

A cup deposit system:

An implementation strategy for NS stations to engage customers to use reusable cups and lower their environmental impact.

Name:
Coach:
Chair:
Coach NS:

Simon Visser
Renée Schuffelers
Ruud Balkenende
Katelijn van den Berg

Summary

The national Dutch railway company Nederlandse spoorwegen (NS) sells yearly 12 million warm beverages on the go in its stores at train stations. Of these, 97.6% are served in a single use paper cup, which can only be used once and then discarded. The disposable cups have significant environmental impact. They result in a lot of waste each year, which has to be burned at the waste disposal plant. Furthermore, they have to be produced and transported to the stations. This means that they have a CO2 emission between 312 (Huhtamaki, 2019) and 2136 tons (Ciraig, 2014).

This graduation project focused on lowering this environmental impact in which warm beverages were drunk at NS stations by motivating user to use reusable cups. It was explored why customers currently do not use reusable cups at NS stations, which solution space can be used to motivate customers to use a reusable cup and how NS can implement this solution space in the NS context.

Different research activities were conducted to under why customers are not using reusable cups now and how NS can motivate thee users. By analysing the results from observations, user interviews and context mapping. Based on the findings 5 barriers were found why customers are not using reusable cups.

Next to these insights 4 personas were created and it was also found how NS can improve the customer experience of drinking a warm beverage at their stations.

Based on these insights two solutions spaces where formulated which were compared to the paper cup. It was concluded that the deposit cup system would be the best reusable cup system for under the right circumstances, but that a user owned cup and a paper cup still have their place.

Because there is no cup deposit system that fits the needs of NS stations the following design goal was formulated:

Design a cup deposit system that has a return rate of at least 98.5% and motivates customers that buy a warm beverage at NS stations to use a reusable cup instead of a single use paper cup, by taking their drivers into account, while at the same time fitting inside the constraints of the NS retail system. This will lower the environmental impact of cups for warm beverages sold at NS stations.

Next to the design goal a design vision was formulated to illustrate how customers should feel when these the system taking each persona into account.

Based on the design goal and the design vision multiple concepts were created from which one was chosen and further detailed into a final concept. This final concept was evaluated with experts within NS. To implement the final concept a road map was made

Glossary

Catman	Category management within NS retail
LCA	Life cycle assessment
NS	Nederlandse Spoorwegen
PSS	Product service system
SHK	Stationshuiskamer
ReCiPe	Score based on damage to human health, ecosystems and resource availability.
ZMET	Zaltman metaphor elicitation technique

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Enjoy reading

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1. Introduction

Context

The national Dutch railway company Nederlandse spoorwegen (NS) sells yearly 12 million warm beverages on the go in its stores at train stations. Of these, 97.6% are served in a single use paper cup, which can only be used once and then discarded. The disposable cups have significant environmental impact. They result in a lot of waste each year, which has to be burned at the waste disposal plant. Furthermore, they have to be produced and transported to the stations. This means that they have a CO2 emission between 312 (Huhtamaki, 2019) and 2136 tons (Ciraig, 2014).

NS acknowledges this problem and is actively trying to lower the environmental impact of their paper cups. To date, NS has conducted three different pilots to test if they can lower the environmental impact of the cups used for warm beverages. They investigated three potential solutions: (1) collecting the paper cups at the station to recycle them, (2) filtering the paper cups out of their general waste at a recycling facility to recycle them, and (3) implementing a reusable cup. Details regarding these studies can be found in the appendix 11. While none of these pilots resulted in a usable solution, they provide a useful starting point for this master thesis.

The first two pilot studies showed that collecting paper cups at stations or filtering them out of the waste stream did not result in paper and plastic, that was of a sufficient quality to downcycle (NS, 2019), let alone to reuse in a completely circular system, for which an even better quality is needed (i.e. use the materials of a disposed cup to make a new cup).

This problem cannot be solved by making the cups out of a different material. A literature study research, see appendix 10, showed that other materials for disposable cups that are on the market also need a high quality waste stream to be circular, are too expensive or have a significantly higher environmental impact.

Based on these findings, I decided to focus on a reusable cup for this master's thesis. In this thesis, a reusable cup is defined as either a cup that is owned by the customer, or a cup that is provided by the shop where the customer purchases the warm beverage.

The user owned cup is in case of the NS a cup the user brings with them and NS serves the warm beverage in this cup.

Multiple LCA's show that a user owned cup has a lower environmental impact than a single use paper cup when it is reused more than 20 times (Huhtamaki, 2019), (Keepcup, 2018).

At NS stations, only a limited number of customers use their own cups. Despite the economic incentive provided by NS (i.e., 25 cent discount per cup), only 2.4% of the warm beverages sold by NS stores are served in a user owned cup.

The cup that is provided by NS will for NS probably be a cup deposit system because many warm beverages NS retail stores sell are on the go. LCA's show that a cup deposit system has the potential to have a significantly lower environmental impact than a single use paper cup (Cupclub, 2018).

NS does not provide a cup for the customer at this moment.

Because the user owned cup is a solution that is already in use at NS stations, this master thesis will first focus on why this solution is not working as intended. The goal is to provide information to NS so that they can decide which direction to pursue in the future, either a user owned cup or a deposit cup. Finally, a design is made for implementation of the solution and a road map is made to guide NS to this solution.

Problem

NS can not motivate their customers enough to use a reusable cup at their stores.

At the moment when customers of NS buy a warm beverage at a NS store they use a paper cup instead of a reusable cup. The paper cup has higher environmental impact than the reusable cup.

Goal

Design a product service system that motivates customers that buy a warm beverage at NS stations to use a reusable cup instead of a single use paper cup, by taking their drivers into account, while at the same time fitting inside the constraints of the NS retail system. This will lower the environmental impact of cups for warm beverages sold at NS stations.

Research questions

The main research of this master thesis is:

Which design solution can NS apply to engage their customers to use more reusable cups and how can they implement this solution?

To answer this research question the following subquestions are formulated and answered in the next chapters:

Chapter 2: *Why are customers of NS not using reusable cups at NS stores?*

Chapter 2: *How can the experience of drinking a warm beverage at NS stations be improved?*

Chapter 3: *Which solution space fits well within the NS retail system?*

Chapter 4 to 6: *How can this solution be implemented?*

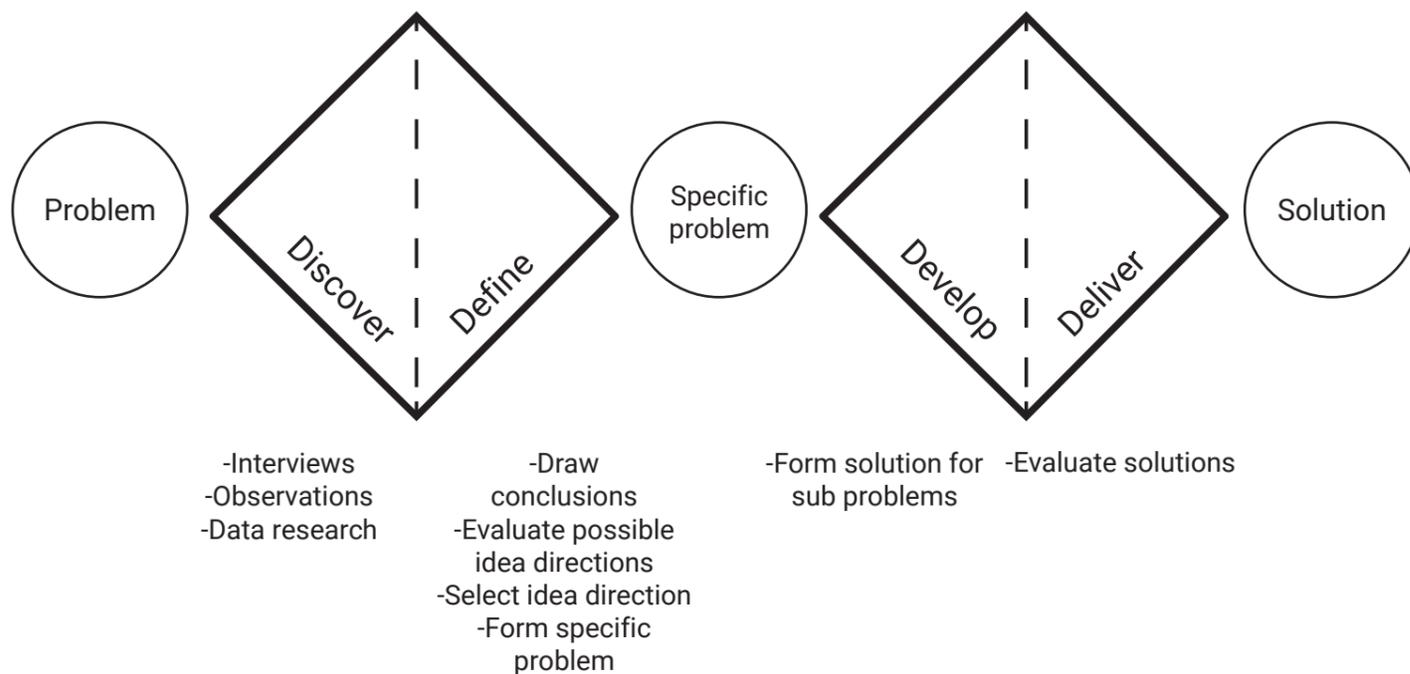


Figure 1: Design process

Approach

For this project, the double diamond approach is used, which is developed by the design council and is presented in figure 1 (Design Council, 2004).

The double diamond is used in the following manner in this thesis. The goal of the first diamond is to find a specific problem that needs to be solved in order to solve the overall problem. This specific problem is found by first diverging to look at all the possible problems and then converge all this information into a specific problem definition in a design brief. The goal of the second diamond is to find a solution for the problem defined in the first diamond. This problem is solved by first diverging

During each diamond an iterative approach is used.

In addition, the created concepts are validated for three factors; desirability, feasibility and viability.

The two diamonds are divided in the following four phases:

1. Discover. The goal of this phase is to understand what the problem is. This understanding can be achieved by doing interviews and observations. During this phase the focus is on the desirability of the reusable cup with the help of data analysis, observations, interviews and context mapping. Based on this research different solution spaces are created which can solve the overall problem. These are compared with the paper cup on desirability, feasibility and viability. This part of the process can be found in chapter 2 and 3.

2. Define. The information gathered from the discover phase is used to define the problem further. Here an solution space (i.e., user owned cup vs NS cup) is chosen based on scores on desirability, feasibility and viability. Based on this chosen solution space, a specific design problem is formulated in the design brief. This part of the process can be found in chapter 3 and 4.

3. Develop. This is the start of the second diamond. Here a solution is searched for the specific problem of the previous diamond. In this step multiple idea generation sessions are conducted to generate as many diverse ideas as possible based on the insights from the first diamond. Based on these sessions multiple concepts are generated. This part of the process can be found in chapter 5.

4. Deliver. In this phase ideas from the development phase are tested and evaluated. One of the concepts generated in the develop phase is selected. This concept is further developed into a solution that is desirable, feasible and viable. This is done with the help of experts within and outside NS. At the end of this phase, a final overview is presented of the solution and a road map to implement it. This part of the process can be found in chapter 5, 6 and 7.



2 User research

This chapter will focus on investigating the reasons why customers are not using reusable cups and how they are experiencing drinking a warm beverage at NS and how the experience can be improved. This investigation is conducted by analyzing data NS already has, observing and interviewing their customers.

Chapter 2.1 Introduction

Chapter 2.2 Exploration of the current situation of drinking a warm beverage

Chapter 2.3 Exploration of what motivates customers of NS to drink a warm beverage

Chapter 2.4 In depth analysis of what motivates customers of NS to drink a warm beverage

Chapter 2.5 Overall conclusions

2.1 Introduction

The main research question of this part of the master thesis is:

- Which design solution can NS apply to engage their customers to use more reusable cups and how can they implement this solution?

This user research phase focuses on the following two research subquestions:

- 1. What are the barriers for customers of NS for using reusable cups at the NS stores?*
- 2. Which factors are important for the customers while drinking a warm beverage at NS stations?*

The results from the first research question are used rate solution spaces in chapter 3 on their capacity to lift each barrier.

The factors from the second research question can be used to rate the solution spaces as well and they are be used in the design phase to design a solution that takes the current habits and values of customers of NS into account. These factors can also be used to improve the current experience of drinking a warm beverage at NS.

It was decided to focus on user owned cups in this investigation, because this is the system NS currently uses and research can be done in the specific context of NS. However, this does not mean the results are not applicable in other reusable cup systems as well, i.e. a cup deposit system.

Each chapter ends with a conclusion that divides the insights of that research for both research questions. Other insides that are used later in this master thesis can be found in under the heading 'Other conclusions'.

Section 2.2 explores how customers currently drink a warm beverage at NS stations and how they experience it based on NS data. This research will provide an overview of what is currently known within NS.

Based on the overview of chapter 2.2 a more in depth research is set up in section 2.3, that explores the current situation of drinking a warm beverage at NS stations and why people are not bringing their own reusable cup.

Based on the results from chapter 2.3 and appendix 5 an even more in depth research is set up that aims to clarify how NS can improve customer's willingness to bring their own cup now and in the future.

2.2 Exploration of the current situation of drinking a warm beverage

The goal of this research is to obtain an overview of how customers of NS drink a warm beverage at NS stations and how travelers experience their warm beverage in relation to their journey with NS. This research will be based on the research NS already did.

Method

Within NS there are two big research projects that are use-full for this master thesis. These projects are combined for this exploratory desk research.

The first research project is carried out within NS stations by category management (Catman) and concerns the behaviour of people buying products at NS stations in 2019. The research was done with a survey that was send to a representative group of NS travellers.

The second research was conducted by the NS customer experience department (van Hagen and Bron, 2014). This research is about how people felt during their journey with NS. The researchers used the qualitative ZMET technique to find the unconscious needs, wishes, associations and motives of the customers. This resulted in 7 customer needs, but also a timeline that showed what experiences travellers had during their journey.

To combine the two researches and collect useful data out of them, multiple steps had to be taken.

First the data of the two research projects needed to be about the same groups. This was ensured by splitting up the Catman research in the lust and the must travellers. A selection was made of work-home commuters (n=104) and those that travel for fun (n=383) from the Catman database.

The second step was to find out how much coffee was consumed monthly by each person. This would give the opportunity to not only look at the amount of people doing something but also their impact they made with the amount they drank. The questions from the Catman research only asked about ranges in which people drank coffee, e.g 1-3 times a month. These ranges were averaged out to use in my calculations, e.g 1-3 times a month becomes 2 times a month.

The resulting numbers of the Catman research were linked to the research of NS customer experience by putting all the information in one visualization so it was clearly visible which numbers were part of which experience.

Results

Behavior of warm beverage drinkers NS

From the research the following visual was made.

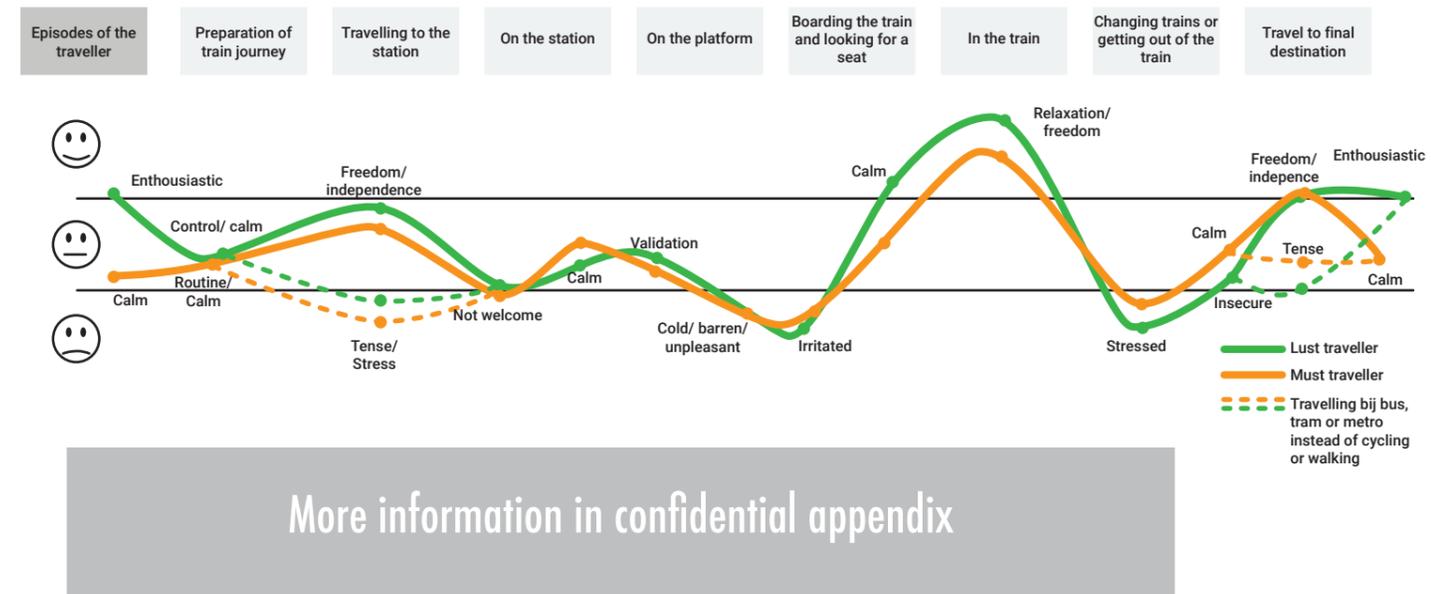


Figure 2: Customer experiences NS travelers linked to what people do with the cup

Figure 2 illustrates that NS controls almost the whole journey of the paper cup that travellers buy at stations. A majority of the customers decides to buy their beverage when they are on the station or on their way to it. Everybody that travels with NS buys their warm beverage at the station. In the end more than 90% of the lust travellers and over 90% of the must travellers throw away their paper cup at NS station or on NS trains.

Figure 3 shows a more systematic way how customers buy a warm beverage at NS.

The Catman research also included more research about how customers drink a warm beverage during their journey with NS. These results can be found in the confidential appendix 1.

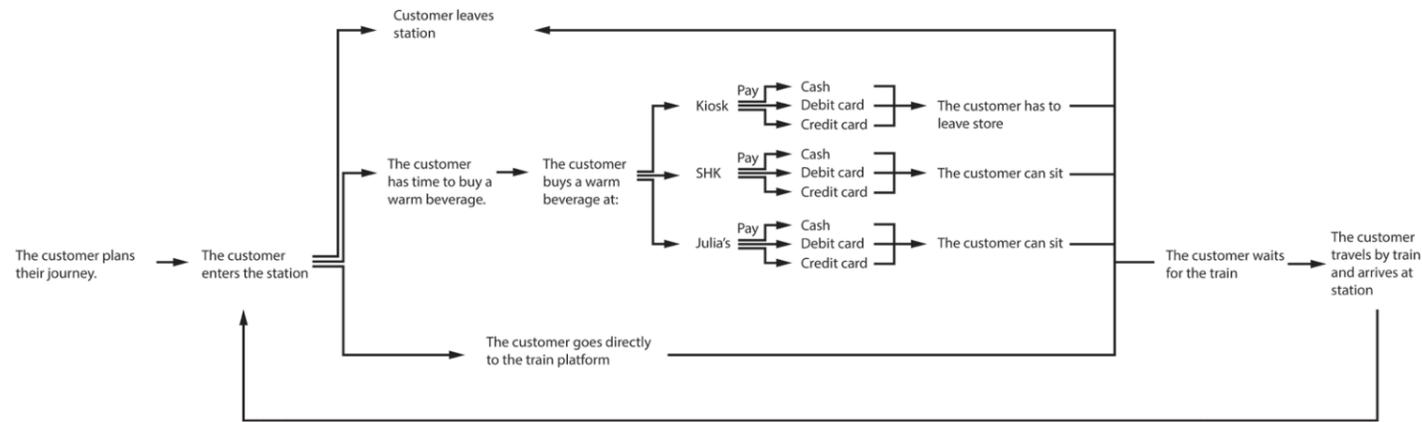


Figure 3: Overview of the journey of the customer.

Experience of warm beverage drinkers NS

In the research of van Hagen and Bron there were also some findings which are interesting for the coffee experience (Hagen & Bron, 2014).

- The experience curve shows that people don't buy coffee at the moments they are most happy. They score a bit below neutral when they arrive at the station. But when people are on the platform and change trains they score their experience the lowest during their journey and this is when they buy a warm beverage. According to Hagen providing the possibility to buy a warm beverage is one of the ways NS is trying to improve this low rating.
- Another interesting observation of this curve is that they score sitting in the train high and that is also the moment most people throw away their cup.

Conclusions

The goal of this research was to form an idea of how customers of NS drink a warm beverage at NS stations and how travellers experience drinking coffee during their journey with NS. From this research the following conclusions can be drawn for each research question.

Factors that influence the experience of drinking a warm beverage at NS stations

- Taste

More information in confidential appendix

- Convenience

More information in confidential appendix

- Comfort

More information in confidential appendix

Other conclusions

More information in confidential appendix

Discussion

There are some irregularities in the data about how many warm beverages are drunk by lust travellers with a reusable cup. The average at NS stations is 2.4% but from this research it seems that 7% of the coffee is drunk out of a reusable cup.

The reason for this could be the small amount of lust travellers that drink coffee with a reusable cup. In this database only 3% of the people use a reusable cup which means that irregularities in the data can have quite a big impact on the overall result.

2.3 Exploration of what motivates customers of NS to drink a warm beverage

The goal of this research is to find out:

- The experience of drinking a warm beverage at NS
- The reason why they do or don't use a reusable cup
- The reason to buy a warm beverage at NS stations

It was decided to focus this research on rush hour travellers. There are two reasons to do this. NS data shows that the rush hour travellers are responsible for a large part of the coffee consumption and thus also have a large effect on the amount of coffee cups that are used.

The second reason is that a reusable cup would also be more beneficial for them as they buy coffee more consistently.

Another benefit of using rush hour travellers is that during rush hour a large amount of interviews can be taken in a relative short amount of time. They also drink a warm beverage more often so they have more experience with drinking a warm beverage at NS stations.

Method

For this research two stations were chosen to do: Leiden, a medium big station (99.000 travellers a day), and Rotterdam, a big station (115.000 travellers a day). The stations were chosen in consultation with an experienced station user researcher from NS to ensure they gave a good impression of the population travelling and buying coffee.

The people were interviewed during rush hour (7:45-10:00).

Each interview was aimed to last for 5 minutes so it would not take too much of their time and there was little risk to have to stop the interview because their train would leave.

Each interviewer had a notebook with them to write the answers in and a paper with the questions. At each station there were two interviewers, to be able to do more interviews but to also have two different views of the situation. Every interviewer was wearing a NS stations jacket so people would recognize that they were interviewing for NS.

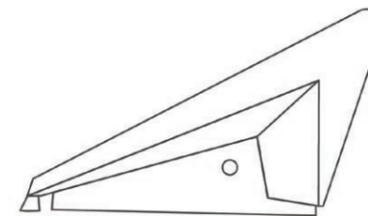
Each participant was selected by looking if they were holding a cup with a warm beverage. The interviewers also ensured that they interviewed people in different age ranges and of a different gender. The distribution can be found in figure 5.

The results were later analysed by summarising the answers of the interviewees and dividing them into groups that could be used to count the amount similar answers that were given.

The questions that were asked and a more elaborate research set up can be found in appendix 4.

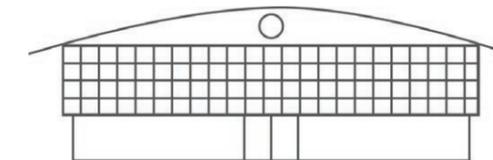


Figure 4: Leiden Centraal, one of the stations where the interviews were conducted.



Rotterdam Centraal

19 participants
79% commuter
50% female
Drank coffee on 43%
of their journeys



Leiden

19 participants
84% commuter
42% female
Drank coffee on 40%
of their journeys

Combined

38 participants
82% commuter
45% female
Drank coffee on 42%
of their journeys

Figure 5: Distribution of the participants on each station and in total.

Results

Reusable cup

92% of the people that were interviewed did think the paper cup was fine (n=28). 16% of the participants mentioned they preferred a single use paper cup over a single use plastic cup. Because the paper cup drank better and was according to them better for the environment.

The five most important reasons why customers don't bring a reusable cup with them are (n=31):

- They forgot to bring the cup with them (26%)
- They will have dirty cup in their bag (19%)
- They don't want to clean the cup (19%)
- They want to travel light (16%)
- They don't travel often enough so it is not worth to bring one (16%)

Other reasons can be found in figure 6. This figure combines both stations, because the goal of this chapter is to get an overall idea of why customers of NS do not use a reusable cup.

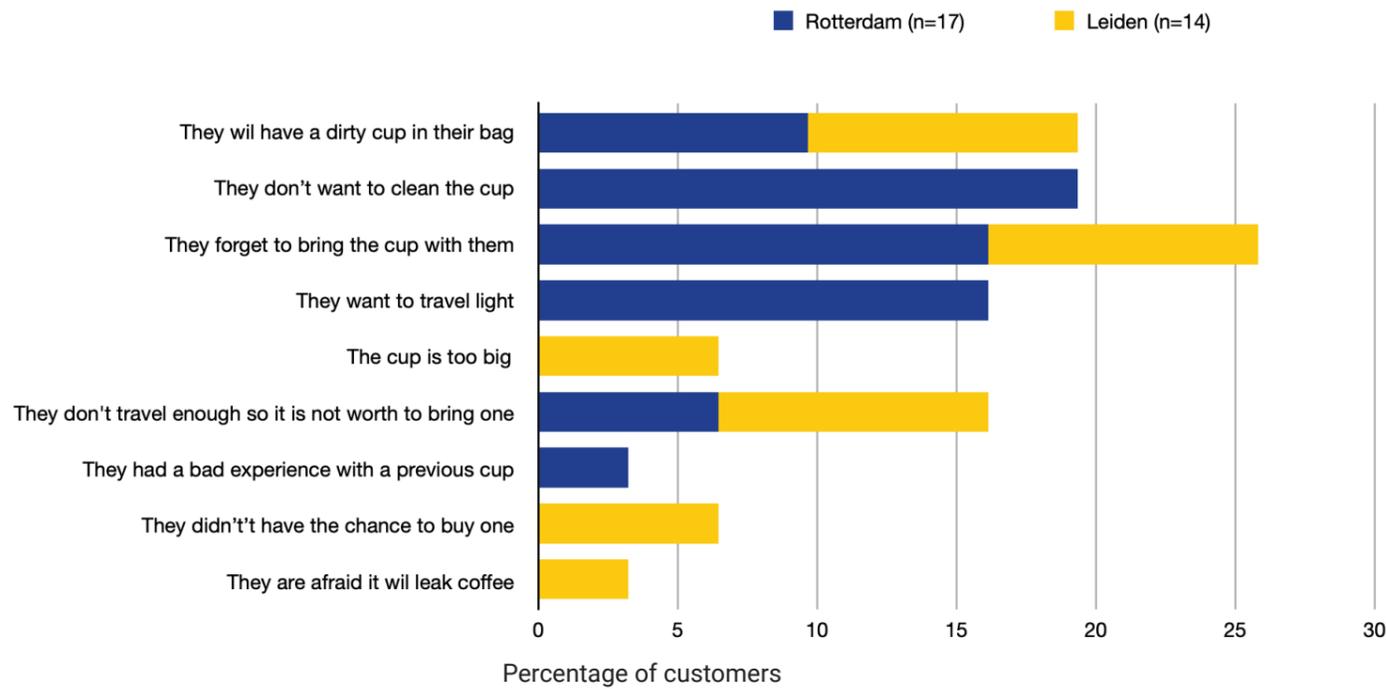


Figure 6: The reasons that people don't bring a reusable cup with them

Experience of drinking a warm beverage at NS

An analysis of the open questions resulted in the following results.

The four most important reasons that people buy a warm beverage at NS stations are (n=32):

- It is easy to buy the warm beverage at NS stations (50%)
- They like the taste of coffee (37%)
- They use it to wake up (22%)
- They use it to warm up (22%)

Other reasons can be found in figure 7.

The four moments people decide to buy a warm beverage are:

- They have the time to buy a warm beverage (25%)
- It is a routine they have built up (18%)
- They have a delay (11%)
- They decide at home (14%)

Other reasons can be found in figure 8.

The complete table with all the answers can be found in appendix 4.

