E. Rusman – Master thesis report 2020

CITIZEN PREFERENCES REGARDING MUNICIPAL SOLID WASTE RE-USE MEASURES

A STATED CHOICE EXPERIMENT TO ANALYZE THE PREFERENCES OF THE CITIZENS LIVING IN THE MUNICIPALITIES SERVED BY MEERLANDEN REGARDING THE RE-USE OF MUNICIPAL SOLID WASTE

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CITIZEN PREFERENCES REGARDING MUNICIPAL SOLID WASTE RE-USE MEASURES

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PREFACE

Dear reader,

In front of you is the last deliverable for the master Engineering and Policy Analysis at Delft University of Technology. I spend the last six months analyzing, reading, writing and re-writing for this thesis to complete the last step I have to take as a student. This journey started by finding an interesting research topic at Meerlanden, namely researching the preferences of citizens regarding the re-use of municipal solid waste (MSW), and ends with this report.

First, I want to thank the members of my graduation committee for all the useful feedback, guidance, help with finding the right focus and help with structuring my thoughts. I would like to thank Dr. Eric Molin for the useful and thorough feedback and the fast replies to my questions. Every time I send something I got fast replies with advice and feedback. Your expert knowledge on stated choice experiments helped and improved my thesis a lot. Next, I want to thank Ir. Lizet Krabbenborg for her critical feedback, time and involvement. I really appreciate the time you took to help and guide me. If I got stuck, you were always ready to help me out. Your feedback improved the structure and storyline of this report enormously. I also want to thank Dr. Jan Anne Annema for helping me find a graduation committee and helping me out when I needed one more member for the committee to meet the requirements to be able to graduate. I want to thank Dr. Udo Pesch for being willing to be part of my committee. Also, your knowledge, comments and critical questions helped with thinking the process through and helped with putting the thesis in perspective. Last, I want to thank Diederik Notenboom of Meerlanden. Thank you for the involvement, ideas, critical comments and enthusiasm about the project. You motivated me to stay positive and were there to help me when needed.

Furthermore, I want to thank my family and friends for keeping me motivated and positive, believing in me through the whole process, and encouraging me. Your advice and rock-solid believe helped me in putting all my efforts in this report and my education in general. A special thanks to my sister for reviewing parts of my thesis multiple times, and providing helpful tips.

Esmee Rusman
Hillegom, August 2020

SUMMARY

Worldwide, material consumption has expanded rapidly. The Netherlands has become wealthier, citizens can afford more products and therefore the amount of municipal solid waste (MSW) increased enormously. The distribution of MSW is associated with environmental problems and health risks. MSW consists of everyday items disposed by households, such as furniture, clothing, electronics, food and product packaging. A large share of these products are not only suited for recycling but could also be re-used. The step from recycling towards re-use is desired as re-use is more sustainable and effective in reducing the associated (environmental) problems and risks than recycling.

However, current local waste management systems are not equipped for re-use. Facilities to handle re-use already exist. The main problem is, that the MSW products are in most cases not ending up at these facilities because the current local waste management systems are designed to stimulate recycling instead of re-use. Re-use is solely in the hands of the citizens themselves. There is insufficient knowledge of what kind of re-use policies are preferred by different citizens. The policy-makers do not know about the trade-offs citizens make regarding re-use. Therefore, this research aims to find what the preferences of the citizens are regarding re-use measures of MSW, and if these preferences are heterogeneous among the citizens or not. The research area of this study are the municipalities served by Meerlanden. Meerlanden is an innovative and sustainable oriented (raw) material handling and energy company which unburdens nine municipalities in the Netherlands of their public space management. They try to increase the value of different waste streams by reusing and recycling as much of the commodities as possible and to contribute to a cleaner environment. In their green energy factory, they upcycle organic waste into six useful products. After this research, new, tailor-made measures in local waste management regarding re-use of MSW can be proposed. This cannot only be used by Meerlanden but also by other waste handling organisations and municipalities in the Netherlands.

The main questions for this study are: *"What are the preferences of the citizens of the municipalities served by Meerlanden regarding re-use of municipal solid waste and how is this related to observed citizen characteristics?"*

An online choice experiment was performed to answer this question. The choice experiment was integrated into a survey and distributed among the citizens living in the municipalities served by Meerlanden which led to 249 suitable respondents. In the choice experiment, citizens were twelve times asked to choose from three MSW re-use measures: Selling through an online platform, Bringing to waste disposal centre and Pick-up service. The alternatives varied per question in their design. The design variables were the presence of a loyalty system, cost/reward system and appointment/use type. After the respondent chose one of the three options, it was asked if they would prefer the chosen option or rather have the current system. Each question was formulated with one out of four contexts. The context indicated for what type of MSW product the choice should be made (sofa, side table, refrigerator or vacuum cleaner). The survey also contained socio-demographic questions, exploratory questions and statements to assess attitude towards the environment and ecological behaviour.

The results of the research showed that citizens living in the municipalities served by Meerlanden were willing to change from the current system towards re-use of MSW. In 80% of the choice situations, a re-use measure was chosen over the base alternative (current situation). This is a positive result as re-use can diminish waste levels and indirectly the negative effects associated with waste. Different MNL models were estimated, showing that citizens preferred the "Platform" and "Bringing to the waste disposal

centre" alternative the most and preferred these two measures more than the base alternative (current situation). The attractiveness of the "Pick-up service" alternative, was mostly determined by the design of the measure. The alternative was most attractive when there was an on-demand appointment system, low costs and no loyalty system.

The Latent Class (LC) model was estimated to determine if there were different clusters within the population with homogeneous preferences. Moreover, it was analysed if these clusters were based on certain citizen characteristics. A LC model with two classes had the best fit with the data (22.02% of the initial uncertainty was explained). The classes were labelled as "Online platform lovers" and "Convenience seekers". The "Online platform lovers" had a high base preference for the "Platform" alternative, where the "Convenience seekers" had an equally strong base preference for the "Platform" alternative as for the "Bringing to the waste disposal centre" alternative. The "Convenience seekers" were more likely to choose a re-use measure if they were rewarded for their behaviour by a loyalty system or by receiving (most) of the rewards from their brought products.

The preferences were related to multiple citizen characteristics. Overall, the "Bringing to waste disposal centre" alternative was most influenced by the characteristics of citizens. The "Pick-up service" alternative was not at all influenced by citizen characteristics. Most of the citizen characteristics found had little to no effect on the attractiveness of the measures (Ability to go to the waste disposal centre, income, gender and education). However, age, ability to bring (small and big) products to the waste disposal centre, and having a divers' license were also found as indicators and these did affect the attractiveness of the measures. Citizens under the age of forty were more attracted to the "Platform" alternative and thus, more likely to belong to the "Online platform lovers" class. Moreover, citizens who were able to bring their products to the waste disposal centre by themselves were more attracted to the "Bringing to the waste disposal centre" alternative. Last, citizens with a drivers' license favoured the "Bringing to waste disposal centre" alternative less than citizens without a drivers' license.

These conclusions lead to the following recommendations for Meerlanden; it is recommended to upgrade the waste disposal centres towards re-use facilities and add an online platform possibility for citizens (preferably a website). Citizens would like for Meerlanden to play an active role in keeping the online environment save, trustworthy, monitored and practical. Moreover, citizens like to be educated through this platform over re-use, re-use possibilities, and what products can be used for re-use. It is advised to reward the citizens for their re-use behaviour as the larger part of the citizens are more prone to re-use when they are rewarded. This can be reached by adding loyalty systems in which citizens can use their points for purchasing products from the re-use stores or platform, or by giving citizens (a part) of the yields of their brought products. Moreover, it is advised to work with an appointment system for "Bringing to the waste disposal centres" alternative. Last, it is recommended to use the yields of the re-use measures for Meerlanden, for the Meerlanden charity fund and making sure that the citizens know what happens with these yields. This increases the positive view of the citizens towards Meerlanden and the re-use measures.

The main limitation of the research was the non-representative sample. The over-representativeness of certain categories, such as high income and high education level, could be since most respondents were gathered through the personal network of the researcher. Because the data were gathered with an online survey, there was a chance of self-selection among the respondents, which could induce selection bias. Respondents entered the survey voluntarily, which could probably cause citizens who like to express their

opinion about re-use or Meerlanden to be overrepresented in the sample. So, it could be useful to incorporate more citizens in the data gathering process to gain more representative results. Moreover, the design of the choice experiment could be improved as most of the attributes were not significant in the estimated models. It is possible that the chosen attributes did not represent the relevant characteristics of the alternatives for respondents to base their choices upon. Therefore, it is recommended to investigate the design aspect for re-use measures more in-depth.

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LIST OF ABBREVIATIONS

In this research, multiple abbreviations are used. As this can be confusing while reading, a list of the used abbreviations is provided in table 1.

TABLE 1: LIST OF ABBREVIATIONS

Abbreviation	Meaning
MSW	Municipal Solid Waste
WPB	Waste Prevention Behaviour
MNL	Multinomial Logit Model
LCM	Latent Class Model
BIC	Bayesian Information Criteria
LRS	Likelihood Ratio Statistic
LL	Log-likelihood
DCE	Discrete Choice Experiment
RUM	Random Utility Theory
ASC	Alternative specific constant
PEB	Pro-environment Behaviour
NEP	New Ecological Paradigm

1. INTRODUCTION

1.1. RESEARCH BACKGROUND

Worldwide material consumption has expanded rapidly. As the Netherlands has become wealthier, the Dutch citizens can afford more products and therefore the waste levels have increased enormously. Moreover, the population is expanding which results in even more consumption and waste. Not only the amount of consumption has changed, but also the type of consumption is different. Nowadays, there is a need for a wide variety of product choice. Furthermore, the products have a shorter lifespan or are produced for single-use and disposable purposes (Malinauskaite et al., 2017). To put this into perspective, the average amount of municipal solid waste (MSW) generated by the inhabitants of the European Union in 2015 was 477 kg per year. Meaning, the MSW produced in one year could cover Malta with a layer of almost 2 meters high (Eurostat, 2017). All this waste is concerning because of the bad influence on the environment as destroying and storing it results in air-, water- and soil pollution, ash disposal from the incineration and rising costs (Hoornweg, Bhada-Tata, & Kennedy, 2013).

To deal with these concerns, the United Nations created sustainable development goals, including the goal that states sustainable consumption should be ensured and improved. The need for materials should not over-extract resources or lead to the degradation of environmental resources. Therefore, policies should be made to improve resource efficiency and reduce waste (United Nations, 2019). Nonetheless, most attention in local waste management is devoted to collecting and recovering commodities through recycling, instead of preventing and re-using waste. Recycling can help decrease the extraction of resources and reduce the eventual amount of waste, but it does not solve the problems as waste prevention and re-use can (Zacho & Mosgaard, 2016).

To visualize this, the waste hierarchy of Lansink (Ladder of Lansink) is commonly used (figure 1). The waste hierarchy of Lansink has become a standard for explaining the urgency of change in waste management (Lansink & de Vries - in 't Veld, 2010). It visualizes the actions regarding waste handling from the most negative impact on the environment (F) to the least (A). Waste management has already climbed the ladder from purely landfill to a focus on recycling (Recycling.com, 2019). The next step would be, looking at the waste hierarchy (figure 1), re-use and reduce (prevent) waste. Waste prevention and re-use of products can be done in all phases of a product life-cycle and for almost all products. Nevertheless, the philosophy of waste prevention and re-use is completely different from waste treatment (step F till C) and therefore, plays no role in current waste management. Most stakeholders in local waste management lack the knowledge, expertise and understanding to incorporate waste prevention and re-use in their local waste systems (Bartl, 2014).

FIGURE 1: LADDER OF LANSINK - THE WASTE HIERARCHY (LANSINK, 2012; WWW.RECYLING.NL)

In the meantime, academic interest in waste prevention and re-use has increased as it is proven to be most effective in solving the problems regarding waste. Re-use and waste prevention are categorized as environmental friendly behaviour. Most research is performed in waste prevention behaviour (WPB). From this, it is known that the effectiveness of behavioural measures increases when aimed at the relevant factors of the desired behaviour. Therefore, it is important to understand the factors related to re-use and waste prevention (Steg & Vlek, 2009). WPB is further explained in section 4.1.

1.2. INTEGRATING RE-USE INTO MUNICIPAL SOLID WASTE MANAGEMENT

The success of integrating re-use into municipal solid waste (MSW) management depends on appropriate measures (alternatives) and the attitudes of citizens. As society is changing, the needs of citizens are changing accordingly. These developments are of influence on the choices citizens make. One of these developments is the increased concern of citizens towards environmental matters (Junquera, del Brío & Muñiz, 2001). A growing number of citizens is feeling the need to take responsibility and live up to certain sustainability standards. They tend to take matters into their own hands instead of blaming companies and the government (Junquera, del Brío & Muñiz, 2001; Devoldere, Dewulf, Willems & Duflou, 2008). The measures (alternatives) proposed should fit these changing needs. Examples of such measures are; MSW pick-up service, an online selling platform facilitated by the municipality, or a local waste centre were MWS can be brought for re-use purposes (see section 2.1.).

Besides attitudes, demographics of citizens can be related to the level of participation in re-using MSW as well (Ma & Hipel, 2016). Presumably, the choices citizens make regarding re-use can differ per (group of) citizens. Perhaps, families with multiple children have other preferences as couples with high incomes. Therefore, valid group-specific behavioural measures are probably needed to target different (groups of) citizens (Steg & Vlek, 2009). Involving citizens from the early stages of decision-making can promote awareness and reduces opposition towards MSW management. Moreover, citizens are more likely to participate when financial and technical support is guaranteed. Measures with both regulations and incentives are shown to be effective in promoting the re-use of MSW. Furthermore, when designing MSW management, the design should be context-aware. It also appeared that the effectiveness of certain measures differed from one location to another. Meaning, the measures (alternatives) should fit the local situation (Ma & Hipel, 2016). The interconnection between these factors, as shown in figure 2, makes the analysis of MSW management complicated. Chapter 4 elaborates in more detail on the different factors named in figure 2.

