: 'Foe-yong-hai' from 'toko de lotus'
Specific traits: Inward-looking, perfectionist, introvert

Say and do

Philipe is a laid back person with a passion for technology. He gets up every morning at 7:15 AM and makes cereal for him and his children. After dropping his children off he goes to his office in the city. There he meets his colleagues Miguel, Sjoerd and Robert and secretary Tom. All together they make robot vacuum cleaners for large areas. Philipe oversees the whole process and is the main contact for external partners. During the lunch break they always go to the sandwich bar across from the street. Philipe spends most of his time at work, sometimes leaving at 9 PM. Then the children go to his ex-wife. After long working days Philipe gets some take away Chinese food and spends his evening in the attic, where his model trains are. Here he programs all the trains as to where the whole system works flawlessly. His goal is to build the whole NS train system and improve on their times. When his children are home they join him or watch television in the attic. Philipe puts his children to bed at 10:30 PM, with hatred from his ex-wife, who wants them in bed at 9:30 PM. Philipe himself goes to bed at 1AM.

Think and feel

Philipe needs personal time in order to feel good, the time he is at his best is while he works on his model trains alone. During working hours this can cause some irritation, but his colleagues know where and when to leave him alone. Philipe needs confirmation to feel proud, as to why he also needs his colleagues around. The only people he generally wants to have around are his twins, even though he has a hard time with his daughter Megan growing up and liking boys. Philipe does not care about health, but more about ease, which is why he likes take-away food.

Need: Mastery

Personal description

Name: Freek
Age: 55
Profession: Carpenter
Relationship status: Single
Children: none
Pets: Dog
Hobbies: Going on long walks, reading
Political stance: Left
Favorite meal: Boerenkool met worst
Specific traits: Independent, Polite, perfectionistic

Say and do

Freek usually gets up bright and early. He enjoys taking his morning coffee while looking at the sunrise from his living room. Occasionally he goes on a morning walk to enjoy the quietness of the early morning before his working day starts. Freek is a self-taught carpenter and has his own company. He usually works alone but occasionally hires someone to help on big jobs, but only if it is truly necessary. If he comes across any problems during his work he usually tells no one and tries to solve everything himself. Each problem he comes across he will investigate thoroughly as he likes to learn and become better at his occupation.

In his free time Freek usually reads books and tries to find activities to educate himself. Freek also does not buy a lot of stuff, he rather makes them himself as he did with the dog house for his dog Bello. He also likes to go on long walks with or without his dog. He likes to explorer new places and find out the history of these places.

Freek only has a few very close friends. As Freek values his alone time he does not need that many friends. When he is with his friends however he does value it very much. He likes to tell them stories about what he has discovered and learned while drinking scotch.
To finish his days Freek usually takes a moment for himself to reflect on his day to get to sleep peacefully after that.

Think and feel

Freek thinks a lot. He likes being alone and he likes to entertain himself. Working on his own little projects he feels most at home. Freek is a sensitive person who needs his own space. He likes to discover who he is and he likes to find out what he is good at. The things he is good at he want to do perfectly. Freek does not like it when he is not perfect at something, he only feels successful once he has completely mastered something. Freek values his alone time very much. He does not feel at home in social places and he has never met the partner of his dreams. Sometimes Freek feels insecure about this but his work, dog and hobbies are there to cheer him up.
Once Freek has something in his mind it is often the only thing he can think of until he has finished or done that specific thing.

In his work Freek does not like to be helped by others. He feels like he has to solve his problems all by himself and he does not like to let others finish his tasks as he feels like he can do it better himself, or he feels like he should be better at it.

Need: Popularity

Personal description

Name: Willemijn
Age: 32
Profession: Food blogger and online diet coach
Relationship status: Married
Children: 2, Boy and Girl
Pets: Labrador
Hobbies: Tennis, high teas
Political stance: Right
Favorite meal: Sushi
Specific traits: Stubborn, eager to succeed

Say and do

Willemijn is a person who comes from a successful environment and she loves to share this with as many people as possible. As part of their job she is eager to convince people to believe what she is saying. Willemijn also is really focused on creating the best content for het blog and diet coaching to make sure she gets positive replies from her followers and customers. She usually gets up early to get her two kids ready for school, she then drives them to school in a car to return home after that to work from her home office.
In and around her house she wants everything to look perfect and interesting. She uses special furniture and items in and around her house to make it interesting. These items are used as conversation pieces showing them to her friends and family. In everything she does Willemijn likes to search for things she can share with others hoping it will generate positive reactions. She also likes it when people agree with her so all her friends are people with the same believes and traits.
Wilemijn loves to go out with friends to have high teas and to talk about her successes at work. In her free time Willemijn organizes stuff at the school of her kids. She likes the compliments she gets from other parents.