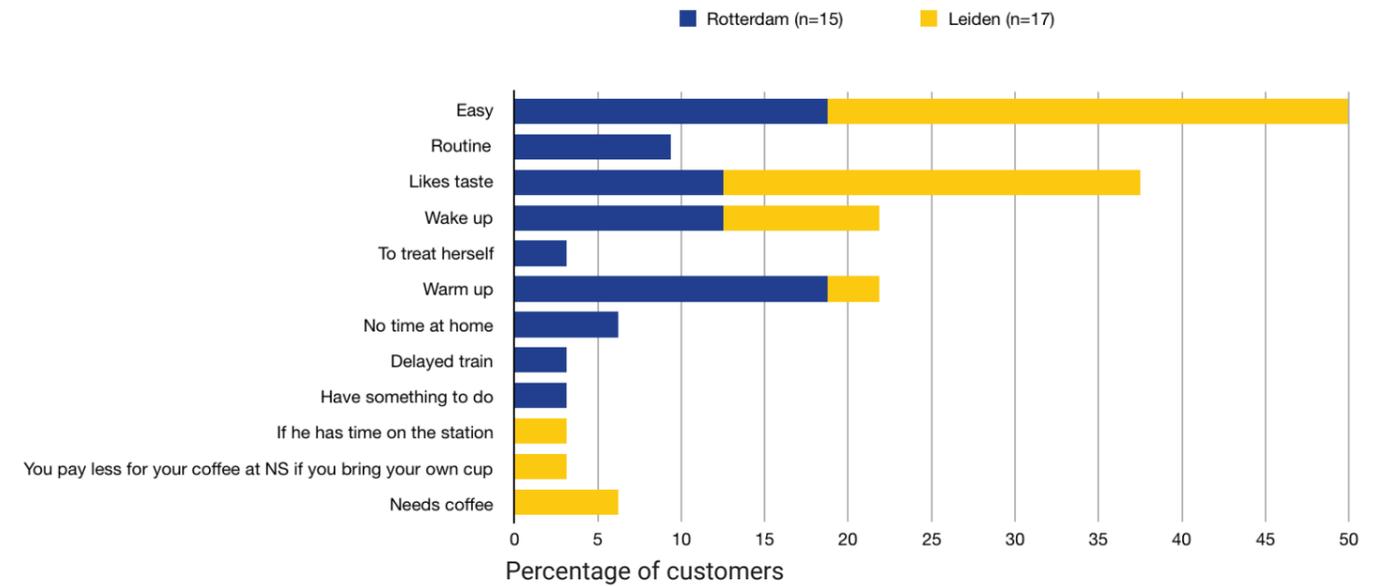


Figure 7: The reasons for customers to buy a warm beverage at NS Stations

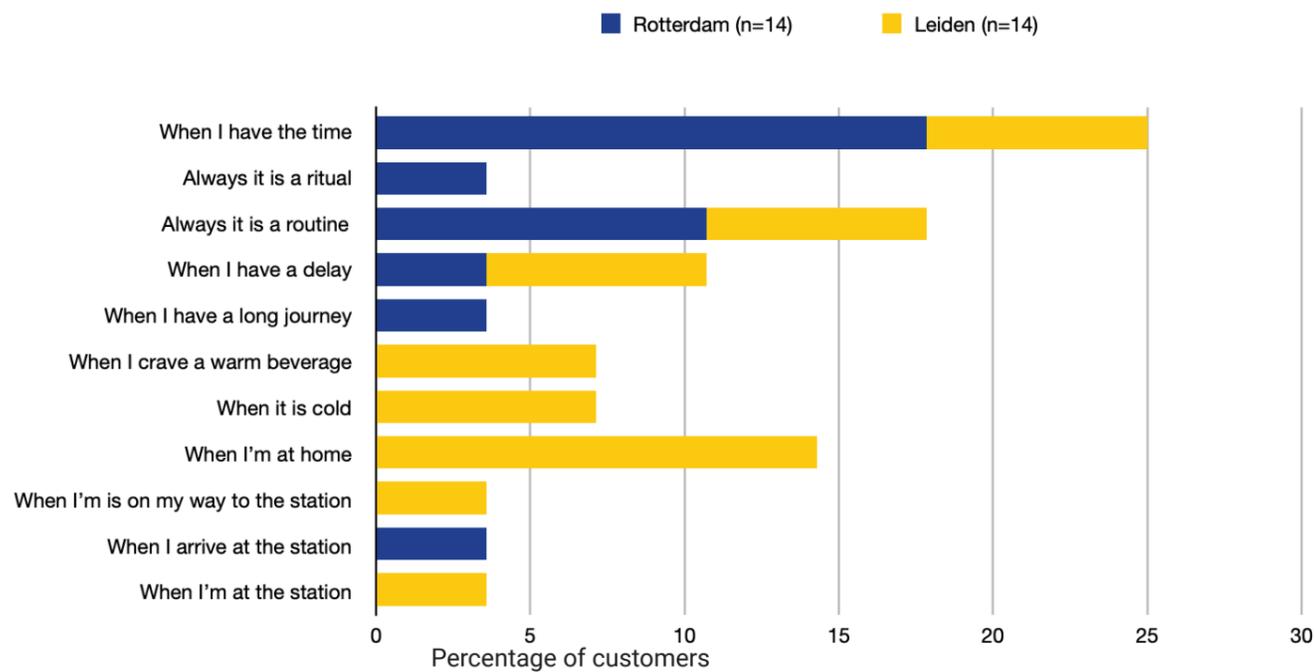


Figure 8: The moments people decide to buy a warm beverage

Conclusion

Based on the research of this chapter the following conclusions can be drawn for the research questions of this chapter.

Barriers to use a reusable cup

- People forget to take the cup with them

This research shows did not use the cup because they forgot the cup.

- The cup is dirty

People don't want to clean the cup themselves and they don't like to have a dirty cup in their bag, which could potentially spill.

- People want to travel light

A travel mug is an extra thing they will have to put in their back which they have to carry with them for the rest of the day and not use.

- Customers do not have the time to buy one

There is also a small interesting group which said that they did not have the chance to buy a cup so that was why they did not have one.

- Customers like the paper cup a lot.

Almost everyone says there is nothing wrong with the paper cups. However if they say that there is nothing wrong with the cup it does not mean they see it as the best solution. According to Rick Schifferstein durable cups, i.e. metal, glass and ceramics, are seen as more viable options to hold tea than paper cups by participants (Schifferstein, 2009). This means that paper cups can still be improved.

- People do not know how bad the cup is for the environment

Most people do not realise the environmental impact of using this single use paper cups. Here the name paper cup is very misleading because it is a cup with plastic in it.

2.4 In depth analysis of what motivates customers of NS to drink a warm beverage

Factors that provide the customer with a better drinking experience at NS

- Convenience

People buy a warm beverage because it is easy to buy the beverage at NS stations. This means that a possible new solution should not compromise this ease of buying coffee at NS stations as people value it very much.

- Time

Looking into when people decide to buy a warm beverage there can be concluded that for most people it is important that they have time to buy coffee. At a station people are on a schedule as they don't want to miss their train. This means that the new design solution should not add to the time needed to buy a warm beverage.

Looking deeper into how people get this time it can be said that the people at stations can be divided in following three groups:

- The person who takes a cup of coffee because their train is delayed.
- People that actually plan at home that they will buy a warm beverage at the station and they leave earlier to have the time to get one.
- People that buy their warm beverage at their transfer station because they have time there.

- Warmth

People seem to value the warmth of the coffee. Data from NS shows that warm beverages are higher during the winter months. This means that the experience of the warmth should be taken into account in the design phase.

- Taste

People like the taste and use the warm beverage to wake up. For coffee these two are related according to Jue-Sheng Ong (Ong, 2018). He says that people mostly like coffee because people feel better because it feels like the coffee gives them more energy. This results is that when they taste the coffee their brain is linking this to the pleasant previous experiences of drinking coffee. The taste is an important part of drinking a warm beverage and the new solution should not compromise on this.

Discussion

Some questions were not answered by everybody as the interviews were on the platform and sometimes had to leave before the end of the research. Therefore some questions are answered more than others. This questionnaire was done during the winter which explains the large amount of people that use the warm beverage to warm up.

Introduction

This research has the following research topics to answer this chapter research questions:

- The manner in which customers drink warm beverages during their journey with NS
- The experience of drinking a warm beverage at NS
- The reasons why customers do or do not use a reusable cup
- The reasons to drink a warm beverage at NS

The previous research existed out of relatively small and quick questionnaires which means it is hard to get to the more in depth information.

This is why this chapter uses a more qualitative approach called context mapping. This technique allows the researcher to not only get information of the past and the current situation it also provides information about the future situation.

In the conclusion this information is used to answer the research questions from this chapter.

Method

To find more in depth answers for the main research question the technique context mapping is used, a special technique developed at the TU Delft (Sleeswijk Visser, 2005). Context mapping is about the context that surrounds a product. Sleeswijk Visser et al define context as all factors that influence the experience of the user. They define an experience as a subjective event felt only by the person who had the experience. This experience is a combination of past experiences, the present moment and future dreams of the person that has the experience.

This means that to design a product that fits into this experience both the past, present and future should be taken into account.

To explain why context mapping can add value to user research, it helps to look at figure 9. Figure 9 gives an overview of the general different techniques of user research and what kind of information they can collect.

The first technique is interviews. During interviews participants are asked what they think about a subject. This leads to information about what people say and think about the product. From these interviews you obtain very explicit knowledge. This information is gathered in chapter 2.2 and 2.3.

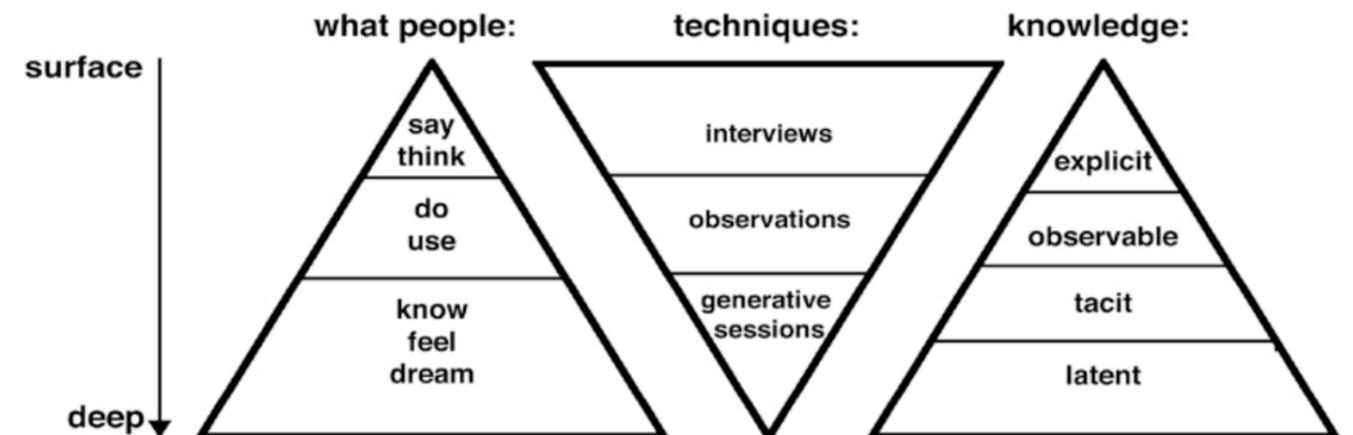


Figure 9: Levels of information for different techniques.

The second technique is doing observations to collect information about what people do and how they use the product. This information is gathered in chapter 2.3.

The third technique is generative sessions, this is the technique that is used during context mapping. Here latent and tacit information is gathered. This is information about what people know, how they feel and what they dream about a product. This information is hard for people to describe and realize. The generative sessions guide participants to realise what they know, how they feel and what they dream about a product.

During this project the context mapping was used in the following way.

First the research goals were formulated. After this the researcher wrote down what the researcher expected based on the previous research, see appendix 12. By realizing what he expected the researcher could prevent asking questions that were guiding the contestants in a certain direction. This also gave an overview about what was already found. After this the sensitising phase was started.

Sensitising

During the sensitising phase the participants got a small booklet. The idea was that this booklet would help them to get insights about how they used a paper or reusable cup. This is the start of helping participants to find their latent and tacit knowledge.

It was decided do this context mapping research over two weeks. The reason for this is that most people do not buy coffee at NS stations each day. Two weeks would give a bigger chance that people would buy coffee and could fill in the questionnaire.

The questionnaire itself existed of 6 moments when questions had to be answered. These moments were on Mondays, Wednesdays and Fridays. They were all on weekdays as the participants were mostly commuters. There was on day between each day with questions so when people didn't buy a coffee one day they still had an experience during the following day. Each question moment was designed in such a way that it would take only around 5 minutes on average to fill in.

The questions during each moment were focused on one specific topic for each day. The topics start quite generally and with each day they are becoming more specific and focus one specific moment of their journey and their coffee drinking experience. The last day is a reflection on how they thought they experienced the whole week. Most of the questions are based on conclusions from previous research or are filling knowledge gaps that became visible during previous research. There is also one question about emotions they experienced on their journey. For this a technique called Premo was used (Laurans, G., & Desmet, P. (2017)). This technique allowed the participants to describe their emotions more easily with the use of pictures. This technique was chosen mainly because it would also help people who are not used to describe their emotions to have some guidance in how to do that. Another benefit is that it has quite a small form factor and can be easily implemented in a small booklet. There are some limitations to this method as Laurans en Desmet describe in their paper. The main one is that people interpret described emotions differently. This would be less of a problem in this study because I would interview the participants later so I could ask them how they actually interpreted the emotions.

To be able for the participants to answer the questions each day a booklet was created. This booklet was given to the participants and the researcher explained how the booklet worked. This booklet was designed in such a way it did not look too official so that people would not be to intimidated by the booklet. Before this booklet was given to the participants two pilots were done. The goal of this was to ensure that people understood the questions and to find out if they gave answers that were useful for this research.

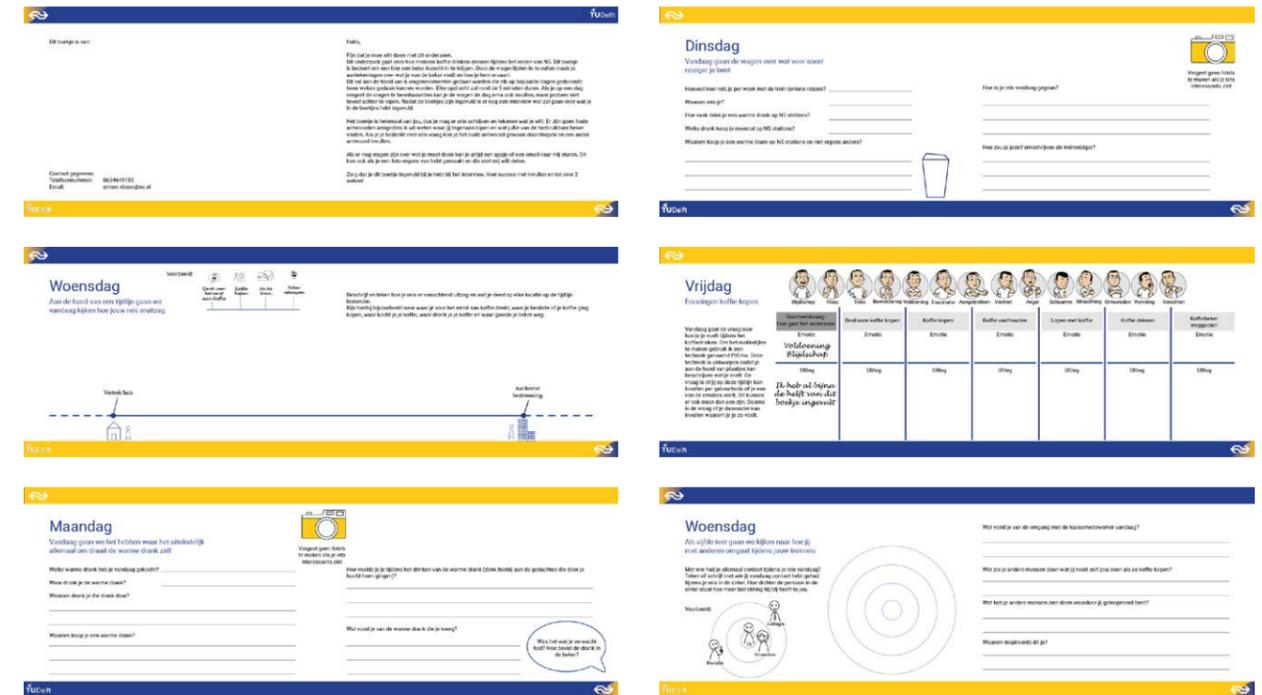


Figure 10: Pages out of the sensitizing booklet.

This pilot was done with three people, two of which were designers and one was not. Based on this pilot the booklet was improved and it could be handed to the participants. The final booklet can be seen in figure 10.

When the researcher handed the booklet to the participants he explained how the booklet worked and asked if the participants had any questions. After this the participant could start to fill in the booklet.

Participants

The participants were found within NS. The reason for this is that it was easy to find them here and to communicate to them.

Each participant with a reusable cup was provided with this cup by NS for free.

The people that were used for this research were all commuters except one. This was done because commuters drink a warm beverage most often. Other groups drink coffee maybe once per month according to the Catman research. This means that sensitising with them would be hard because they would only be able to fill in all the questions about one experience.

The test group was split up in two groups; the people with a reusable cup and the ones without a reusable cup. This was done to obtain a better understanding of both people who used a reusable cup and those who didn't. This would later give the opportunity to compare both groups.

Generative sessions

After the two weeks an interview was done about what participants filled in. This is also the part where insights about their experiences were generated. Next to talking about what they filled in two emotion lines were drawn. The first is about how they experienced travelling with NS and what role a warm beverage played in this. The second was about how they experienced multiple steps of drinking a warm beverage. The interviews lasted between 20 and 60 minutes and were recorded.

Analysis

Based on the recording a summary of each interview was made with the most important quotes. These quotes were together with the conclusion that could be drawn written down on statement cards. All of the statement cards were clustered. These clusters already gave insights about the behaviour. However within the participant group there is quite a big difference how the participants behaved. To find groups that behaved similarly, personas were created. A persona is used to describe a certain group and how they behave. These personas can later be used to find for example a target group. The personas are formed based on the earlier created clusters. The personas are created by looking which clusters were opposites from each other. In total 15 opposites clusters were found. From these 15 opposites 2 were chosen to put on two axis. These opposites were chosen based on how much participants had said something about that topic and how relevant the opposites were to explain the behaviour of customer buying a warm beverage at NS stations. With the help of the two axis a diagram was created in which four groups for personas could be placed. The other information that was gained from the interviews was later used to enrich the personas.

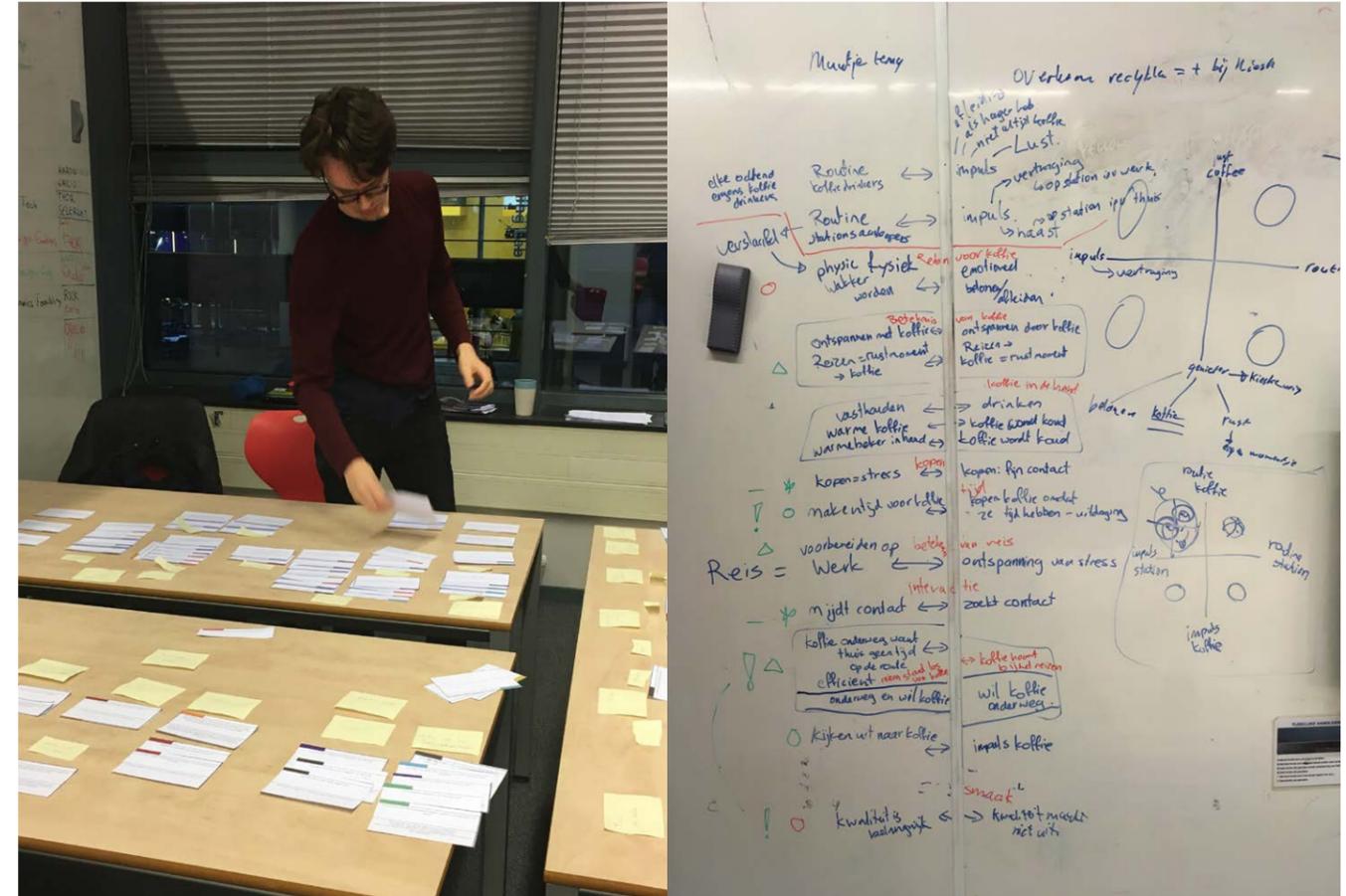


Figure 11: Analysing the data from the research and creating the axis.

Results

The results of the context mapping can be divided in two parts, the results that applied to everyone that was interviewed, overall result, and the results per persona. The results are based on analysis of the clusters and an analysis of the customer journeys that are made during the interview.

Overall results

After the results of the interviews were clustered and analysed the following result were found.

- Everyone sees the train journey as a moment for themselves.

It is the time they can spend on starting their workday, waking up or relaxing. Most of the participants do not want to talk to people during their journey except when they know the person very well. Drinking a warm beverage is also something they do for themselves as most of them can easily get a warm beverage at their job.

- Buying a warm beverage during their journey adds to a more positive feeling during their journey.

- The customers experience of drinking a warm beverage during their journey has a few ups and downs, see figure 12.

From all of the participants 8 start out with feeling quite positive at the moment they decide to buy a warm beverage. Buying the beverage is scored lower by some but also higher by some others. This can be due that some are stressed about if they will miss their train while others are looking forward to get the warm beverage. Holding the warm beverage is scored quite high by 9 out of 11 people. Interesting to see is that most of the lines also go up from the moment on they have bought the beverage.

The lines go down when customers walk with the warm beverage.

After this step the lines go up again when people drink the warm beverage and when they have to clean the cup or throw it away the lines go down.

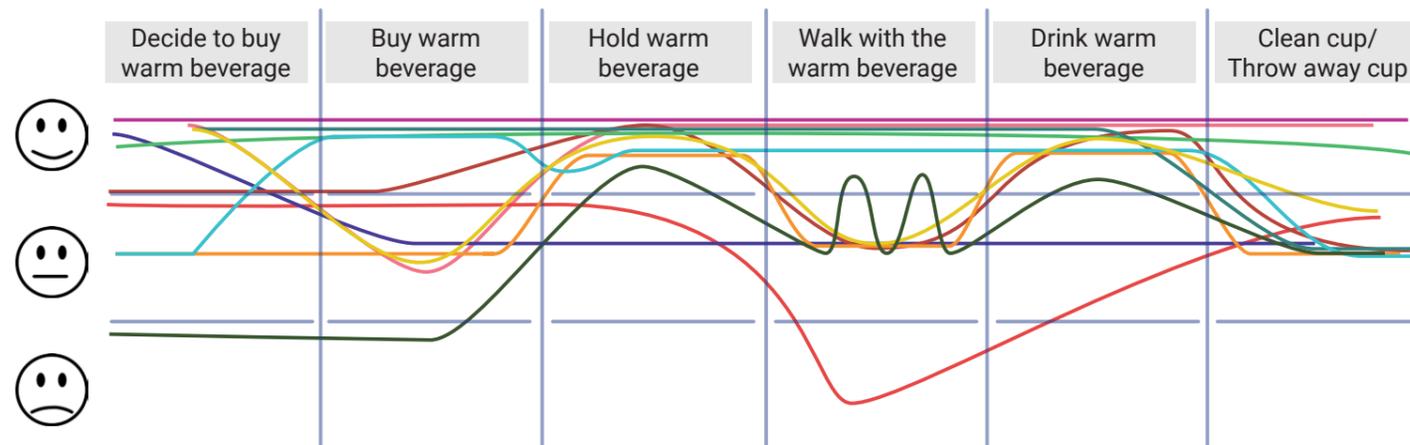


Figure 12: Experience curve of all participants.

Paper cup compared to reusable cup

When the customers with a paper cups and a user owned cup are compared the following observations can be made:

- If the lines of the participants are divided in users of reusable cups and paper cups it becomes visible that they don't differ much.

- A small difference can be seen in when the participants buy their warm beverage. Here two of the lines of participants with a reusable cup go down while the lines of the participants with a paper cup stay the same. One participant said she was a bit unsure if the barista would accept her cup at first.

- When the participants reusable cup were asked why they used the cup it was mostly because they could save money and it was better for the environment.

- When the participants were asked why they were not using a reusable cup the reason were similar to the ones found in chapter 2.3.

- Three participants said they did not want to have a cup for the rest of the day in their bag, which could potentially leak. This is an interesting reasoning as it goes further than they say they do not have space. They say they do not want to use that space for a cup and want to have an emptier bag. This also explains why a lot of customers did have the space in their bag on Den Haag Central station but did not carry a reusable cup.

- The other two participants said that they did not know which reusable cup would work for them.

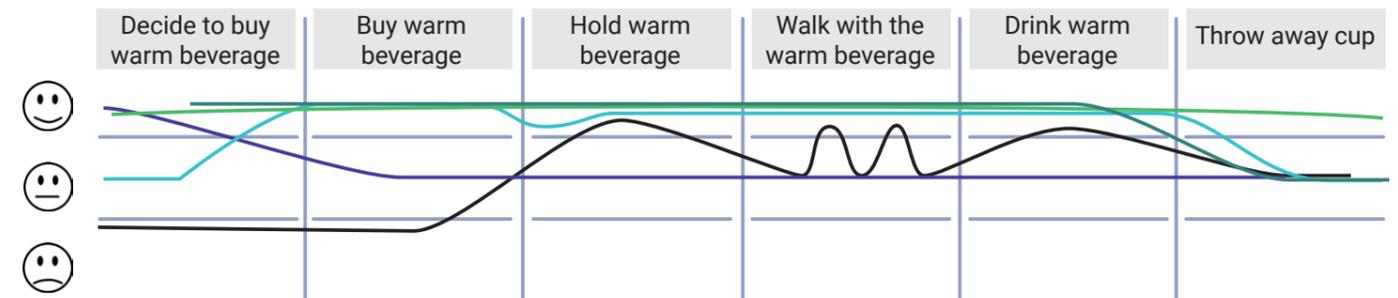


Figure 13: Experience curve of the paper cups.

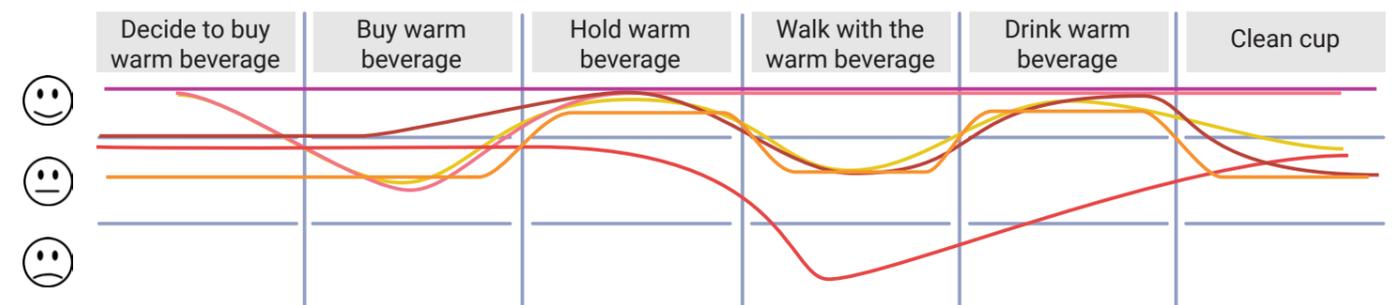


Figure 14: Experience curve of the user owned cups.

Results per persona

After analyzing the interviews as one group the participants were divided in four groups with two axis, which can be seen in figure 15.

The ratio driven buyer wants to buy a warm beverage because they want to drink a warm beverage in the morning or are used to drink a warm beverage every time they go by train. The emotion driven customer wants to buy a warm beverage because something good or bad happened to them and they want to treat or comfort themselves. This axis is based on that when customers of NS buy a warm beverage there are reasons that are very different. It also shows that this initial reason to buy a warm beverage influences their whole experience.