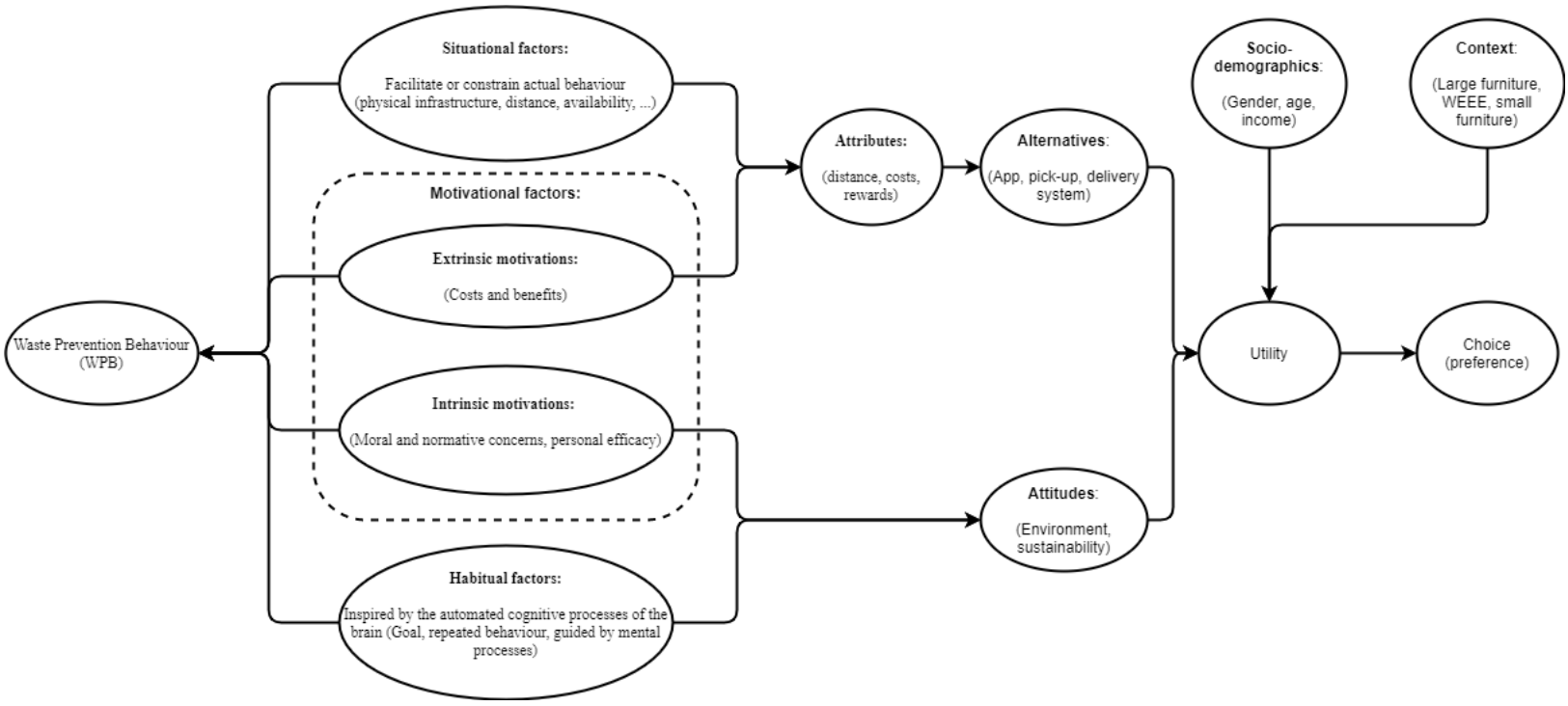

FIGURE 2: CONCEPTUAL FRAMEWORK OF THE INTERCONNECTION OF THE FACTORS RELATED TO THE ANALYSIS OF MSW MANAGEMENT (CREATED BY THE AUTHOR)

1.3. PROBLEM DESCRIPTION AND KNOWLEDGE GAPS

The distribution of municipal solid waste (MSW) is associated with environmental problems and health risks. MSW consists of everyday items disposed by households, such as furniture, clothing, electronics, food and product packaging. A large part of these products can be re-used even before recycling. MSW does not contain industrial, hazardous, construction and demolition waste (The Environmental Protection Agency, 2015).

The step from recycling towards re-use is desired to diminish the environmental problems and health risks. Up to now, local waste management is not able to incorporate waste prevention and re-use of MSW into their systems. The main problem is that local waste management does not have policies on re-use to make sure the MSW products are ending up at facilities already organized for re-use. Examples of these facilities that stimulate re-use are second-hand shops, second-hand construction markets, repair shops and art cafes (Bastein, Roelofs, Rietveld & Hoogendoorn, 2013). Only policies regarding recycling are designed. Re-use is solely in the hands of the citizens (Bastein, Roelofs, Rietveld & Hoogendoorn, 2013; Bartl, 2014). As citizens are mostly driven by convenience, a large part of the re-use facilities is only limitedly used (Gilli, Nicolli, Farinelli, 2018). There is no sufficient knowledge about the trade-offs citizens make regarding re-use and to what extend their preferences are linked to certain citizen characteristics and the type of MSW. For example, it is not known what the trade-off is citizens make between convenience and financial benefits.

From the literature, it became apparent that knowledge of local waste prevention and re-use is still lacking. Especially on how local waste management systems should be designed to encourage waste re-use and prevention (Zacho & Mosgaard, 2016). There were two knowledge gaps found. As mentioned in section 1.1., the importance of integrating re-use in MSW management is acknowledged by many

researchers. Moreover, researchers are recognizing the importance of integrating social dimensions in MSW management analysis. However, the contribution to the literature on this combination is far from sufficient, especially compared to the level of research into the technical issues (Ma & Hipel, 2016). Furthermore, most publications are from Asian countries. These countries experience more challenges and barriers with MSW management than European countries, as they have a high population density, large urbanization rate and fast economic growth (Shekdar, 2009). This is not comparable to the situation in the Netherlands.

1.4. RESEARCH OBJECTIVE AND RESEARCH QUESTIONS

By incorporating characteristics of citizens and their preferences for re-use alternatives in multiple contexts in the analysis, policy-making in local waste management can be enhanced. From a social perspective, it is argued that certain characteristics may influence the different options citizens prefer (Prillwitz & Barr, 2011; see section 1.2.). This supposed difference in preference is important to take into account when trying to formulate measures for re-use. This leads to two objectives that will be addressed in this research:

- Determine what the preferences of citizens are regarding different re-use measures
- Determine to what extent these preferences regarding re-use measures are related to characteristics of the citizens

Since this study will be conducted within the scope of Meerlanden (see chapter 2.2.), these objectives are translated into the following research questions: *"What are the preferences of the citizens of the municipalities served by Meerlanden regarding re-use of municipal solid waste and how is this related to observed citizen characteristics?"* To be able to answer these questions, several sub-questions are answered.
The sub-questions which are answered in this research are:

1. *What are the preferences of the citizens regarding the re-use of municipal solid waste and to what factors or citizen characteristics are these related?*
2. *What are different clusters among citizens of the municipalities served by Meerlanden and to what observed citizen characteristics are these related?*
3. *How do preferences differ between different types of municipal solid waste?*

1.5. RESEARCH RELEVANCE

This study has societal as well as scientific relevance. There is societal relevance because 1) better insights into the preferences of citizens regarding the re-use of municipal solid waste (MSW) are gathered. This can lead to more effective, tailor-made policies in local waste management, which possibly increase re-use and contributes to the diminishing of MSW levels. Indirectly, the diminishing of MSW can lead to a reduction of the problems related to waste disposals such as health problems and negative effects on the environment. 2) Citizens may feel more involved in the policy-making process because they were able to state their preferences. This can have a positive influence on the ease of implementation of new measures in local waste management, but also on the willingness of citizens to become more involved in re-use. By doing this, the policies regarding waste prevention and re-use will possibly be more supported. The stated choices of the citizens can be used to investigate what citizens state they will do when certain scenarios would be implemented. Leading to even more knowledge about the preferences of citizens regarding the re-use measures.

It is scientifically relevant since little empirical research is performed on the design of local waste management systems to encourage waste re-use and prevention. This research enriches the literature by investigating the preferences of citizens regarding different re-use measures in local waste management and therefore adds to the knowledge gaps mentioned in section 1.3. Moreover, to the best knowledge of the researcher, stated choice models are not yet used to analyse the preferences of citizens towards re-use alternatives. This topic may be too complex to be assessed in a stated choice experiment. If the information load becomes too large, respondents may be inconsistent with their choices. Therefore, it is important that at the end of this research a reflection about the usefulness of this method on this topic is discussed. This will be described in chapter 8.

Last, this research is relevant as a master thesis subject. This problem fits very well with the Engineering and Policy Analysis (EPA) program studied by the researcher. The subject relates not only to sustainable development goals but is a hot topic in daily life as well. Everywhere, people, companies and organisations try to reduce waste and packaging material to decrease their negative impact on the environment. By performing this research, advice about better fitting policies can be given, supported by the citizens.

1.6. REPORT STRUCTURE

The report is written with the following structure: In this chapter (chapter 1), the problem is explained, the research objectives are given and research questions are formulated. In chapter 2, the current municipal solid waste system is discussed and an introduction of Meerlanden is provided. Meerlanden is an innovative player in the current system and also the company at which the research is performed. The methods used for this research are explained in chapter 3. Next, in chapter 4, a literature review is performed and combined with the information gathered from the exploratory research at Meerlanden. This provides insight into the factors that are known for their influence on waste prevention behaviour and delivers the needed information to construct the choice experiment and the survey. In chapter 5, the design of the experiment and the survey is constructed. The results of the survey are discussed in chapter 6, as well as the model estimations. In chapter 7, the model estimates are used to analyse different scenarios. In chapter 8, the conclusion of this research is given and policy recommendations based on the research and scenarios are provided. Last, in chapter 9, the limitations of the research are discussed and recommendations for further research are done. The structure of this research paper is visualised in figure 3.

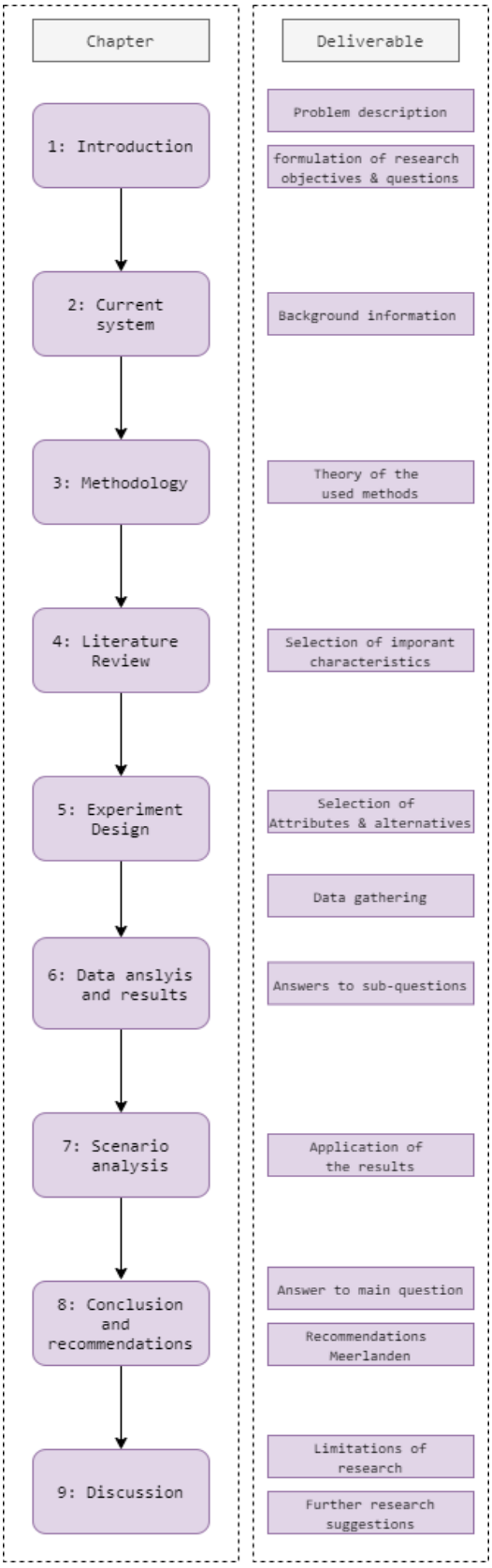

FIGURE 3: FLOW DIAGRAM OF THE RESEARCH REPORT

2. CURRENT MUNICIPAL SOLID WASTE SYSTEM

2.1. COLLECTION OF MUNICIPAL SOLID WASTE

There are multiple collection methods of municipal solid waste (MSW) known. These can be separated into governmental and non-governmental collection methods. The municipalities of the Netherlands have a legal obligation to collect MSW but can determine for themselves how to shape this obligation. Therefore, there is a wide diversity among the municipalities in the Netherlands with regards to the collection of MSW (Aarnink, 2004). Next to the governmental obligation, citizens have created initiatives for collecting MSW. Nowadays, these two are (almost) never connected, whereas this would provide more service and opportunity. Moreover, both have the same goal; reducing the amount of MSW.

2.1.1. GOVERNMENTAL COLLECTION METHODS OF MUNICIPAL SOLID WASTE

There are two main forms of MSW collection; 1) on-call pick-up service, and 2) planned collection routes. Picking up the MSW at citizens homes is labour-intensive for the municipalities. Also, the possibilities to separate waste for distribution are limited which leads to higher costs. However, picking-up MSW at the citizens' houses does provide high service levels. If there are well-equipped waste centres in the municipalities, the municipality can choose for a paid pick-up service (Aarnink, 2004). Moreover, municipalities may choose for a system where a set number of times or a set quantity of MSW will be collected for free and after those times/quantity citizens need to pay a fee. Another possibility is that municipalities always charge a fee on MSW collection. Last, in some cases, the collection is combined with regular waste collection (Aarnink, 2004). However, this complicates the separation of the different types of waste even more.

Some municipalities do not choose for pick-up service but provide the option for bringing MSW to the waste centres. Waste centres are becoming more popular and take a more prominent place in the waste disposal system. An important reason for this is the high rate of re-use possibilities (Aarnink, 2004). This option varies from free disposal to different payment systems. For instance, all waste types have the same tariff or some types, such as re-usable products can be brought for free as others need to be paid a fee for. Bringing it to the waste centres has a positive effect on the environment as it improves the separation of waste and re-use of waste. Last, there are fewer costs, allowing citizens to bring waste to the centres is cheaper than collecting it (Aarnink, 2004). However, this method is more intensive for the citizens. Citizens may throw their MSW out with other waste types instead of separating it and bringing it to the waste centres.

The consideration between pick-up and delivery is an important one for the municipalities. Both have their pros and cons. It depends on the municipality and the preferences of the citizens what kind of system will work best. Municipalities are looking for the best combination of environmental considerations, costs and service levels for their municipality (Aarnink, 2004).

2.1.2. NON- GOVERNMENTAL COLLECTION METHODS OF MUNICIPAL SOLID WASTE

Next to the mandatory MSW collection of municipalities, there are several non-governmental initiatives to reduce MSW. In the Netherlands, different local initiatives are trying to increase the rates of re-use. For instance, there are multiple upcycle centres where artists use MSW to create art or make new design products. Citizens can bring their waste to the centres and entrepreneurs use it as materials for their sustainable businesses. Another initiative is the so-called “sustainability centre”. Citizens bring their products to the centre and the products go through a disassembly hall where workers with a distance

towards the job market disassemble and separate the useable parts and commodities which can be reused or recycled. The products that are in good shape are checked, cleaned and/or repaired and can be sold in the second-hand shop. The workers gain work experience and lots of products, parts and commodities can be re-used. Sorting and repairing for re-use is labour-intensive and therefore, in a lot of secondhand shops, the income of sold goods is (partly) for the store. Some products such as furniture can also be brought directly to the secondhand shops. Secondhand shops are playing an important role in the collection of MSW as they increase the lifespan of products. A large part of the products in secondhand shops would otherwise be distributed as waste and be incinerated (Bastein, Roelofs, Rietveld, & Hoogendoorn, 2013). These initiatives depend solely on the involvement of the citizens (Bastein, Roelofs, Rietveld, & Hoogendoorn, 2013). Due to the increase of taxes on the distribution of waste, citizens are more driven to prevent and re-use. In practice, 75% of the waste distributed at the waste centres can be recycled or re-used. Only 25% is actual waste (Aarnink, 2004).

For some end-of-life products, such as clothing, re-use is a well-established practice already. Because clothing represents a basic human need, people in industrialized countries experience ethical concerns about the disposal of it, and therefore support the idea of second-hand shops or donating their clothes to charity (Baden & Barber, 2005). Unfortunately, clothing is an exception. This is mainly because the export of second-hand clothing has beneficial effects in the receiving country, contrary to, for instance, WEEE (waste of electric and electronic equipment). Globally, 70% of WEEE ends up on open dumps in China or goes to recycling facilities which are not up to basic safety standards and impose big risk and danger to the environment and the health of the residents near the recycling facility (Cooper, 2011; Bartl, 2014).