Think and feel

Being burnt on being successful and likeable Willemijn is constantly thinking about everything she does. Everything she does she has to do for a reason and she wants others to like what she is doing. If people do not agree with her or do not like what she is doing she feels sad and insecure.
Her friends make her feel happy and these people are very important to her. Her followers from her foodblog and her happy customers are also people in her live that make her feel liked and happy and this drives her to do her job well.

Need: Safety

Personal description

Name: Erica
Age: 47
Profession: Stay-at-home mother
Relationship status: Married to Ralf (50), a local supermarket manager
Children: 2 children, Linda (age 15) and Job (age 17), both attending middle school
Pets: a cat and a dog

Hobbies: walking the dog, baking delicious cake, walking outside ("Even lekker uitwaaien"), relaxing on the sofa in the evening
Political stance: left-wing green progressive
Favorite meal: a home-made lasagna
Specific traits: organized, keen on structure and wants to be in control as much as possible. Also quite caring, places family first, often even above her own well-being.

Say and do

Erica is the kind of mother that really runs the family. With a busy husband and two moody adolescents in house, she is very keen on order and structure. She uses a large calendar attached to the kitchen fridge to keep track of all activities of everyone and often reminds her children and husband of activities they have planned. During a regular day, she starts with a walk with the dog. Afterwards, she does most of the household tasks (although some tasks are divided to Ralf and the kids), and may do groceries. When the kids get home from school, she often has to remind them of things they still have to do for that day, and she might bring the kids to their various after-school activities. She cooks almost every meal, keeping an eye on the nutritional value of the food. During the evenings, she will often take a short power nap, after which she enjoys sitting on the sofa watching SBS 6 with the cat sleeping on her lap. When time allows so, Erica will take care of the garden as well, which she usually does during weekends if no other activities are planned. Otherwise, she may take initiative to take the family on a day out, which she meticulously planned in advance, double-checking entrance fees, free parking space and the nearest toilet locations. Generally, she conveys her messages in a kind tone, which usually is enough, but with two adolescents, every now and then she will have to be blunt to get a point across.

Think and feel

For Erica, her husband and children really come on first place. She wants what's best for them and will assist them as much as possible, often neglecting her own feelings. Potentially risky situations grasp a lot of attention from her. Therefore, she wants to be in control of situations as much as possible, which is why she is trying to be very involved in the lives of her housemates. Every now and then, as a result of her caring attitude and neglect towards her own feelings, she needs some time for herself, so she can relax, clear her mind and not-think about daily life. Spending some time in the evenings on the couch does help a bit, but it does not clear her mind off all things she or her housemates are involved in, and other things she might be worried about. Having a dedicated "mamadag", where she does an activity for herself (like going to a spa, or visiting a city with a friend) help her relax. Her caring attitude comes back in her attitude towards climate change; she sees that it is a problem, and feels the responsibility to contribute to the solution, because the risks of not doing something are simply too high to her. Generally, safety of her family and herself are very important to Erica, and she tries to get a hold on situations by controlling as much variables as possible.

Need: Connectedness

Personal description
Name: Davey
Age: 21
Profession: HBO student media & communication
Relationship status: Single, but available
Children: 0
Pets: 0
Hobbies: Spending time with friends, going out, social media, going to the gym
Political stance: Not interested into politics
Favorite meal: Usually a salad with avocado, chicken, mozzarella and various other additions, but every now and then he also loves a great restaurant-grade burger (so no fast-food variants)
Specific traits: energetic, smooth talker, sporty, spontaneous person,