The axis of quality versus efficiency explains what customers value when buying a warm beverage. The quality driven buyer is someone that will wait longer and pay more for a warm beverage. The efficiency driven buyer is focused on getting a warm beverage as fast as possible. This axis showed the value customers have for the quality of the warm beverage.

Each participant was then placed in the quadrant and groups were created out of these participants. These groups were then turned into personas. The resulting quadrant can be found in figure 15. A more detailed explanation on how this quadrant was created can be found in appendix 13.

The resulting personas with their descriptions can be found on the following pages.

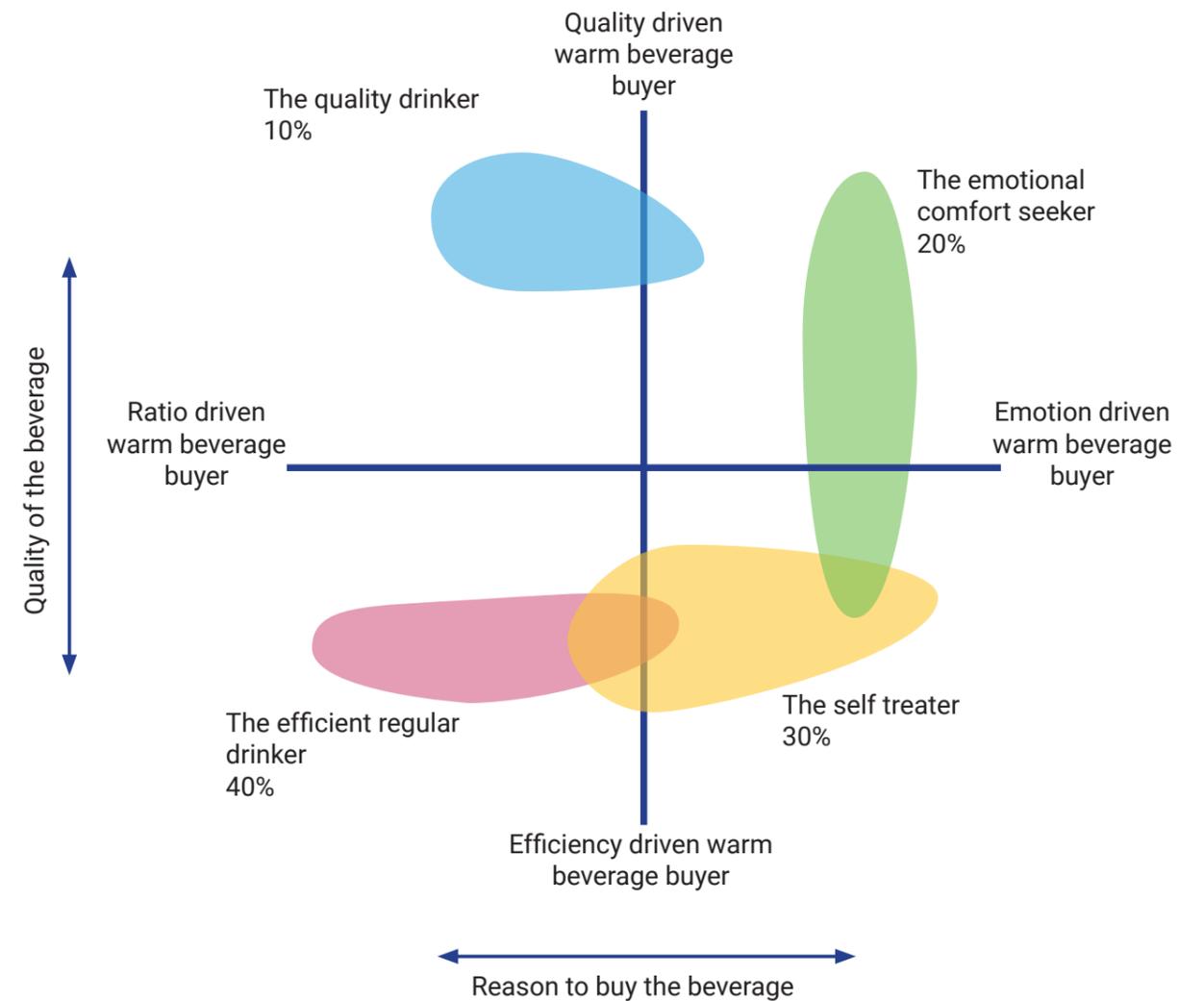


Figure 15: Division of the four personas

The quality drinker



Kind of traveller



Description persona

The quality drinker is someone that wants to treat themselves by buying a warm beverage. They do buy the warm beverage regularly and it is part of routine. The warm beverage gives them something to enjoy and wakes them up during their journey. These people are also to spent more time and money to buy their warm beverage.

*"Ik krijg altijd het gevoel dat ik wat scherper ben na een kopje koffie dan voor die tijd."
 "Het duurt even maar je krijgt betere koffie."
 "Als je in de trein zit en je haalt je kopje koffie is dat ook het teken dat je met je kopje koffie bezig bent en niet met andere dingen."*

Emotions during journey

At the emotion curve it becomes clear that the quality drinker has quite a steady line without big ups and downs. This reason for this could be that they are used to buy the coffee so they know what they can expect. There are two ups during their journey which are holding and drinking the beverage.

"Dingen die anders zijn tijdens het ritueel zijn moeilijk te verwerken in verband met ochtendritueel."

Sustainability

The quality drinker is aware of the environmental impact of using paper cups. Because they regularly buy a warm beverage it is more beneficial for them to use a reuseable cup. One of the reasons they to not buy one is because they don't know which one is good. Because they travel often and take a cup with them every day it needs to be a cup where not much can go wrong.

"Ik heb nog niet de goede beker gevonden."

Good experience

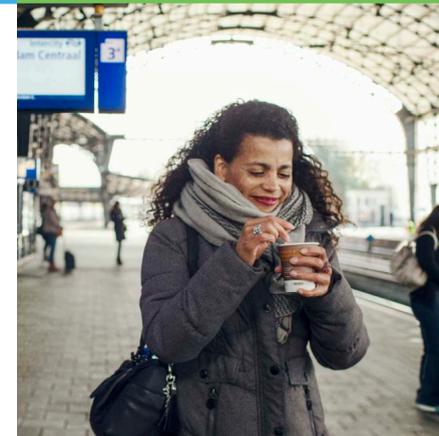
Their best experience is when they can start their day well with the help of a warm beverage.

Bad experience

When they can not start their day well in the train because there are no seats left. When their warm beverage is for cold they are also quite dissappointed.

"Ik heb ook wel eens gehad dat ik in de trein zat en de koffie al bijna koud was."

Emotional comfort seeker



Kind of traveller



Description persona

The emotional comfort seeker is someone that wants to treat themselves by buying a warm beverage. This treat is used to make themselves feel better at a moment they think is fitting. They don't buy a warm beverage regularly an they only buy a warm beverage when they have the time to do so. These people are willing to spent more time and money to buy their warm beverage.

"Ik had geen handschoenen aan, ik was m'n sjaal vergeten, ik heb verder ook nooit handschoenen aan, ik had het gewoon zo koud op de fiets, en je hebt haast, en nog stressen want je geen fietsplek kan vinden, dus toen wilde ik even echt ontspannen zitten in de trein met koffie."

Emotions during journey

At the emotion curve it becomes clear that the emotional comfort seeker feels bad at the moment they decide to buy a warm beverage. The negative emotion is why they decide to buy the warm beverage. Their negative feeling goes away when they have the warm beverage and stays until they finish the warm beverage. It is interesting to see that when they walk the line goes up and down because they like to have their warm beverage but don't like to walk with it.

"Bij mij is het super erg verbonden aan, ik drink hier niet zo veel koffie maar ik dronk altijd koffie in Shanghai als ik soort van thuis miste en weinig had geslapen en gegeten, dus als ik een beetje down ben ofzo dan ga ik denken aan koffie kopen."

Sustainability

The emotional comfort seeker does not focus on sustainability during thier journey. They don't want to have an extra object in their bag if they don't need it often. They are however aware of that they use a one time use cup and try to prevent that. They feel nothing when they have to throw away their cup.

*"En ik heb niet zo'n zin de hele tijd om spullen in m'n tas te doen die ik alleen maar maanden lang meedraag en dan een keer in de maand gebruik, of ik wel een thermoskan bij me maar daar zit dan alleen maar water in en kan er geen koffie in."
 "Koffie beker weggooien, voelde me daar redelijk neutraal over"*

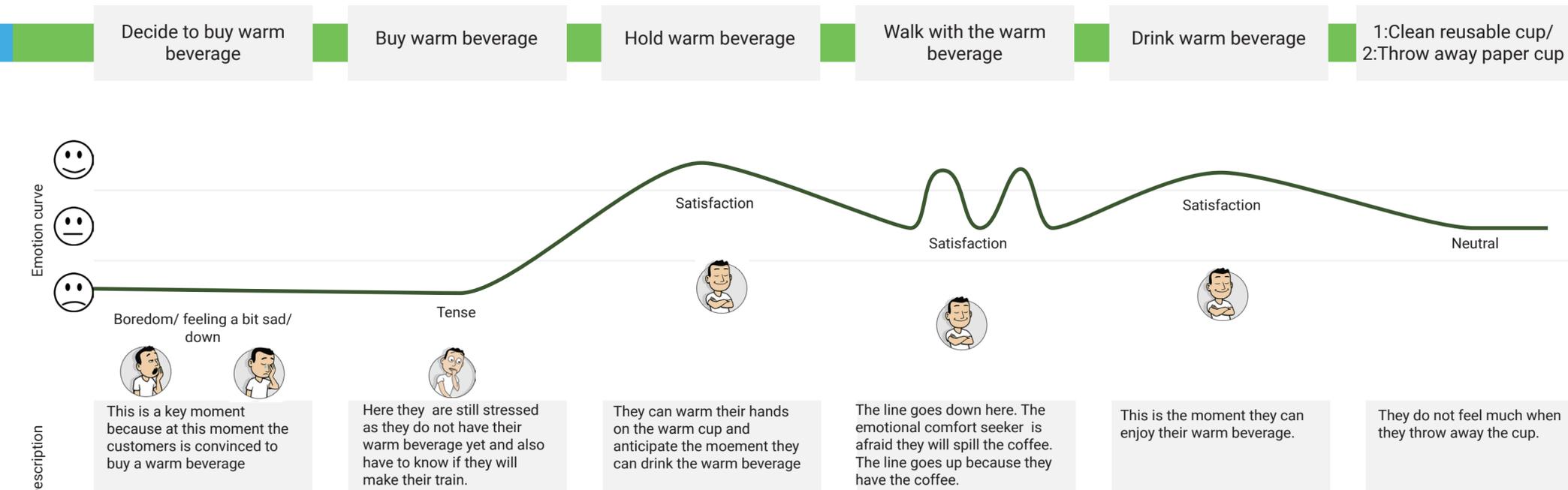
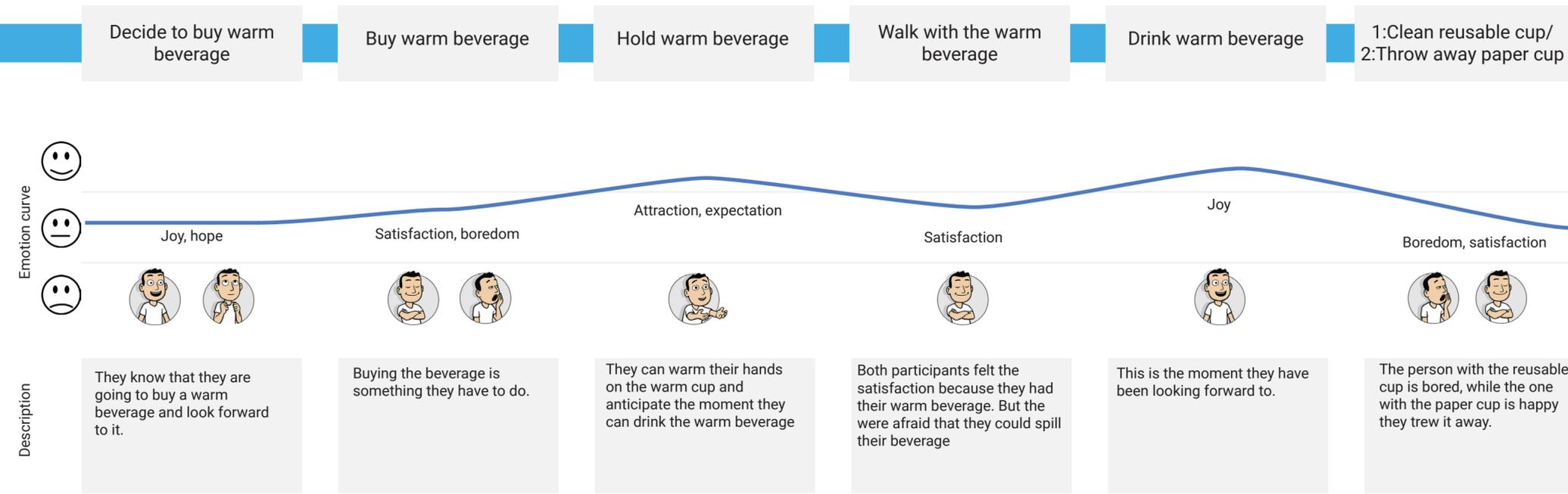
Good experience

The emotional comfort seeker got an extra cookie when they bought a cup of coffee. This was something they were pleasantly suprised by.

Bad experience

A barista was unpolite to them.

*"Ik ging koffie kopen bij de Chocolate Company, en toen vroeg ze opeens, wil je een koekje of een truffel? Nou, dat was wel een leuke verrassing."
 Is altijd wel fijn als ze niet aggressief zijn. Nou met koffie is het niet echt voorgekomen dat iemand echt chagarijig is, maar meestal denk ik beetje van okee, beetje van snel, dat het gewoon snel voorbij is"*



The efficient regular drinker



Description persona

The efficient regular drinker wants to buy a warm beverage because they need it to start their routine. They use the warm beverage to mostly relax and to start their work day. They buy a warm beverage regularly and they know where they can buy it at their station. They don't want to pay too much and they want a warm beverage that is good enough.

"Ik ga niet eerst naar een ander peron om daar nog eens m'n koffie te halen en dan weer terug. Dat is allemaal teveel gedoe."
"Koffie staat gewoon als symbool van een goeie ochtend start."
"Ik denk dat koffie drinken onderdeel is van een soort beleving, iets gezelligs, iets aangenaams creëren voor je dag en uiteindelijk het koffie drinken zelf maar een klein onderdeelje daarvan."

Emotions during journey

At the emotion curve it becomes clear that the efficient regular drinker feels has quite a steady line without big ups and downs. This reason for this could be that they are used to buy the coffee so they know what they can expect. Comparing quality drinker to the efficient regular drinker it can be seen that the efficient regular drinker starts happy and that the line goes down when they do not like something while the line of the quality drinker goes up when they like something.

"Beetje blij dat je zo koffie gaat drinken, beetje gezellig moment voor jezelf."

Sustainability

The efficient regular drinker is aware of the environmental impact of using paper cups. Because they regularly buy a warm beverage it is more beneficial for them to use a reusable cup. One of the reasons they do not buy one is because they don't know which one is good. Because they travel often and take a cup with them every day it needs to be a cup where not much can go wrong.

"Welke beker moet ik nu gaan kopen, die niet kapot of open gaat in mijn tas."
"Weten welke beker het beste is, welke het duurzaamst, misschien dat de consumentenbond er een moet aanbevelen, dat ik weet waarom ik welke moet hebben."

Good experience

The train was completely empty and she had all the space she needed. She also had enough time to get a coffee.

Bad experience

When you don't have a place to sit but you do have your coffee with you. When people hit your coffee when you are walking on the station.

"Maar eigenlijk is het in een ideale wereld het fijnst als iemand in de trein langs komt die dan koffie verkoopt. Dan hoef je niet met al je jassen en tassen en koffiebekers zo'n trein in te stutelen. Zeker op het moment dat je eigenlijk helemaal geen plek hebt is sta je eigenlijk daar met je koffie die je liever niet had gehad."
"Mensen lopen kris kras door elkaar en kunnen zo tegen je aan lopen."

The self treater



Description persona

The self treater wants to treat themselves by buying a warm beverage. This treat is used to make themselves feel better at a moment they think is fitting. They see the warm beverage as something that increases their level of comfort. This means it is not particular the quality of a warm beverage that matters, but the fact it is a warm beverage is important. They use it to have a moment for themselves. They do buy this beverage on a more regular basis than for example the quality emotion person. They also want to spend less money and time on their beverage.

"Ik haal koffie als ik vertraagd ben. In plaats van ergens wachten ga ik proberen om ergens mijn werktijd kan gebruiken. Dan haal ik vaak koffie. Dit gebeurt een keer of 5 per maand."
"Dan sta je lekker met je koffie. Lekker om wat warm te hebben."

Emotions during journey

It is interesting to see that this line starts quite high. It climbs higher from that point and there are two points where they enjoy the warm beverage. Interesting is that here every participant felt joy when they were buying their warm beverage. This could be because they are treating themselves and they enjoy every step of the journey.

"'S ochtends is het warm houden. Ik heb best wel snel koude handen en het is best wel lekker om je handen daarmee te warmen. Daarnaast vind ik het ook een lekker manier om wakker van te worden, wat actiever te worden. Het geeft mij een goed gevoel de smaak is erg lekker in combinatie met 's ochtends brood."

Sustainability

Because the self treater still travels quite often it is beneficial for them to look into reusable cups. However some of them also don't travel enough to think it is worth it to bring a cup. While others think it is worth it for them to put some effort in to be better for the environment

"Je loopt de rest van de dag met een koffie beker."
"Ik probeer eigenlijk zo licht mogelijk te reizen."
"Trots als ze hem wel bij zich heeft en dus geen papieren beker gebruikt. Het voelt beter dat ze een herbruikbare beker heeft die je dan schoonmaakt dan eentje die je weggooit."

Good experience

The train journey allow the self treater to have enough time for themselves and also to enjoy their warm beverage. Another benefit is that they can comfort themselves when they miss the train.

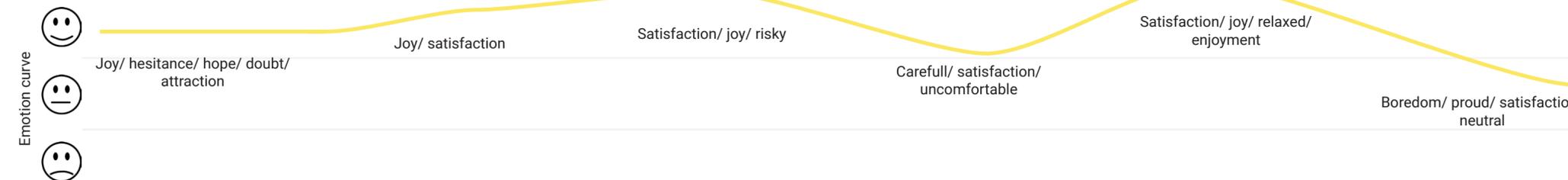
Bad experience

De beste treinreis is van Apeldoorn naar Utrecht/ Amsterdam. Ik vind een uur lang genoeg en in die plek is het wel mooi om je werk te hebben voorbereid en daarbij past een kop koffie. Op z'n treinreis is het ideaal. Dan kan je als je binnenkomt gelijk beginnen. Mij beste ervaring met koffie is als ik mijn overstap mis als troost een kop koffie kan halen

Kind of traveller



Kind of traveller



Description

- They need their warm beverage and when they decide to buy it they are happy.
- They don't want to be slowed down and they are unsure if their cup is a hassle to the barista.
- They can warm their hands on the warm cup and anticipate the moment they can drink the warm beverage
- They are afraid that they will spill their warm beverage.
- This is the moment they have been waiting for and they enjoy it.

Description

- When the occasion occurs that the treating the self treater thinks they deserve a warm beverage they buy a warm beverage.
- They like to buy the warm beverage, because they can allow themselves to buy a warm beverage. They also like the contact with the barista
- They can warm their hands on the warm cup and anticipate the moment they can drink the warm beverage
- They are satisfied because they have their beverage, but they are also afraid to spill it.
- This is an important moment as they are enjoying the warm beverage
- Both the participants with the reusable and the paper cup are feeling neutral. The one with the reusable cup does feel some pride

Conclusions

Based on the research of this chapter the following conclusions can be drawn for the research questions of this chapter.

Barriers that prohibit customers from using a reusable cup

The customer does not want to take a dirty cup with them.

This research showed just like the research from chapter 2.4 that customer do not like the idea of having a dirty cup with them that could potentially leak

The customer does not want an extra object in their bag.

Chapter 2.4 showed that customer said they did wanted to travel light. However a small research described in appendix 5 shows that people do have the space to bring a cup with them. During this research it became clear that people do have the space but for some people the reusable cup results in more clutter in their bag which they do not want.

The customer does not know which reusable cup is reliable.

Communicating to the customer that the solution is reliable is very important.

The solution should inform customers about the impact of paper cups.

Customers feel nothing when they throw away their cup. To persuade customers to switch to more sustainable alternatives they should know what the consequences are.

Factors that provide the customer with a better drinking experience at NS

Make sure the new solution does not take the attention away from the warm beverage

Most customers said they just want to enjoy their warm beverage and they do not want to way it is served to them to be very complex. This means that the system should support and improve the drinking of a warm beverage and not take attention away from the warm beverage.

The new solution should not lower the quality of the warm beverage.

Drinking the warm beverage is for every participant the most important part of buying a warm beverage. This is the main reason why people buy the warm beverage. According all the personas the quality of the warm beverages at NS stations is sufficient for what they expect. This is for both the quality focused drinkers and the efficiency focused drinkers.

Warmth

The solution should take into account that the customers like to feel the warmth of the beverage. Every participant liked to hold their cup when it is still warm. This means that the solution should keep the warm beverage warm at least as long as the paper cups NS uses now.

Allowing the user to walk more confidently with their warm beverage

During the journey walking with the warm beverage was scored lower than the other points. This was because they were afraid they were going to spill the warm beverage. Lowering the change of spillage will improve this.

Make buying a warm beverage as smooth as possible

For most customers buying the beverage was not one of the positive points because they have to wait in a cue. Most of the time they want to get out of the cue as soon as possible to catch their train. Making sure this process goes as smooth as possible can lower the amount of frustrations.

Keep the target group in mind

A new solution should ideally take all groups into account. At present NS serves each group very well so the new solution should do this as well. However, adapting the solution to the wishes of the each group might result in a better acceptance of the new solution. This means that the solutions should offer a higher quality option for the quality drinkers. But also a very efficient method for the efficient regular drinker and the self treater.

2.5 Conclusions research chapter

Other conclusions

A new solution should take into account that some customers are bored while other joyful or tense.

With the help of the personas it became visible that people experience waiting for their warm beverage differently. It is important to say that we are now only looking at their main emotions, which means that they could also feel other emotions when they buy the warm beverage.

The quality an efficient regular drinker both are bored or satisfied, which could be due to the fact that they just want their warm beverage for the morning. The comfort seeker says to be tense when they have to wait because they are afraid to miss their train. The self treater on the other hand seems to be joyful and satisfied, because they are treating themselves and like the contact with the barista.

This insight is used for the vision in chapter 4.

Deciding to buy a warm beverage

When the customers decide to buy the beverage, there are two groups, the ones that buy a warm beverage because they want to treat themselves, the self treater and the comfort seeker, and the ones that buy a warm beverage out of habit, efficient regular and quality drinker.

The emotional buyers decide at the station that they are buying a warm beverage. For the emotional buyers the cup should not be branded as an NS cup, because customers see the warm beverage shops as something that makes them feel better because something went wrong with the trains. Based on this there could be assumed that selling a product from NS would keep that negative emotion.

The rational buyer often knows when they leave the house or even earlier that they will buy a warm beverage because drinking a warm beverage at the station is a habit for them. This group also sometimes buys a warm beverage because they want to treat themselves. For the rational buyers a cup could be promoted as a NS cup. Linking the cup to travelling could help the more regular travellers remember to bring the cup as planned journeys are experienced as less negative.

This insight is used for the vision in chapter 4.

A new solution should be explained clearly in the shop.

This insight is used in chapter 3.9 for a demand.

The customer should feel proud when they use the new solution

Most participants that used the reusable cup did not like cleaning it but they did feel proud that they used the reusable cup. This insight is used for the vision in chapter 4.

The barista needs to actively support the new solution.

A few participants did not want to be a hassle for the barista with their reusable cup. When they found out the barista was okay with the cup they felt more comfortable using it.

This insight is used in chapter 3.9 for a demand.

The research questions of this chapter were:

1. *What are the barriers for customers of NS that cause them to not use reusable cups at the NS stores?*
2. *Which factors are important for the customers while drinking a warm beverage at NS stations?*

To answer the first question 5 barriers that stop customers from using the a reusable cup.

To answer the second research question 6 factors are formulated in which customers hold value when they buy a warm beverage at NS stations. These need to be taken into account to design a solution that is similar or improves the experience customers have now when they buy a warm beverage at NS stations.

Both the Barriers and factors are formed into wishes that are used in the next chapter to make a decision on which solution space would work for NS. They are also used in the other chapters as guidelines which need to be taken into account when designing a new solution.

Barriers that prohibit customers from using a reusable cup

Customers do not want to be responsible for a dirty cup

Having a dirty cup in your bag has the risk that it can spill the leftovers of the warm beverage in the customer's bag. Customers also do not like cleaning the cup when they get home.

Wish 1: *The product service system, pss, should enable customer to not be responsible for their dirty cup.*

Customers do not want to bring an extra object with them just for their warm beverage

A reusable cup for warm beverages takes not only physical space in a customer's bag, which quite a few do not have, it also makes the bag more cluttered. Because most customers will use the cup maybe once a day and most travellers might only use it once a month it is not worth for them to always take the cup with them.

Wish 2: *The pss should provide a cup that the customer does not have to bring with them.*

Customers forget to bring their reusable cup

This applies mostly for most travellers, because most travellers tend to decide later that they want a warm beverage. Bringing a reusable cup is not in the routine of the customer.

Wish 3: *The pss should help customers to not forget their cup.*

Customers are afraid they chose a cup that does not work for them

This means that customers are afraid they might buy the wrong cup, which could for example leak in their bag or a cup that is not nice to drink from. According to customers there is still not a reusable cup that works for their use. There are a lot of cups on the market that do not work well. Providing a cup within the NS store that works well could give customers enough certainty to buy a reusable cup.

Wish 4: *The pss should ensure customers it has a cup that will work for them in the NS travel context.*

Customers do not see the need to use one as they do not know the impact of their paper cup

A group of customers do not know that there is plastic in paper cups. The name paper cup is a bit misleading. Customers think the cup is just made out of paper and think it is not that bad for the environment, while it is actually made out of paper and plastic and is quite bad for the environment. Customers see the plastic lid as a lot worse because it is clearly made out of plastic and thus seen as bad for the environment.

Informing them about this could change their behavior as most customers that have a reusable cup have the environmental impact as one of their reasons to use a reusable cup.

Wish 5: *The pss should inform customers about the environmental impact of a paper cup.*

Factors that provide the customer with a better drinking experience at NS

Make sure the new solution supports the warm beverage

Most customer just want to enjoy their warm beverage and they do not want to way it is served to them to be very complex. This means that the system should support the drinking of a warm beverage and not take attention away from the warm beverage. The factors that play a role in supporting the warm beverage are:

Provide the customers with a cup that allows them to walk with the beverage confidently

Walking with a warm beverage is experienced as very stressful by most customers. Lowering this stress level will motivate them to use a reusable cup more often.

Wish 6: *The pss should allow customers to walk with their warm beverage confidently.*

Improve the experience of the warmth of a warm beverage

The warmth is one of the most important motivations for a customer to buy a warm beverage. It should improve on this experience by keeping the beverage warm for longer and making the cup more comfortable to hold.

Wish 7: *The pss should improve the experience of warmth of the warm beverage as much as possible compared to the paper cup.*

Improve the taste of the warm beverage

The taste is an important motivation for a customer to buy a warm beverage. At the moment the taste of a warm beverage is good at NS stores, but with the help of a new solution this can be improved.

Wish 8: *The pss should improve the taste of the warm beverage as much as possible compared to the paper cup.*

Lowering the time that is needed to buy the warm beverage

If it costs too much time to get a warm beverage they might decide to not buy a warm beverage. This means that the new solution should not cost significantly more time for the customer to use compared to the paper cup and preferably should use less.

Wish 9: *The pss should allow the warm beverage to be served in as little amount of possible.*

Provide the customer with a cup that provides a better experience than the standard cup

Customers are willing to wait longer for their warm beverages when they know it has a good quality. Julia's is known for their high quality. However this is quality is found in the drink and not yet in the cup. A new solution could provide an option for a service that is more focused on providing a better experience.

Wish 10: *The pss should give the customer a better option than the standard option.*



3. Comparison of possible solution spaces

This chapter describes why the cup deposit system is the system that has the largest potential for NS. At the start two solution spaces are formulated. These solution spaces are later compared to the existing paper cup system with the help of research from earlier chapters and literature. Based on the conclusions of this chapter a design brief is formulated which is used as a starting point for the remainder of this thesis.