2.2. INTRODUCTION MEERLANDEN

This research is executed by a company named Meerlanden. Meerlanden is an innovative and sustainable oriented (raw) material and energy company. Their mission is: “together faster circular”. Their goal is to bring the circular society closer to the citizens by stimulating and educating on re-use and recycling. They want to bring all waste back into the cycle. From a traditional waste handling company, Meerlanden transformed towards an innovative waste collection and handling company which unburdens nine municipalities in the Netherlands of their public space management. Moreover, they try to increase the value of different waste streams by reusing and recycling as much of the commodities as possible and to contribute to a cleaner environment. Together with their subsidiaries, Meerlanden provides services for approximately four thousand SME companies, and thirty municipalities in the Netherlands of which eight are shareholders (Aalsmeer, Bloemendaal, Diemen, Haarlemmermeer, Heemstede, Hillegom, Lisse and Noordwijk). For these shareholders, Meerlanden accommodates the waste collection, therefore, these municipalities are selected as the main research area.

Meerlanden uses an innovative process of fermenting and composting to recycle organic waste in their green energy factory. From the organic waste, six useful products are created. Due to the fermenting process biogas is made. This biogas is separated into green gas (CH_4), CO^2 and citrus oil. The green gas is enriched with fragrance and pigment before it is distributed in the public gas network, the CO^2 will, in the future, be delivered to the greenhouses in the neighbourhood when the pipes are laid out. Last, the citrus oil is used for non-toxic weed control. What is left of the organic waste is called digestate and is composted. High-quality compost is produced. The warmth originated by this process is captured and also transferred to the greenhouses in the neighbourhood. By the winning of this warmth, condensation arises and water is released. This is used for anti-slippery control and cleaning the streets of the municipalities.

This all leads to a reduction in CO^2 emissions and increases the biodiversity in the public spaces of the different municipalities served by Meerlanden (figure 4).

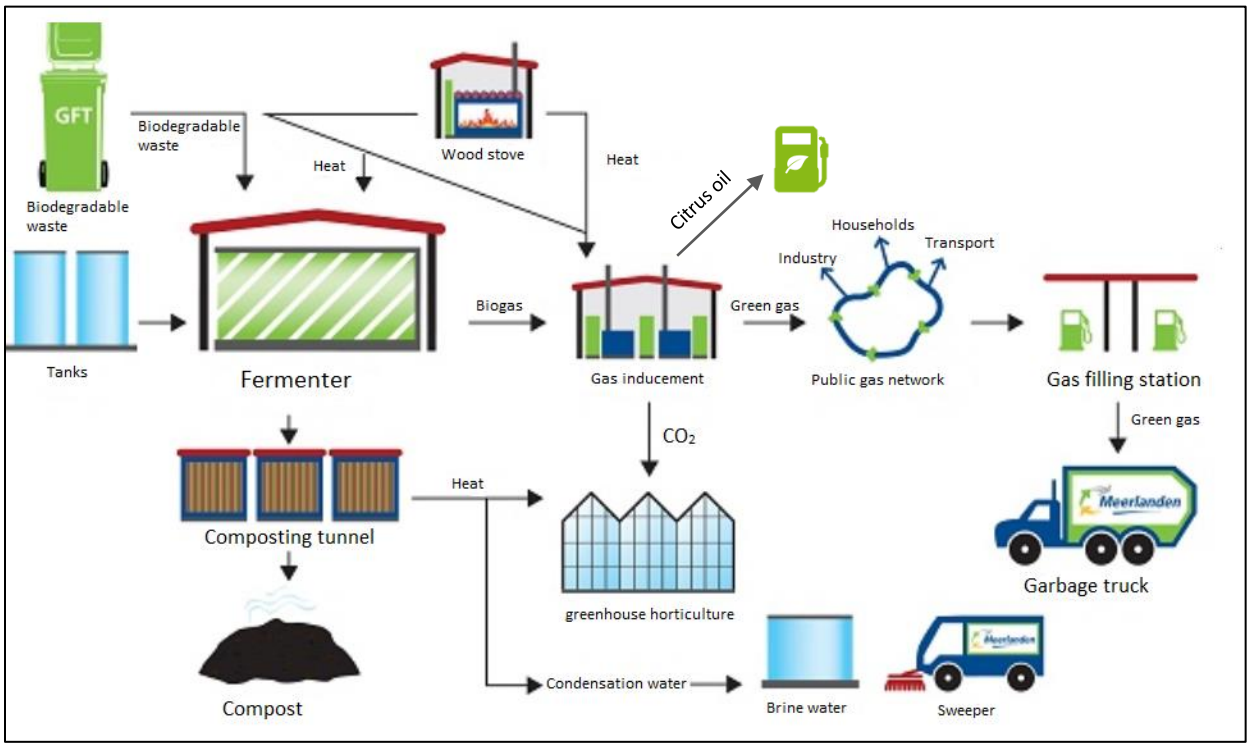

FIGURE 4: 100% ORGANIC WASTE RECYCLING IN THE GREEN ENERGY FACTORY MEERLANDEN (MEERLANDEN.NL) TRANSLATED FROM DUTCH TO ENGLISH BY THE AUTHOR

Last, the non-organic waste is divided into e-waste and other non-organic waste. The e-waste is disassembled by Meerlanden. The disassembly of e-waste is done by citizens who experience a distance to the job market to help them reintegrate into society. After this step, the non-organic waste left is delivered to partners of Meerlanden in the waste disposal sector. This way, also all non-organic waste is recycled to commodities and new products as much as possible.

Because of the goal and mission of Meerlanden, the research is executed at this company. As the Meerlanden is already driven by innovation and working towards a circular economy, they were searching for possibilities to eventually increase re-use. Exploring the preferences of citizens regarding re-use is the first step in this process and will help understand the trade-offs citizens make regarding re-use alternatives. Moreover, by doing the research at Meerlanden, the research is enhanced with background knowledge into local waste management and provided with a scoped research area. Because, as described in section 1.2., it is important to specify measures on the local needs. Measures working in one area can have the opposite effect in another area. By using the scoped area of Meerlanden, the results are specified for their municipalities. Last, Meerlanden already performed desk research into different sustainability attitudes based on the motivacation theory (motivacation, 2018; see section 4.2.2.), this is useful background knowledge for this research.

3. METHODOLOGY

The methods used to answer the main- and sub-questions are explained in the following sections. First, in section 3.1., the use of a literature study and exploratory research is explained. For this research, it is chosen to use a stated choice experiment as there is little knowledge about how to design re-use measures in local waste management supported by the citizens. With the use of a stated choice experiment, the preferences of the citizens regarding re-use measures can be explored. In section 3.2., the steps taken to create a stated choice experiment are discussed. Moreover, the data gathering process and the population are described. Next, in section 3.3., discrete choice modelling is explained and the models that are used in this research are shown.

3.1. LITERATURE STUDY AND EXPLORATORY RESEARCH

For this research, a stated choice experiment is used (see section 3.2.). Since, in this stated choice experiment, respondents need to choose between different municipal solid waste (MSW) re-use measures, it is important to first analyse what aspects are of relevance for the different measures and in what aspects these measures differ from each other. This can be done with the use of qualitative methods. The qualitative part of the analysis is conducted through a literature study and explorative research at Meerlanden (see section 2.2.). With these methods, the different aspects of re-use measures are found. As there is little known about re-use measures, recycling measures and current municipal solid waste (MSW) collection systems are also incorporated in the study. The aspects found are checked on their relevance for re-use and thus, the choice experiment.

The literature study conducted in chapter 4, provides insights into the current behaviour of citizens regarding waste recycling and prevention. Also, insights into the factors that influence waste prevention behaviour are found. Moreover, the aspects of the measures that are important for citizens to base their choices upon can be selected based on the gathered knowledge. The literature is found by using online databases such as Google Scholar, Science Direct and Scopus. Furthermore, the snowballing technique is used to find more relevant literature. The search strategy and used literature are further elaborated in appendix I.

Next to the literature research, exploratory research (Stebbins, 2001) at Meerlanden is conducted to gain insight knowledge about local waste management. Meerlanden is an innovative player in the Dutch waste disposal sector that works towards a circular economy (see section 2.2). Distributing waste as sustainable as possible is their goal. By researching at Meerlanden, this provides first-hand knowledge about local waste management and different re-use alternatives. Moreover, they can provide important constraints, opportunities and information which can enhance the research. Furthermore, they already researched different characteristics of citizens towards re-use and have thought of different re-use options which are within the possibilities of local waste management to implement. Their expert knowledge in combination with the literature research will help determine which variables are important to include in the choice experiment.

3.2. STATED CHOICE EXPERIMENT

A choice experiment is a data-gathering technique for discrete choice modelling (section 3.3.). To perform a discrete choice experiment (DCE), revealed or stated preference data can be used. Revealed preferences are observed by the researcher and are the choices individuals make in real-world situations. Whereas stated preferences are replies of individuals on (hypothetical) choice sets in hypothetical situations, often

presented in a survey setting (Hensher, Rose, & Greene, 2005). For this research, a stated choice experiment will be used because re-use is not common behaviour for the citizens and not yet part of local waste management (dell'Olio, Ibeas, Oña, & Oña, 2018). Therefore, it is not possible to use revealed preference data for this research.

3.2.1. STATED CHOICE PRINCIPLES

A stated choice experiment contains multiple choice sets where each choice set has at least two options. From this point forwards, these options are called alternatives (Street, Burgess & Louviere, 2005). The respondents choose one of the alternatives per choice set. These alternatives are mutually exclusive, exhaustive and finite. Meaning, choosing one alternative implies that the decision-maker cannot choose any of the other alternatives in the choice set, all alternatives are included in the choice set and the researcher should be able to count the alternatives and eventually, be done with counting (Train, 2003). Each alternative has a set of attributes which are the important aspects of the alternative. These attributes have attribute levels that vary between the different choice sets. The selection of the alternatives, attributes and attribute levels are based on the literature review and exploratory research performed in chapter 4 and named in section 5.3.

There are multiple design choices to make when designing a stated choice experiment. Next to the selection of alternatives, attributes and attribute levels, the form of the alternatives should be determined. The alternatives can be generic or labelled (Street & Burgess, 2007). The generic form uses the same attributes for all alternatives, whereas the labelled form uses alternative specific descriptions per alternative. Both forms have their advantages. The labelled form helps respondents base their choices on the true policy context. However, the generic form makes sure that respondents will not base their choice on the labels but purely on the attributes and thus provides better information about the trade-offs among attributes (Blamey, Bennet, Louviere, Morrison & Rolfe, 2000; Willis, 2002). The design choices made for this research are discussed in chapter 5.

3.2.2. DATA COLLECTION AND POPULATION

The stated preference data is collected through an online survey. The survey does not only contain the choice experiment, but also socio-demographic questions, statements about sustainability attitudes and environmentally friendly behaviour, and exploratory questions to help interpret the results. The selection process of these additional questions is explained in chapters 4 and 5. The statements are answered on a five-point Likert scale. The information gathered with these additional questions can be used to estimate the class membership model of the latent class model (see section 3.3.2.2.).

The sample is aimed to be representative for the population of the municipalities served by Meerlanden in terms of socio-demographics. This is analysed in section 6.2.1. As the survey is distributed online, it is possible that certain groups are not properly reached. For example, elderly who do not have a computer or citizens who are not comfortable with the Dutch language. However, online distribution is an easy method for reaching a high number of people. To try to include as many citizens as possible, everyone who visited the waste disposal facilities of Meerlanden between 29th of May and 13th of June 2020 were provided with a flyer to participate in this research.

The stated preference data gathered with the survey is cleaned and coded by using Python. The descriptive statistics are analysed with SPSS, a statistical program. Thereafter, the models, which are

named in section 3.3.2., are estimated with an estimation package named Apollo which runs in R. The data analysis, model estimations and results are discussed in chapter 6.

3.3. DISCRETE CHOICE MODELLING

Discrete choice experiments (DCE) describe the choices of a respondent among alternatives and can be used to analyse choice behaviour (Train, 2003). It allows for uncovering to what extent different variables influence the choice of an individual regarding these different alternatives (Koppelman & Bhat, 2006). DCE creates a better understanding of multidimensional behaviour due to holistic profiles, the profiles provide context under which the citizens make a choice (Kroesen, 2019a). The contexts are, for instance, the different types of municipal solid waste (MSW) as described in section 1.3.

3.3.1. DATA ANALYSIS AND MODEL ESTIMATION

Discrete choice experiment (DCE) models are usually derived under an assumption of utility maximisation behaviour of the decision-maker. The models used in this research are based on Random Utility Maximization (RUM) theory. Meaning, individuals will choose the alternative that maximizes their utility (Koppelman & Bath, 2006). By estimating discrete choice models, the probability that an individual chooses for a certain alternative can be specified (Train, 2003).

A RUM based choice model allows for respondents' heterogeneity and inconsistency, is postulated in economics and is flexible and practical in multi-attribute and multinomial choice situations (Chorus, 2019). There are multiple alternatives (i,j) from which the respondents (n) choose the alternative that provides the highest utility (U_{in}) for them (Train, 2003). In equation 1 is shown when alternative i is chosen.

$$\boldsymbol{U_{in} > U_{jn}} \qquad \forall \mathbf{j} \neq \mathbf{i}$$

EQUATION 1

The total utility of an alternative for a respondent is determined by two components; 1) a systematic component (V_i) and 2) an error term (ε_i) (equation 2). The systematic component is all that can be related to observed factors within the experiment. For every observed factor, a parameter (β) is estimated. This parameter represents the weight of the factor (X). The error term adds the unobserved utility of an alternative and is everything that is not represented in the systematic component, such as the randomness of choice, unobserved factors and heterogeneity in tastes (Koppelman & Bhat, 2006). This means, that even if the systematic utility of an alternative is high, the other alternative can still be chosen by the respondents because of the error term. Choices can only be predicted with probability. Ceteris paribus, the higher the systematic utility, the higher the choice probability. The observed utility is the weighted sum of attributes (m) (equation 3) (Chorus, 2019).

$$\boldsymbol{U_{in} = V_i + \varepsilon_{in}}$$

EQUATION 2

$$\boldsymbol{V_i = \sum_m \beta_m X_{im}}$$

EQUATION 3

The utility function (equation 4) is formulated per alternative (Train, 2003). β_m is the coefficient of attribute m and X_{im} represents the attribute level of attribute m. The taste weights (β_m) are estimated at the sample level and not for each respondent separately, which leads to the assumption that the attribute values are the same for each respondent. The utility is the weighted sum of attributes. By multiplying the

taste weight (β_m) with the value of the attribute (m), the contribution of the attribute (m) to the total utility (U_{in}) results (Koppelman & Bath, 2006; Chorus, 2019).

$$\boldsymbol{U_{in} = \sum_m \beta_m X_{im} + \varepsilon_{in}}$$

EQUATION 4

Also, an alternative specific constant (ASC) can be added to the utility function. ASC represents the total (average) utility that is associated with an alternative. Thus, it explains the utility of the labels of the alternatives for the respondents (equation 5). The ASC is the utility of an alternative when the values of all attributes would be zero. Therefore, this cannot be explained with the observed factors. As only the difference in utility matters, not all alternatives have an ASC. The base alternative is set to zero and the other alternatives have an ASC (Chorus, 2019; Molin, 2019b). Meaning, the alternatives are compared in terms of the utility of alternative i relative to the utility of the base alternative.

$$\boldsymbol{V_i = ASC + \sum_m \beta_m X_{im}}$$

EQUATION 5

3.3.2. TYPE OF MODELS

The utility function described above is used to calculate choice probabilities. The choice probability is the change that an individual chooses a certain alternative from the set. There are multiple choice models known in the literature and these have their own set of assumptions. For this research two types of choice models are estimated; the Multinomial Logit model (MNL) and the Latent Class model (LCM). These models are discussed in the next sections.