Say and do

Although doctors didn't confirm ADHD with Davey, he is definitely quite a spontaneous and energetic guy. He loves making new friends and spends a lot of time with them. He goes to the gym three times a week, and he tries to eat healthy as much as he can, to compensate for the unhealthy habit of going out and drinking some beers with his friends, which he also does for multiple nights a week. A general day will start with Davey waking up to his alarm clock and checking his phone for messages. A bit sleep-drunk he will stand up. After eating a nutritious breakfast, he will go to class, where he always arrives one minute be-

fore the classroom closes. He tries to pay attention during class but is distracted by notifications from his mobile phone every now and then. After class he will often try planning something with his friends. When he is by himself he might study, or spend time on social media, where he will upload multiple images per week showing himself and the activities he undertakes with his friends. When you meet Davey at a party, you can expect him to send you a friend request the day after. When you meet him at a (semi-)corporate drink, he will take initiative for communication, he will always have business cards on hand, and you will be added to his LinkedIn connection list within several hours. All in all, he comes across quite open and will talk smooth.

Think and feel

Davey cares a lot about what others think about him. He wants to be liked by other people and wants to spend time with the people that like him. This likeability has an influence on his behavior, as he is sometimes insecure about other people's conception of him. One of the consequences of this is that he will keep his thoughts for himself, instead of sharing them with other people, especially if the thoughts may be confronting to others or may contain controversial ideas. Another consequence is that he will do a real effort in the gym to look as good as possible, as he feels it is an investment into how much other people will like him, or that people will like him better if he looks better. Generally, he enjoys it when people like him, the more the better, and if people do not like him, he will see that as his own problem and will look for ways to turn that around. Being around nice people gives Davey energy and makes him feel good, which is something he actively strives for on a daily basis.

Need: Self-realization

Personal description

Name: Noor
Age: 24
Profession: Art-student
Relationship status: Complicated
Children: 0
Pets: no
Hobbies: Painting/drawing, visiting galleries, writing blogposts, hanging out with friends
Political stance: Central-left
Favorite meal: Extensive breakfast
Specific traits: ambitious, creative, sometimes insecure, extravert

Say and do

Noor is an art student. She likes the freedom to fill in her own days. She doesn't go to lectures much, but she likes to rise up early. It gives her time to work on creative projects. She likes making breakfast because it gives her a way to start her day easily. Art inspires her, she thinks it is interesting to see how other people express themselves creatively. She often visits parties in galleries with friends. It gives her opportunities to talk to other artists. She keeps a diary, the most important insights she shares on her blog for her friends to read and discuss. Her blog posts attract 10.000 readers every month, it comforts her that her ideas reach people, she hopes to have an impact on their lives.

Think and feel

Noor is young and all her life she's been told that she could do whatever she wants to do. This is true, but she has not yet made her choice. She likes everything, but life seems too short to do everything. Her room looks neat because organizing physical space keeps her mind from thinking about her chaotic life and the future. She flows in and out of situations as they occur and even though she would like to know better what the meaning of her life is, she likes that the chaos brings her many different experiences that she otherwise would not have had. She is searching for insights. What is her passion? Does she want kids? Eventually, she thinks, but maybe never. What is important? She thinks life is interesting for its own sake, if nothing else. But she will keep searching.

Need: Stimulation

Personal description

Name: Jane
Age: 25
Profession: Journalist
Relationship status: Single
Children: 0
Pets: 0
Hobbies: Dancing, surfing, skating, photography
Political stance: left
Favorite meal: Pad Thai
Specific traits: creativity, curiosity, passion, ambition

Say and do

Jane gets up in the morning at 8 am, has breakfast and goes to work. She usually rides the bike because she enjoys watching what is happening around her which is not really possible when riding a car. Her work routine differs from day to day. Since Jane works as a journalist she sometimes spends time at the office to write an article or to do desk research, but she also often needs to go out to interview people and take photos of the things and people she writes about.

After work Jane usually meets her friends. They do other activities each time. Sometimes they would have dinner together at a restaurant, sometimes they would have a cup of coffee together, sometimes they would cook, or they would go to the cinema and the like.

Sometimes, Jane does not meet her friends but instead she takes some time for herself. Then she would go to a dancing class, or she would do sports, or just listen to music and read a book at home.

Since Jane has no general night routine, she has no exact time when she goes to bed. Usually she goes to bed between 11 pm and 12.30 pm.