3.1 Proposed solution spaces

Introduction

With the opportunities from the previous chapter in mind two solution spaces were formulated. The solution spaces each represent a possible alternative system for NS to increase the use of reusable cups for drinking a warm beverage. And they differ mainly on who has the ownership and responsibility for handling. These solution spaces are based on existing systems altered to fit the context of NS.

- User owned cup

For this solution space NS will nudge and provide benefits for the customer to bring their own reusable cup, a visualization in figure 16 shows the customer journey.

Paper cups will still be sold next to the user owned cup because only accepting reusable cups will hurt the sales of NS quite a lot, which means that is hard to implement. The nudging is done with the help of small changes in how warm beverages are sold at NS. With the help of these changes the behavior of the customer can be changed. There is quite a bit of research done into how to motivate customers that buy warm beverages to bring a reusable cup. Examples of nudging techniques are: posters that provide information, presenting the user owned as the standard option and asking customers to pay for their paper cup. From now on this option will be called the 'user owned cup' to prevent confusion with the other reusable cup system.

- A cup deposit system.

In this cup deposit system the customer pays a deposit and receives their warm beverage in a reusable cup in an NS store. When they finish their warm beverage they return their cup at one of the bins at the station they arrive at and get their deposit back. NS will pick up the bins and cleans the cups. After the cups are cleaned NS brings them to a NS store where they can be sold again. An overview of a system like this can be found in figure 17.

In this chapter both solution spaces are evaluated and compared to the current paper cup system on their viability, feasibility and desirability with the help of the following 7 topics:

- Desirability
- Size potential user group
- Environmental impact
- Hygiene
- Future proof
- Cost for NS
- Ease of implementation

The paper cup is also included in the comparison to provide a frame of reference for the new solutions. At the end of this chapter, one solution space is selected that has the largest potential for NS for further development.

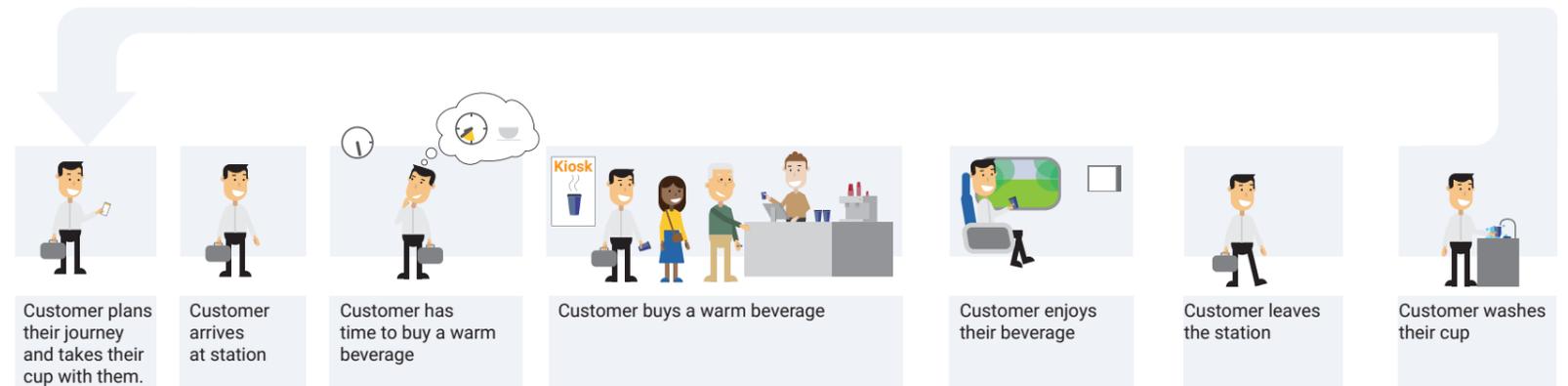


Figure 16: Visualization user owned cup journey

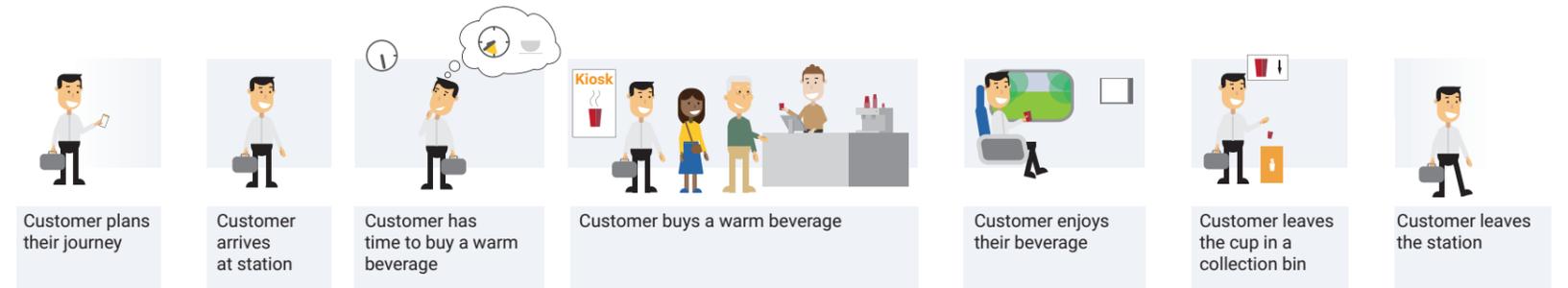
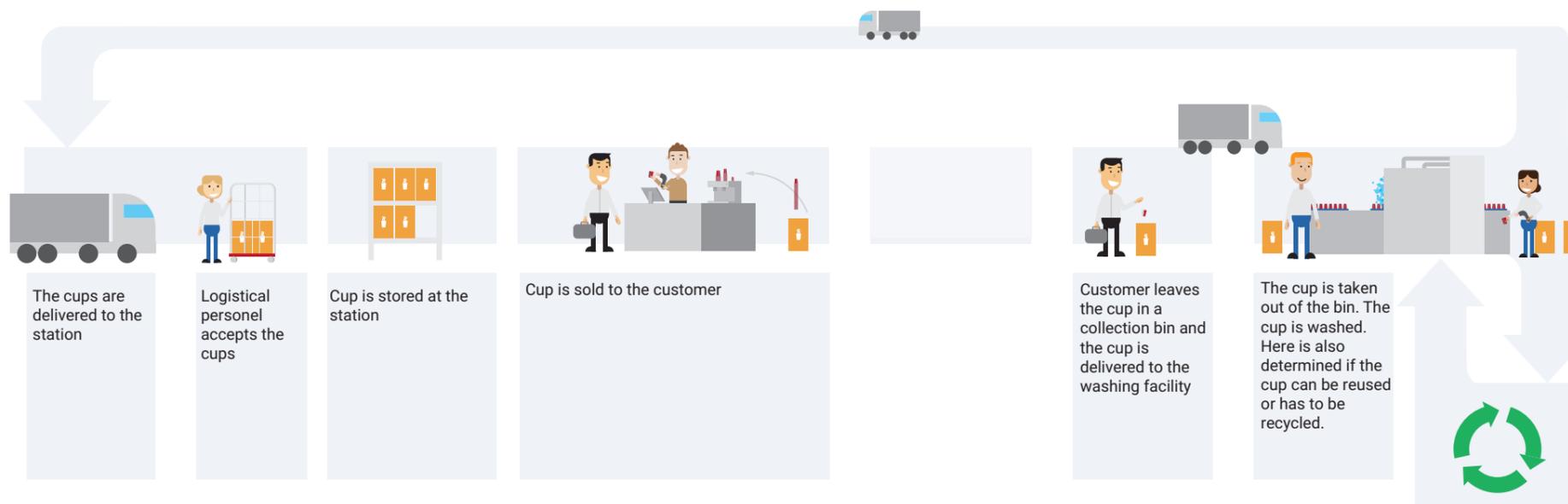


Figure 17: Visualization cup deposit system journey



3.2 Desirability

This chapter compares the paper cup, the deposit cup and the user owned cup based on their desirability. The desirability is based on the desirability factors for warm beverage cups as defined in chapter 2. A Harris profile (Roozenburg, 1998) is used to visualize the individual scores in the evaluation (figures 18 and 19). Here -- means that a solution space scores bas, - means it scores moderate, + means it scores good and ++ means it scores very good. In this table it becomes visible that the paper cup and the deposit cup score similarly and the user owned cup scores significantly worse.

1. The customer has to have responsibility to dispose the paper cup and they can do that in any bin. They do not need to bring the user owned cup with them. They need to drop the deposit cup off at a specific bin.

2. The customer can drop off both the paper cup and the deposit cup. They do not need to bring the user owned cup with them.

3. The customer is provided with the paper cup. The user owned cup can be forgotten by the customer. The cup deposit system also provides a cup at the store.

4. As concluded in chapter 2.6, using a different cup than the current paper cup creates a fear for consumers that they buy a wrong cup, unsuitable for traveling. The customer is satisfied with the current paper cup. NS could recommend a certain user owned cup to reduce the fear, and the deposit cup system provides the customer with a cup which should guarantee it is suitable for traveling and accepted by the barista at the Kiosk.

5. The biggest opportunities to inform customers about the environmental impact of paper cups are in the shop itself and advertisements. This means that both cup systems have the potential to inform the customer but one solution has not more potential than the other.

1. As concluded in chapter 2.6, there is not a big difference on how customers experience walking with a paper cup versus a reusable cup. However Schifferstein (2017) showed that people perceive metal and ceramic cups filled with warm beverages as less fragile than paper cups. This could mean that people with a harder cup feel more confident. However no research is performed for plastic cups.

2. During this master thesis this factor is left out of scope because there is too little data to evaluate on this factor.

3. Rothstein (2006) says that a ceramic, glass and a good quality plastic cup have the preferred taste experience over the paper cup (Rothstein, 2006). More research has to be conducted to be able to determine precisely which cup gives a better taste experience.

4. The paper cup does not cost a lot of time to serve as they are provided by the store themselves. The reusable cup is a cup that sometimes needs to be cleaned, see appendix 2 Kiosk employees. This can cost quite a lot of time. However according to baristas this is not a real deal breaker compared to the total amount of time it costs to serve one warm beverage. The deposit cup system can be used fast as well but the barista needs to ask if the customer wants a deposit cup and also have to explain how the service works, which could cost time.

5. Every paper cup that NS uses now is practically the same and does not provide a better option for the customer. The user owned cup can be chosen by the customer themselves which means it has the potential to have a better experience. Because the deposit cup is made of plastic, it has the more potential than the paper cup to be altered to provide a better experience.

Barriers to not use a reusable cup

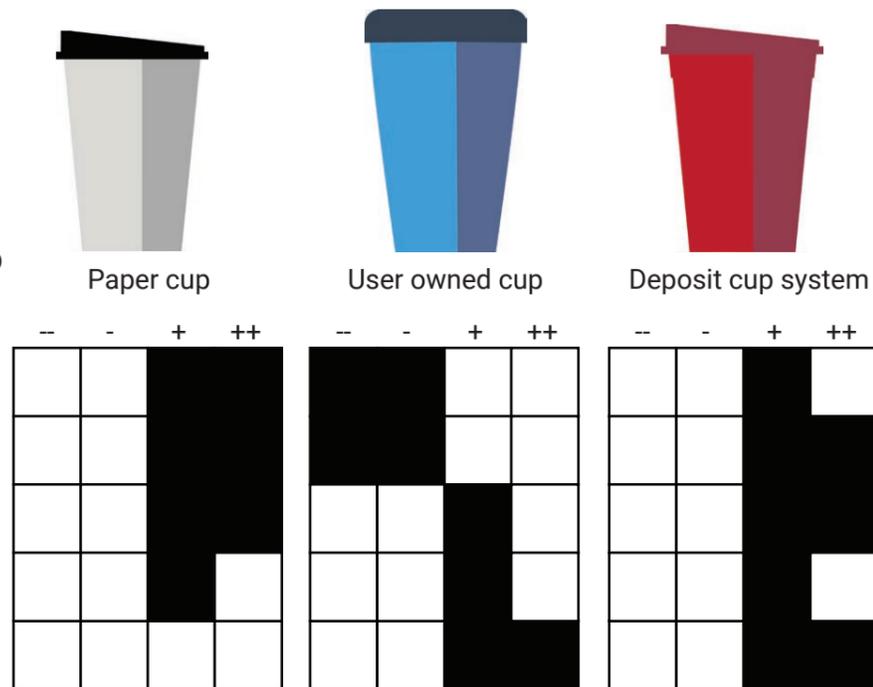


Figure 18: Harris profile to compare barriers

Improvement on drinking a warm beverage at NS stations

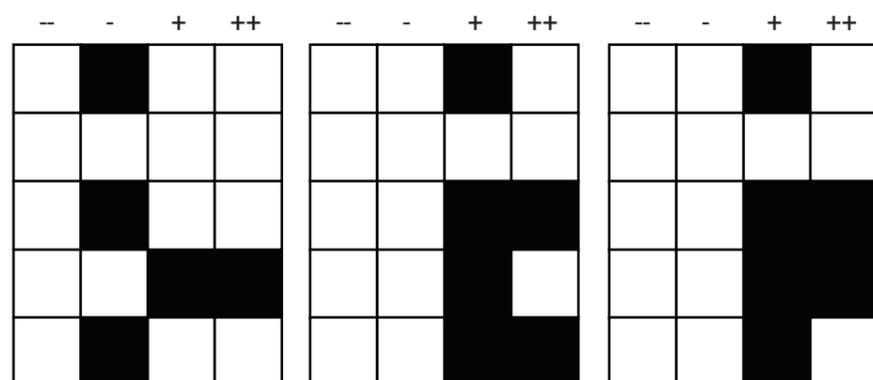


Figure 19: Harris profile to compare improvements

3.3 Size potential user group

The size of the potential user group is very important as a solution can only have an impact if customers also use it customers also need to use it. This evaluation looks at the potential group of customers an solution space can motivate to use a reusable cup.

During this evaluation it is assumed that NS is still providing customers with the choice for a paper cup. The reason for this is that experts in the field recommend to still provide customers with the choice (Webinar KIDV, 2020). It is also less likely that NS would start only accepting reusable cups because this would hurt their warm beverage sales, which makes it less desirable for NS.

Paper cup

The paper cup is used by NS at the moment and it has quite a large target group. Research from chapter 2.4 showed that almost every customer was satisfied with the paper cups.

User owned cup

At the moment the user owned cup is used at 2.4% of the sales of NS and this is a low number compared to other warm beverage selling chains like Starbucks.

Research shows that this number can be increased. Lenaghan (2019) shows that Starbucks increased their user owned cup rate from an average of 2.2% to an average of 5.8% in 35 stores by asking a £0.05 charge for a disposable coffee cup. Interesting to note is that a discount, what NS is currently doing, does not seem to work very well as the retailer who give a discount only 1-2% is ordered i a user owned cup. Poortinga & Whitaker (2018) show similar results on average due to the charge on a paper cup, 3.3% to 7.6%. This research also showed that a discount did not result in a significant improvement. Interesting to note as well is that when customers had to pay for their cup the amount of warm beverages sold by the stores did not go down.

This research also looked into environmental messaging, which led to an increase of an extra 2.3% on average. It also showed that selling user owned cups at a store would result in an increase of 2.5% extra.

Encouragers	Sympathisers	Benevolents	Indifferent	Rejectors
Connect through values	Inform and proof	Inspire	Reward	Ignore or confront
Goes for sustainability, trendsetter	Aware of importance sustainability and acts often accordingly	Only choses sustainability if there is no compromise on price/quality	Pay little attention to sustainability, are quite sceptical	Doesn't pay attention to sustainability, distrust it
'Sustainable' or 'better world as explicit message	Sometimes willing to compromise on price/quality	Simple, short message	Self-interest (other benefits) determine choice	Get personal (in direct surroundings self-interest)
Longs for authenticity; needs substantiation and evidence through concrete activities	Communicate sustainability next to other advantages	Emotion (good feeling)	Reward sustainable behaviour	Don't communicate sustainability
Searches and shares actively information	Objectification through hallmarks, authority or peers	Empowerment (exemplary behavior)	Exemplary behavior; breaking habits	Conservative

Figure 20: 5 groups of sustainable behavior of Dutch inhabitants

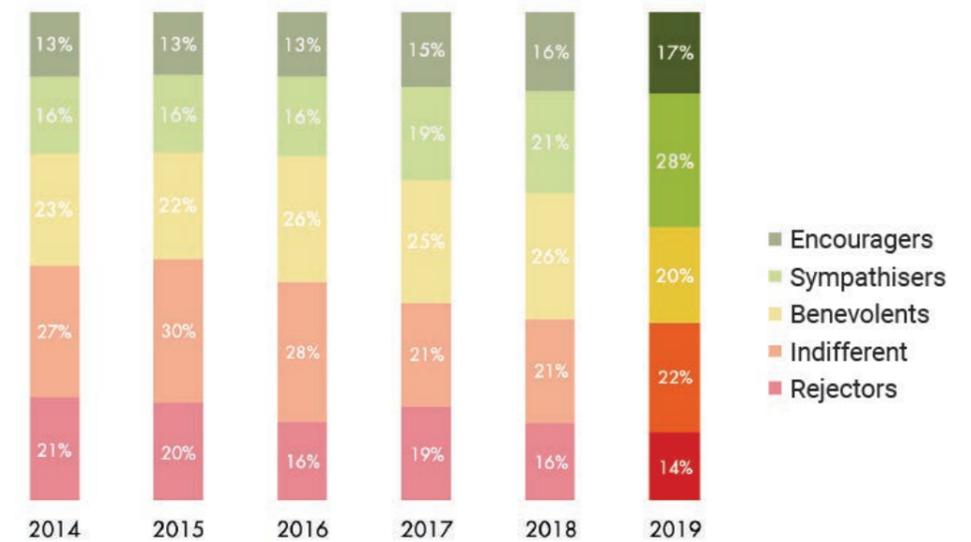


Figure 21: Group percentages over time

According to a sustainability expert within NS, NS travelers are more interested in sustainability than the average person from the Netherlands. This is also found in a research done within NS (Brüggenwirth, 2019). They divide the Netherlands in five groups which can be seen in figures 20 and 21.

These insights can be used to determine to potential target group for user owned cups. Figure 21 shows that the encouragers, which account for 17% of the Dutch population, are willing to pay more, just because it is more sustainable. The user owned cup has a high potential to be used by this group. However selling the reusable cup to the sympathizers, 28% of the Dutch population, will already be harder. This groups wants more benefits and is less likely to pay for a new reusable cup and put the effort in using it. The benevolent group will be even harder to convince.

This is why in this master thesis it is assumed that the first two groups are in the best case scenario to use the reusable cup during their journey, while convincing the other groups might be harder. An assumption could be made that these two groups would use the cup, which means that 45% might use it. This number can however still grow as figure 21 shows.

Combining these papers it can be assumed that with the help of nudging users to use user owned cups a maximum target group around 45% percent is possible.

3.4 Environmental impact

Deposit cup system

Looking at the deposit cup it can be said that this solves most of the problems that the reusable cup has, see chapter 2.7. Next to this it can also provide benefits compared to the paper cup, see chapter 2.7.

Looking again at figure 18 and 19, because of the benefits this cup provides without having the downsides of the user owned cup the benevolent group, the indifferent group and even the rejector group might be in reach. Taking figure 21 into account there can be said that the cup deposit system has the potential to attract more customers than the user owned cup.

To have a better acceptance of the system, experts recommend communicating clearly at each touch point how the system works (Webinar KIDV, 2020).

Ideally this system is expandable to allow other shops to partake in the initiate to reach a larger user group.

A downside of the cup is that customers have to pay a deposit. This deposit needs to be high to cover the cost when a customer does not return the cup. The deposit can be expected to be around 1 euro as this is common at other deposit cup providers (Recup, 2020; Freiburg cup, 2020). This high deposit could potentially scare away customers.

Conclusion

In conclusion it can be said that the user owned cup has the possibility to reach a large group of customers, but it has its limits. Because the deposit cup has some benefits in comparison to the user owned cup it can reach a larger target audience. The paper cup is even better, because NS is using it now and everybody seems to be happy with them.

To evaluate the environmental impact of each solution space, a literature study in combination with a scenario analysis was conducted.

The literature study was conducted to find out what the environmental impact is of paper cups compared to a user owned cup and to a deposit cup. During this analysis multiple existing LCA's are used. An LCA stand for life cycle assessment. During a life cycle assessment products are compared on their environmental impact over their life cycle. The information gathered from the existing LCA's is later used to compare the paper cup, a user owned cup and deposit cup based on multiple scenario's which are applicable to NS. The results from these scenario's are validated with the already existing LCA's.

Literature study

Four studies are used to further look into details. The first is from Huhtamaki, a paper cup manufacturer, the second is from Keepcup, a user owned cup manufacturer, the third is from CIRAIG, an independent research company, and the fourth is from Cup Club, a start up with a deposit cup system (Huhtamaki, 2019; Keepcup, 2018; CIRAIG, 2014; Cup Club, 2018). These four studies were selected, because they represent a range of backgrounds and perspectives for a reliable outcome. As there is no comparison yet between a user owned cup and a deposit cup both cups are compared to paper cups.

User owned cup versus paper cup

In the literature study it was found that when a plastic reusable cup like the Keepcup (figure 22) was compared with a polyethylene lined paper cup the reusable cup was better after it was used 20 to 30 times in the amount of kilo's of emitted CO² (Huhtamaki, 2019; Keepcup, 2018; CIRAIG, 2014).

On other parameters such as the impact on human health, resources, eco systems and water use, the user owned cup not always scores better. CIRAIG and Keepcup show that a user owned cup has a lower impact on human health and resources, Keepcup (2018) says the user owned cup compared to a paper cup has a lower impact on the eco system while CIRAIG says it has a similar impact.

The reason for this difference is because CIRAIG looks at a scenario where the cup is efficiently washed than the scenario Keepcup uses. Keepcups scenario also does not take soap into account while CIRAIG does and names the soap as one of the big contributors to the impact on the eco system. CIRAIG also shows that when the cup would be washed with a machine the user owned cup would score a lot better, see washing of the ceramic cup. This means that when washed efficiently the user owned cup has less impact than the paper cup on the eco system.

The user owned cup scores worse or similar to the paper cup on water usage. LCA show that the cup needs to be cleaned every time it is used.

Both CIRAIG and Keepcup show that washing the cup has the most environmental impact during the life cycle of a reusable cup. This means that washing more efficiently will lower the environmental impact of the reusable cup significantly. Keepcup recommends to hand wash a cup with cold water for a short time as they see that heating water costs quite a lot of energy and increases the CO² emissions significantly.



Figure 23: Paper cup that was used for the Keepcup LCA.



Figure 22: Keepcup that was used for the LCA.

Deposit cup versus paper cup

Research of Cup club shows that the deposit cup scores better than a paper cup if the deposit cup is used more than 72 times and the recycle rate of a paper cup is 1%. This is quite a lot more than the previously described user owned cup. The main cause they see for this high emission is the electricity needed to power the dish washer as it accounts for 80% of the CO2 emission of a deposit cup. The electricity also accounts for most of the emissions of the ReCiPe factors, see figure 25.

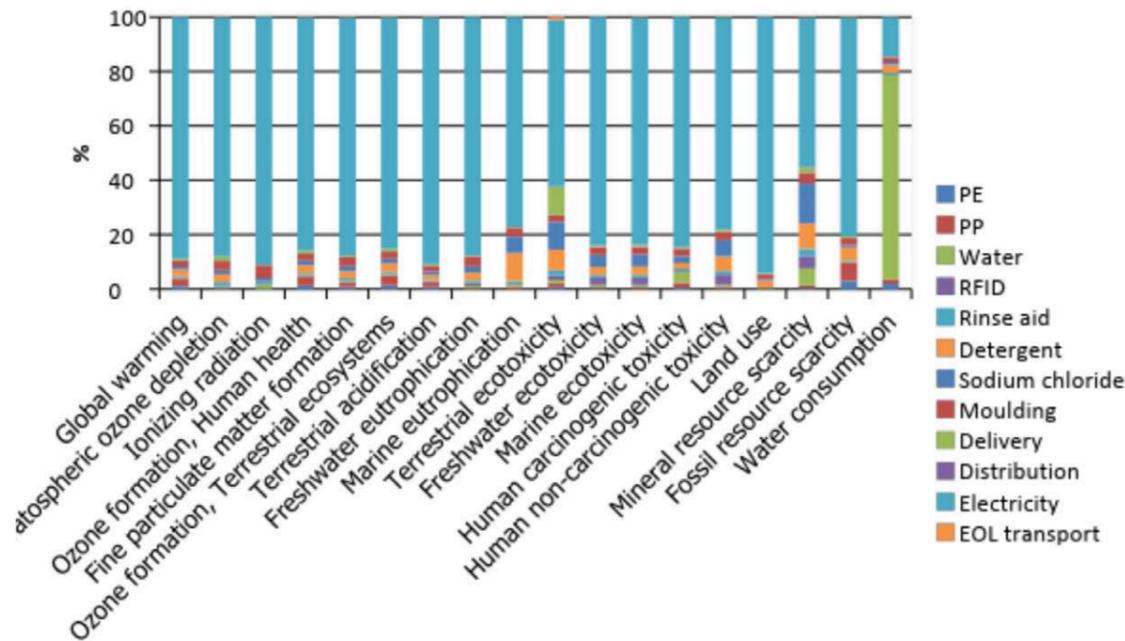
The LCA of Cup Club also performs a sensitivity analysis for the sourcing the cups from China instead of the UK, increasing the distance to the washing facility and washing the cups more energy efficiently. They found that sourcing the cups from China instead of the UK and increasing the distance to a washing facility had a small impact on the environmental impact, respectively up to 3.3% and 2% lower. However they say that it does have a limited impact over the whole life cycle of a deposit cup.

They found as well that lowering the energy needed to wash the deposit cups would significantly reduce their environmental impact.

One factor they did not look at in this LCA, is the return rate which can have a significant influence on the environmental impact.



Figure 24: Cup club cup that was used for the LCA.



Analysing 1 p 'cup club inc washing uk';
Method: ReCiPe 2016 Midpoint (H) V1.01 / Characterisation

Figure 25: Breakdown of Cup clubs environmental impacts (Cup Club, 2018)

Scenario analysis

A scenario analysis was conducted to be able to say something about the environmental impact the cup would have in the use case of NS. The scenario analysis is about how the user owned cup and the deposit cup compare to each other. The paper cup is included to be able to give a frame of reference. However a very broad range is used for the emissions of the paper cup as literature shows a lot of different results.

For this scenario analysis there is chosen to look at a 8 OZ cup, the cup most beverages are sold in at NS.

For this scenario analysis there is chosen to look at different scenarios within NS to have a model to later base design decisions on. The main factor that is tested on is CO2 emissions, because there not enough information could be found for the other factors to make a reliable estimation.

The scenario analysis focuses on four topics:

- What is the effect of using a cup deposit system compared to a user owned cup for a longer period of time?
 - What contributes the most to the use scenario of deposit cups based on:
 - Production
 - Transport to the NS store
 - Use
 - What contributes the most to the use scenario of deposit cups based on:
 - Production
 - Durability
 - Return rate of the cup
 - Transport distance to the washing facility
 - Collection bin
 - Washing the cup

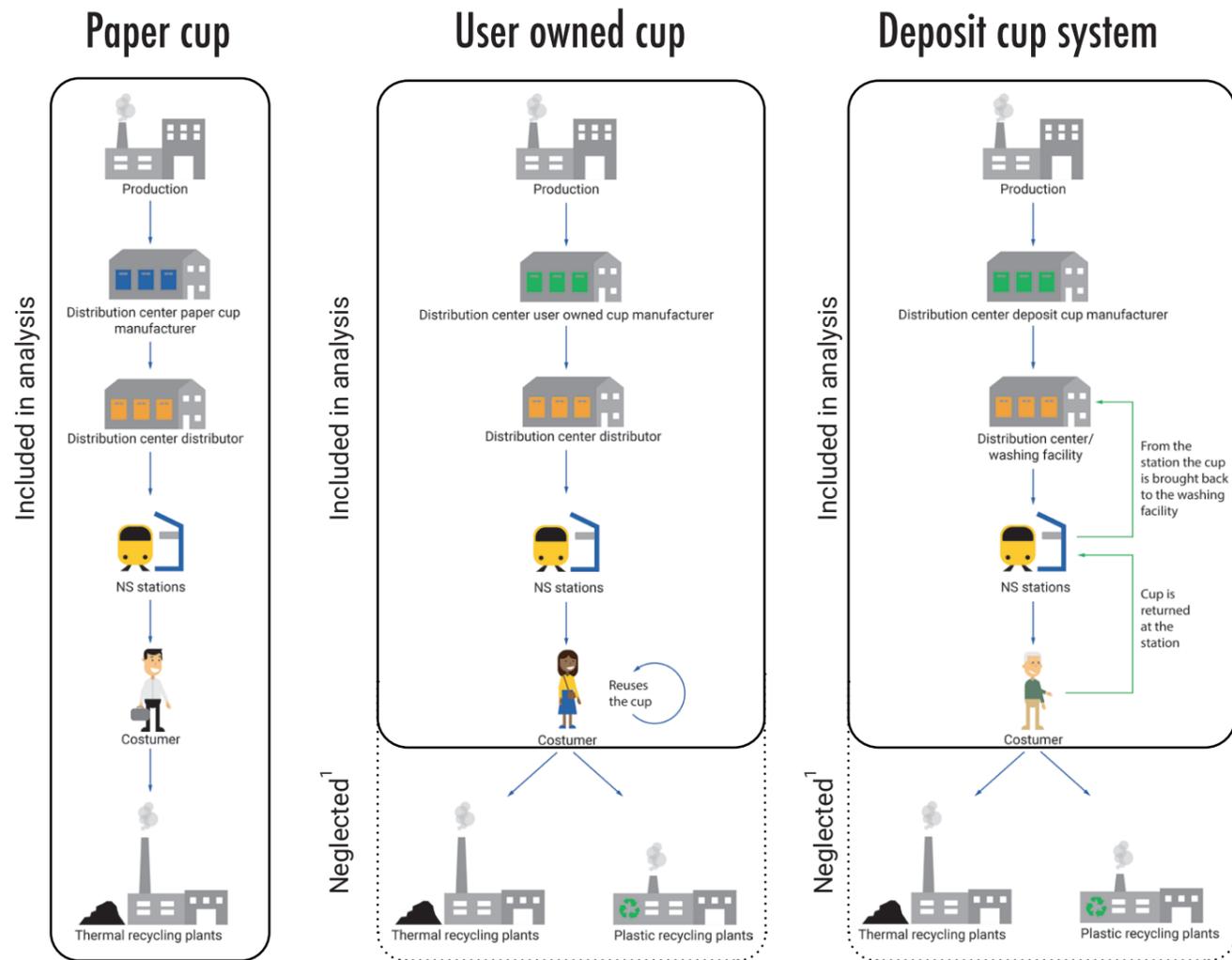


Figure 26: Scenario's of the paper cup, user owned cup and the cup deposit system

¹See assumption 2 in appendix 7.