3.3.2.1. MULTINOMIAL LOGIT MODEL

The Multinomial Logit model (MNL) is the most commonly used model in choice modelling. It is the most popular model due to its simplicity. The model estimates the probability (P) that an individual (n) chooses alternative (i), given the other alternatives (J) (equation 6). J is a set containing j alternatives.

$$\boldsymbol{P(i) = \frac{\exp(V_i)}{\sum_{j=1}^{J} \exp(V_j)}}$$

EQUATION 6

The MNL-model has some limitations. The model does not consider random taste variation for the attributes of alternatives but assumes that every individual has the same preferences. Furthermore, the model does not accommodate multiple choices per individual, while dislike for an alternative by individuals will probably show through all their answers and goes beyond the observed factors (Streets & Burgess, 2007; Chorus, 2019). Since it is apparent in this research that there is a difference in preferences among the citizens and expected that each citizen shows a certain preference throughout the choice experiment, assuming that each choice is made by a new citizen can bias the results. Nonetheless, the MNL model provides good first insights into the preferences of the citizens. Therefore, the model is still estimated.

3.3.2.2. LATENT CLASS MODEL

The Latent Class model (LCM) can be used to accommodate for some of the limitations underlying the multinomial logit (MNL) model (Cranenburgh, 2018). Where the MNL-model assumes taste heterogeneity,

the LCM assumes that different clusters of citizens have homogenous preferences within the cluster, but that the preferences between the clusters differ. With the LCM, a different set of parameters is estimated for each cluster. These clusters are latent and cannot be observed directly, they emerge in the estimation process (Molin & Maat, 2015; Cranenburgh, 2018).

The number of clusters is not known beforehand. Multiple models are estimated with a different number of clusters each. For all these models, the model fit is calculated (see section 3.3.2.3.). Based on these model fits, the model with the best fit with the data is chosen. With this, the number of clusters is determined. The LCM (equation 7) estimates these clusters based on observed characteristics of the respondents (Kroesen, 2019b). Where $P_n(i|\beta)$ indicates the probability a citizen (n) chooses alternative i given the model parameters (β).

$$\boldsymbol{P_n(i|\beta) = \sum_{s=1}^{S} \pi_{ns} P_n(i|\beta_s)}$$

EQUATION 7

Another assumption of the LCM is that each individual has a probability of belonging to each of the clusters. Therefore, simultaneously with the parameters, a class membership model is estimated (equation 8). This is the chance that an individual (n) is part of a certain cluster (s) from a set of clusters (S) based on their characteristics (e.g. attitude or socio-demographics). The class membership model indicates how the clusters are related to characteristics of individuals. By averaging the predicted individual cluster probability across all respondents, an average cluster probability (π_{ns}) is obtained. This provides an indication of the relative size of each cluster in the population (Molin & Maat, 2015). To estimate π_{ns}, a cluster-specific constant (δ_s) and a vector of the parameters (γ_s) are jointly estimated. The functional form of the utility for all segments allocations is given by the linear-additive function (g(o)). This function is based on observed variables such as socio-demographics and attitudes (Z_n) (Cranenburgh, 2018).

$$\boldsymbol{\pi_{ns} = \frac{exp^{\delta_s + g(\gamma_s, z_n)}}{\sum_{l=1..S} exp^{\delta_l + g(\gamma_l, z_n)}}}$$

EQUATION 8

The LCM is estimated to predict the choice probability of observing choice i, by weighting the choice probabilities for each cluster (based on the set of parameters for that cluster) by the estimated share of each cluster (S) with the class membership probabilities (π_{ns}) used as weights (Molin & Maat, 2015; Cranenburgh, 2018). For this research, it is interesting to know if there are different clusters among the citizens and to what characteristics this heterogeneity within the clusters is attributed. Therefore, the LCM is estimated.

3.3.2.3. GOODNESS OF FIT

The goodness of fit is a measurement that describes how well a model fits the gathered data. The maximum likelihood principle tries to find a set of parameters that makes the data the most likely. However, the likelihood of the estimation can become very small and even with modest-size datasets, the

likelihood becomes almost zero. Therefore, the log-likelihood is used instead. The log-likelihood becomes very large and is negative of sign. The log-likelihood (LL) is calculated with equation 9.

$$\boldsymbol{LL(\beta) = \ln\left(\Pi_n \Pi_i P_n(i|\beta)^{y_n(i)}\right) = \sum_n \sum_i y_n(i) * \ln(P_n(i|\beta))}$$

EQUATION 9

The LL is used to calculate the McFadden's rho-squared (equation 10). McFadden's rho-squared is a measurement of model fit, it provides a percentage of initial uncertainty explained by the estimated model. If ρ is equal to zero, the model does not provide a better fit than just throwing a dice. When ρ is equal to 1 (which is not possible), there is a perfect fit with the data. LL_β is the log-likelihood of the estimated model, LL_0 is the log-likelihood of the model when all β's are equal to zero (Chorus, 2019).

$$\boldsymbol{\rho^2 = 1 - \frac{LL_\beta}{LL_0}}$$

EQUATION 10

To compare the model fits across models, the likelihood ratio test can be used. This test can only be used when the null model (LL_A) can be obtained by constraining the parameters of the β model (LL_B). So the models need to be nested. To estimate the likelihood ratio test, equation 11 is used. First, the difference between the likelihoods is multiplied by 2 to determine the likelihood ratio statistic (LRS), this is a positive number. Second, the difference in model parameters (degrees of freedom) is taken and looked up in the corresponding row of the chi-square table (Appendix V). This table provides the threshold values per degrees of freedom. Hereby, the significance of the model is checked. If the threshold is smaller than the calculated LRS at the wanted significance level, then the β model is significantly better than the null model (Chorus, 2019).

$$\boldsymbol{LRS = -2 * (LL_A - LL_B)}$$

EQUATION 11

However, when comparing model fits of the different Latent Class models (LCM), the log-likelihood estimates cannot be used because the different LCMs are not nested models of each other (Molin & Maat, 2015). When adding more classes, the model fit based on log-likelihood will increase because there are more degrees of freedom. This increase in model fit is not always valid. Therefore, the Bayesian Information Criterion (BIC) is used to compute the LCM model fit. This criterion is the most widely used statistic in LCM. BIC has a penalty term for the number of used parameters to solve the problem of the log-likelihood. A model with a lower BIC value is preferred, has a better fit, than a model with a larger BIC value. The BIC value can be calculated with equation 12 and is based on the log-likelihood principle, the number of parameters (M) and the number of observations (N) (Magidson & Vermunt, 2004).

$$\boldsymbol{BIC = -2 * LL + \ln(N) * M}$$

EQUATION 12

4. LITERATURE REVIEW

The goal of the literature review is to gain insights into the important concepts of this research. Many research is done into waste prevention behaviour, waste recycling, characteristics that are related to certain decisions citizens make and physical re-use systems. This provides important background knowledge for the choice experiment. The articles used in this review and the search towards these articles is named in appendix I.A. In section 4.1. a review of waste prevention behaviour is provided. In section 4.2. a review about citizen characteristics that are known by the literature of influencing citizen preferences is given. Last, a conclusion of the literature review is provided in section 4.3. to recall the important findings for this research.

4.1. WASTE PREVENTION BEHAVIOUR

Waste prevention behaviour (WPB) is based on several long-known attitude-behaviour theories. Many of these theories start with the assumption that citizens make rational choices. They assume citizens will choose the alternative whereby they perceive the highest benefits against the lowest costs in terms of money, effort and social approval (Steg & Vlek, 2009). One of the most used theories is the theory of planned behaviour by Azjen (1991). The theory of planned behaviour links the beliefs of a person to behaviour. According to the theory, intentions, subjective norms and perceived behavioural control shape the actual behaviour of a person. This theory is known for successfully explaining different types of environmental behaviour.

Multiple researchers have used the theory of planned behaviour to explain WPB. They concluded that WPB is driven by different categories of factors. However, not all papers define the same categories and some add an extra sub-division. Generalized, the subdivisions are quite similar and for that reason are clustered in three, overarching categories (figure 5). These categories are; 1) Motivational factors, 2) situational factors and 3) habitual factors (Steg & Vlek, 2009; Turaga, Howarth & Borsuk, 2010; Zacho & Mosgaard, 2016; Gilli, Nicolli & Farinelli, 2018). Motivational factors contain intrinsic and extrinsic motivations. These factors are individual motivations to engage in re-use policies. Examples of motivational factors are costs and benefits such as rewards, moral and normative concerns and personal efficacy. However, human behaviour does not only depend on motivational factors, but also on situational factors. Situational factors facilitate or constrain the actual behaviour. For instance, physical infrastructure and distance have a strong impact on WPB. Last, there are habitual factors. Behaviour is in most cases habitual and inspired by the automated cognitive processes of the brain. Habit is driven by three factors; 1) a goal, 2) a satisfactory outcome after certain behaviour and 3) mental processes, such as emotions and perception. Habitual behaviour may involve misperceptions and selective attention. Citizens focus on the information that matches their choices and ignore it otherwise. It is not easy to change habitual behaviour (Schultz, Oskamp & Mainieri, 1995; Stern, 2000; Steg & Vlek, 2009; Turaga, Howarth & Borsuk, 2010; Zacho & Mosgaard, 2016).

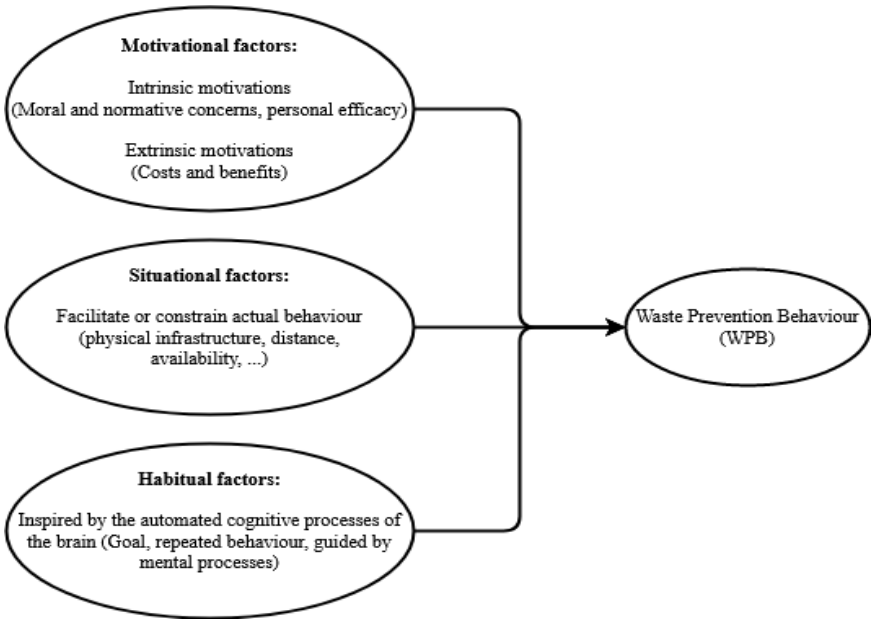

FIGURE 5: CONCEPTUAL FRAMEWORK WPB CREATED BY THE AUTHOR, BASED ON STEG & VLEK (2009) AND THE THEORY OF PLANNED BEHAVIOUR (AZJEN, 1991)

4.1.1. DRIVERS OF CITIZEN BEHAVIOUR REGARDING WASTE HANDLING

Considering waste prevention behaviour (WPB), different drivers regarding waste handling can be found. From the literature, there is little known about the preferences of the citizens regarding the re-use of municipal solid waste (MSW). Nonetheless, there are studies about the preferences of citizens towards recycling. Even though this is not the same, this can be valuable background information to estimate what will influence re-use.

As mentioned in section 1.3., studies about citizen preferences regarding waste handling are mostly conducted in Asian countries. Due to the poor waste collection and processing of solid waste there, the waste problems are more urgent to tackle than in Europe (Bartl, 2014). However, there are some studies conducted in European countries as well. In general, the same results were found. Therefore, the studies are still included in this research (Chan & Bishop, 2013; Czajkowski, Kadziela & Hanley, 2014; Czajkowski, Hanley & Nyborg, 2017).

From these studies can be concluded that social, moral and economic attributes are important determinants for the choices citizens make (Bortoleto, Kurisu & Hanaki, 2012; Chan & Bishop, 2013; Czajkowski, Kadziela & Hanley, 2014; Czajkowski, Hanley & Nyborg, 2017). Meaning that motivational factors, intrinsic as well as extrinsic, can be important in the trade-off's citizens make. For instance, respondents from these studies state that they place value on the reduction of negative externalities regarding waste disposal and perceive goods and services with an environmental friendly sign or label as utility adding (Czajkowski, Kadziela & Hanley, 2014). Notable is, that from most studies it became apparent that the citizens act environmental friendly because of peer pressure, the desire of a positive self-image and to posture a green external image (Stern, 2000; Czajkowski, Kadziela & Hanley, 2014). Moreover, personal benefits, such as offering some kind of rewards, are known for causing a significant difference in the willingness of citizens to recycle. The type of reward does not matter that much, basically any kind of reward is effective. If the reward is in relation to the amount of waste citizens recycle, an even higher

increase in recycling behaviour is seen (Struk, 2017). Another important determinant named is convenience. Ease of use and little effort needed to recycle are indicated as important factors (Struk, 2017; Schultz et al., 1995).

Foremost, the right balance between the intrinsic motivations to act sustainable and environmentally friendly and the extrinsic motivations and situational factors are important. Because if the inconvenience becomes too large, citizens experience demotivation and a loss of utility. Convenience is largely determined by time and costs, and thus important for the decision-making process of citizens. Moreover, it was proven by Stoeva & Alriksson (2017) that when the citizens were satisfied with the local conditions for waste disposal, their behaviour depended on their attitude towards recycling. If there were no proper conditions for waste disposal, citizens would recycle significantly less. When social goals may become in conflict with the economic utility citizens experience (too costly and time-consuming), free-riding tendencies can become present and citizens often choose personal, economic utility over moral incentive, assuming that others will choose for the collective benefit (Uusitalo, 1990). Therefore, a change in behaviour cannot be established by only promoting the collective benefits of the activity but also the personal benefits should be promoted and the barriers to active involvement should be taken away (Stern, 2000; Bortoleto, Kurisu & Hanaki, 2012; Czajkowski, Kadziela & Hanley, 2014).

4.1.2. Attitude measurement scales

Over the last few years, rational choice models are incorporating the moral norms of social psychology. Two most used theories to study pro-environmental behaviour (PEB) in rational choice models are norm-activation theory and value-belief-norms theory. Norm activation theory is a theory of Schwartz (1997) and uses the theory of moral decision making to explain individuals' altruistic behaviour. The theory withholds a fundamental proposition and two preconditions. The fundamental proposition is that the activation of personally held moral norms influences pro-social behaviour (such as PEB). The preconditions are; 1) the individual must be aware that his or her action has consequences for the welfare of others and 2) the individual must feel a personal responsibility to undertake that action. However, according to this theory, the activation of personal norms is not enough to activate PEB. Personal moral norms reflect the expectations individuals have for themselves and are derived from shared social norms. Violation of such a norm gives a feeling of guilt and loss of self-esteem while living up to the norms gives a feeling of pride and enhances self-esteem. People differ in the values they attach to particular norms, they rank different norms as most important. Therefore, the activation of personal norms can generate different levels of moral obligation in comparable situations (Turaga, Howarth & Borsuk, 2010).