Think and feel

Jane is very curious and likes to observe her environment. She likes spontaneity and she enjoys learning new things. Moreover, Jane gets bored very easily; this is why she enjoys doing a variety of different activities during work, as well as after work. She wants to explore the world and gain knowledge. Jane also enjoys meeting new people, especially when they have a different culture since she likes to learn about different cultures.

Jane enjoys her life, and most of the times she is a very happy and optimistic person. Her feelings are very intense, so when she sometimes has a bad day, she feels really bad; probably worse than another person would feel in the same situation. Then she needs to be alone and take care of herself. The other day, she is as happy as always.

Jane goes on vacation whenever she can. She would sometimes go on vacation with friends of her, but most of the times she would go alone. When she is on a trip alone, she meets more people and she finds to learn more about the culture of the country than when she is with a group of friends. During her vacation, Jane takes a lot of photos and keeps a travel diary. Also, before going on the vacation, she prepares herself by reading a lot about the countries and places she goes to.

Appendix I - CUTA

Het begint te regenen

• TIJD: FREQUENTIE:

Shannon is op haar werk

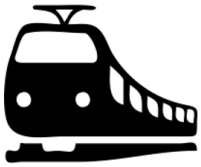
• TIJD: FREQUENTIE:

Peter is op zijn werk

• TIJD: FREQUENTIE:

Shannon is aan het rijden in de auto

• TIJD: FREQUENTIE:

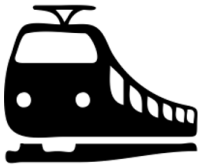


Shannon is aan het reizen in de trein

• TIJD: FREQUENTIE:

Peter is aan het rijden in de auto

• TIJD: FREQUENTIE:



Peter is aan het reizen in de trein

• TIJD: FREQUENTIE:

Shannon zit thuis

• TIJD: FREQUENTIE:

Peter zit thuis

• TIJD: FREQUENTIE:

Shannon is aan het golfen

• TIJD: FREQUENTIE:

Peter is aan het breien

• TIJD: FREQUENTIE:

Shannon wordt nat en koud

• TIJD: FREQUENTIE:

Peter wordt nat en koud

• TIJD: FREQUENTIE:

Het dak begint te lekken

• TIJD: FREQUENTIE:

De straat overstroomt

De tuin loopt vol water

• TIJD: FREQUENTIE:

De kelder loopt vol water

• TIJD: FREQUENTIE:

Er ontstaan vochtplekken op de muren

• TIJD: FREQUENTIE:

Shannon controleerd of de tuin overstroomd

• TIJD: FREQUENTIE:

Peter controleerd of de tuin overstroomd

• TIJD: FREQUENTIE:

Shannon controleerd of de straat overstroomd

• TIJD: FREQUENTIE:

Peter controleerd of de straat overstroomd

• TIJD: FREQUENTIE:

Appendix H - Miniature Role Playing

Planning Mini Roleplaying session:

Resources:
Paper
Pens
Lego
Miniature people
Scenario context
Scenarios
Stuff to take notes
Photocamera

How it works:
Designer explains the problem
User plays out a day together with other user, talking as they do
Users are able to discuss and clarify with help of talking or drawing
Designer takes notes and summarizes in the end
Important that users can change scenarios as they go

Time planning:
15 min Preparation
5 min Introduction
10 min Immersion

35 min Validation and generation
5 min Present own ideas
10 min Play out situation 1: heavy rainfall
10 min Play out situation 2: catch rain
10 min Play out situation 3: use water usefully

Or

35 min Validation and evaluation
5 min Present own ideas
10 min Evaluate situation 1: heavy rainfall
10 min Evaluate situation 2: catch rain
10 min Evaluate situation 3: use water usefully

5 min Evaluate session with users

Appendix I - Requirements validation

K1 - Analysis phase

Table K1. Based on problem definition.