Results scenario analysis

Effect of a deposit cup on the long term

Looking at figure 27 it becomes clear that the more the user owned cup is used, the better it scores compared to the deposit cup. This is due the fact that the deposit cup has a limited life span, which is smaller than the user owned cup. Keepcup says their user owned cup can be used for a 1000 times. However in practice people might get rid of the user owned cup earlier. There is however little research into how much cups are actually used so this is still uncertain. The deposit cup can be used 40 to 120 times before it is broken according to a cup deposit expert. Figure 27 also clearly shows that both solution both perform better than the paper cup.

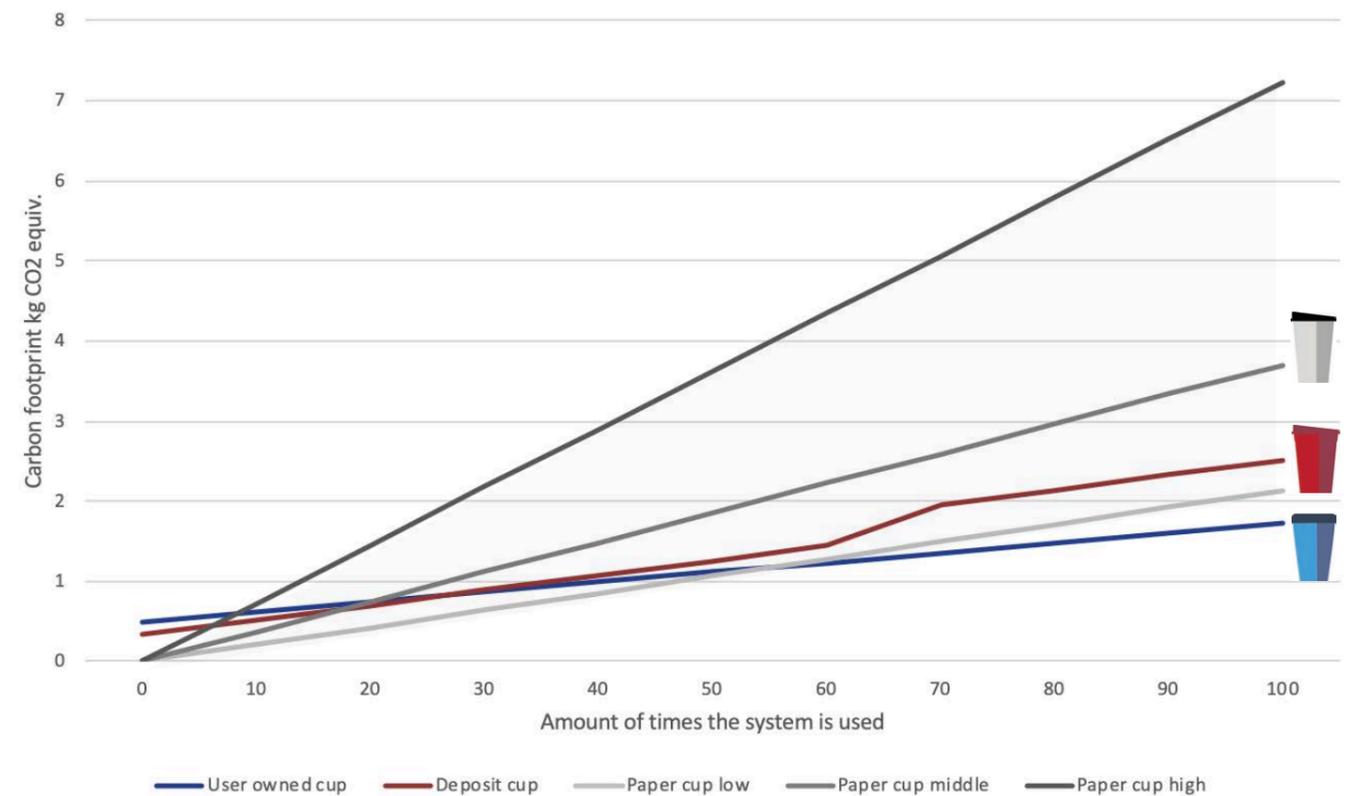


Figure 27: Comparing the CO2 emissions of a paper cup, user owned cup and deposit cup. The deposit cup her has a medium transport distance and a 98.5% return rate.

Contribution of the use scenario

Looking at the use scenarios in figure 28, it can be said that washing the user owned cup cup has the biggest impact. The soap and the energy needed to heat the water is responsible for most of the environmental impact.

This means that making sure that people wash their cups efficiently can greatly lower the environmental impact of the reusable cup.

Looking at the deposit cup system it becomes clear that transport has little effect on the impact of the deposit cup. However, the production of the cup and the use phase of the cup have a big impact. The production of the deposit cup is large because one deposit cup has a limited life span. This means that lowering the number of cups needed for the cup deposit system will lower the environmental impact significantly.

During the use of the deposit cup the electricity needed to heat the water for the dish washing machine is responsible for most of the environmental impact.

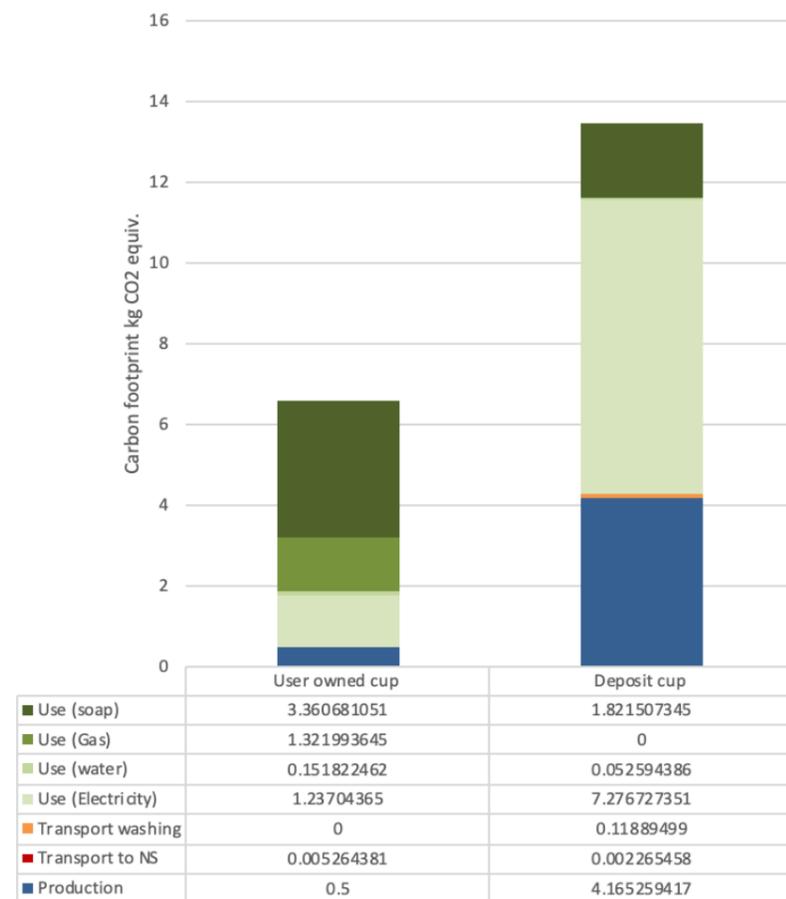


Figure 28: Life cycle user owned cup and deposit cup used 500 times with a return rate of 98.5% and a middle transport distance.

Effect of transport distance on deposit cups

Figure 29 shows that the transportation distance has a very small effect, when the distance is changed. When the distance is quadrupled the overall environmental impact increases with 1.25%. This means that transport has no significant impact on the environmental impact of a deposit cup within the NS ecosystem. This is similar to the findings of the LCA of Cup Club.

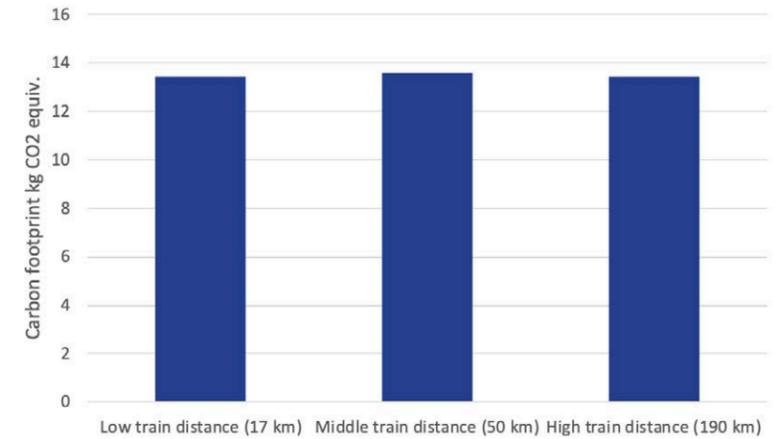


Figure 29: Effect of travel distance used 500 times with a return rate of 98.5%

Effect of energy needed to wash the cups

Figure 30 showed that the electricity needed to wash and dry the cups has the biggest impact in the life cycle of the deposit cup. Lowering this would result in a significant improvement for the environmental impact. Figure 30 shows the improvements that can be achieved when the cups are washed with a more efficient washing machine. Figure 30 shows what the CO2 impact would be when the washing machine is powered with the power of wind mills. NS uses green energy for their stations and trains and they could also do that for washing the cups.

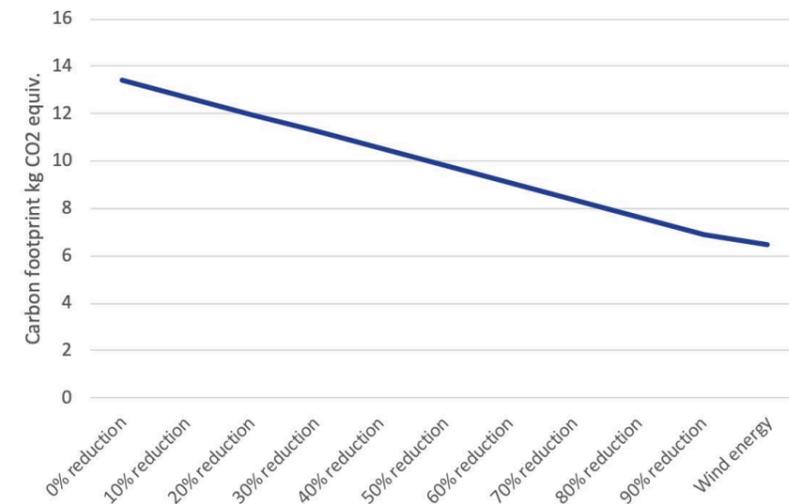


Figure 30: Effect of energy efficient washing and using green energy used 500 times with a return rate of 98.5% and a middle transport distance.

Effect of return rate of the deposit cups

The environmental impact of a deposit cup is greatly determined by how many times the cup is used. Based on the conversation with a cup deposit expert, it was found that their cups can be used 40 to a 120 times. The return rate has an even bigger impact on how long the cup can be used. With an average return rate of 95% the cups will be used on average 20 times, which Cup Club already achieved. This is a lot lower than how long it will last.

During this analysis it was found that for the deposit cups the return rate has a very high impact on the environmental impact, see figure 31. This figure shows that impact can be lowered significantly with a higher return rate. For example a return rate of 98% the deposit cup has 28% lower environmental impact than the 95% return rate.

The highest return rate for plastic bottles in Germany high number might be possible as this is the top return rate in Germany for deposit bottles (CE Delft, 2017). This would result in an emission of 11.74 kilograms of CO2 for using the deposit cup system 500 times on a middle train distance. This means that having a good return rate will lower the environmental impact significantly.

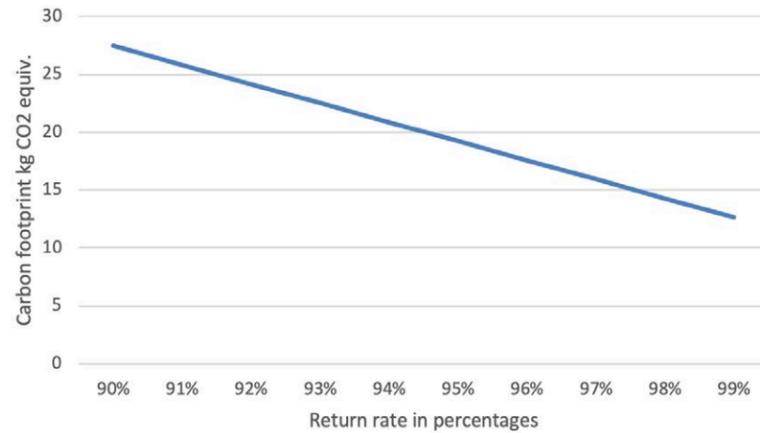


Figure 31: Effect of return rate used 500 times transported over a middle long distance.

Conclusion

This research shows that the user owned cup is the best option looking at the CO2 impact at this moment. Literature research showed that after 20 times the user owned cup is better than a paper cup and a deposit cup system is better after 72 times.

Looking at other environmental factors research showed that an user owned cup scored better on human health, resources and eco systems compared to a paper cup. It did however score worse on water usage. The deposit cup system scored better on recipe factors than the paper cup according to Cupclub. While the return rate was not included in their calculations there results showed that washing the cups had by far the biggest impact and the cups themselves did have very little impact. This means these results can also be applied to the deposit cup system used in this master thesis.

The analysis performed in this master thesis showed that the deposit cup system has the potential to have a similar or even better environmental impact with some improvements; a good return rate, 98.5%, and the cups are washed on wind energy and/or with a more efficient dish washer.

This analysis also included paper cups for a point of reference. This showed that especially when the deposit cup system complies with the earlier named improvements it could be a significant improvement over the paper cup. It also shows that the return rate should not be below 96.5% if the dishwasher is powered by wind energy to be below the lowest emissions a paper cup could have. When a medium paper cup emissions are used this number drops to 92.5%.

3.5 Hygiene

Hygiene is very important for warm beverage cups. A cup has a the potential to infect people. This chapter presents a comparison of each solution of the health risks it could pose to the customer.

Paper cup

The paper cup can be handled in a way that has a low risk to transmit diseases. The production and transport of the cup are generally save. The only risk for the customer is that if the barista is sick, they can infect them.

User owned cup

The reusable cup is not as hygienic as the paper cup and the deposit cup system. When an infected customer hands their reusable cup to the barista there is chance that an illness transfers to the baristas hands. Then when the barista serves the next customer they can infect their paper or reusable cup with the virus and thus also the customer that buys the warm beverage.

A paper and deposit are given by the barista to the customer so the barista will not touch a cup from someone else. This can only cause a safety risk when the barista is sick themselves.

An example can be found in the Covid-19 virus. This virus stops being infectious after 7 days on plastic and stainless steel, materials that are often used for a reusable cup (Chin, 2020). This means that the virus can get on for example the baristas hands and on the next customers cup (Barboza, 2020). This meant that NS could not accept any user owned cups at their store.

A solution proposed by a group of researchers is to serve the drinks contact free. Here the customer has to hold their cup while the barista fills the cup with a warm beverage (Barboza, 2020). Making this possible at NS stores would mean that significant changes have to be made to the store itself.

Cup deposit system

The deposit cup poses no risk to the customers if it is washed correctly (Barboza, 2020). The only risk for the customer is that if the barista is sick, they can infect them.

Conclusions

In conclusion it can be said that during a pandemic a reusable cup can pose a risk of infection while the chances are a lot smaller when a paper or a deposit cup is used.

3.6 Future proof

This master thesis looks how NS can lower their environmental impact. This is a solution that will be implemented in the future. This means that the solution should be future proof. To determine how future proof each solution is a small risk assessment is performed about which outside factors could pose a risk to the solution in the future.

Paper cups

At the moment an EU regulation, called the single use plastic directive, is in the making that bans certain plastic packaging and ask for a reduction of others. This is still a regulation that is being defined by each member state. This means that it could also still change. That is why in this report there is looked at what the last version of the EU regulation states about each kind of packaging (European commission, 2019). It combines this with information of the first regulation the Dutch government set up.

This regulation has an influence for NS as the polystyrene lids for the cups are named as one of the products that should be reduced.

The single use plastic directive also says that countries should reduce their single use cups that are made out of plastic by 25%. It is still unclear if paper cups lined with a plastic coating will be part of this mandatory reduction. The reduction now applies for cups where the main structural component is plastic. Paper is the main structural component of paper cups, which means that the plastic could be seen as an additive. Defining which cups are banned has to still be defined by the Netherlands.

Another impact assessment of the EU sees the reduction of paper cups lined with plastic as a possibility, but they see not enough possibilities yet to reduce the amount of cups used (European commission, 2018).

In the end this means that a reduction for paper cups with a plastic lining could be a possibility in the future, but that this still has to be decided by the Dutch government. For the lids on paper cups it is more certain that a reduction is needed, because EU regulation proposes a reduction. However it is not clear yet what the Netherlands will eventually do and what role NS has to play for this.

User owned cup

At the moment there are no EU regulation being made to ban or reduce the use of user owned cups. It is even referred to as a solution for the reducing the amount of single use plastic cups.

The user owned cup does have the risk that it spreads diseases, see chapter 3.2.3. This can mean that when there is a new pandemic these cups will be banned, which also happened during Covid 19.

There is little risk that the user owned cup gets banned by regulation but there is a risk that it can not be used during a pandemic.

Cup deposit system

At the moment there are no EU regulation being made to ban or reduce the use of a cup deposit system. It is even referred to as a solution for the reducing the amount of single use plastic cups.

There were no other risk found that could pose a treat to a cup deposit system.

https://www.internetconsultatie.nl/ontwerpbesluit_single_use_plastics

Conclusion

In conclusion it can be said that the deposit cup has the least amount of risks and can be seen as the most future proof. The user owned cup has the risk it gets banned during a pandemic and is thus less future proof. The paper cup is the least future proof because of the risk that there is a possibility that NS is forced to lower the amount of lids and paper cups they sell.

3.7 Cost

At the moment NS uses paper cups which are integrated into their retail system. Implementing an alternative cup for the paper cup will have a cost for NS. To find out of the costs are manageable a cost analysis is conducted for both a reusable cup and a deposit cup. For both the paper and the deposit cup it is assumed that the same amount of cups and lids NS sold in 2019 are also needed for these systems. The user owned cup is used for 10% of the total NS sales per year as the target group for this solution is a lot smaller. Both the user owned cup have next to the costs NS has to run the system also a discount to financially stimulate each system.

Paper cup

The paper cup has a very low cost. Figure 33 shows a price of a paper cup of NS. This is an estimation on prices that were found online and the real prices of NS could be even lower as they order in very large quantities.

User owned cup

The costs of the cup are paid by the customer and not by NS themselves. The reusable cup has three factors were the cost will be higher than the paper cup: logistics, the price of the cup itself and nudging techniques.

The logistics and price of the cup itself can are part of the price of the cup which the customer pays. NS does have to pay for the nudging techniques which can be divided by the amount sales where the cup is used.

Deposit cup system

The deposit cup has a different business model because the customer pays a deposit of one euro and after they return the cup the deposit is payed back. NS does not have to pay for the cup. However NS has to pay for product that support the deposit cup system. In figure 33 an estimation can be found of the costs per cup for NS and the investment costs for NS. In the end the cost per cup is around 10 cents per cup if NS sells the same amount of warm beverages as in 2019 in a deposit cup. This price per cup is similar to the 20 cents that Cup club asks for their service (Cup Club, 2020). However figure 32 shows that this price goes up significantly when the system is used less because the initial investments are very high.

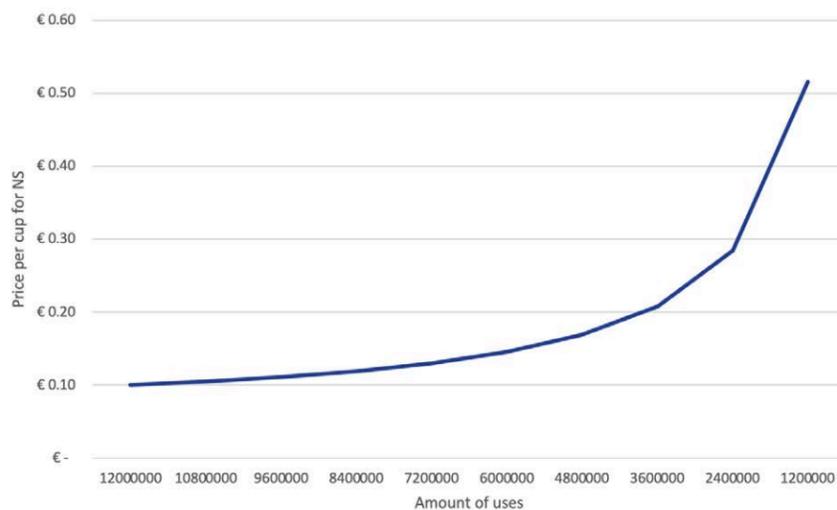


Figure 32: Price per cups for NS for the amount of usage per year

Solution	Paper cup	User owned cup	Deposit cup system
Price per use	€ 0.05	€ 0.05 + € 0.25 discount	€ 0.10 + € 0.25 discount

Figure 33: Costs for NS of using each solution

Conclusion

Based on these cost estimation it can be said that the deposit cup requires a high initial investment and also costs quite a lot more per cup if it is compared to the paper cup and the user owned cup, see table 33. The user owned cup also has a fairly low price for NS as they only have to pay for nudging techniques. This is the reason the user owned cup and the paper cup have a lower cost than the deposit cup system.

3.8 Ease of implementation

NS also has to implement the new solution. This is why it should be taken how easy it is for NS to implement all three solution spaces. To know how easy a solution is to implement there is looked at a few factors:

- Does NS have experience selling a similar product?
- Does it fit inside the NS retail system?
- Do other companies have experience selling a similar product?

Paper cup

The paper cup does not have to be implemented by NS anymore as they are already using it.

User owned cup

The user owned cup is also fairly easy to implement. A user owned cup can be sold with the already existing distribution system. NS did already sell reusable cups in the past and it should be easy to do again.

Deposit cup system

The deposit cup will be the hardest solution space to implement. NS does not have experience with setting up a deposit system yet. However, they are setting up a deposit system for plastic bottles. This might give them valuable insights on how to set up a deposit system within NS and might also provide a framework in which a deposit cup system can be set up.

There are a few companies who are setting up a cup deposit system for cafes, e.g. Cubclub and Recup. Looking at similar field there are also companies like Goodless which already have a system where cups can be tracked and the deposit can be automatically refunded to the customers bank account. However it will still be a challenge for NS to implement a cup deposit system as they have to change their retail system to fit the deposit cup system.

NS also needs to take into account that to be able to collect 95% of the cups it also needs to be able to collect cups at very small stations. There are some stations that are not connected to the logistical system of NS retail and only picking up cups at these stations can be very expensive.

The cup deposit system also needs to take into account that cups used are less stackable than the paper cups and will need more storage space at stations. Some stations in the Netherlands already have limited storage space and asking for extra space for the cups could pose a problem.

Conclusion

The paper cup is very easy to implement, because it is a solution NS is already using to serve warm beverages. The user owned cup is also to implement because it can be distributed relatively easy within the current NS retail system. The deposit cup will be harder to implement because NS has to change their distribution network and develop a system that can work at their stations. Here they need to take into account that there are stations that are hard to reach and stations that have limited storage capacity.

3.9 Conclusion

Comparing the paper cup, reusable cup and deposit cup it can be said that the deposit cup is the best solution for NS under the right circumstances.

Figure 34 shows an overview of how the user owned cup and the cup deposit system score compared to the paper cup.

Comparing the deposit cup with the paper cup, it can be said that it is more future proof solution, because it is more environmentally friendly.

Comparing the deposit cup with the user owned cup there are a few factors that make it better. The deposit cup scores better on desirability, hygiene and size of the user group.

However the deposit cup also has its risks. There are two factors that break or make the environmental impact of the deposit cup: the energy needed to wash them and the return rate. First lowering the energy uses while washing the cup should be as low as possible and if possible the machine should be run with green energy as both will lower the environmental impact significantly. If the return rate goes below 95% the it will be less environmentally friendly than a paper cup.

Another risk is that the deposit cup is a new concept. This means a system needs to be developed by NS that allows them to use deposit cups. The deposit cup system will NS also cost more money than their current paper cup, which might stop them from implementing the solution.

However most of these risks are manageable through good design and a good implementation. Based on the research from this and the previous chapter a program of requirements is made, see page 68. This is used in the next chapters to look at the implementation of a cup deposit system for NS.

It does not mean that the user owned cup and the paper cup do not have a place anymore at NS stations. The user owned cup is still a very environmentally friendly cup and also provides benefits to user who have specific preferences for a cup.

The paper cup also still has its place. The main reason for this is that switching completely to a deposit cup system will mean that customers who buy a warm beverage and then leave the NS station, because they are going abroad or just wanted a warm beverage, can not buy a warm beverage anymore. These customers could keep the cup till they return to a station but this would be neglecting the benefits of the cup deposit system as a system where customers do not have to bring the cup with them everywhere.

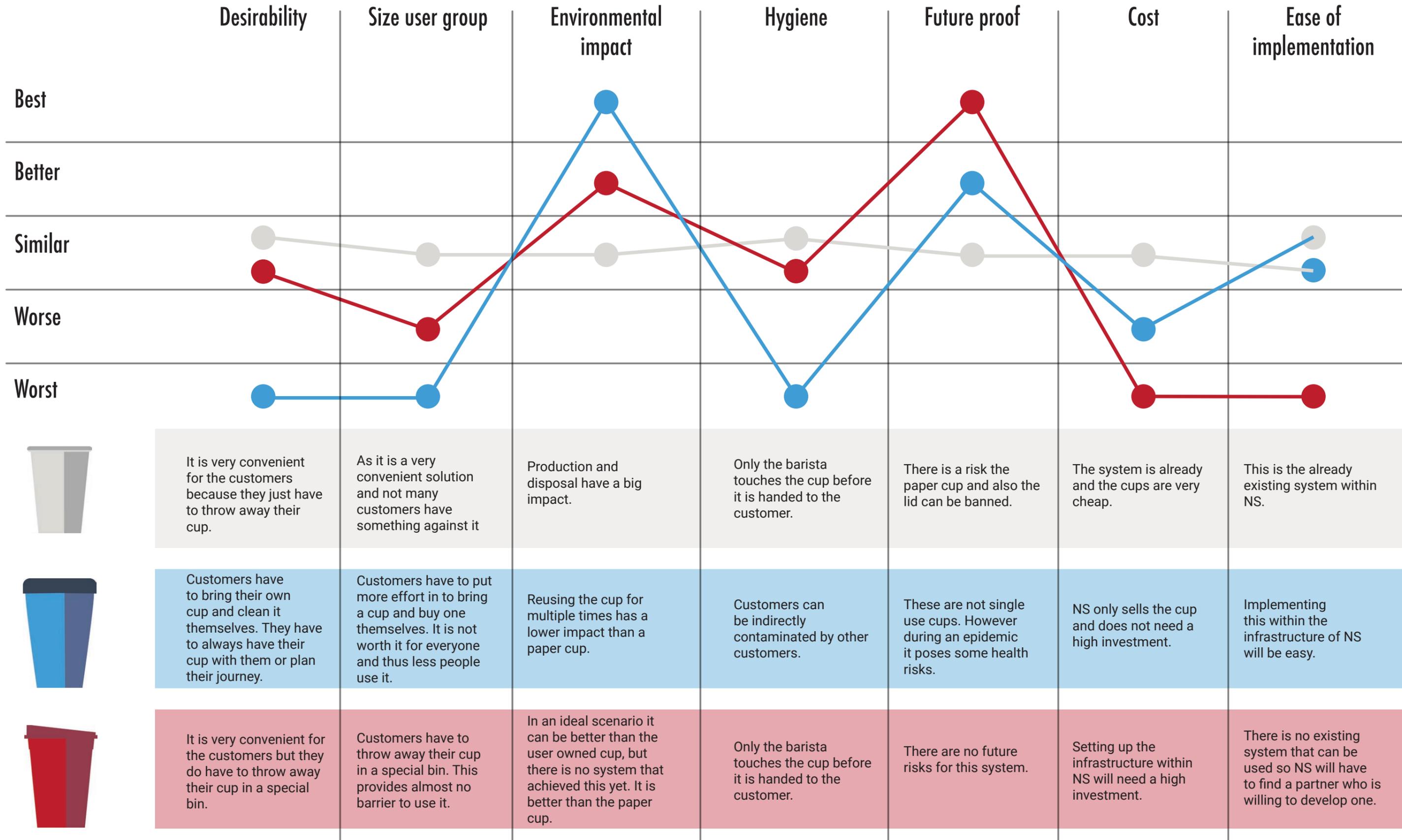


Figure 34: Overview disposable, user-owned and deposit cup



Program of requirements

Demands

Desirability

To give user an opportunity to easily return a cup the amount of bins placed should be able to collect 95% of the warm beverage sold with the deposit cup system.