In addition to the theory of Schwarz, the researchers Stern, Dietz & Kalof (1993) stated that PEB was a combination of personal norms based on altruistic values, norms based on self-interest and altruism towards other nonhuman species. From this idea, the Value-belief-norms theory was created by Stern, Dietz, Abel, Guagnano, & Kalof (1999). This theory hypothesizes that people's norms are activated when they believe that environmental conditions have consequences to the objects they value, e.g. self, other humans and non-human species and that they can take action to reduce the consequences to the valued objects. These beliefs are shaped by general beliefs about human-environment interaction. This can be measured with the New Environmental Paradigm (NEP) perspective of Dunlap, Van Liere, Mertig & Jones (2000). There is empirical evidence that, in general, the NEP attitudes also predict PEB; stronger attitudes are associated with a greater tendency to engage in PEB (Turaga, Howarth & Borsuk, 2010).

However, more recent research from Kaiser, Hübner & Bogner (2005), states that, as a general measure, NEP has an acceptable overall fit. On the contrary, they concluded that the influence of NEP worldview on the value-belief-norms theory is insufficiently covered (Turaga, Howarth & Borsuk, 2010). Kaiser created in 1998 a scale named the General Ecological Behaviour scale and extended this scale as a reaction on the revised NEP scale. This scale assesses different types of conservation behaviour (Kaiser & Wilson, 2004).

4.2. CHARACTERISTICS OF CITIZENS RELATED TO WASTE HANDLING

In the literature, different citizen characteristics are named related to waste handling behaviour. It is stated that attitude towards sustainability and pro-environmental behaviour are indicators for the choices citizens make, but also norms and values are determined for behaviour. Moreover, socio-demographics seem to be related to waste handling behaviour as well (Stroeva & Alriksson, 2017; Li, Zhao, Ma, Shao & Zhang, 2019). From the literature review performed by Li et al. (2019), it became apparent that psychological factors such as attitudes and moral norms contribute more to waste re-use and reduction than demographics or external factors do.

Before the literate is furtherly reviewed, it is important to clarify two concepts named in this section. Pro-environmental behaviour and sustainable behaviour are commonly used intangible in the literature. However, there is a little difference. Sustainable behaviour is more of an overarching category which holds all issues and activities that do not compromise the ability of future generations to meet their own needs now. Whereas, pro-environmental behaviour is specified as something that does not harm the planet directly (United Nations, 2012). As for waste prevention behaviour and waste handling, both apply and therefore both are taken into account when reviewing the literature.

4.2.1. SOCIO-DEMOGRAPHICS

In a literature review by Struk (2017), it is suggested that waste measurements which are targeting specific household groups based on certain socio-demographics are more efficient and effective than non-specific measurements. However, this is only of importance if the quality of the whole waste handling system is sufficiently present and of sufficient quality.

In the literature, many studies explore the link between socio-demographic characteristics and waste handling behaviour of citizens. The most commonly used characteristics in the papers include gender, age, household income, education level, dwelling type and family size, household composition, and marital status (Czajkowski, Kadziela & Hanley, 2014; Ma & Hipel 2016; Tarfasa & Brouwer, 2018; Alcock, White, Pahl, Duarte-Davidson & Fleming, 2020). From these studies, it became apparent that for instance females are more willing to recycle, participate in waste reduction and portray environmental friendlier behaviour than men. Moreover, females tend to exhibit higher concern for the environment. Observations about age are equivocal, the results differ per study. However, there is a supposed relation between concerns about the environment and age. Younger people show higher concerns about the environment. Moreover, income and education level show a positive and significant correlation with willingness-to-participate in recycling and waste reduction activities. Citizens with higher education levels name time and collection frequency as important factors for their willingness-to-participate. Also, larger detached and semi-detached housing unit inhabitants are more likely to participate in waste reduction and recycling activities. Furthermore, it is suggested that married people are more concerned for the quality of the environment and more willing to participate in waste reduction activities such as waste recycling (Diamantopoulos, Schlegelmilch, Sinkovics & Bohlen, 2003; Ma & Hipel, 2016). Last, there is some

contradiction about family size. In the research of Ma & Hipel (2016), it is stated that smaller families have higher willingness-to-participate in recycling activities. However, the research of Diamantopoulos et al. (2003) concludes the opposite. They state that a higher amount of children correlates positively with environmental friendly behaviour and stronger concerns about the environment. Moreover, they found a higher level of participation in recycling activities. This difference can be explained due to the year the research is performed in or due to the research area of the included articles. The review of Ma & Hipel (2006) contains worldwide research whereas the review of Diamantopoulos et al. (2003) only contains research from Europe and the USA.

4.2.2. CITIZEN-PROFILES TOWARDS SUSTAINABLE BEHAVIOUR

Environmental sustainability is a key issue in today's world. The term sustainable development has been used for environmental, social and economic dimensions to protect the planet of the future (Vlek & Steg, 2007). The social dimension is linked to the behaviour of citizens, however, citizen behaviour is not consistent. Citizens can have the intention to behave sustainably but, next to environmental considerations, many other factors play an important role in determining their actual behaviour such as status, convenience, ease and opportunity (Steg & Vlek, 2009; Cleveland, Kalamas, Laroche, 2012). From a previous study conducted by Meerlanden (Meerlanden, 2019), five citizen-profiles towards sustainability are determined. These are frontrunners, sympathizers, benevolent citizens, indifferent citizens and rejecters. All these groups have different characteristics and drivers for their behaviour. These attitudes are based on the motivacation theory (Motivaction, 2018). This theory is based only on qualitative research and not tested yet with quantitative research.

<u>Frontrunners:</u>

Citizens in this category have sufficient knowledge about sustainability and portray sustainable behaviour. Frontrunners identify strongly with caring for a better world. When they buy new products they are conscious about the influence of the purchase on the environment, animal health and humanitarian subjects. They trust companies with a sustainable and green image more than other companies. Propagating this behaviour gives them satisfaction and joy. They want to stimulate others to behave similarly and share their knowledge about sustainability with their surroundings. Frontrunners like to see themselves as the ambassadors of sustainable behaviour. Therefore, their motivations are mostly intrinsic and they are easily motivated for instance by giving them the stage to show off their pioneering behaviour. They are willing to put effort and time into re-use and are willing to pay more. Sustainability is more important than price.

<u>Sympathizers:</u>

Compared to frontrunners, sympathizers are somewhat more sceptical and preserved. They have sufficient knowledge about the effects of waste on the environment and see sustainability as an important factor when they purchase products. This group is motivated to act sustainable and willing to put in some effort. They are idealistic and see sustainable behaviour as normal behaviour instead of a fun activity as the frontrunners experience it. However, this makes their behaviour constant. Sympathizers feel a strong need to make the world a better place and are, to some extent, willing to make concessions to improve their influence on the environment. Sympathizers are easily motivated by removing barriers such as time and distance. Incentives to motivate them are for instance green labels or quality marks to steer their choices. Moreover, sympathizers like getting alternatives. This way they can choose what alternative fits their routine best.

Benevolent-citizens:

Benevolent-citizens have a positive attitude towards sustainable behaviour, however, they are not willing to make concessions. Sustainable behaviour should be practical and should fit their daily life. This group is easily discouraged by barriers and is sensitive to negative stories or experiences of others. This group will not actively pursue sustainable behaviour. The alternatives offered to them must be approachable, cheap and easy. Also, subsidies can be an important driver for benevolent-citizens and can prevent relapsing to old behaviour. Because their knowledge about sustainability is average, they are often not conscious of their influence on the environment. They think there is little they can do to improve the environment. This makes them hesitant in changing their behaviour. However, this group is also sensitive to the social norm and moral messages. Working on their emotions and morality will motivate them, they need to know what the effects are of their current behaviour and what the personal benefits are if they change. This group is willing to change but needs a clear and simple message without having to make concessions on price, quality or ease.

Indifferent-citizens:

Indifferent-citizens are sceptical towards sustainable behaviour, they understand their influence on the environment but are not convinced that they should change this behaviour. Moreover, they are sceptical about the sustainability claims of organizations and companies. This group is retentive to their habits and routines and do not like change. However, this group is very susceptive for the social norm. If the social environment will change their behaviour, this group will automatically change accordingly. Another important incentive for this group to change is a financial benefit linked to the desired behaviour. Because of the sceptical attitude and routine driven behaviour, the benefits should be made very clear. Breaking through the routine needs active guidance from regulating parties. Also, visible enforcement is needed to maintain this group from going back to their usual behaviour. As the social norm is of a big influence on this group, a stimulating environment which can serve as an example is of importance.

Rejecters:

This group is consciously against sustainable behaviour. Rejecters are cynical and suspicious and do not want to be associated with sustainable behaviour. It contradicts with their lifestyle. Moreover, this group thinks they know a lot but lacks theoretical and practical knowledge about waste separation. They have little to no knowledge about sustainability and do not see how their actions affect the environment. Citizens in this group think it is the responsibility of the government and businesses to improve the environment. Unfortunately, this group is not susceptive for the social norm. Rejecters are mainly focused on self-interest and lack the conviction that they can and want to do good for the environment. This group is very consistent in their behaviour and is not willing to change. Rejecters choose the easiest way out. The most important drivers of this group are ease and self-interest. They do not account for the influence of their actions on the environment. To reach this group it is important to confront them with things that are of self-interest for them and their surroundings. They will only change their behaviour if it is the easiest option or personal benefits such as financial benefits are linked to a certain behaviour. As this group is very reluctant towards sustainability, enforcement has no use. This will only increase the negative attitude towards the measures. It is more effective to work on the other groups first, this can help remove the barrier for the rejecters in the long term.

4.3. CONCLUSION

It became apparent that waste prevention behaviour (WPB) explains one type of behaviour. However, it does not explain multidimensional behaviour such as the trade-offs citizens make (Moisander, 2007;

Kroesen, 2019ab), it does, however, explain the underlying drivers of these trade-offs. Social, moral and economic factors are determinants for the choices citizens make, which leads to two important trade-offs; 1) between morality and economic benefits, and 2) between social goals and convenience. Citizens perceive high utility from "doing good", but if the inconvenience or economic burden becomes too large, they will choose for the more convenient option. Creating a reward system may increase the willingness of citizens to recycle considerably. The kind of reward does not matter. These are important findings to use in creating the choice experiment as it becomes more clear what factors are of importance for citizens to base their choices upon (Sheau-Ting, Sin-Yee, & Weng-Wai, 2016).

Furthermore, it is proven that a change in behaviour can be sustained if it is based on the preferences of the citizens (Steg & Vlek, 2009). As mentioned before, these preferences differ per person. It is possible that among these differences clusters can be found based on certain characteristics. If these clusters can be found, tailor-made policies can be designed to facilitate the different preferences of the different clusters (Kroesen, 2019a). As suggested by Nixon and Saphores (2007), an integrated approach should be used to combine both the socio-economics (such as demographics) and psychosocial (such as personal values, beliefs and attitudes) characteristics to determine these clusters. Meerlanden did already do qualitative research into the different types of citizens' profiles towards sustainable behaviour. They demonstrated that there are different profiles and this will help select the most important attributes for the citizens to incorporate in the choice experiment. However, these types are not quantitatively proved yet.

From these literature reviews, it seems logical to include the socio-demographics in the research as this can explain the differences in choices citizens make. However, both the research of Vencatasawmy, Öhman & Brännström (2000) and Diamantopoulos et al. (2003) state that socio-demographic variables are not significant factors for explaining recycling behaviour. As described above, there are some discrepancies in the literature about these factors. There is mixed evidence about the influence and even about the direction of the correlation. Most studies indicate a limited or ambiguous value when socio-demographic characteristics are used for segmenting. Nevertheless, as socio-demographics are relatively easy to apply and gather compared to other segmenting measures, it is widely used. Vencatasawmy et al. (2000) recommends to jointly consider a wide range of variables to evaluate which of them has the strongest influence on willingness to recycle.

5. EXPERIMENT DESIGN

An online survey is used for collecting data. The survey is created in a program called Qualtrics. This program makes it possible to distributes the four versions (blocks) of the choice experiment equally among the respondents (see section 5.3.). The final survey can be found in Appendix III.B. By performing a survey, it is easier to get information representing a large population compared to other data gathering methods. Representativeness is potentially high (Granello & Wheaton, 2004). The survey is distributed by providing a link to the survey on the social media of Meerlanden and of the researcher, to the social network of the researcher who forwarded it into their social networks, in a local newsletter, and through flyers with access code to the survey distributed by the researcher at the different waste disposal facilities of Meerlanden (appendix III.C.).

The target group of this research are the citizens living in the municipalities served by Meerlanden (see section 2.2.) and are 18 years or older. The age limit is chosen because it is assumed that younger people are not actively involved in the distribution of waste or the re-use of products in the household. They are probably influenced by how their parents behave and the rules they have regarding waste disposal at their houses.

5.1. DESIGN APPROACH

From the literature and explorative research at Meerlanden (see section 2.2.), different alternatives are thought off and different attributes are formulated. From analysing the vision for future waste centres provided by Meerlanden, “milieustraat 3.0.” (Meerlanden, 2019), a selection of the alternatives and attributes was made. This was done considering what attributes are probably most important for the decision-making process of the citizens and are in the range of influence of Meerlanden. From there, the stated choice experiment and survey were iteratively improved. By consulting Diederik Notenboom, strategic advisor of Meerlanden, choices are made regarding the alternatives, attributes and attribute levels. Thereafter, the survey was shown to the graduation committee of the researcher and furtherly improved based on their feedback. Then, a pilot was performed with people who are not familiar with the method and/or the subject. The pilot-group was very diverse in age, background and education level as the targeted population will also be very diverse in these characteristics. Also, the feedback (Appendix III.A.) required with the pilot was implemented, the pilot is furtherly discussed in section 5.1.1. Last, the survey is discussed one more time with the graduation committee of the researcher and the strategic advisor of Meerlanden. After the last changes were made, the survey was distributed for data gathering.

5.1.1. PILOT SURVEY

Before the surveys were distributed among the citizens, a pilot survey was performed. This pilot was done in two groups. The first group consisted of eight persons. The second group consisted of four new persons and four persons who already filled in the pilot, to check if they experienced the survey as improved compared to the first time. The pilot groups were diverse in gender, education level, study background, and age. Therefore, it could be checked if the survey was understandable for all citizens and to generate a wide range of feedback as it is supposed that education level and age are important pillars for understanding the survey. The pilot groups were given the following points to take into account when making the survey:

- Clarity and readability of the questions
- Clarity and readability of the explanation parts

- Lay-out (Is the background distracting, does the layout compromise the readability of the text, layout of the figures and so on)
- Grammar
- Understandability of the questions, did you get all the information needed to answer the questions?
- Did you miss any questions or information which you think should be added?
- Length and feasibility of the survey
- Other points you want to provide feedback on

Last, the pilot groups were asked on what device they made the survey as this could influence the experience and the feedback. The comments were taken into account and improvements were made to the survey. The adjustments are mentioned in appendix III.A.