Nr.	Requirement	Protection	Stepping stone	Garden blox
1	The provided solution should be on a private level.	5	5	5
2	The provided solution should be placed on residents' own property (around the house).	5	5	5
3	The provided solution should be a fitting solution for people in the Netherlands.	5	5	5
	Wish (weighed x0,5)			
4	The provided solution might create a community.	1	3	2

Table K2. Based on stakeholder analysis

Nr.	Requirement	Protection	Stepping stone	Garden blox
5	The provided solution should not hinder the user in their own environment.	3	5	5
6	The provided solution should not hinder neighbours in their own environment.	1	5	5
7	The provided solution should be more effectively solving the problem of water difficulties than the current situation.	2	5	4

Table K3. Based on market analysis

Nr.	Wish (weighed x0.5)	Protection	Stepping stone	Garden blox
8	The provided solution should have a pleasant design for its visible parts.	3	4	5

Table K4. Based on context analysis

Nr.	Requirement	Protection	Stepping stone	Garden blox
9	The solutions should be suitable for small and bigger urban areas.	4	4	3

Table K5. Based on survey

Nr.	Requirement	Protection	Stepping stone	Garden blox
10	The provided solution should strive to prevent water from entering the user's house unintentionally.	5	3	3
11	The provided solution should be permanent.	3	5	4
12	The provided solution should strive to prevent streets and other public infrastructure from flooding.	1	5	5
13	Water should be reused purposefully by the provided solution	-	-	-

Table K6. Based on interview

Nr.	Requirement	Protection	Stepping stone	Garden blox
14	The design has to be implemented without the need for permits or excessive alterations to existing infrastructure.	5	4	3
15	The design, when possible, has to be suitable for use as a cooperative solution.	3	4	3
16	The design needs to be accessible for every member of the community.	4	3	3
17	The design needs to contribute to the community in one or another way.	2	4	4

K2 - Design phase

Table K7. Based on possible problem scenarios

Nr.	Requirement	Protection	Stepping stone	Garden blox
18	The electrical circuits should either be; closed off for water, high enough for the water levels not to reach the electrical circuit or inside a house or shed.	-	-	-
19	The solution should provide an automatic option for days which are not spend at home or should always provide an automatic solution.	4	5	5
20	The solution should withstand storms and possible damages following the storm.	3	3	3

21	The solution should stay in place in a storm.	3	5	5
22	The solution should be closed off for any animals or other species.	4	3	4
23	The solution should provide access to the user when something is wrong.	4	3	4
24	The user should be notified about any problems with the water.	2	2	2
25	The solution must not be in the way of normal human behaviour.	3	5	4
26	The solution must not have any sharp edges.	4	4	3
27	The solution must not provide any danger to the users or their children/friends/visitors.	3	3	5
28	The solution should filter garbage, leaves or any other objects from the water.	1	4	4
29	The solution should still work in all seasons.	4	2	4
30	The solution should always have an opening for collecting water and/or should provide options to keep the opening free of obstructions	1	4	4
31	The solution should be able to move with the user.	4	1	1
32	The product should still have an added value when there is little to no rainfall.	1	3	5
33	The solution should be modular or fit in many housing situations.	5	3	3
34	The solution must work with temperatures between -20 degrees Celsius and 40 degrees Celsius.	-	-	-
35	The piping may not crack at temperatures between 0 and -20 degrees Celsius	-	-	-
36	The solution must stay within municipality guidelines.	5	3	3
37	The solution must not infiltrate the comfort of others.	-	-	-
38	The solution must not be a visual nuisance to the user and others.	3	5	4
Nr.	**Wish**			
39	The price of the solution should be partially paid by government or municipality.	-	-	-

Table K8. *Based on needs personas*

Nr.	Requirement	Protection	Stepping stone	Garden blox
40	The product must be multifunctional.	1	4	5
41	Rain water must be reused purposefully	1	5	4

Table K9. *Based on in-depth personas*

Nr.	Persona	Protection	Stepping stone	Garden blox
42	Yellow (Erna)	4	4	4
43	Green (Lydia)	5	5	5
44	Grey (Marieke)	3	1	1
45	Red (Harm)	2	4	2
46	Blue (Frits)	3	4	4

Total score

Concept Protection: 125 points

Concept Stepping stone: 153 points

Concept Garden blox: 152 points

Appendix J - Ideas from design phase

Appendix K - Concept rating survey

Introduction

Dear reader,

For the past 9 weeks, we have been working hard to find solutions for heavy rainfall, which could be applied on private property. Following our extensive research, we developed three product concepts. All concepts have a water buffer function as a common denominator. However, the added value of each individual concept varies a lot, and we are very keen to find out which concepts potential users like best, which is why we want to hear from you. Please find on the next page, the criteria we would like you to keep in mind while examining the product concepts.

Thank you in advance for participating in our evaluation survey!