The deposit cup system should give the customer the possibility to use a lid to limit spillage.

The barista needs to be able to serve the cup within 2 minutes.

The barista needs to actively support the new solution.

User group

The cup deposit system needs to communicate that this solution is better for the environment.

The cup deposit system needs to have other benefits for the customer, because the environmental benefits will not be enough to reach a larger user group.

The cup deposit system needs to communicate what other benefits there are for the customers.

The cup deposit system needs to clearly communicate how the system works at each touch point.

There should be a financial incentive, i.e. pay more for a paper cup, for users to engage user to use the cup deposit system.

The cup deposit system needs to be expandable to allow shops that NS does not won to use the system as well on the stations.

LCA

The cup deposit system needs to have a return rate above 95%.

The washing of a cup deposit system needs to be done with green energy to lower the environmental impact.

The washing of the cups needs to be done with a dishwasher to limit the amount of water used.

Hygiene

The cup needs to be washed according to the hygiene codes in the Netherlands.

Ease of implementation

The logistical system behind the cup deposit system should be able to collect at least 95% percent of the cups at stations.

The should be enough space to be able to store cups at stations.

Wishes

Desirability

I should be clearly communicated why the cups work for the customer.

The cup deposit system should ensure customers it has a cup that will work for them in the NS travel context.

The cup deposit system should inform customers about the environmental impact of a paper cup.

The cup deposit system should allow customers to walk with their warm beverage confidently.

The cup deposit system should improve the taste of the warm beverage as much as possible compared to the paper cup.

The cup deposit system should improve the experience of warmth of the warm beverage as much as possible compared to the paper cup.

The cup deposit system should allow the warm beverage to be served in as little amount of possible.

The cup deposit system should give the customer a better option than the standard option.

LCA

The cup deposit system needs to have a return rate above 98.5%.

Ease of implementation

NS should preferably work together with a partner that already has experience with a cup deposit system.



4. Design brief

4 Design brief

In this research it was found that a deposit cup system would be the best solution for NS to lower the environmental impact of their cups based on desirability, feasibility and viability. There are still a lot of challenges to implement this solution. To solve these a problem, project goal and a design vision are formulated.

Specific design problem

In NS stations stores use mostly paper cups to serve their warm beverages in, which has a significant environmental impact. For customers there is the possibility to bring their own cup, but they are not motivated enough. The previous chapters show that a cup deposit system can potentially motivate customers to use a reusable cup more.

At the moment there is no cup deposit system that fits the needs for the context of the NS stations. This means that a new system needs to be designed for NS.

This new cup deposit system needs to take into account that to keep the environmental impact low the return rate should be at least 95% and the cups should be washed with green energy.

The cup system needs to be intuitive and easy to use and it also should use as much as possible of the existing NS infrastructure to make it easier to implement.

Specific design goal

The specific design goal of this project is:

Design a cup deposit system that has a return rate of at least 98.5% and motivates customers that buy a warm beverage at NS stations to use a reusable cup instead of a single use paper cup, by taking their drivers into account, while at the same time fitting inside the constraints of the NS retail system. This will lower the environmental impact of cups for warm beverages sold at NS stations.

Design vision

This design vision focuses on how customers should feel when they use a cup deposit system.

The main emotions the customer should feel are confident, relax and proud.

The user needs to feel confident enough to use the system, because it is a new system and customers could feel insecure to use it.

They need to feel relaxed because traveling especially during rush hour, when most warm beverages are bought, can be very stressful. This closely relates to being confident as stress can be relieved when customer know how something works. However it is also influenced by how the system works itself. For example that the customer is able to hand in their cup easily at many drop of points.

Proud is an emotion that was found in the context mapping research. Customers felt proud when they were washing the cup because they knew they did something good for the environment. Keeping this emotion in this interaction will improve the overall interaction a lot.

Next to the main emotions customers feel there are also a few sub emotions that are focused on the specific personas.

An overview of how each emotion can be used at each step can be found in figure 35.



Touch points

Confidence

While the customer is planning the journey the app can already give information about the cup deposit system. This can give the customer more confidence to use the system.

Fascination

At this moment the app can be used to fascinate the user for the new system by showing the benefits of the deposit cup.

At this moment it is hard to influence the user with touch points. However advertisements could be used to promote the warm beverages and the cup deposit system.

Relaxed

Because a warm beverage is often bought during rush hour queueing can be very stressful. Due this high stress level the customer might choose for the saver option which they already know, the paper cup. ensuring them they are able to get their warm beverage in time will make them more relaxed.

Relaxed

Because a warm beverage is often bought during rush hour queueing can be very stressful. Due this high stress level the customer might choose for the saver option which they already know, the paper cup. ensuring them they are able to get their warm beverage in time will make them more relaxed.

Relaxed

Drinking the warm beverage is a moment for the customer themselves and the product should allow to relax and not worry about where they for example have to hand in the cup and if they will get their money back. Providing this information is again possible via the cup and the train advertisement screens.

Confidence

This is the moment the customer will get confidence to use the system the next time they buy a warm beverage at a NS station.

Proud

Proud was one of the positive emotions many reusable cup owners felt when they were cleaning their cup. The deposit bin is the perfect place to remind them they did something good for the environment.

Confidence

Confidence is another important factor to convince the customer to choose for a deposit cup. The Kiosk can show information on how the system works and that it is reliable can improve the confidence of the customer.

Confidence

Confidence is another important factor to convince the customer to choose for a deposit cup. The Kiosk can show information on how the system works and that it is reliable can improve the confidence of the customer.

Confidence

At this moment the user is confident enough to decide to use the deposit cup. However at this moment it is important that the customer also has the confidence in themselves to bring the cup back. This can be achieved by providing the customer with information about where and how they can hand in the cup via the cup itself and information screen in the train.

Treated

The personas showed that the emotional buyers want to treat themselves. Taking this into account it might be wise to treat these people kindly to make them feel more at ease.

Treated

The personas showed that the emotional buyers want to treat themselves. Taking this into account it might be wise to treat these people kindly to make them feel more at ease.

Fascination

At this moment the adds in the Kiosk can be used to fascinate the customer for the new system by showing the benefits of the deposit cup.

Fascination

At this moment the adds in the Kiosk can be used to fascinate the customer for the new system by showing the benefits of the deposit cup.

Joy

As most participants said they felt joy while drinking the warm beverage this is an emotion that should be kept. The cup can influence this by improving on the taste of the warm beverage.

System design

Relaxed

Another point where the deposit cup can provide relaxation is when the customer has to walk with the cup. This is one of the most stressful moments for a customer during their journey and the deposit cup should allow the customer to close it off.

Relaxed

Finding a bin should be relaxed. When customers leave the station they all want to do it as fast as possible. They do not want to be held up by searching for a deposit bin.

The quality drinker ●● The emotional comfort seeker
The efficient regular drinker ●● The self treader

Figure 35: Overview of emotions of the customer journey





5. Idea generation

5.1 Idea generation

For the ideation phase three creative sessions were organized: one with a NS graduation student and two sessions with TU Delft students from the industrial design faculty, see figure 36. More information about the session can be found in appendix 14.

Next to the ideation phases with students there were also ideation phases conducted with NS personnel. These were focused on specific sub problems of each department and how these could be solved.

Based on earlier research and an analysis of hand in methods and pay back methods, see appendix 16, three concepts were generated, see figures 37, 38 and 39. These focused on the part where customers drink out of the cup and hand in the cup. It did focus on earlier parts because when the customers buys the cup it should be just like buying a warm beverage in a paper cup. The ideas from the three session, visible in appendix 14, and the brainstormings with NS personnel were used to enrich the ideas that already came up during the research process.

The resulting concepts are described in this chapter. One of these concepts was chosen. This chosen concept will be further developed in the next chapter.



Figure 36: Creative session

1. The bare minimum concept

This concept is focused on providing a cup deposit system that is easy to use and efficient. This concept does not need electricity which means it is easy to place on every spot of the station. This allows NS to place at every exit and it ensure that customers can find it easily.

For the interaction this concept relies on two very simple principles. When the customer places the cup in one of the holes it first slides slowly into the bin till it reaches a point and falls down on one of the cup stacks. The slow movement could spark some satisfaction and the sound of the cup dropping provides the customer with a confirmation that the cup is in the bin.

The bin can be placed in the train, next to a retail partner or on the platform.

The money is paid back directly via the bank card or deposited onto a savings card.

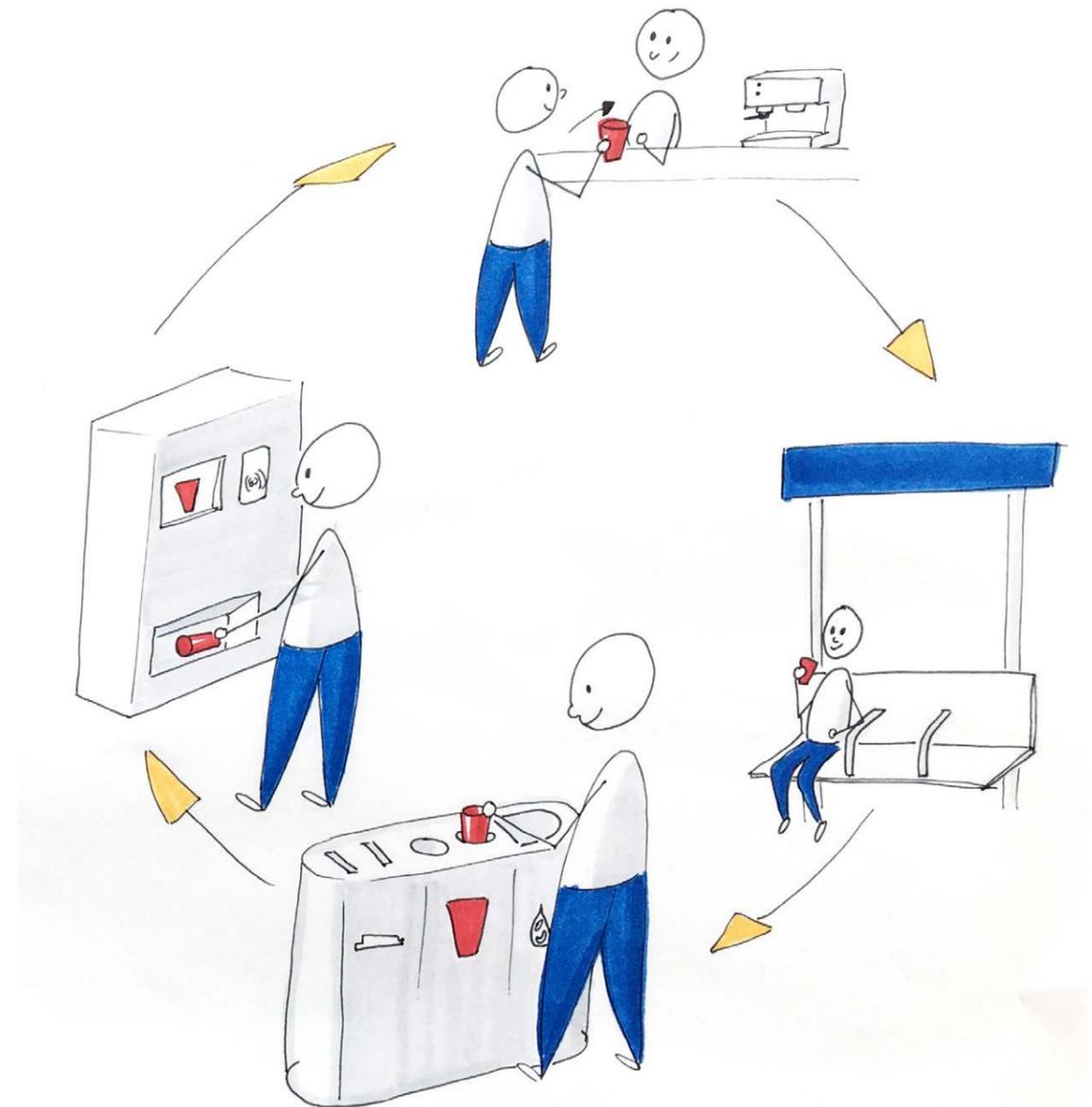


Figure 37: Explanation of the bare minimum concept.

2. The exclusive concept

This concept is focused on exclusivity. Each part of the journey is designed with the customer in mind that is willing to pay more for their warm beverage to get a good surface. It starts with the cup itself, this cup is rounded and has a handle to provide the customer a firm grip on the cup. The cup also has a specific shape to let a warm beverage taste as good as possible. Handing in the cup can be done or by rail catering when they are in the train. When this is not possible the customer can hand in the cup at a retail partner of NS. The money is paid back directly via the bank card or deposited onto a savings card.

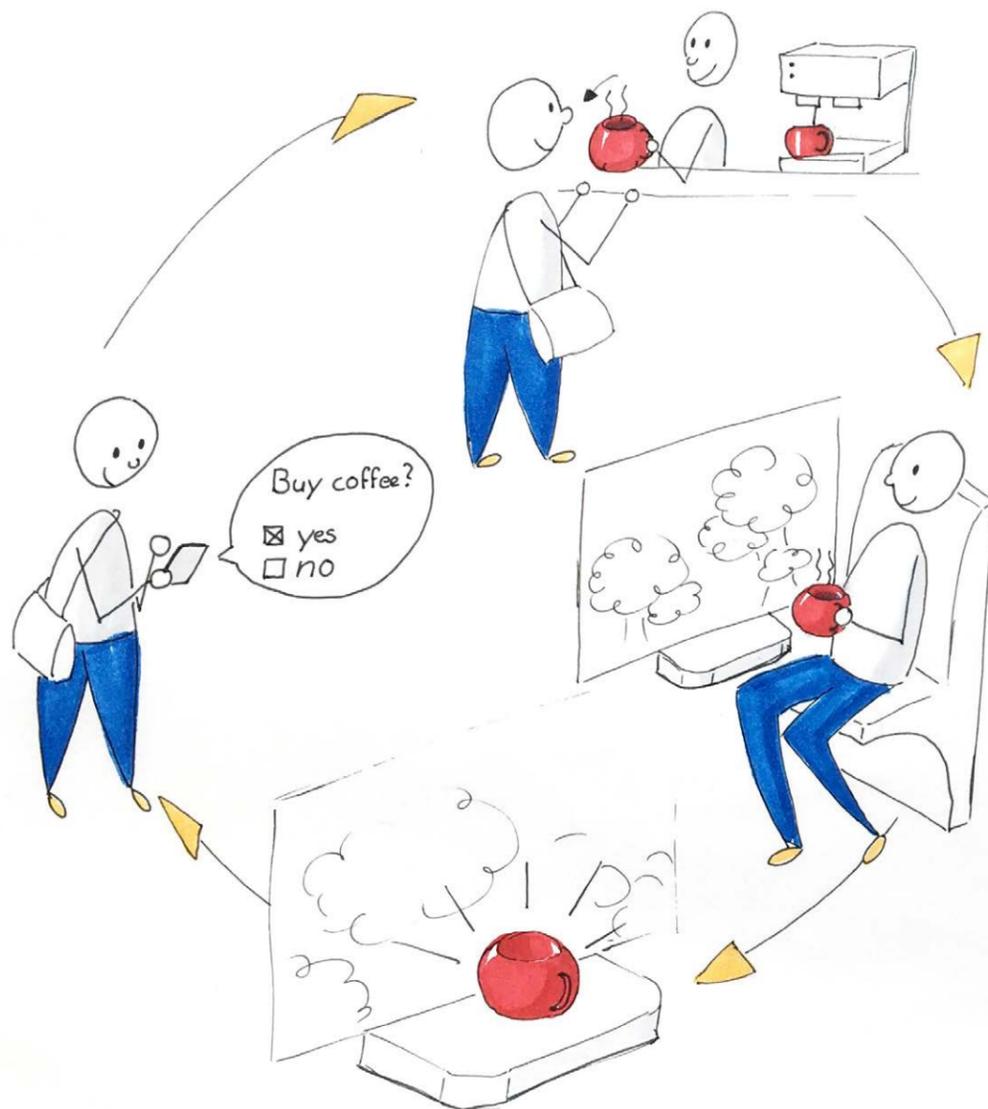


Figure 38: Explanation of the exclusive concept.

3. The interactive concept

This concept is focused on making the interaction between the user and the cup deposit system as enjoyable as possible. On the cup this is done via informative quotes and a QR code that provides the customer information on where the cup has been. The machine where the cup can be handed in has a screen that provides the customer with positive feedback. The machine also provides the user with sound feedback when the cup is handed in.



Figure 39: Explanation of the interactive concept.

Conclusion

In the end it was decided to continue with concept 1. As NS is very focused on providing a service for all their customers and concept 2 will be too expensive for most. Concept 3 is more feasible, but here the need for a source of energy limits the placement of the machine a lot. This means fewer machines can be placed and it will be harder to cover all the exits of a station.

This does not mean parts of these concepts are not useful. The link to a bank card in the exclusive concept is used for the new concept as this is way more useful in the NS context.

The AR animations from the interactive concepts could be used as a promotional activity with the cup. If NS wants to do a promotion stickers with QR codes can be placed on the cups so customers can scan them and look at a specific animation.

The bins of the interactive concept can also be used as hero bins to promote the use of the deposit cup system at large stations.



6. Implementation of a deposit cup system at NS

This chapter explores how NS can implement a cup deposit system. It first looks at the desired interaction for the customer. This desired interaction can be achieved through both the touch points and the technical aspects of the system. Touch points are the points where the customer interacts with the products, while the technical aspects enable the system to function.

Based on this each touch point is first designed. After this the technical aspects are designed in such a way the desired emotions of the touch points can be achieved. The technical aspects also focus on the viability of the product. In the end an overview of the touch points and the technical aspects are presented.

6.1 App/website

Many people use the NS app or website to plan their journey in the Netherlands; the NS app has 2 million users. This is also the first possible touch point with the customer. Additionally It is a touch point where customers are referred to from other touch points, because this is a touch point customer can reach from almost any place using their phone.

The goal of this app is to make the user feel confident in using the cup deposit system, as well as feel fascinated by the system itself. To allow the customer feel confident in using the cup deposit system they are provided with information on how the system works. They are also provided with information on where they can hand in the cups. Other concerns they might have are addressed in the FAQ, frequently asked question.

To make the user feel fascinated with the new system, the app also shows the benefits of the new system for the user, namely the improved drinking experience and the improved environmental impact.

Figure 40 shows an overview of the needed pages in the app or website.

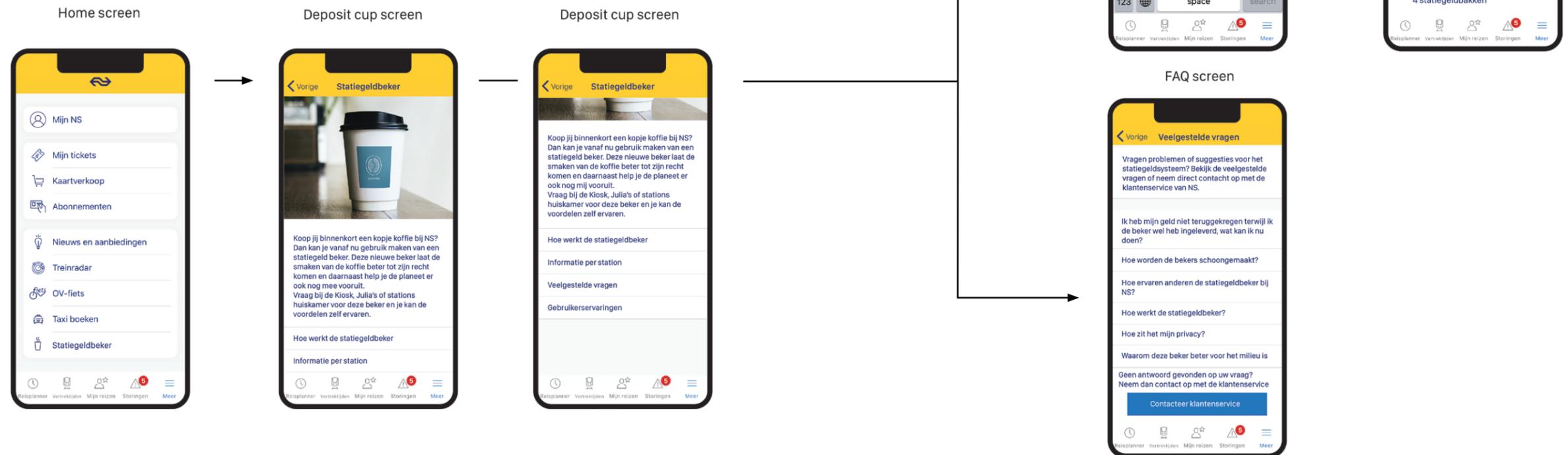


Figure 40: An overview of the needed pages in the app or website.

6.2 NS store

The NS store is the second important touch point of the user. This is the point where the user needs to be convinced that the deposit cup is a better alternative than the paper cup.

This is achieved by three objects in the NS store and the barista themselves.

Figure 41 on the next page describes each element and the design choices that can influence the user in the NS store. The elements in the NS store explain each step of the process of using the deposit cup to help the users feel more confident in using the system. This will also make them feel more relaxed. In addition to the elements focus on the improved drinking experience, which might fascinate customers. The elements also focus on providing this information in a kind, personal manner which allows emotional warm beverage customers to feel more at ease.

The barista can also influence the customer by having a slightly different conversation than they normally have. Here they ask which cup the customer wants, to make the customer consciously choose for a type of cup instead of presenting the paper cup as the standard solution. The barista can also help the user build confidence by explaining them how the system works.

The element that are discussed are:

1. Poster
2. Information board
3. Cup placement
4. Conversation with the barista



Figure 41: Elements in NS store

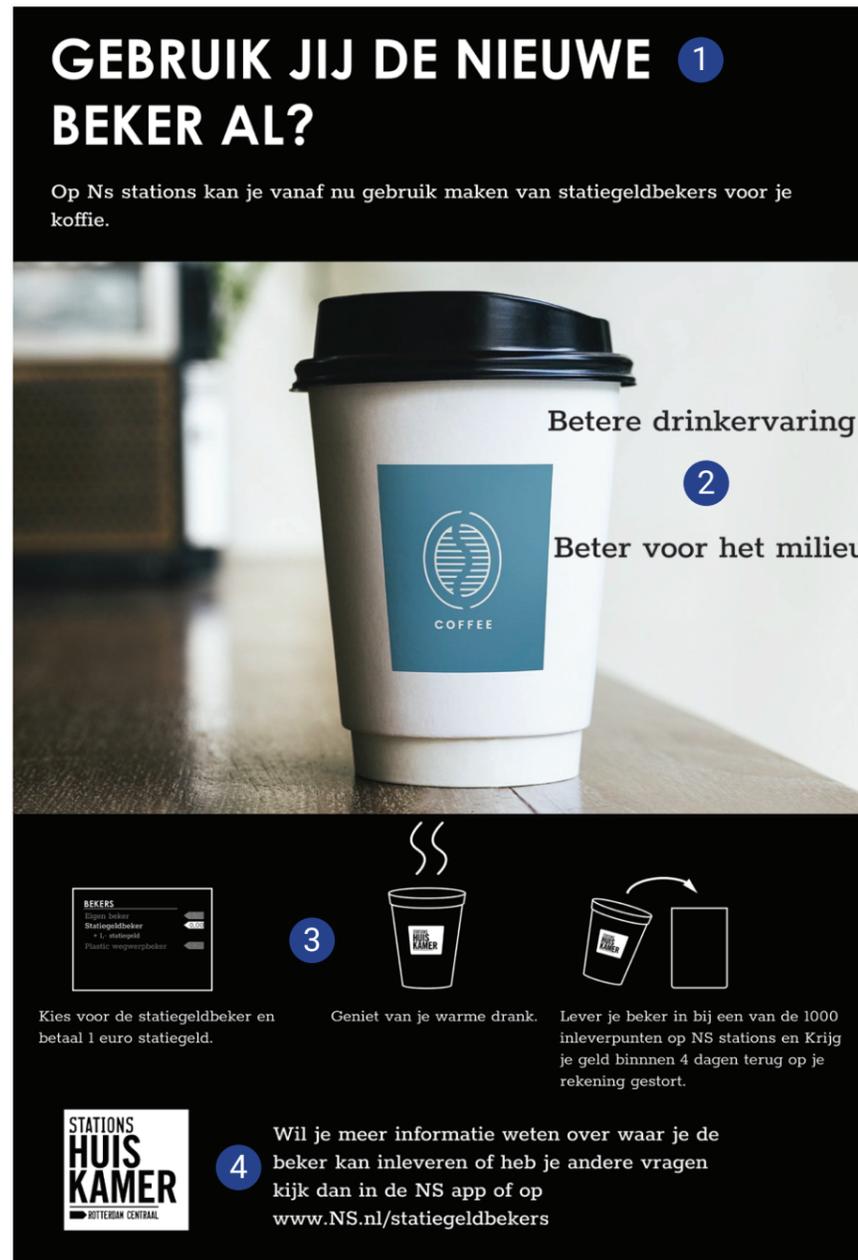


Figure 42: Information poster for a Stationshuiskamer

1. Poster

This poster is hung in the store so customers can read it when they are waiting to order their warm beverage. The poster used to make the users feel confident to use the cup deposit system and it is also used to make them feel fascinated with the new system based on the wishes of the quality drinker and the efficient regular drinker personas. To also take the emotional comfort seeker and the self-treater into account the second step of the process focuses on the warmth and the quality of the beverage itself

1. The title focuses on the fact that the cup of the cup deposit system is new and is better than the paper cup. It does not focus on the deposit part as some customers might be put off by that.
2. The cup focuses first on the drinking experience instead of the environmental part to show the customer the warm beverage experience improves by choosing for this option. This was done based on the research found in chapter 3.3.
3. This explanation is used to make the user more confident in using the system.
4. This part provides the customer with more information so customers can become more confident by having their questions answered.

TIJD VOOR EEN WARME DRANK		THEE & MEER		BEKERS	
Capuccino Extra Sterk	2,70	Warme Chocolademelk	2,70	Eigen beker	0,00
Capuccino	2,50	Diverse Soorten Thee	2,50	Statiegeldbeker + 1,- statiegeld	0,00
Koffie Verkeerd	2,50			Plastic wegwerpbeker	0,25
Koffie	2,20				
Dubbele Espresso	2,70				

Figure 43: Updated information board for a Stationshuiskamer

2. Information board

1. The added cup part shows the total cost of each cup. Here it becomes very clear for customers they are paying more for the paper cup and less for the reusable cups. Research showed that when customers have to pay instead of getting a discount they are more motivated to use the less expensive option (Lenaghan et al., 2019), (Poortinga & Whitaker, 2018). The board also provides information about the amount of deposit that has to be paid.
2. The deposit cup option is the middle option which might result in that customers choose it earlier based on the compromise effect (Simonson, 1989). Because the user-owned cup is often seen as giving up a lot of comfort as a user for the environment. The paper cup is worse for the environment but is also very convenient. Providing a middle option might move customer to earlier choose for that option as they do not need to give up a lot of comfort but are still good for the environment.
3. It uses "plastic wegwerpbeker" (plastic single-use cup) instead of "papierbeker" (paper cup) to show that the cup is single-use and that it is plastic in the cup.



Figure 44: Cups for in the Stationshuiskamer

3. Cup placement

The cups are placed on a prominent spot in the shop. This is based on a principle that Starbucks uses to sell their reusable cups. By placing them near the counter it is even easier for the customer to choose to use one of the cups.