5.2. STRUCTURE OF THE SURVEY

The survey consists of multiple components:

- Welcome text (Appendix III.B.)
- Explanation of the difference between recycling and re-use (Appendix III.B.)
- Explanation of the choice experiment and alternatives (Appendix III.B., section 5.3.1.)
- Explanation of the attribute levels (Appendix III.B., section 5.3.2.)
- Stated choice experiment (Appendix III.B., section 5.3.)
- Statements regarding sustainable behaviour and attitude towards the environment (section 5.4.3.)
- Socio-demographics (section 5.4.2.)
- Exploratory questions choice experiment(section 5.4.1.)

5.3. DESIGN OF CHOICE EXPERIMENT

This section explains the choices made for the alternatives, the attributes and levels, and experimental design.

5.3.1. ALTERNATIVES SELECTED

For this research, labelled alternatives (see section 3.2.1.) are chosen because the different alternatives in a choice set contain different characteristics and the choice for a certain alternative can be preferred. From the vision “milieustraat 3.0.” about the new waste disposal centres created by Meerlanden (Meerlanden, 2019), the current municipal solid waste (MSW) systems, and the literature review performed in chapter 4, three alternatives are selected. These alternatives are elaborated in this section. These alternatives are:

1. Selling through an online (Meerlanden) platform
2. Bringing it to the waste disposal centres by yourself
3. Pick-up service driven by the citizens themselves

<u>Selling through an online (Meerlanden) platform:</u>

Selling through an online platform is already a well-known form of re-use. Citizens offer their products for selling, trading or give it away to others. The plus side of this alternative is the ease, citizens do not have to leave their house to get rid of their products. However, the downside is that the products will stay at

citizens' houses until they found a new owner. These platforms can be local such as a Facebook page, or national such as "Marktplaats". The platforms can even be international like eBay. Creating such a platform for citizens of the municipalities served by Meerlanden can help in making a more local, trustworthy, and convenient environment. A platform created for Meerlanden can also provide additional information about re-use and ideas and inspiration for re-use.

Bringing it to the waste disposal centres by yourself:

At the waste disposal centres, there will be a host who will help the citizens with their products. At the entrance, the host will help determine what products can be re-used and what should be recycled. The citizens can get rid of their products at once, and all products are disposed most optimally. Moreover, there is a second-hand shop, second-hand construction market, repair-café and an art-café at the waste disposal centre where citizens can buy things they need or get their broken products fixed. These shops, markets and cafes are all based on the products brought to the centres. Because all these shops are at the same place, citizens can perform all activities at once.

Pick-up service driven by the citizens themselves:

The pick-up service is an alternative for the citizens, by the citizens. It has societal value as well as convenience for the citizens. The citizens can apply for the pick-up service through Meerlanden by phone, app or website. The pick-up service picks the products up at the citizens' houses and brings the products to the waste disposal centres. The citizens should specify what kind of products they would like to have picked up because the driver has limited space in the vehicle. The citizens pay a fee for this service and this fee is for the driver of the pick-up service. This pick-up service can be a way for citizens to earn some extra money or bridge their experienced gap to the job market.

5.3.2. ATTRIBUTES AND ATTRIBUTE LEVEL SELECTION

The attributes and attribute levels selected are shown in table 2. In this section, it is elaborated what the definition is of the attributes, why these are selected, what levels are included and for what reason. There were several guidelines taken into account when selecting the attributes. These were; 1) attributes that are characteristic for the alternatives and 2) attributes that are fundamental for the choices citizens make. It should provide enough information for citizens to base a realistic choice upon.

Because this analysis makes use of labelled alternative (see section 5.3.1.), every alternative has its own set of attributes and attribute levels (table 2). Per alternative, there are three attributes, with two attribute levels each. For each alternative, it is tried to find characteristics based on the important drivers for behaviour found in chapter 4. Therefore, there is a "how" attribute, this related to the convenience citizens base their choices upon. Second, there is a "costs or benefit" attribute, because all choices are framed on a consideration between costs and benefits in terms of money. And last, there is a loyalty system as citizens are sensitive for reward systems and discounts. They like to be rewarded for certain behaviour.

Selling through online (Meerlanden platform):

1. Online platform: As was mentioned in section 4.1.1., convenience is highly important for citizens when they make a choice. Therefore, it is important to determine if they prefer an app or a website. When selling online, the first consideration citizens make is how to access the platform.

It can be that older citizens are more comfortable with using a website instead of an app as they perceive this as less complicated.

2. Rewards: A known characteristic of selling through a platform is that the rewards are (partly) for the seller. However, by some platforms, a part of the earnings is for the hosting partner (owner of the platform) because they host the platform and optimize the different option and possibilities of the platform to make it as user friendly as possible. Because citizens are driven by financial rewards, it is possible that citizens will not prefer an option where they lose a part of their earnings to the platform. Therefore, it is assumed that this attribute can be determined for the choices citizens make.
3. Loyalty system: A loyalty system can create an incentive for citizens to pursue certain behaviour. Because the loyalty system can provide discounts, it is assumed that citizens can find this utility adding, and thus important to base their choices upon.

Bringing it to the waste disposal centres by yourself:

1. Appointment: To provide citizens with a realistic choice set, it is important to know if they need to make an appointment or can go whenever they want. Because the measures should fit their lifestyles, it is assumed that the need for an appointment is determinant for the trade-offs the citizens make.
2. Rewards: By this alternative, citizens can get rid of their products all at once. However, it is important to know the trade-off between this convenience and financial benefit. As with second-hand shops, citizens often do not get the earnings because the shops have costs for maintaining the shop and storing the products. This is the same for Meerlanden and therefore, (a big part of) the earnings is for Meerlanden. It can be the case that citizens are more willing to go to the waste disposal centres themselves if they receive a share of the earnings from their products.
3. Loyalty system: A loyalty system can create an incentive for citizens to pursue certain behaviour. Because the loyalty system can provide discounts, it is assumed that citizens can find this utility adding, and thus important to base their choices upon.

Pick-up service driven by the citizens themselves:

1. Appointment: When disposing municipal solid waste citizens want, in most cases, to directly dispose the products and do not want to hold on to it for too long as it can be space-consuming. Therefore it is apparent that citizens prefer on-demand appointments. However, as they probably want to dispose all products at once, it can also be an option the plan ahead and reserve a pick-up service in the future to make sure all the products can be picked up at once.
2. Costs: As the pick-up service is driven by someone from the neighbourhood, the costs can be held low. It is important to find out what the trade-off is citizens make between the costs and convenience of pick-up service.
3. Loyalty system: A loyalty system can create an incentive for citizens to pursue certain behaviour. Because the loyalty system can provide discounts, it is assumed that citizens can find this utility adding, and thus important to base their choices upon.

TABLE 2: ATTRIBUTES AND ATTRIBUTE LEVELS

SELLING THROUGH ONLINE (MEERLANDEN) PLATFORM	
ATTRIBUTES	LEVELS
ONLINE PLATFORM	• Through Meerlanden app • Through Meerlanden website
REWARDS	• Earnings are all for you • 70% of the earnings is for you, 30% of the earnings are for Meerlanden
LOYALTY SYSTEM	• There is a loyalty system • There is no loyalty system
BRINGING IT TO THE WASTE DISPOSAL CENTRES BY YOURSELF	
ATTRIBUTES	LEVELS
APPOINTMENT	• No appointment • Reserve a timeslot
REWARDS	• Earnings are all for Meerlanden • 70% of the earnings are for Meerlanden, 30% of the earnings are for you
LOYALTY SYSTEM	• There is a loyalty system • There is no loyalty system
PICK-UP SERVICE DRIVEN BY CITIZENS THEMSELVES	
ATTRIBUTES	LEVELS
APPOINTMENT	• On-demand • Reserve a timeslot
COSTS	• € 15,- • € 25,-
LOYALTY SYSTEM	• There is a loyalty system • There is no loyalty system

5.3.3. EXPERIMENTAL DESIGN AND CONSTRUCTION OF CHOICE SETS

To construct the different choice sets a design method should be chosen. The choice sets can be constructed with an efficient or experimental design. For this research, it is chosen to use an experimental design. For an efficient design, priors are needed and these can be estimated based on the performed pilot study. However, requiring priors is too time-consuming and a high amount of pilot respondents are needed. Moreover, there are no parameters from literature to compare with. Therefore, the experimental design is used for creating the choice sets and the pilot is used for improving the survey.

The experimental design shows how the attribute levels should be combined in the different choice sets. This is done with a program called Ngene, a software package to construct experimental designs. The choice sets are constructed simultaneous and with orthogonal fractional factorial design. This design is used to make sure no correlations between the main effects occur, leading to the smallest possible standard errors. Orthogonal fractional factorial designs also reduce the number of choice sets (Molin, 2019a). Depending on the number of attribute levels, a basic plan is chosen to construct the profiles for the choice sets. This plan indicates how much choice sets should be used to gain an orthogonal design and attribute level balance. There are two attribute levels per attribute, meaning that masterplan 4 (Appendix II.A.) is chosen, this leads to twelve choice sets in the experimental design. The experimental design and choice sets created in Ngene are furtherly explained in appendix II.B.

As mentioned before (see section 1.3.), municipal solid waste (MSW) contains multiple waste types. Because the type of product can be determined for the choices citizens make, context variables are added to the choice experiment. By describing a scenario, the respondents will experience a more realistic choice

situation. Moreover, adding scenarios tests if there is a difference in preference regarding a certain product. The product groups proposed are big furniture (sofa), big e-waste (refrigerator), small furniture (side table), and small e-waste (vacuum cleaner) (Molin, 2019d). However, if each questionnaire would contain all four scenarios, there would be four times twelve choice sets which is too much for one respondent to answer. Therefore, blocking is used. The questionnaire is cut in four blocks of three questions by using a blocking scheme to contain attribute level balance (appendix II.B.). The blocks are not orthogonal, however, the complete design is still orthogonal. After blocking, the four scenarios can be put into one questionnaire, leading to four questionnaires with still twelve choice sets each (three questions per product).

In the choice experiment, there is also a base alternative. This is a separate alternative to determine if the respondents prefer the chosen alternative or prefer the current waste disposal system more. Making this a separate choice allows for still examining the trade-offs among attributes but also estimates the stated willingness to change from current disposal behaviour towards re-use (Louviere, Hensher, & Swait, 2000). An example of a choice set is given in figure 6.

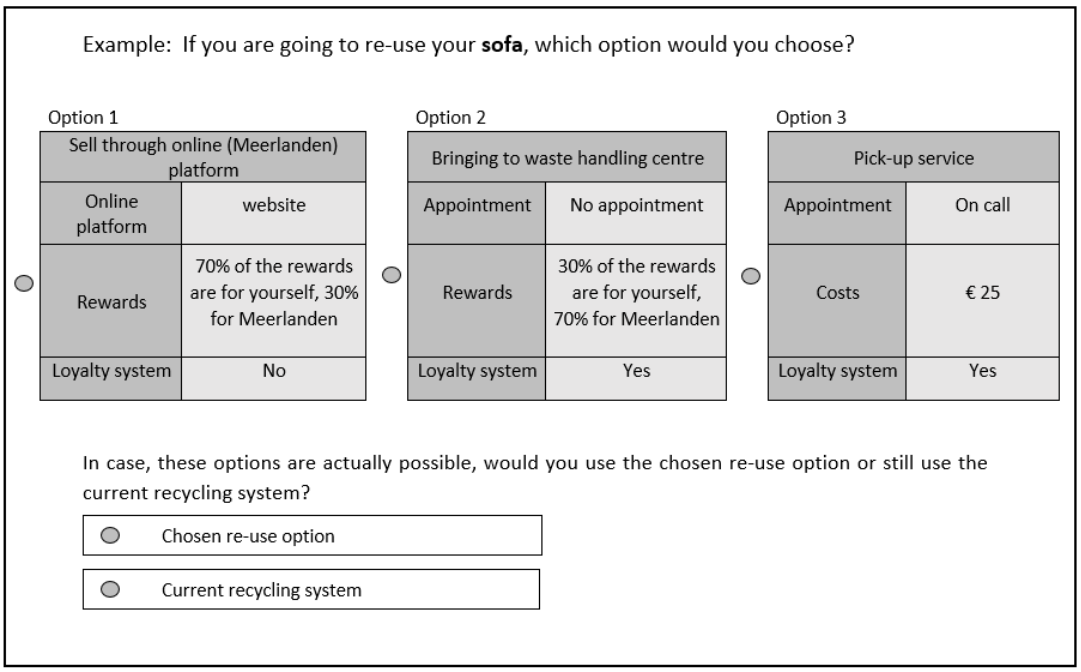

FIGURE 6: EXAMPLE OF A CHOICE SET (TRANSLATED FROM DUTCH TO ENGLISH)

5.4. ADDITIONAL QUESTIONS SURVEY

The literature review revealed that several types of variables can have a relation with citizens preferences towards municipal solids waste (MSW) systems. To be able to analyse the relationship between these variables and preferences, this survey also measured the following characteristics: socio-demographics, attitudes and current waste handling behaviour. The characteristics are divided into exploratory questions related to the choice experiment (section 5.4.1.), socio-demographic questions (section 5.4.2.), and last, validated statements related to sustainable behaviour and attitude towards the environment (section, 5.4.3.).

5.4.1. EXPLORATORY QUESTIONS

The choices citizens make are not only dependent on the attributes named for the different alternatives (see section 5.3.2.). When citizens make decisions, it also dependents on their current situation. Therefore, some exploratory questions are added to the choice experiment to provide the context under which the citizens made the choices. For instance, citizens without a driver's license will probably let this influence their choices. Therefore, a question is added to see if the respondents have a driver's license. For the same reason, there are two questions added about the ability of respondents to bring their products to the waste disposal centres. Last, there is a question if respondents bring their products by themselves or let others do it for them. Citizens who ask others to bring their products may prefer the pick-up service more for instance.

As the waste disposal centres are already existing, the travel time component is not added as an attribute in the choice experiment. At first, this was the case, but, because citizens will probably choose from their current situation, they will not consider this time if their current travel time is shorter or longer than the mentioned time. Therefore, the attribute is not added in the choice experiment. However, travel time to the waste disposal centres is added as an exploratory question. Because in some municipalities the waste disposal centre is in the neighbourhood, as in other municipalities, the citizens need to go to another municipality to visit the waste disposal centre. This can influence the choices citizens make.

Due to the COVID-19 pandemic, there were very long rows at the waste disposal centres of Meerlanden. As the alternatives contain the attribute level "on appointment" and the alternative "pick-up service". Citizens who have visited the waste disposal centres during the COVID-19 pandemic may answer the choice experiment with this in mind. For that reason, there are two questions related to COVID-19 included in the exploratory questions. Moreover, there are statements about pandemics in the survey, it could be that the current situation is of influence on the answers of citizens. As this research is not able to check if there is a difference in results before COVID-19 and now, these questions can provide an indication of the effect but not show the actual effect.

5.4.2. SOCIO-DEMOGRAPHIC QUESTIONS

As described in section 4.2.1., socio-demographics may be indicators for the preferences of citizens. Therefore, these are incorporated into the survey. Due to privacy considerations, for every question, there is a "do not want to answer" option. There are no questions which are directly related to an individual. The socio-demographics included are gender, income, year of birth, municipality the respondent lives in, educational level, living arrangement and household size.