Best regards,

Tom, Sanne, Merle, Sven and Yanick
Industrial Design Engineering
University of Twente

Concept rating

We would like you to examine the three concepts and for **each concept** answer the following questions:

1. How would you rate this concept on a scale from 1 to 5? *(1 - hate it, 5 - love it)*

2. What aspects do you like best about this concept?

3. What aspects do you dislike about this concept?

4. Would you want to have this concept on your own plot, and why?
- Yes, because...
- No, because...

5. Are there any other comments about this concept?

After evaluating the individual concepts, please answer the following questions regarding comparison of all concepts:

1. What concept do you like best, and why?

2. Would you want to have this product on your plot?

3. How much would you want to pay for this product?

4. Are there any other remarks in general?

Thank you for participating!

It helps us a great deal!

Contact information

-

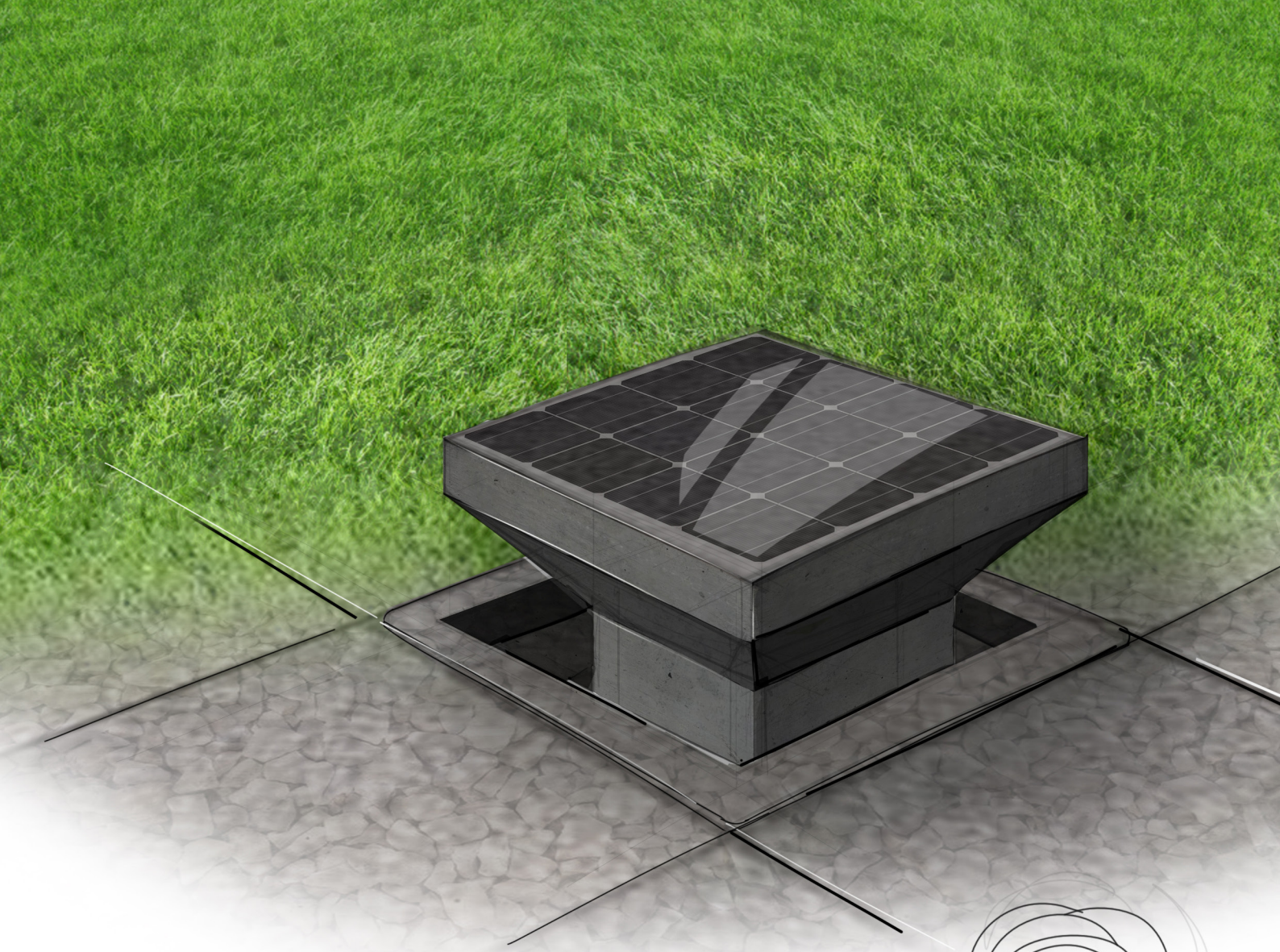
Concept Protection

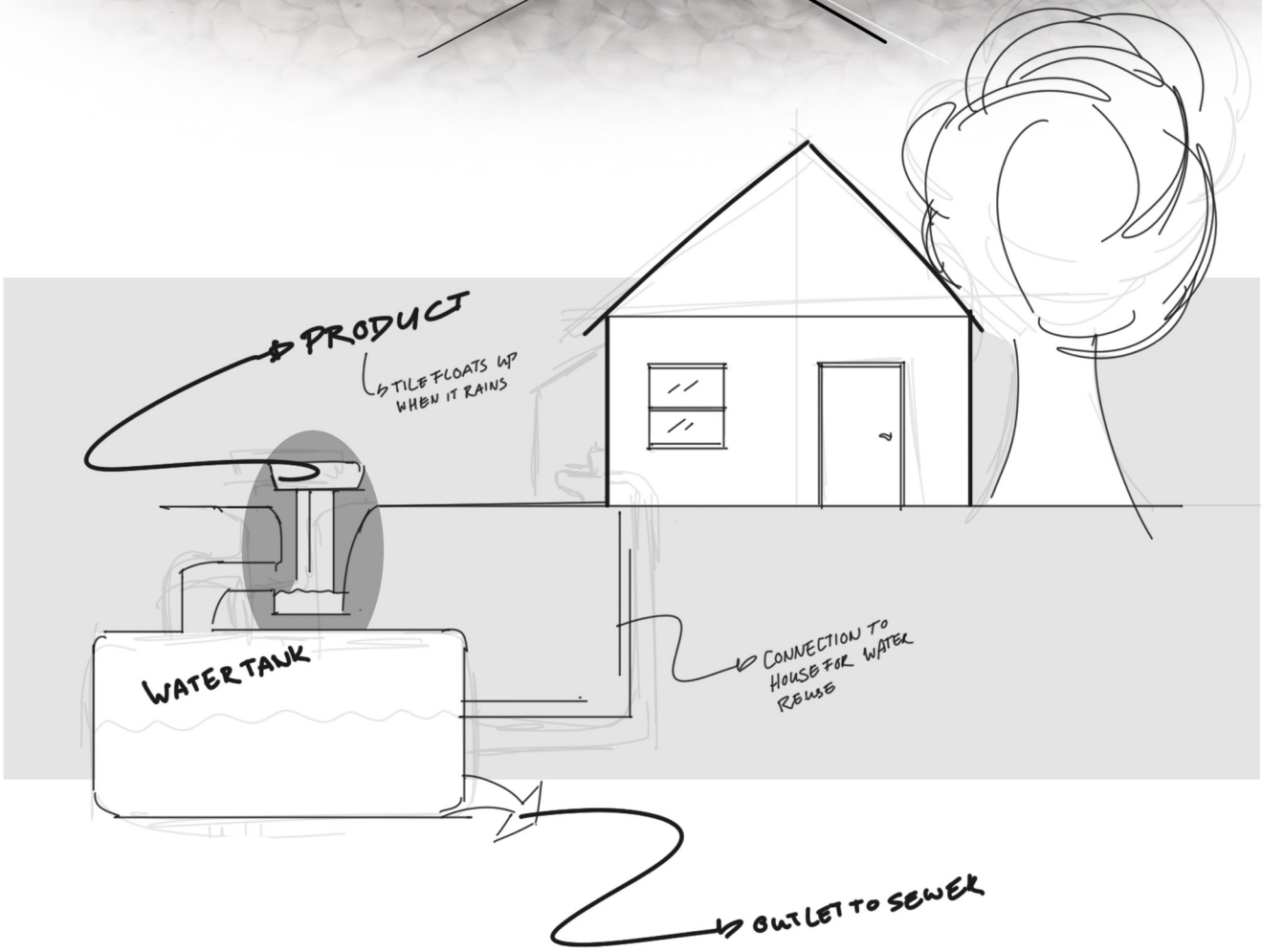
This concept focusses on protection of gardens and property from excessive rainfall. The idea is that the system responds automatically when needed. The goal of the system will be to divert the rainwater away from the homes of the owners.