Figure 45: New standard conversation of barista

4. Conversion with the barista

The conversation the barista will have won't be much longer. The barista only has to ask if the customer wants a deposit cup. This is done to show that the barista supports the cup. By asking this question it is also presented as a standard, which might make it more likely for the customer to choose this option. The conversation could be longer when the barista has to explain the deposit cup system to the traveler. However, it is reasonable to assume that this will mostly will happen at the introduction and that eventually everyone understands how the system works.

6.3 Cup

The cup is also a very important touch point, because after the customer leaves the store this is the one source of information they have with them during their train journey. It can also provide the customer with a better drinking experience.

The design and more information about the cup and the lid can be found in this chapter. Inspiration can be found in appendix 15.

Cup design

The main design of the cup can be found in figure 46 and it takes into account the following principles:

1. The insight of the cup is white because research showed that people think the taste improves. The explanation for this could be the contrast between the dark warm beverage and the light cup.
2. The rim is used to attach a lid. The rim is rounded off to improve the drinking experience.
3. The color of the outside of the cup is red. Research showed that people experience that the warm beverage in a red cup is warmer than for example a blue cup (Guéguen, 2012). According to this paper this can be explained by that people link warmer colors to warmth.
4. The wording on the cup focuses on the pleasures of a warm beverage to take the emotional comfort seeker and the self treater personas into account.
5. The information on the cup is kept simple and refers to the website and app of NS as a source for more information. This might make the user feel more confident and relaxed as they know what they have to do with the cup when it is empty and they have to leave the station.
6. Little feet underneath the rim ensure there is space between each cup when it is stacked so the liquid can flow out of each cup.
7. The feet on the bottom of the cup lift the bottom of the cup from the ground to limit the chance of the bar code being damaged.
8. The bar code on the bottom of the cup is used to track the cup. The barista scans the barcode when the customers orders a warm beverage and when the cup is washed the code is scanned again to know if the cup is handed in.



Figure 46: Design of the deposit cup system



Figure 47: Cup design for each formula of NS.

Branding

The branding is kept fairly similar to the already existing cups at NS. However there are a few differences. The first is that the coloring of the Kiosk cup is inverted so customers experience the cup warmer.

The second change is that the Stationshuiskamer and the Julia's cup now have a red rim. This red ring is a visual link to the bin they have to be thrown in. The cups are not completely red as that would divert too much from the brand style.

The third change is that the Julia's cup has a curved cup to mimic a more traditional mug.



Figure 48: Multiple sizes of cups

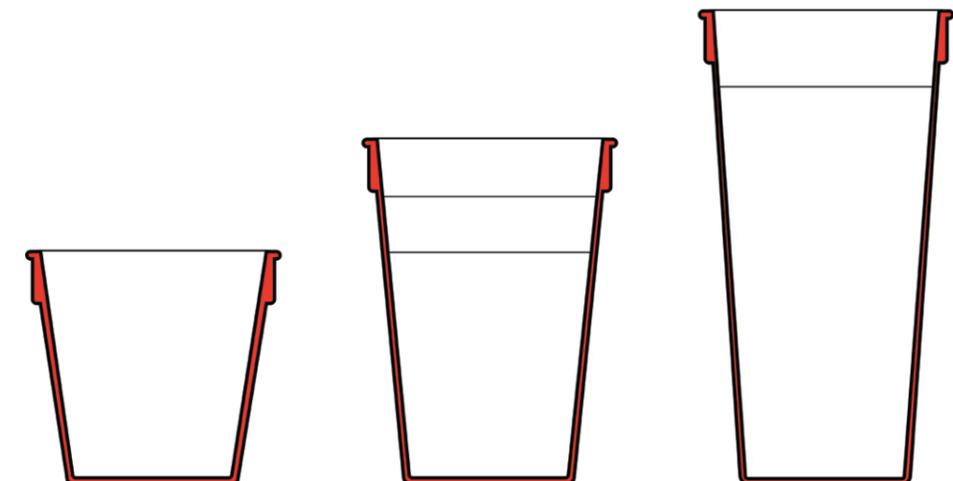


Figure 49: Cross section of the multiple sizes of cups

Size

NS uses three main sizes of cups to serve their warm beverages in: 6 OZ (177 ml), 10 OZ (295 ml) and 16 OZ (473 ml). Because the precise numbers are confidential only a rough explanation can be given. NS data shows that the 10 OZ cup is sold the most by far because it is used for the coffee and cappuccino. The 16 OZ cup is used a lot less than the 10 OZ cup, but still has a significant amount of sales. The 6 OZ is sold very little.

Because the 10 OZ cup is sold most often the main ratios of the cup used in the cup deposit system are optimized for this cup. The 6 OZ cup and the 16 OZ cup are shortened or lengthened to be able to fit their use. The rim is kept the same size between cup sizes, so only a single lid size has to be produced. Between the different cup sizes the rim and bottom diameters are the same. This allows cups of different sizes to be easily stacked together, see figure 51.

Figure 49 shows a cross section of each cup. Here the strengthened rim becomes visible. This is used to provide a firmer grip on the cup and it isolates the warm beverage more from the hand making it easier to hold.

Inside the cup lines are visible for 8, 10 and 16 OZ. This can help the barista to pour the right amount of milk into the cup. This is needed for the cappuccino, cappuccino extra strong and koffie verkeerd.

The lid

User research demonstrated that customers do not like walking with a cup with a warm beverage as they are afraid they will spill the warm beverage. Providing a solid lid for the cup will make people feel more at ease during walking. The lid will be provided as a deposit lid. However, a next and interesting step for NS could be to sell user-owned lids where the user can choose their ideal lid for their drinking experience. This chapter will describe the features of a deposit lid.

1. The drinking hole is based on what other reusable cups are using.
2. The lid informs the user it is a deposit lid. It also shows that there is a warm beverage in the cup.
3. This hole is used to ensure the cup does not form a vacuum during drinking that would prohibit the warm beverage from coming out of the cup.
4. A tab allows the user to easily take the lid off the cup.
5. The lid is green to give the lid a recognisable color that links it to the deposit bin it should be put into.
6. The diameter of the lid is quite a bit larger than the diameter of the rim of the cup to ensure the customer can not put the lid in the hole for the cup.



Figure 50: Lid design

Stackability

In order to transport the cups and lids as efficient as possible, to keep the transport costs to a minimum, they are designed to be as stackable as possible.

The main problem to make the cups stackable is the multiple sizes of the cups. This problem is partly solved by keeping the same rim and bottom diameters for every cup.

In practice the 10 OZ cup is used the most by far, which means that stackability will not be a concern.

The lids are not that stackable due to their design but because they are quite thin they take up little space.

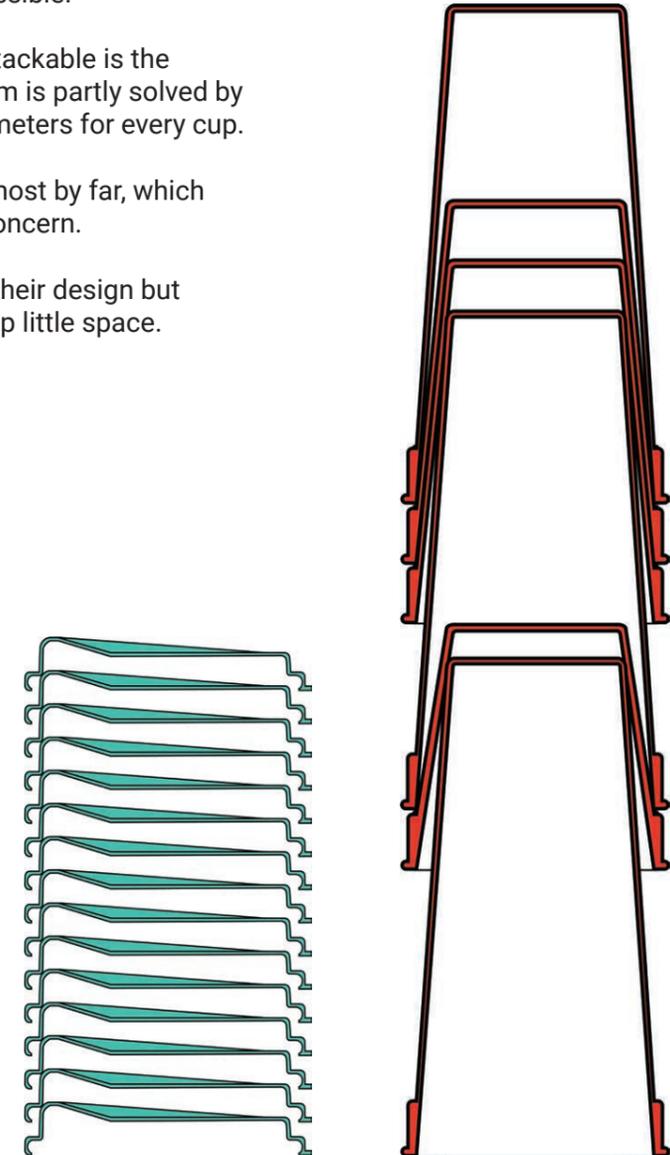


Figure 51: Examples of the stacked lids and cups

6.4 Bin

The bin can be seen as the most important touch point, because it is the point where the customer has to hand in their cup and a positive end experience can be achieved. In this chapter the bin design and placement are explained.

The following design considerations are made for the bin:

1. The information on the bin is kept simple and refers to the website and app of NS as a source for more information. It also focuses on a positive message like "fijne dag!".
2. Each bin accepts both lids and cups, which are stacked in tubes to stack them as efficiently as possible, see figure 51. The bin also provides a general bin where customers can dump their warm beverage left overs.
3. The design of the bin is similar to the design of the existing NS bins to fit into the station based on the design guidelines of bureau Spoorbouwmeester, design agency for NS. The bin is quite low key so it does not distract other travelers. The style of the bins themselves is based on the style bins have at stations now. This does not only fit in the current style of stations but also allows NS to use their standard bins.

4. There are three versions of the bin. The small bin is placed in front of or on the side of Kiosks to allow customers to hand in their cups at the platform. Placing the bins next to a Kiosk is very logical as customers bought their warm beverage there. The medium bin can be placed in a hall of the station or in spaces where there is more room to hand in the cup. The large bin has similar features but it is even larger to accommodate for more cups.

5. Each color of the cup is linked to the respective bin it should be placed in.
6. The same designation for both the cup and the lid is used in the store, on the cup and lid itself and on the bin.
7. The waste bin, cup bin and lid bin are ordered in such a way that the customers first needs to clean their cup then take off the lid and put both the cup and the lid in the bin.
8. There are more holes for the cups due to the fact that cups have different heights and need more space to be stored on average. Additional, it is also expected that not all customers want a lid. This is why for every two cup tubes there is one lid tube.

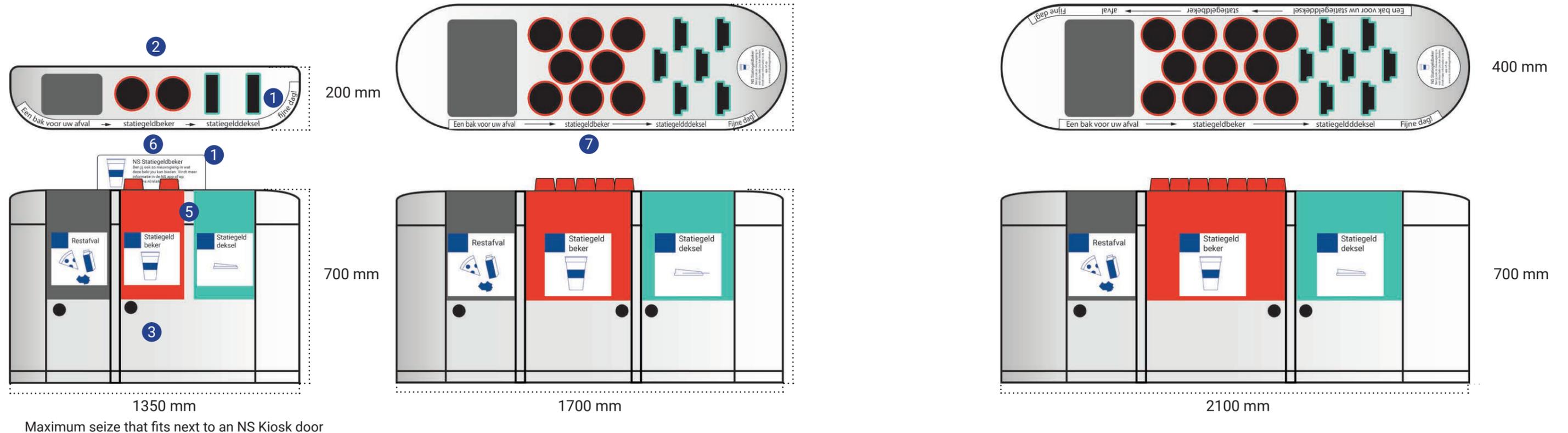


Figure 52: Design of the three bins

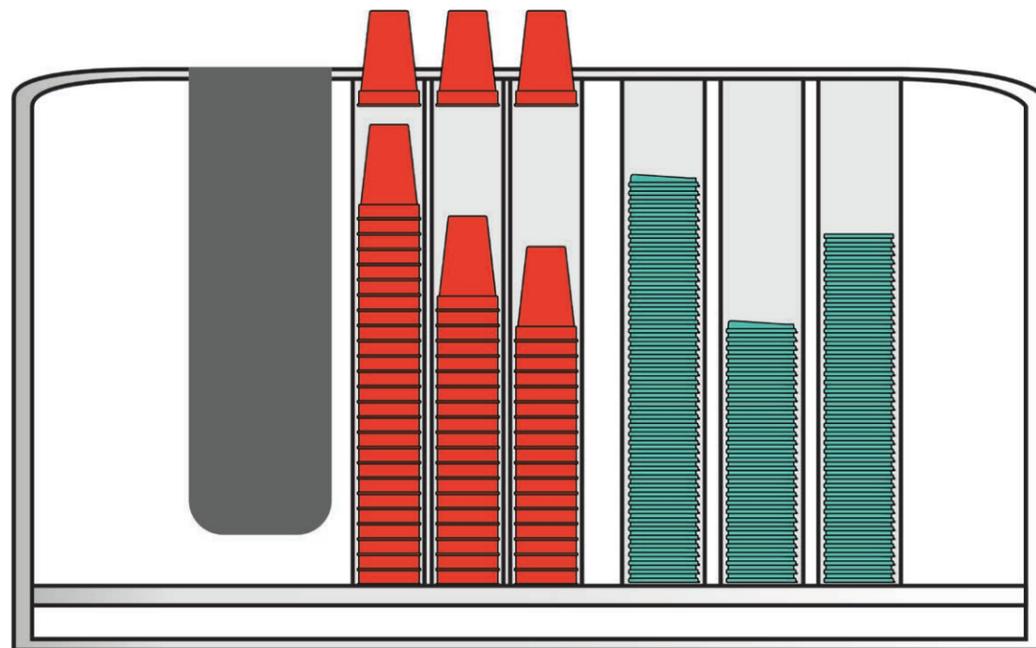


Figure 53: Internal structure of the bin with a waste bag and tubes that hold the cups.

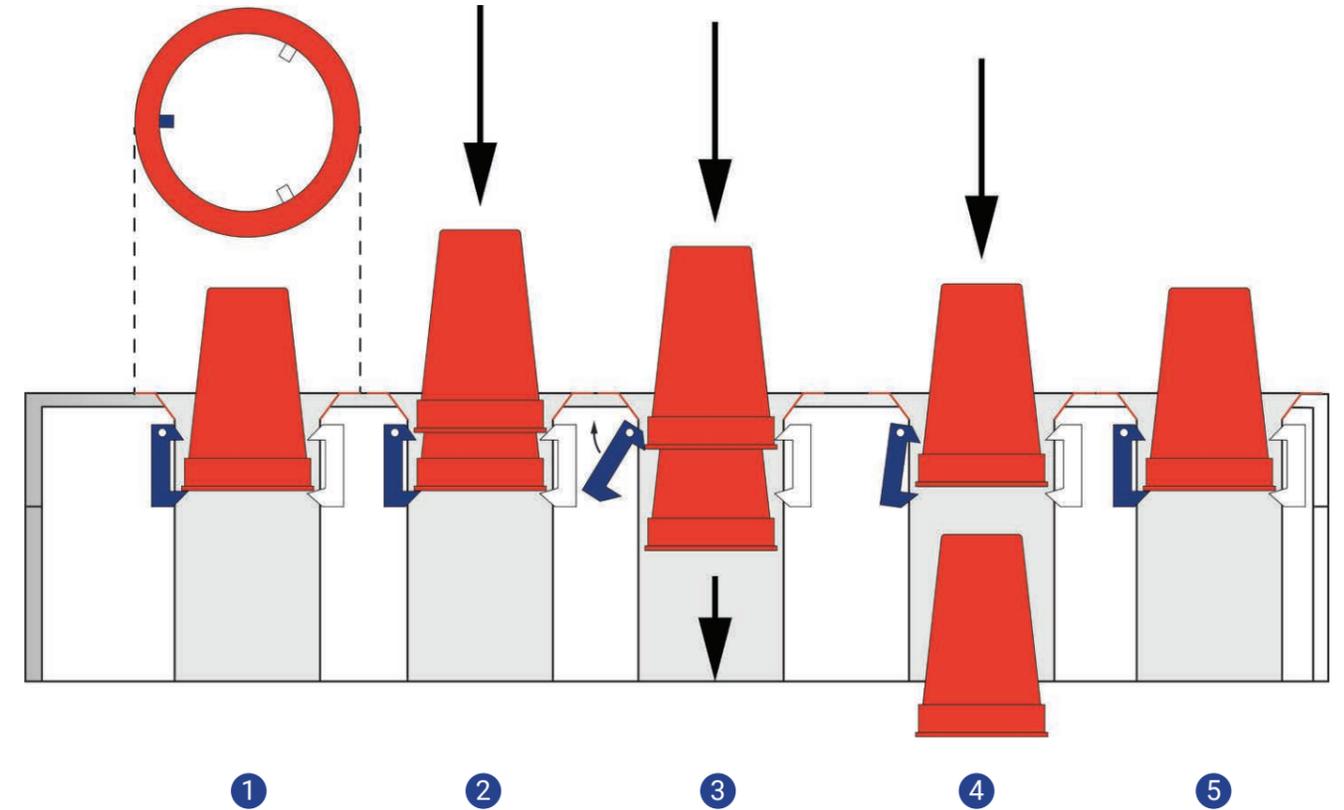


Figure 54: Explanation of the cup mechanism.

Cup mechanism

The mechanism that provides the user interaction is very minimal. Choosing to not use electricity, to be able to place the bins everywhere, and due to the limited amount of noise a product on a station can make, very little possibilities to create a mechanical interaction are possible. However a small interaction is made in this bin. This interaction works with the following steps:

1. This is the standard position of the bin.
2. Now a user pushes their cup on the cup that is already in the bin.
3. By pushing the cup down a small lever is activated by the cup in the collection tube.
4. The lever returns to its original position and keeps the new cup in its place.
5. The bin is back in its standard state.

This system prevents foreign objects from being put into the bins there is always one cup that seals of the tube.

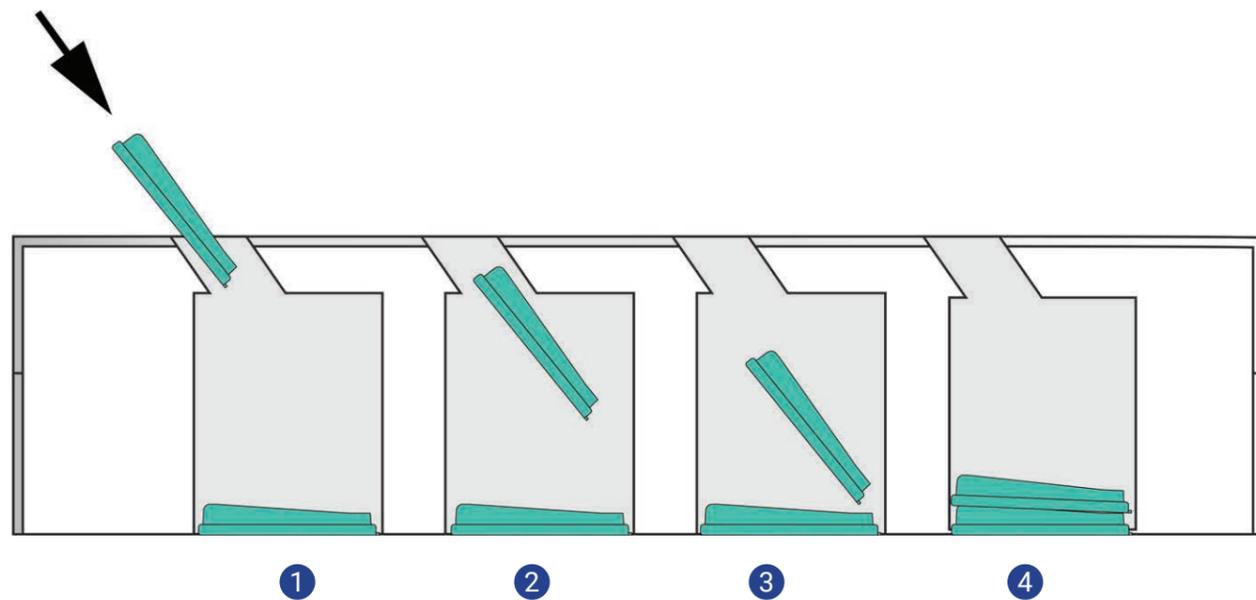


Figure 55: Explanation of the lid receptacle.

Lid mechanism

The lid receptacle is very simple, see figure 55 It uses a slide to ensure that the lids land in an angle so they will neatly stack.

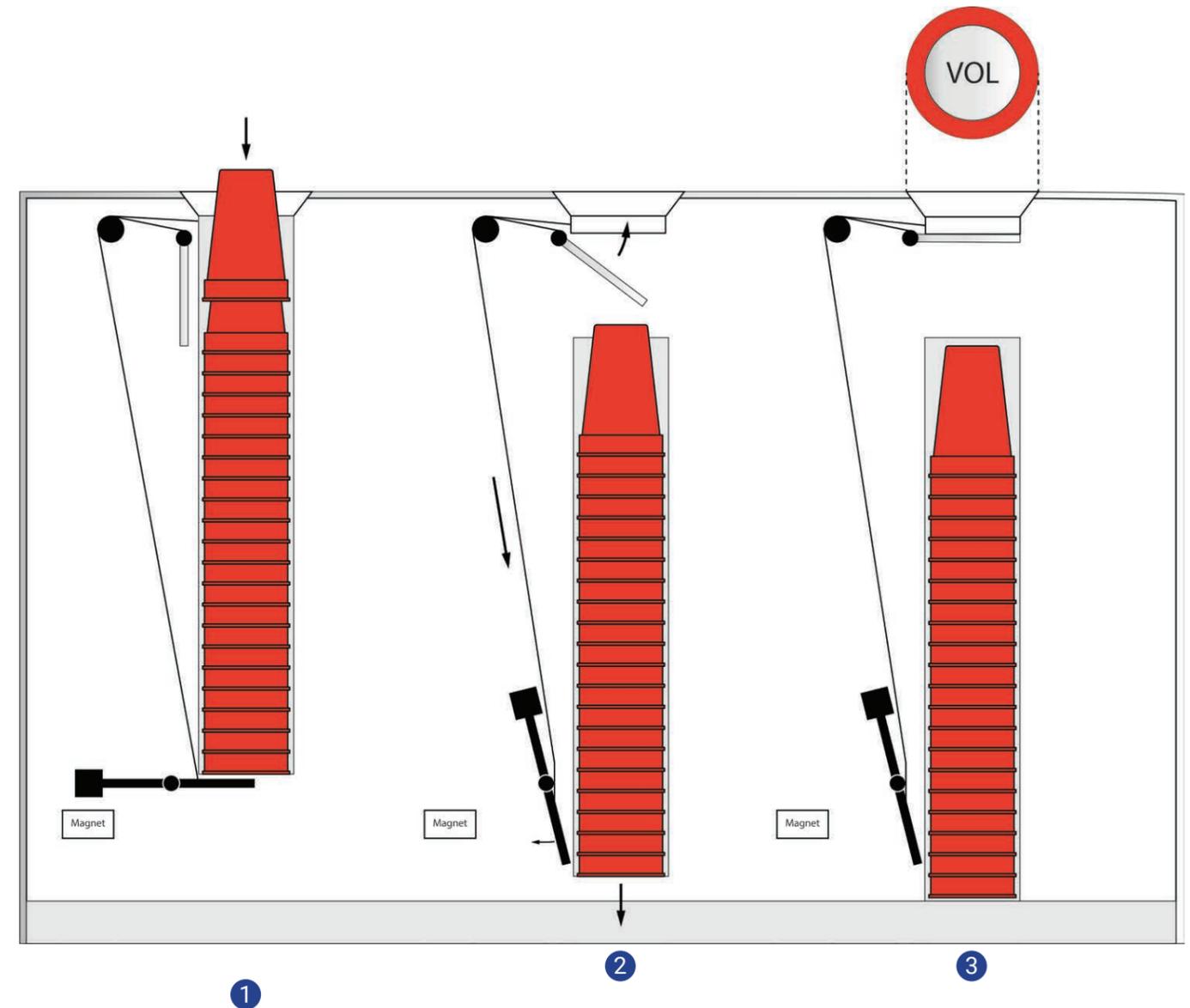


Figure 56: Explanation of the tube mechanism.

Tube mechanism

Because the upper cup blocks the entrance customers can not see when the tube is full. To show this to customer a lid system is designed to close of each cup deposit hole when a tube is completely filled. This is achieved with the following steps:

1. The tube is held in place by a lever that is connected to a magnet which keeps it in place.
2. When the last cup placed in the tube the magnet can not hold the tube anymore and gives out. The lever pivots and activates a pulley at the top of the bin that closes the deposit hole. The pulley is also attached to the pin that holds the last cup in its place so this cup can also fall down.
3. The hole of the bin is now closed of with a sign that says it is full. The tubes can now be taken out of the bin as a whole so any leftovers of warm beverage don't spill over the inside of the bin. After the tubes are taken out, empty tubes are placed and the system is reset.

When the tube is not fully filled logistics personnel can easily push down the tube. The magnet has to hold the weight of 30 cups which weigh around 30 grams each, which means they weigh about 1 kilo in total. This is not a considerable amount of force so logistics personnel should be able to push down the tube by themselves.



Placement of the bins

To get to the return rate of 98.5% it needs to be easy to find a bin for the customer. This is why there are three types of bins:

1. The small bin

This bin is placed next to and in front of the Kiosk to allow customers to easily hand in their cup. Its placement is also why it is so small. On the platform at especially busy stations there is very little space to place a bin and Kiosks are only allowed to have objects protrude 20 cm from their walls.

2. The medium bin

The medium bin is placed onto the platform of a smaller station as there is generally a bit more space on these platforms. However, due to the shape and size variety of these available spaces a smaller version of the medium bin might be necessary to better utilize the available locations.

3. Large bin

The large bin is designed for large stations. There are a few stations that receive more than 2000 cups per day. This means that multiple large bins are needed to collect all of these cups. These bins are placed mostly in the hall of a station. However, placing them here will not go without some hiccups as there still is limited space in these halls.