5.4.3. SUSTAINABILITY AND ENVIRONMENTAL BEHAVIOUR QUESTIONS

As attitude towards the environment and sustainable behaviour seem to be indicators for the preferences of citizens, certain statements are added. First, the statements of the New Ecological Paradigm (NEP) are added. These statements check the attitude towards the environment and determine pro-environmental behaviour (Dunlap et al. 2000). The NEP contains fifteen statements. These are answered on a five-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree). Because the statements of the NEP are not asking about real behaviour, also the statements of the General Ecological Behaviour scale (GEBS) are used. Originally, the GEBS contains forty statements, divided into seven subcategories (Kaiser, 1998). From these seven categories, there are two related to waste. These two are used for this research. These categories are 1) Ecological garbage removal and 2) Garbage inhibition. Together, these contain ten

statements. These ten statements are also answered on a five-point Likert scale (not applicable, never, sometimes, often, always).

5.5. ETHICAL IMPLICATIONS

Because surveys are used to gather data, certain ethical implications are taken into account. When gathering data, some privacy issues need consideration. The gathered data for this research is anonymous, there are no questions that can be traced back to the respondent. Moreover, the respondents will click on a link and are directly directed to the questionnaire, there is no contact between the respondent and the researcher about participation. Furthermore, the respondents can withdraw from the questionnaire whenever they want, without any consequences.

The data is saved on the server of a licenced questionnaire (Qualtrics), the computer of the researcher and the server of Meerlanden as the research is performed at their company. Only the researcher and supervisors of this research have access to the gathered data. The readers of the research can only access the data with the permission of the researcher and supervisors. Qualtrics complies with the applicable data privacy laws such as GDPR (General Data Protection Regulation) and CCPA (California Consumer Privacy Act), as well in the role of the data controller, as in the role of the data processor of customer data (Qualtrics, 2020).

Last, an ethical request is submitted at the TU Delft to make sure the data is handled correctly. The Human Research Ethics Committee (HREC) has screened the proposal to make sure ethical protection is maintained and have given their consent.

6. DATA ANALYSIS AND RESULTS

In this chapter, the results of this research are discussed. First, the data were prepared and cleaned. This process is described in section 6.1. Thereafter, the descriptive statistics are discussed in section 6.2., this provides knowledge about the representativeness of the study sample. In section 6.3., the models were estimated and the main results of the analysis are summarized in section 6.4.

6.1. DATA PREPARATION

The data were gathered between the 22th of May 2020 and the 13th of June 2020. 525 individuals opened the link to the survey, whereof 251 respondents filled in the survey. This is a dropout rate of 52% which is very high. A possible explanation for this dropout rate could be that the survey was intended for certain municipalities and this was not always clear from the introduction text containing the survey link. This is supported by the time responders dropped out, right after reading the introduction where the municipalities were mentioned for the first time. Another explanation could be that the survey has quite a long introduction (four pages) and therefore some respondents would choose to fill in the survey another time but by closing the survey and opening again, a new session was initiated or last, respondents did not fill in the survey after closing. On average the respondents did 46 seconds on reading the introduction, the median duration of filling in the survey was around 16 minutes.

The data gathered with the survey were cleaned and prepared for the analyses. The different steps taken to prepare the data are explained in appendix IV. After cleaning the data, 249 respondents were suitable for inclusion in the analyses. As not all respondents filled in the survey in total, there are some differences in the number of observations between the blocks. Moreover, some respondents only answered the opt-out questions, these are considered in the data as valid answers and thus included. Therefore, there were 2634 suitable observations if the base alternative was not taken into account. When the base alternative was taken into account, there were 2707 suitable observations. As discussed in section 5.3.3., blocking was used, to ensure that the respondents would evaluate all four contexts. In figure 7, an overview of the number of observations per product type per block is given. The different product types included between the 149 and 189 observations per block each.

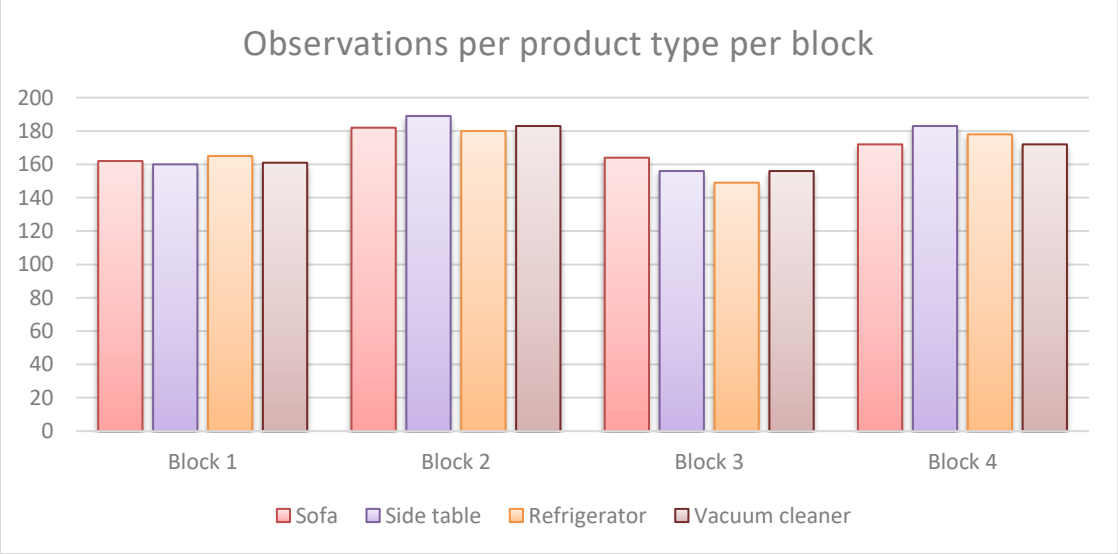

FIGURE 7: NUMBER OF OBSERVATIONS PER PRODUCT TYPE PER BLOCK

6.1.1. VARIABLE CODING

As the variables used in the choice experiment were, except for costs, age and income, nominal variables, the variables were coded before they were used for the model estimations. Table 3 gives an overview of the coded variables. Income is a categorical variable and therefore coded per category, cost and age were not coded and therefore, not added to the table. For the other variables, effect coding was applied since there was no reference category for the different attributes. With effect coding, the sum of utility contributions is zero, thus, the average utility contribution is also zero. The utility contribution of the attribute levels expresses the difference from zero (Molin, 2019c). This is under the condition that everything else is kept constant. The first part of the table shows the coding of the attribute levels of the choice experiment. The second part of the table shows the socio-demographic variables. Some variables were grouped as it was not important for the research to take every level into account separately. This was done for education and family status. The third part of the table contains the exploratory variables, and the last part the contexts, indicating for which product type the choice set was answered.

TABLE 3: VARIABLE CODING

ATTRIBUTES OF THE CHOICE ALTERNATIVES			
Variable	Level	Coding	
TYPE OF PLATFORM ALTERNATIVE 1	Through Meerlanden app	1	
	Through Meerlanden website	-1	
REWARD SYSTEM ALTERNATIVE 1	Rewards are all for you	1	
	70% of the rewards are for you, 30% is for Meerlanden	-1	
LOYALTY SYSTEM ALTERNATIVE 1,2 &3	There is a loyalty system	1	
	There is no loyalty system	-1	
APPOINTMENT ALTERNATIVE 2	No appointment needed	1	
	Reserve a timeslot	-1	
REWARD SYSTEM ALTERNATIVE 2	Rewards are all for Meerlanden	1	
	70% of the rewards are for Meerlanden, 30% of the rewards are for you	-1	
APPOINTMENT ALTERNATIVE 3	On-call	1	
	Reserve a timeslot	-1	
SOCIO-DEMOGRAPHIC VARIABLES			
Variable	Level	Coding	
GENDER	Male	1	
	Female	-1	
EDUCATION	No educational qualification, primary school	1	0
	Preparatory secondary vocational education (basic), intermediate vocational education level 1		
	Preparatory secondary vocational education (theoretical), higher general secondary education & pre-university education (year 3)	0	1
	Intermediate vocational education level 2, 3 or 4		
	Higher general secondary education & pre-university education (year 5/6)		
	Bachelor's degree	-1	-1
	Master's degree, PhD		
INCOME	Less than € 20.000	0	
	€ 20.001 - € 30.000	1	
	€ 30.001 - € 40.000	2	
	€ 40.001 - € 50.000	3	
	€ 50.001 - € 60.000	4	

	€ 60.001 - € 70.000	5		
	€ 70.001 - € 80.000	6		
	€ 80.001 - € 90.000	7		
	€ 90.001 - € 100.000	8		
	€ 100.001 or more	9		
CURRENT FAMILY STATUS	Single with children living at home Married/living together with children living at home	1		0
	Single without children living at home Married/living together without children living at home	0		1
	A child living at home Single with roommates	-1		-1
EXPLORATORY VARIABLES				
Variable	Level	Coding		
DRIVER'S LICENCE	Yes	1		
	No	-1		
ABILITY TO TRANSPORT BIG WASTE	Yes	1		
	No	-1		
ABILITY TO TRANSPORT SMALL WASTE	Yes	1		
	No	-1		
ABILITY TO GO TO THE WASTE DISPOSAL CENTERS YOURSELF	I do it myself	1		0
	Sometimes I do it myself	0		1
	I ask others to do it for me	-1		-1
CONTEXT				
Variable	Level	Coding		
PRODUCT TYPE	Sofa	1	0	0
	Vacuum cleaner	0	1	0
	Side table	0	0	1
	Refrigerator	-1	-1	-1

6.1.2. SUMMATED SCALE CONSTRUCTION

As mentioned in section 5.4.3., there were different statements included in the survey. These statements are related to attitude towards the environment and ecological behaviour. To measure these attitudes, two validated scales were used, namely; New Ecological Paradigm (NEP) and General Ecological Behaviour Scale (GEBS). Because both of these scales were already validated scales (section 4.1.2.), the statements were not furtherly checked with factor analysis. Both scales are supposed to be unidimensional and internally consistent. Meaning that the statements of a scale together represent a single, underlying factor and that the respondents respond to the statements consistently. In this research, NEP represents citizens' attitude towards the environment and the GEBS represents the ecological attitude towards garbage. The statements of the two scales were combined in two summated scales, one for NEP and one for GEBS.

The respondents rated the statements of the GEBS and NEP on a 5-point Likert-scale. The ratings were coded from 1 to 5, where 5 was most positive (e.g. "completely agree" and "always"). The summated scales were constructed by adding up the values of the statements related to the attitudes and divided by the total number of statements, 10 for the GEBS and 15 for the NEP scale. By doing this, the total score becomes on a scale from 1 to 5 again. A higher total score indicates a more positive attitude towards the environment and a more positive attitude towards performing ecological behaviour during garbage distribution. In appendix VII.B., the descriptive statistics of the statements are discussed in detail.

In the GEBS, statements 1,2,6 and 8 were contradicting towards the other statements. If a respondent indicated a high value for one of these questions, he or she stated to not perform ecological behaviour during garbage distribution. Therefore, for these four statements, a reversed variable was constructed. By subtracting the rated value from 6, the statements were placed in the same perspective as the other statements and could be added to the summated scale. By the NEP statements, this was done for statement 2, 8, 10 and 12. The same technique as for the GEBS was used.

6.2. DESCRIPTIVE STATISTICS

The descriptive statistics of the research were used for multiple purposes, including to check the distribution among the different versions of the survey and whether the sample was representative of the population. Representativeness of the population was based on the socio-demographic questions added to the survey.

6.2.1. REPRESENTATIVENESS OF THE SAMPLE

Before the models were estimated it was important to determine if the sample obtained with the survey was representative for the population because this could have implications for drawing conclusions based on the analyses. The population of this research were the citizens living in the municipalities served by Meerlanden. As not all data were available for each municipality separately, the representativeness was also checked for the population of the Netherlands.

The representativeness was checked with a nonparametric chi-square test. If the chi-square test was significant, the H0 hypothesis was accepted, indicating that the sample was statistically different from the population. The statistical tests performed to check the representativeness of the sample can be found in appendix VI. The tests were performed for gender, age, educational level and income. For gender and age, both the representativeness with the municipalities served by Meerlanden was checked as the representativeness with the whole population of the Netherlands. For educational level and income, the data were not found for all municipalities and therefore, only the representativeness with the population of the Netherlands was checked. For each variable there were missing values, these were discussed in appendix VI as well. The "do not want to say" responses were counted as missing values.

The sample turns out to be not representative for the population of the municipalities served by Meerlanden nor for the population of the Netherlands (Appendix VI). The distribution between the municipalities and the total population did not differ enormously causing the same results for both analyses. There were more women included in the sample compared to the population. When looking at age, the categories 26-45 and 46-65 were overrepresented whereas the categories 18-25 and 65+ were underrepresented. For income, the higher income groups were overrepresented. This was similar for educational level. However, although the sample was not representative of the population, all categories were presented enough in the sample to analyze the influence of the variables. The distribution of the respondents over the categories of the different variables are shown in table 4, also the distribution percentage of the population is shown in table 4.

TABLE 4: SAMPLE PERCENTAGE COMPARED TO THE POPULATION PERCENTAGE OF SOCIO-DEMOGRAPHICS

GENDER (MUNICIPALITIES)		
	Sample	Population
MAN	41.7%	49.2%
WOMAN	58.3%	50.8%
GENDER (NETHERLANDS)		

	Sample	Population
MAN	41.7%	49.7%
WOMAN	58.3%	50.3%
AGE (MUNICIPALITIES)		
	Sample	Population
18-25	11.1%	13.9%
26-45	33.3%	27.1%
46-65	41.7%	35.8%
65+	13.9%	23.2%
AGE (NETHERLANDS)		
Age	Sample	Population
18-25	11.1%	14.4%
26-45	33.3%	46.8%
46-65	41.7%	16.0%
65+	13.9%	22.8%
INCOME (NETHERLANDS)		
	Sample	Population
€ 0 – € 30.000	17.6%	60.7%
€ 30.001 – € 50.000	28.5%	32.0%
€ 50.001 – € 100.000	43.6%	6.7%
€ 100.000 +	10.3%	0.7%
EDUCATIONAL LEVEL (NETHERLANDS)		
	Sample	Population
LOW	8.6%	30.6%
MEDIUM	37.4%	37.4%
HIGH	54.1%	32.0%

6.2.2. CHARACTERISTICS OF THE SAMPLE

There were multiple socio-demographics and exploratory questions added to the survey that could be of interest for the interpretation of the results. The distribution over the different product types is given in appendix VII.A. The descriptive characteristics of the total sample are summarized in table 5. The percentages slightly deviate from those presented in table 4 as the missing values were not taken into account in table 4.

There were more women than men in the sample (52.6% vs 37.8%). Most of the respondents were between the 45-65 years old (36.1%) and were relatively high educated (48.2%). Moreover, most respondents had a relatively high income (between € 50.000 -€ 100.000)(28.9%). About an equal amount of respondents are living with, as without children (38.5% vs 37.3%). The category "other" contains respondents who live with their parents or with roommates (12%). Most respondents came from the municipality Haarlemmermeer (34.1%), which makes sense as this is the biggest municipality Meerlanden represents. The second best represented municipality was Hillegom (21.3%). This was expected as the researcher is from this municipality and the data was gathered through the social network of the researcher.