The system can be implemented in several ways but the main concept is an inflatable flood barrier embedded into the bottom of a garden fence. Once the system detects a flood the it will inflate the barriers blocking the water from the streets from getting into the garden and potentially flood the house. A second way to implement this concept into the garden is to create paths that can be used to divert and drain water away from the garden. Throughout the garden inflatable barriers will be incorporated within garden decoration or furniture at tactically chosen positions. When needed these barriers will form a drain and divert the excessive water in the garden away from the house towards a location that can handle the water or and temporary water storage tank. This second solution can be especially useful for gardens with large patio's or paved surfaces as these types of gardens do not drain water efficiently.

Both these implementations of the idea can be incorporated to function fully autonomously and respond to the outdoor conditions in a smart way giving home owners the peace of mind that their property is safe. Examples of smart responses can be, as mentioned earlier, automatic deployment, but also adjusting to waves created by passing vehicles and such.

When the system is not needed it will be fully deflated and incorporated within the garden furniture and decorations.




PRODUCT
TILE FLOATS UP WHEN IT RAINS
WATER TANK
CONNECTION TO HOUSE FOR WATER REUSE
OUTLET TO SEWER

Concept Stepping Stone

The concept basically consists of an underground water reservoir. The core idea of this concept is that the stored water can be used for green purposes. Think for example of flushing the toilet or generating small amounts of electricity. The excess water will slowly be distributed to the sewage system of the city over a larger stretch of time. In this way the system will not overloaded.

The product for the user should not take up too much garden space. Most of it will be underground. The visible part of the product, the part that can be seen in the garden, takes the shape of a garden tile with a solar panel embedded in it.

When it rains, the water level below the tile rises and lifts the tile up. This shows people that the product works, that it is actively solving their problem and at the same time allows more water to be absorbed and stored in the storage tank underneath.

Multiple tiles can be arranged in patterns across the garden. When all active and floating on water, the difference in water level might even evoke a suggestion of waves. Although the garden will not be flooded with water, but the tiles suggest that it might have been without the product.

Garden Blox

Modular outside furniture

The comfort of being outside
with the needs of the future

Concept Garden Blox

In this day and age, people increasingly experience pressure from various sources such as work and social media. Following this trend, people more and more have a need for some place to get some rest and relax. Being surrounded by nature helps people relax, and the soothing sounds of flowing water will certainly calm anyone down, especially when lying in a comfortable position. Garden Blox provides all this, and much more, in a modular setup tailored to the need of the users.

Garden Blox are modules of one square meter which can have various functions. The example in figure n shows a fountain Bloc, a chaise longue and a plants Bloc. However, there are many more possibilities. Garden Blox could be used for growing vegetables, various ways of seating could be created, a fireplace or barbecue Bloc, or a grand statue Bloc as a centrepiece.

But it does not stop here. Not only do the modular Garden Blox form a personal, tailored conversation piece for gardens of any size, but they also help the local community at periods of heavy rainfall. Below every Bloc is the possibility of creating a water reservoir, which will help reduce the load on the sewage system during periods of heavy rainfall. Due to the large surface areas of the Blox, they could potentially store vast amounts of water. For example: below the blox in Figure n, in case of a reservoir depth of just 1 meter, the Blox are able to store up to approximately 5500 litres of water, a number which could be even higher in gardens with more Blox or a higher reservoir depth. The Garden Blox act as a buffer in case of heavy rainfall, after which the water can be used for various applications. For instance, stored water might be used to water the plants in the garden, or for decoration through fountain Blox. These are just two of the many possibilities to reuse the stored water.

All in all, Garden Blox serve a twofold purpose. On the one hand, they are a convenient and flexible solution for anyone wanting to add some functionality to their gardens, be it relaxation, gardening or decoration. On the other hand, the water storage space below the Blox serve a community purpose by reducing the load on the local sewage system in case of heavy rainfall, thus reducing risks of streets overflowing. Furthermore, the reservoir adds convenience through water reuse for various applications.