Both the medium and the large bins can be made modular so NS can only leave a few holes open when a station receives a small amounts of cups each day. This limits the spread over all of the tubes so logistical personnel does not have to take half full tubes with them

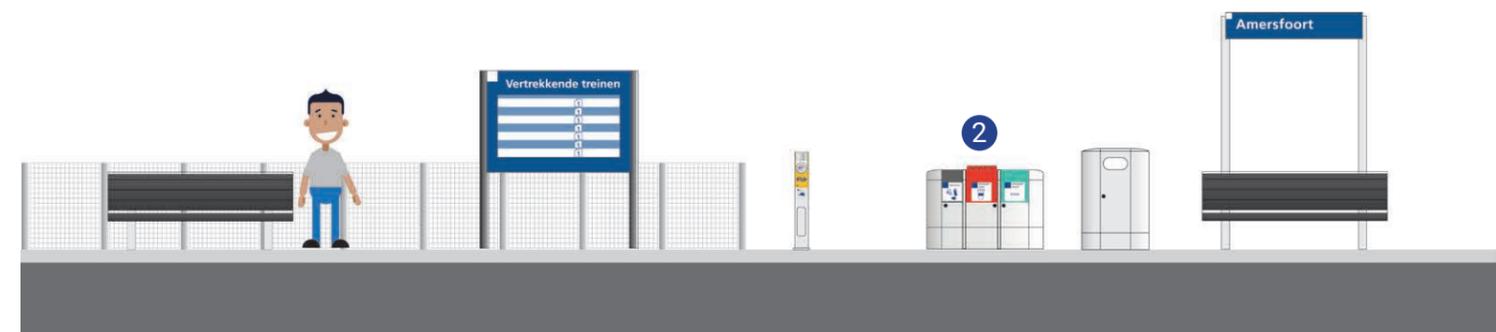
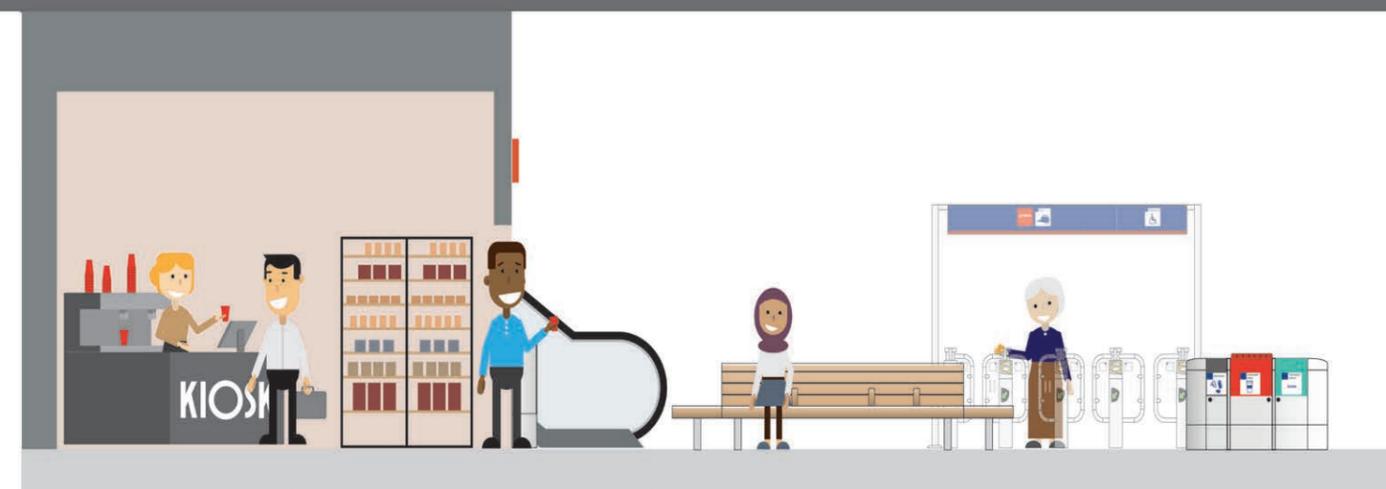


Figure 57: Visualisation of a large and an small station of NS.

6.5 Service for cups

Washing the cups is done with the use of the NS's already existing logistical network. Figure 58 gives an overview of how the system in general works. Afterwards it is shown how the system would work in the existing logistical network of NS.

1. Database service provider

The database of the service provider is closely linked to the NS database. The service provider's database will keep track of the cups from the moment they are in the bin till the moment they are delivered to the NS store.

2. Service provider logistical personnel

The logistical personnel bring the cups from the washing facility back to the stations.

3. NS Logistical personnel

Accepts the delivery from the truck and bring it to the store at the station or to the storage space of that station.

4. Barista

The barista supports the process by scanning the bar-code on each cup so it can be linked to the bank card of the customer.

5. NS database

This database is used by NS stores to track the cups with. A plug-in for the point of sale system of NS will allow the barista to scan the bar code of each cup and link the deposit to the respective customer's bank card. When the cups are handed in, the deposit is transferred back to the bank account of the customer.

6. Washing personnel

In addition to washing the cups, washing personnel scans the bar-code of each cup to determine which customer has handed in that cup. They also inspect the cups and pack them up to for transport to the stations.

7. Recycling broken and worn out cups

When a cup arrives at the washing facility it is first washed and inspected. If it is broken or worn out the cup is sent with other broken and worn out cups to a recycling facility. At the moment it is not possible to recycle PP food safe because that is not possible yet. This could change in the future. However, because the PP from these cups has a high purity it could be recycled into non-food-safe polymers.

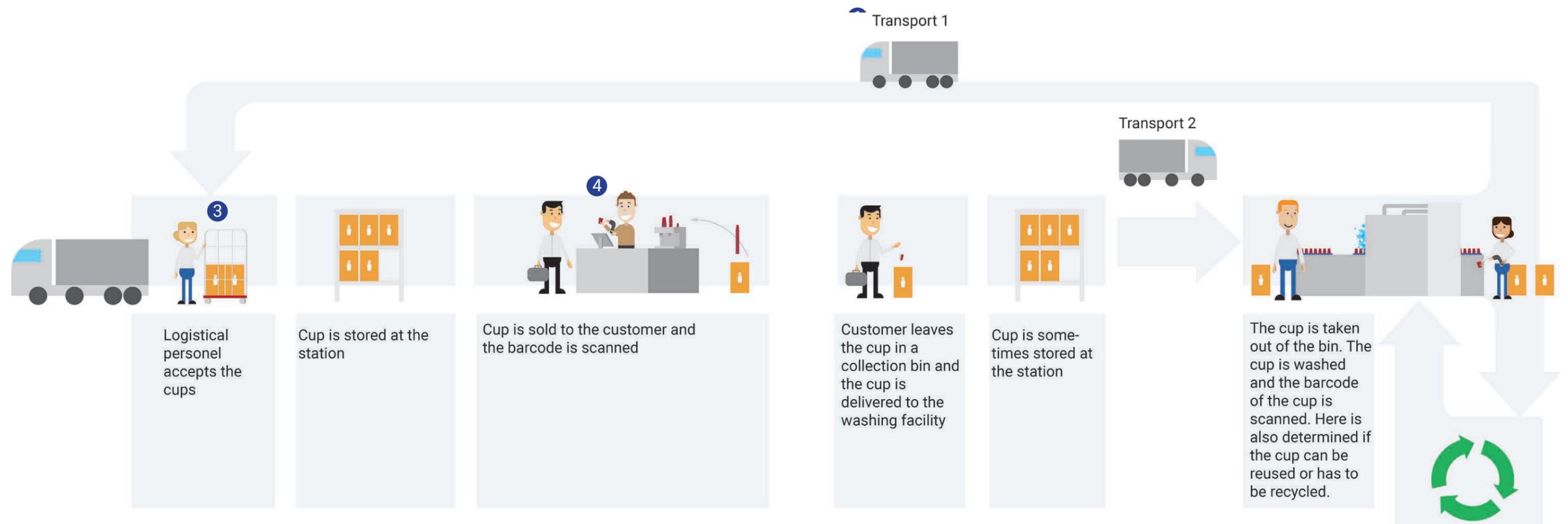


Figure 58: Back-end system of the cup deposit system.

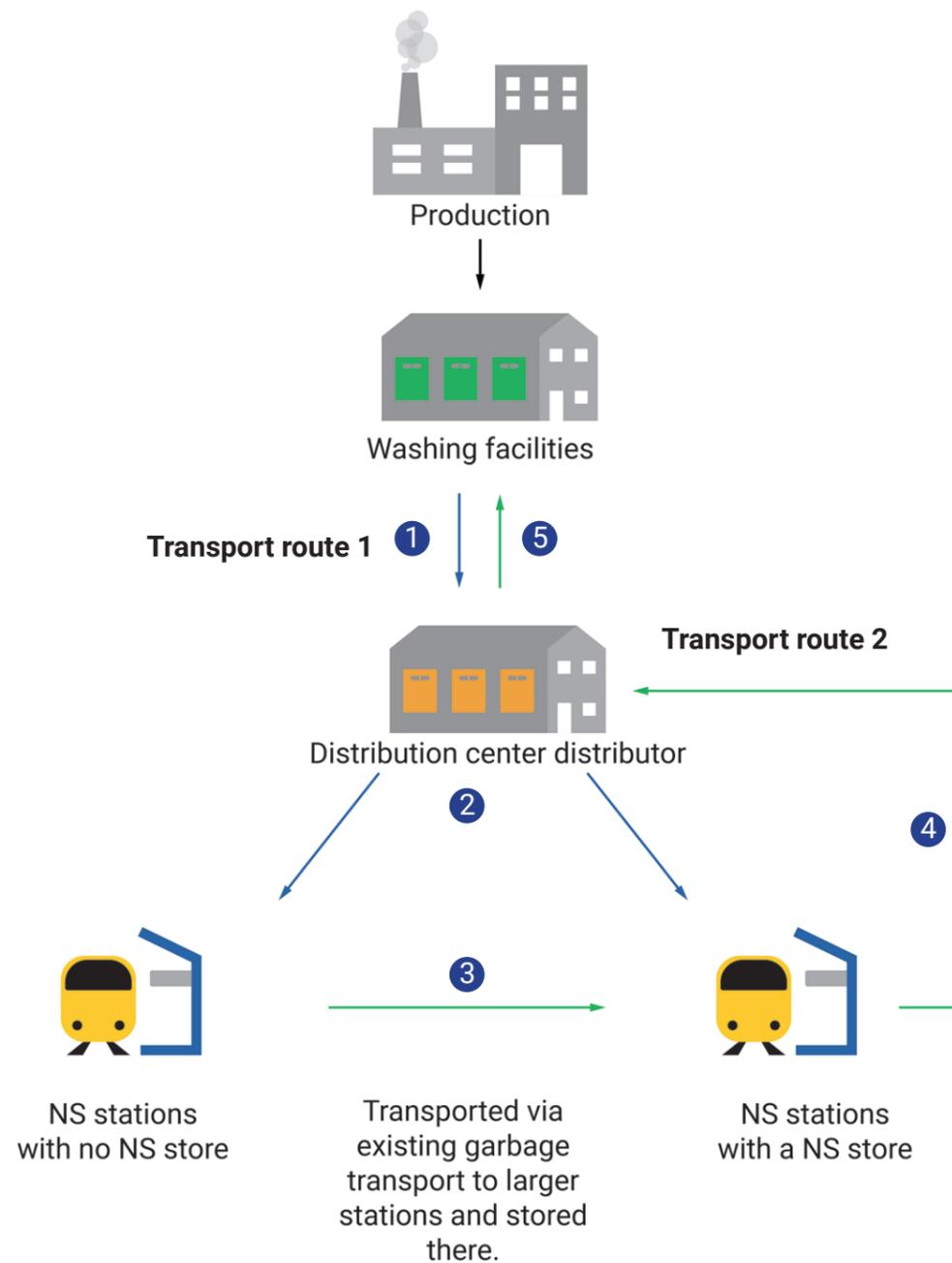


Figure 59: New logistical infrastructure needed for deposit cups

Overview transport system

To be able to transport the cups and lids with the current infrastructure of NS the following system is proposed, see figure 59. First the cup and lid are transported to the washing facility where they are washed. But when they are at the washing facility their journey can be seen as delivering the cups to the station via transport route 1. The cups are returned to the washing facility via transport route 2.

Transport route 1

1. From the washing facility the cups are transported to distribution centers of the NS distributor.
2. In the distribution centers of the distributor the cups and lids are added to the other products that have to go to the station.

Transport route 2

After this the customers use the cup and leave it in a bin at a station. Here there are two routes the cup can take.

3. In the case of a smaller station without a NS store, which means it is not connected to the NS distribution system, it is picked up by a garbage disposal van. This van already needs to go to most stations without a store and there is a chance they can take the cups with them. This garbage van brings it to a bigger station where the cups are stored till the NS distribution system picks it up.

4. In the case of a station with a NS store the cups are picked up by the NS distribution system via return sending.

5. After the cups are returned to the distribution center of the distributor they are picked up by the washing facilities of NS and are washed.

6.6 Road map

This road map shows 4 horizons NS can work toward when they want to implement a cup deposit system. At each horizon multiple tests are conducted so NS can collect more information on how to implement a cup deposit system. Additionally using this information NS can decide if they continue with developing the cup deposit system.

Each research question is linked to the decision they support via red lines. Sometimes it is needed to do multiple tests before a decision is made. This is when the arrow of the questions points at the next research question. If the bar is rounded of at the end this means this question is the last question that needs to be answered to make a decision.

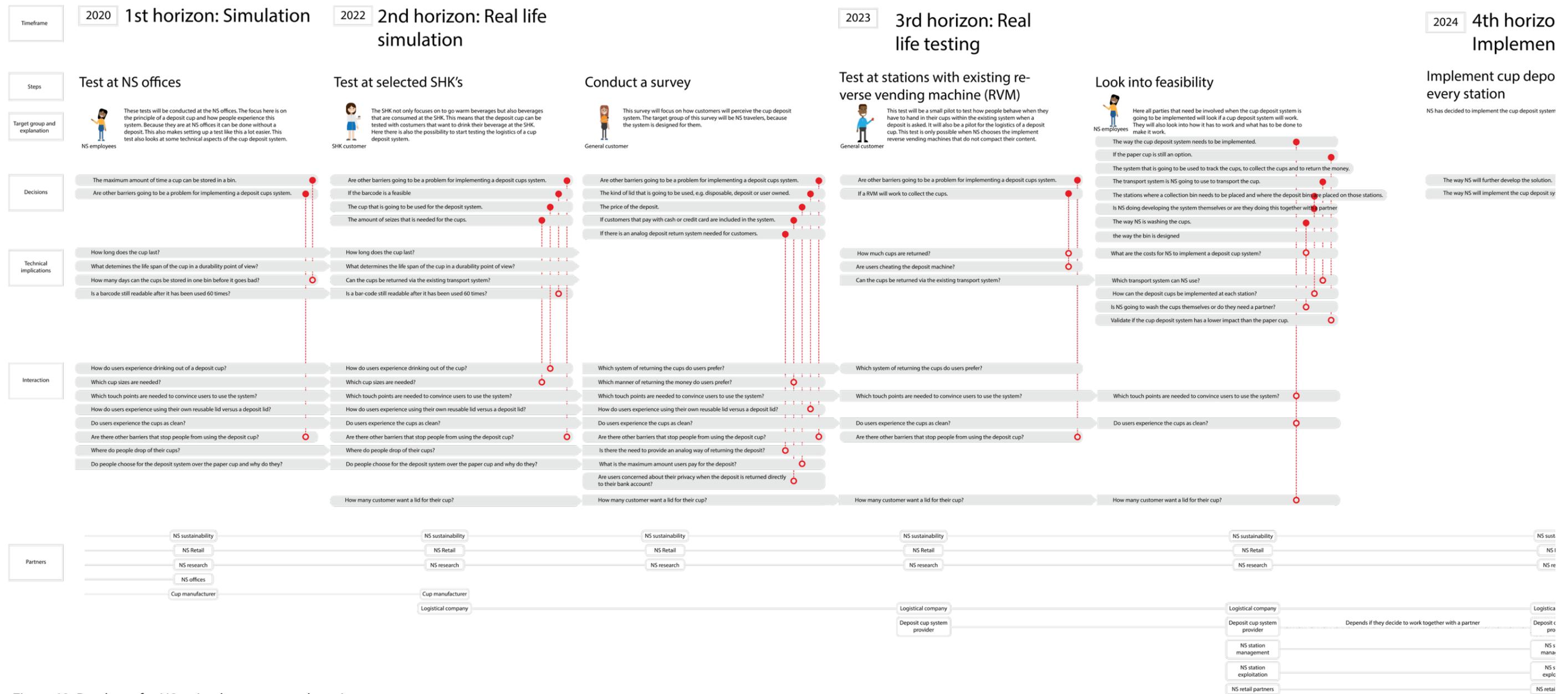


Figure 60: Roadmap for NS to implement a cup deposit system

6.7 Final system

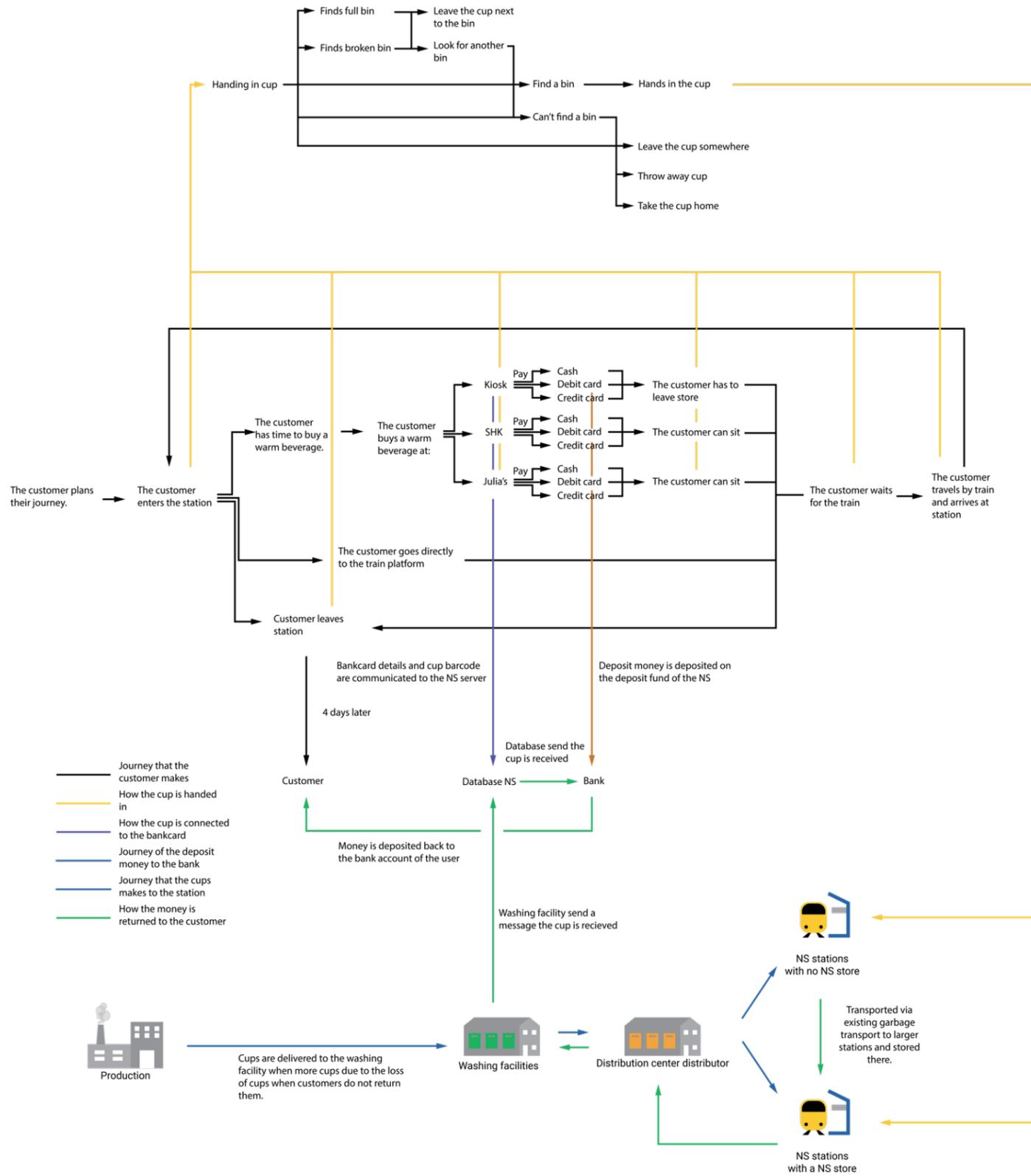


Figure 61: Overview of how each part of the system interacts with each other.



Figure 62: Renderis of final solution

7.1 General conclusion

This graduation project focused on lowering the environmental impact in which warm beverages were drunk at NS stations by motivating user to use reusable cups. It was explored why customers currently do not use reusable cups at NS stations, which solution space can be used to motivate customers to use a reusable cup and how NS can implement this solution space in the NS context.

Different research activities were conducted to understand why customers are not using reusable cups now and how NS can motivate these users. By analysing the results from observations, user interviews and context mapping. Based on the findings 5 barriers were found why customers are not using reusable cups. Which were:

Customers do not want to be responsible for a dirty cup

Customers do not want to bring an extra object with them just for their warm beverage

Customers forget to bring their reusable cup

Customers are afraid they chose a cup that does not work for them

Customers do not see the need to use one as they do not know the impact of their paper cup

Next to these insights 4 personas were created and it was also found how NS can improve the customer experience of drinking a warm beverage at their stations.

Based on these insights two solution spaces were formulated which were compared to the paper cup. It was concluded that the deposit cup system would be the best reusable cup system for under the right circumstances, but that a user owned cup and a paper cup still have their place.

Because there is no cup deposit system that fits the needs of NS stations the following design goal was formulated:

Design a cup deposit system that has a return rate of at least 98.5% and motivates customers that buy a warm beverage at NS stations to use a reusable cup instead of a single use paper cup, by taking their drivers into account, while at the same time fitting inside the constraints of the NS retail system. This will lower the environmental impact of cups for warm beverages sold at NS stations.

Next to the design goal a design vision was formulated to illustrate how customers should feel when using the system taking each persona into account.

Based on the design goal and the design vision multiple concepts were created from which one was chosen and further detailed into a final concept. This final concept was evaluated with experts within NS. To implement the final concept a road map was made, see figure 60.

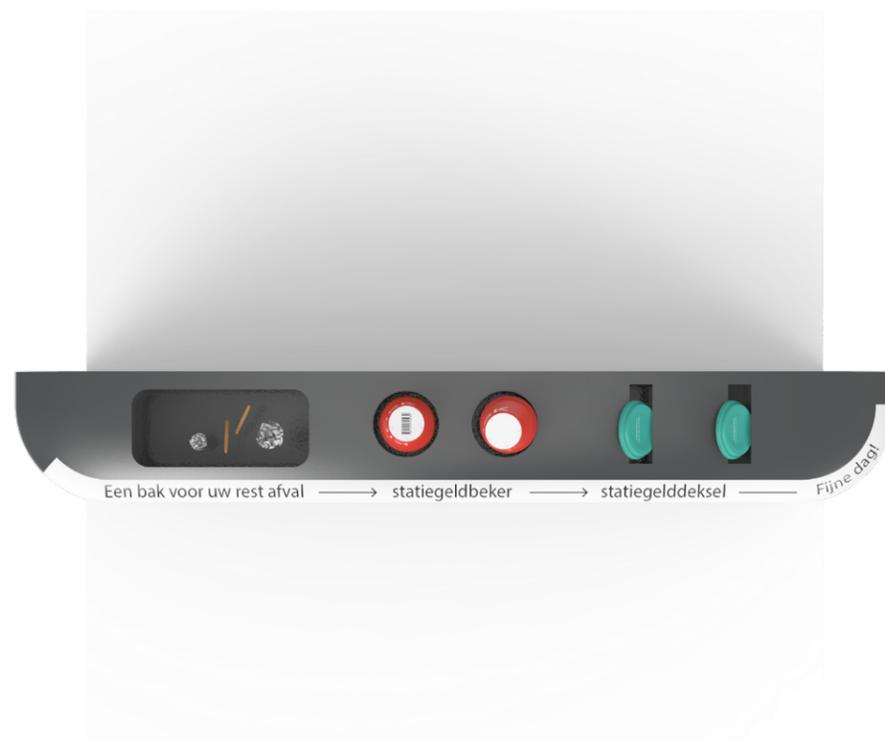


Figure 63: Renderis of final solution

7.2 Limitations

In this project there were multiple limitations which are discussed below.

Limited test capabilities

The limitation that impacted this project the most was that Corona made testing a reusable cup system very hard.

This resulted in that the final concept could not be validated with user. Especially in the case of a cup deposit system testing is very important. It is a new kind of system customers are not used to. The user is an integral part of this solution especially because the return rate needs to be very high to make this system a success. This is why quite a few assumptions were made during this project which need to be validated. For this reason a road map was created to show how NS can implement a cup deposit system with the help of testing.

The final concept is however evaluated with the help of experts within NS to be able to improve the concept.

Design limitations

NS has a lot of different stations with their own set of demands. During this project it was tried to keep most demands into account but a few could have been missed. This means that NS should work together with the station manager to be able to implement a cup deposit system successfully at each station.

Project limitations

Due to the complex nature of designing a cup deposit system for NS the concept that is delivered in this master thesis should be seen as a starting point for NS. This project focused on interaction while keeping the feasibility in mind. However this still means that a lot of feasibility need to be further detailed which can change the design significantly. For this the road map also provides some guidance.

7.3 Recommendations

The recommendations are divided into two parts. The first is for how NS can continue with this concept and the second is how NS can lower their environmental impact without a paper cup .

Recommendations cup deposit system

Most recommendations are already described in the roadmap. However there are a few key aspects are very important to keep in mind.

Keep the fire going

Because implementing a cup deposit system is complex to implement it is very important to keep moving forward. Because there is no regulation yet that forbids paper cup there is no direct incentive for NS to change to a deposit cup system.

This why the project that develops this project further should have an enthusiastic case manager who has both knowledge from the retail side of NS and sustainability and is willing to push this project forward. This is why the road map is quite fast paced. This is to keep the initiative going and prevent the project from stalling.

Feedback loops

As already described in the road map implementing this system should be implemented with an iterative approach as it is a new system.

Use wind energy to wash the cups

NS is already completely running on wind energy so this should be easy to do for NS. But it is an important notion as the environmental impact can be significantly lowered. It could be the case that NS work with a partner who does not run on green energy and then it is important to change that. NS also needs to look at what washing machine is used as reducing the energy usage is always better then running it on green power.

Look when to implement

Chapter 3.3 also showed that costumers of NS are becoming more sustainable conscious. It can be expected that this trend continues to go upward. This means that NS should keep this trend in mind and implement the cup deposit system when they see fit based on this data.

Recommendations current practice

Stimulate user owned cups

This master thesis concluded that there is still a place for user owned cups in the future. But at the moment user owned cups are the easiest way for NS to lower the amount of paper cups used.

This is described in more detail in chapter 3.3. The paper that were found in this chapter showed that significant increases could be achieved by using a few simple techniques. They also showed that these techniques can be implemented without losing sales.

The five levers of change model can also be used to influence the customers to behave more sustainable (Unilever, 2011). This model combines the multiple nudging technique and guides the costumer more which means it can give an integral solution for stimulating user owned cups.

7.4 personal reflection

Change lid giving procedures

Quite a few NS stations try to lower the amount of lids they use. They do this by not giving a lid as a standard with customers. This already lowers the use of lids significantly. However this can still be improved as there are also baristas that still provide the customers with each cup. Communicating clearly to each NS store that the lids should not be given by the barista to the customer, but they should be placed next to the counter so the customer has to pick them. This can greatly reduce the amount of lids used.

Switching to plant based milk

Huhtamaki (2018) showed that the milk in the warm beverage is by far the biggest contributor, 73% of the total emission, to the environmental impact and not the cup itself, 9% of the total emission. Huhtamaki is a paper cup producer so they choose a latte which has significantly more milk than a cappuccino for example. But this does not mean that they do not have a point. Even if it is a cappuccino it still has a significant impact. This impact could be lowered with plant based milks. At the moment there are multiple barista editions on the market that are especially developed for milk in warm beverages. Switching to these alternatives might be a bit more expensive but reduce the environmental impacts significantly.

I defined four learning goals at the start of this project, see appendix. I will use these to reflect on my process. This reflection ends with a general reflection about the project.

Learn how to implement a truly sustainable solution in a large company.

Working at NS gave me the opportunity to work on this learning goal. I learned how to stay in contact with multiple stockholders within NS to improve my ideas and make them more feasible. It also showed me that there are always multiple parties that want something else. In my case it was the sustainability department and the retail department. The sustainability department wanted to make NS more sustainable while the retail department wanted this as well but they also need to make a profit in their shops. However keeping an open mind for both parties resulted in a concept that could potentially be acceptable for both departments.

Looking at the truly sustainable part of my learning goal I can say that I learned a lot on how to design a truly sustainable solution. I learned that interpreting environmental impacts can be done in many different manners. I learned that there is always some kind of benefit involved for the brand that does for example a LCA and they always take some liberties that makes their product come out better. This learned me to look with a critical eye to other work and my own work.

Improve my context mapping skills

Contextmapping allowed me to get very in depth information about my target group. I really like to use this technique and will definitely use it in the future. I think my context mapping skills are definitely improved. Having to completely describe it in this report also gave me even more knowledge about the technique because I now also had to explain it.

Prove that I can influence people behavior with the help of design

When I was preparing to start testing my ideas to stimulate the use of a user owned cup Corona caused the Netherlands to shut down. This severely limited my testing capabilities, because NS did not accept user owned cups anymore and the same applied to other stores. This meant I had to change my focus to a deposit cup system. For this system it is even harder to test it outside of its context. This made me decide to not test the solution.

Prove that I can successfully complete a design project and prove that my solution actually improves on the alternatives

Here it is a similar case as for the third learning goal. Corona limited a lot of testing possibilities as well. I could however with quite a bit of certainty that my solution would cause less environmental impact than the paper cup under the right circumstances.

General reflection

I really liked to do this project because I learned a lot during this project. However there are still quite a bit of points I can improve on. For this reflection I will highlight the two that are in my opinion the most important.

The first is writing a report by myself. In the years of both my bachelors and my master I disliked writing reports. I always started late and could barely finish my report on time. However during most courses I was able to get by. This master thesis was a whole other story. Because I had to actually produce a report people could read that were not involved in my project it was a lot more complicated. It eventually became so complicated that my project itself started to suffer - this is something I did not experience before and now I had to deal with it.

Luckily both my mentors and chair helped quite a lot on improving my report writing skills. I think I can say that I grew a lot during this master thesis but that I also have still a long way to go.

The second point I need to improve on is communicating better with all of my stakeholders. While communicating with people within NS went fine I did not communicate enough with my mentor and chair from the TU Delft. Had I done this more frequently quite a few problems could have been solved earlier.

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