When considering the situational variables, most respondents had a drivers' license (85.9%) and bring their products to the waste disposal centres themselves (65.1%). The majority of the sample was able to bring small products such as a vacuum cleaner or side table to the waste disposal centres (86.0%). Whereas less than half of the respondents were able to bring larger products such as a refrigerator or sofa to the waste disposal centres (42.0% vs 47.4%). Most respondents were within 10 minutes to the nearest waste disposal centre (40.8%). Furthermore, almost all respondents have been to a waste disposal centre

before (83.1%) and only a small part (6.8%) has never been to a waste disposal centre before. The majority of the respondent who has been to a waste disposal centre visited before the COVID-19 pandemic (47.4%). The waiting lines during the COVID-19 pandemic could have influenced the respondents' preferences since they were longer than before the pandemic. However, most respondents (71.1%) state that their answers were not influenced by the COVID-19 pandemic. No conclusion could be drawn since there were no data gathered before the COVID-19 pandemic.

One of the alternatives was the option of selling through an online platform. More than half of respondents indicated that they would still use the current online platforms, but would also like to use a Meerlanden platform (54.6%). A small percentage of the respondents prefer a Meerlanden platform (11.2%) over the existing platforms. However, twenty-three per cent of respondents indicated not to use such a platform if it would be created. From the gathered data it became apparent that most respondents used the anonymous link (63.1%). Only a small part of the respondents was gathered with the flyers (7.6%), the rest opened the survey through social media (29.3%).

The mean and median NEP score was 3.8 on a scale of 1 to 5. Meaning that respondents had a somewhat positive attitude toward the environment. Whereas the mean GEBS score was 3.6 on a scale of 1 to 5 and a median score of 3.7. The respondents had a somewhat positive attitude towards ecological behaviour. In appendix VII.B., the descriptive statistics of the NEP and GEBS statements are given.

The missing values per variable were approximately 10%. One exception was the variable income where more missing values were found (33.7%). The distribution of the respondents over the categories for the different context was respectively even. No category was overly represented for a certain product type.

TABLE 5: DISTRIBUTION OF RESPONDENTS IN THE SAMPLE OVER THE DEMOGRAPHIC AND EXPLORATORY VARIABLES

DEMOGRAPHIC VARIABLES			
Variable	Variable level	% of respondents in total sample	# respondents in total sample
GENDER	Man	37.8%	94
	Woman	52.6%	131
	Missing values	9.6%	24
AGE	18-25	9.6%	24
	26-45	28.9%	72
	46-65	36.1%	90
	65+	12.0%	30
	Missing values	13.3%	33
EDUCATION	Low	7.6%	19
	Medium	33.3%	83
	High	48.2%	120
	Missing values	10.8%	27
INCOME	€ 0 - € 30.000	11.6%	29
	€ 30.001 – € 50.000	18.9%	47
	€ 50.001 - € 100.000	28.9%	72
	€ 100.000+	6.8%	17
	Missing values	33.7%	84
FAMILY STATUS	Living with children	38.5%	96
	Living without children	37.3%	83
	Others	12%	30
	Missing values	12.2%	30
MUNICIPALITY	Aalsmeer	2.8%	7
	Bloemendaal	2.4%	6

	Diemen	1.6%	4
	Haarlemmermeer	34.1%	85
	Heemstede	1.6%	4
	Hillegom	21.3%	53
	Lisse	12.4%	31
	Noordwijk	1.2%	3
	Teylingen	4.8%	12
	Zandvoort	0.4%	1
	Others	4.0%	10
	Missing values	13.2%	33
EXPLORATORY VARIABLES			
Variable	Variable level	% of respondents in total sample	# of respondents in total sample
DRIVERS LICENSE	Yes	85.9%	214
	No	4.1%	10
	Missing values	10.0%	25
BRINGING PRODUCTS YOURSELF	Yes	65.1%	162
	Sometimes	15.7%	39
	No	9.2%	23
	Missing values	10.0%	25
ABLE TO BRING SMALL PRODUCTS	Yes	86.0%	214
	No	4.4%	11
	Missing values	9.6%	24
ABLE TO BRING BIG PRODUCTS	Yes	42.2%	105
	No	47.4%	118
	Missing values	10.4%	26
TRAVEL TIME TO CENTER	0-10	40.8%	101
	10-15	31.1%	73
	15+	19.9%	37
	Missing values	11.2%	38
LAST VISIT CENTER	Never	6.8%	17
	Before COVID-19	47.4%	118
	During COVID-19	35.7%	89
	Missing values	10.0%	25
INFLUENCE CORONA	Yes	6.0%	15
	A bit	13.7%	34
	No	71.1%	177
	Missing values	9.2%	23
USE MEERLANDEN PLATFORM	Yes	11.2%	28
	Would use both	54.6%	136
	No	21.3%	53
	Missing values	12.9%	31
ACCESS METHOD	Anonymous link	63.1%	157
	QR code	7.6%	19
	Social media link	29.3%	73
ATTITUDE VARIABLES			
Variable	Variable level	Mean of score	Median of score
NEP SCALE	*	3.8	3.8
GEBS SCALE	*	3.6	3.7

6.2.3. DESCRIPTIVE STATISTICS OF THE CHOICE EXPERIMENT

There were twelve choice tasks in each version of the survey. The respondents received three choice tasks per product type, there were four products (see section 5.3.3.). First, they were asked to choose the alternative that they would most likely use in real life. After this choice, the respondents were asked if they would prefer the chosen alternative or the current system. In figure 8, the distribution of the choices made by the respondents on the different choice tasks are presented in percentages. The base alternative

(current system) is not included in this graph. For this distribution, the statistical test crosstabs was used to determine if the choices were independent or dependent with the choice tasks. As shown in appendix VII.B., there was an association found between the choices and the choice tasks (p-value of 0.00).

In figure 9, the base alternative is included in the graph. The base alternative was chosen between 15% and 25% of the times. Meaning that at least 75% of the observations per choice set were in favour of the re-use system over the current system. Also with the base alternative included, there was an association found between the choices and the choice tasks (p-value of 0.00). The results of the statistical test can be found in appendix VII.C.

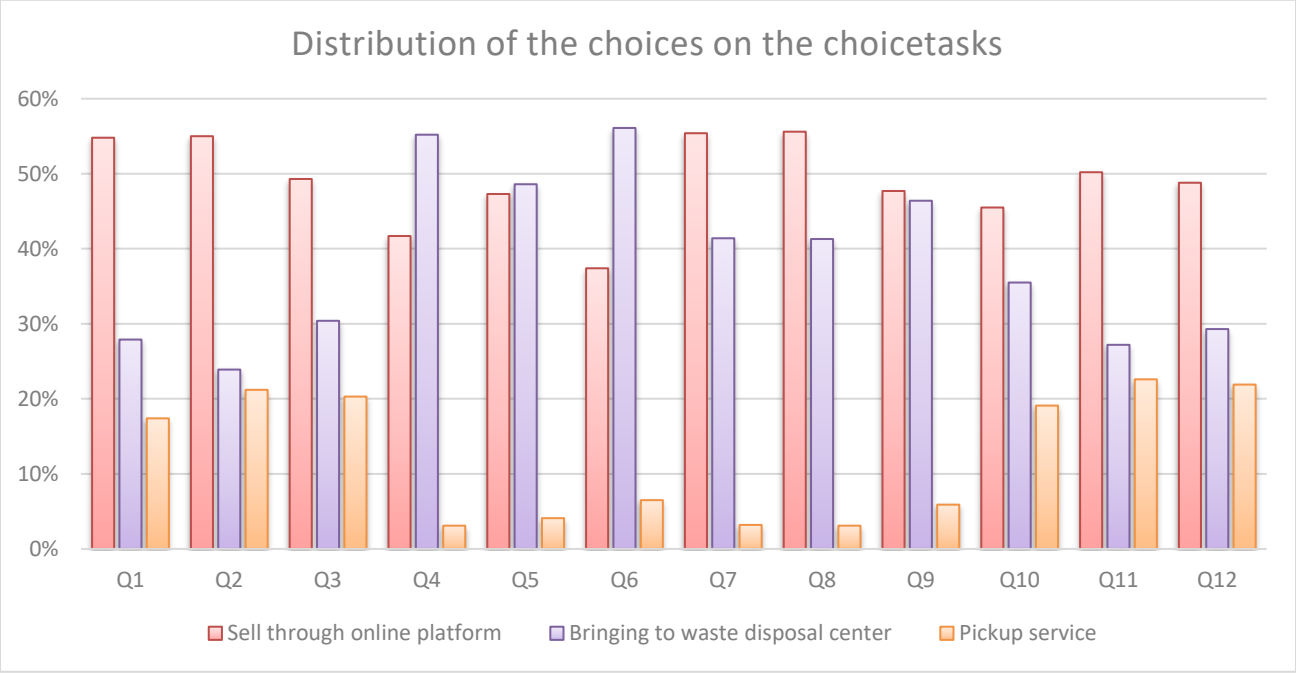

FIGURE 8: DISTRIBUTION OF THE CHOICES OF RESPONDENTS ON THE CHOICE TASKS

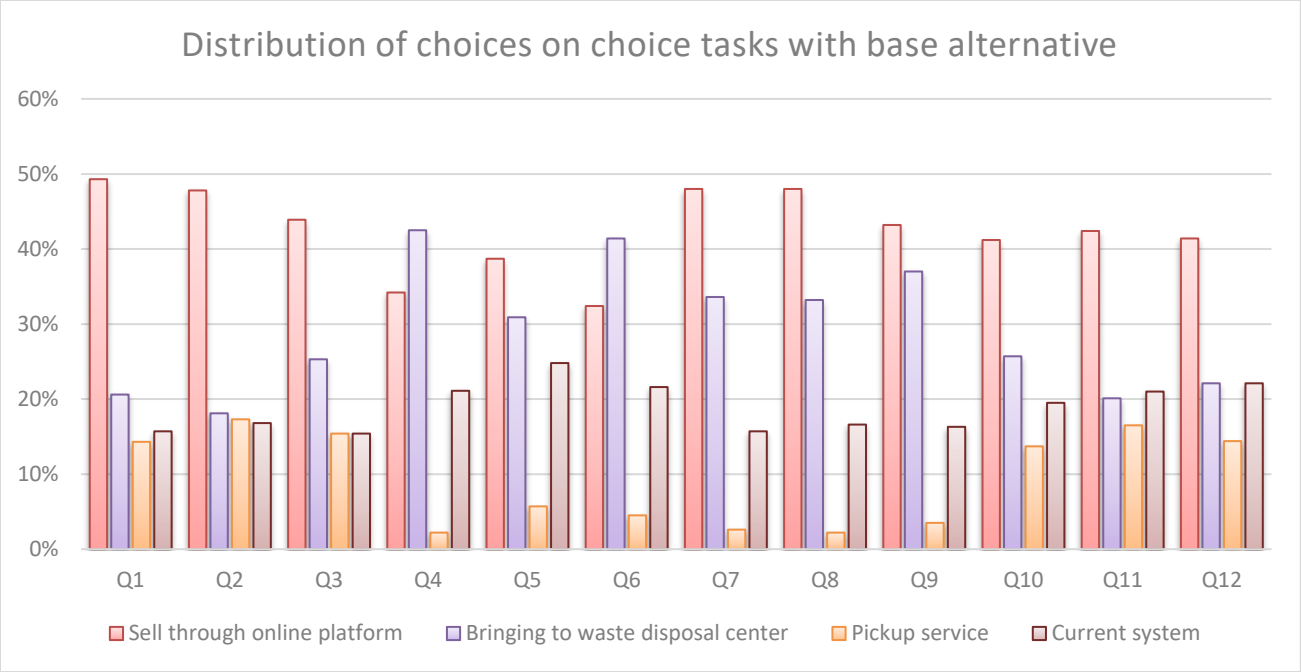

FIGURE 9: DISTRIBUTION OF THE CHOICES OF RESPONDENTS ON THE CHOICE TASKS WITH BASE ALTERNATIVE

To answer sub-question four, it was of interest to determine if the choices of the citizens were influenced by the different product types. In figure 10, the choices were distributed over the different product types without the base alternative. In appendix VII.C., the statistical test to check the association between the choices of the citizens and the different product types was checked. The Pearson chi-squared test was not statistically significant (p-value of 0.10). This means that there was no association assumed between the choices of citizens and the different products in the sample. However, since the sample was not representative (see section 6.2.1.), it is uncertain if this would be the case in the total population. In figure 11, the base alternative was taken into account. For all product types, the base alternative (current situation) is approximately chosen in 20% of the observations. Thereby, 80% of the observations would prefer the re-use system. For this situation, the Pearson chi-squared test related to the crosstabs analysis was statistically significant (p-value of 0.00). Indicating that there was an association between the choices made by the respondents and the contexts (Appendix VII.C.).

Because the base alternative (current situation) was not dominantly chosen and because there was an association between the contexts and the preferences of the citizens when the base alternative was included, the base alternative was taken into account when estimating the models in section 6.3.

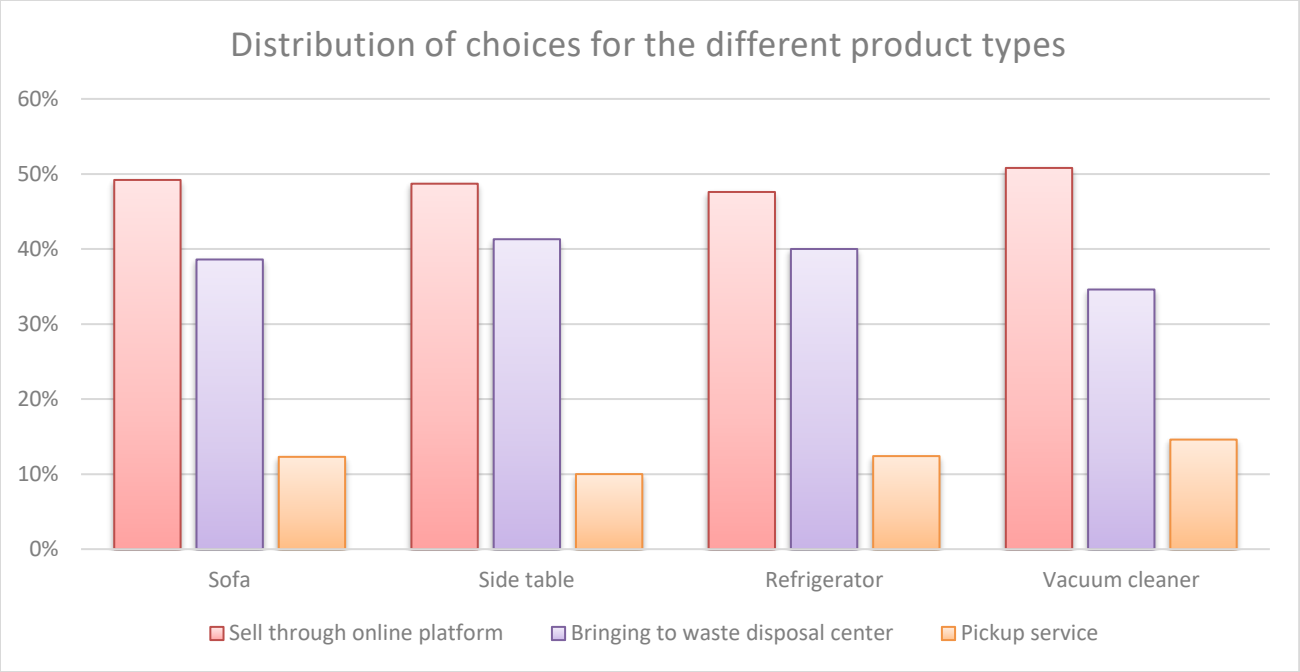

FIGURE 10: DISTRIBUTION OF THE CHOICES OF THE RESPONDENTS FOR THE DIFFERENT PRODUCT TYPES

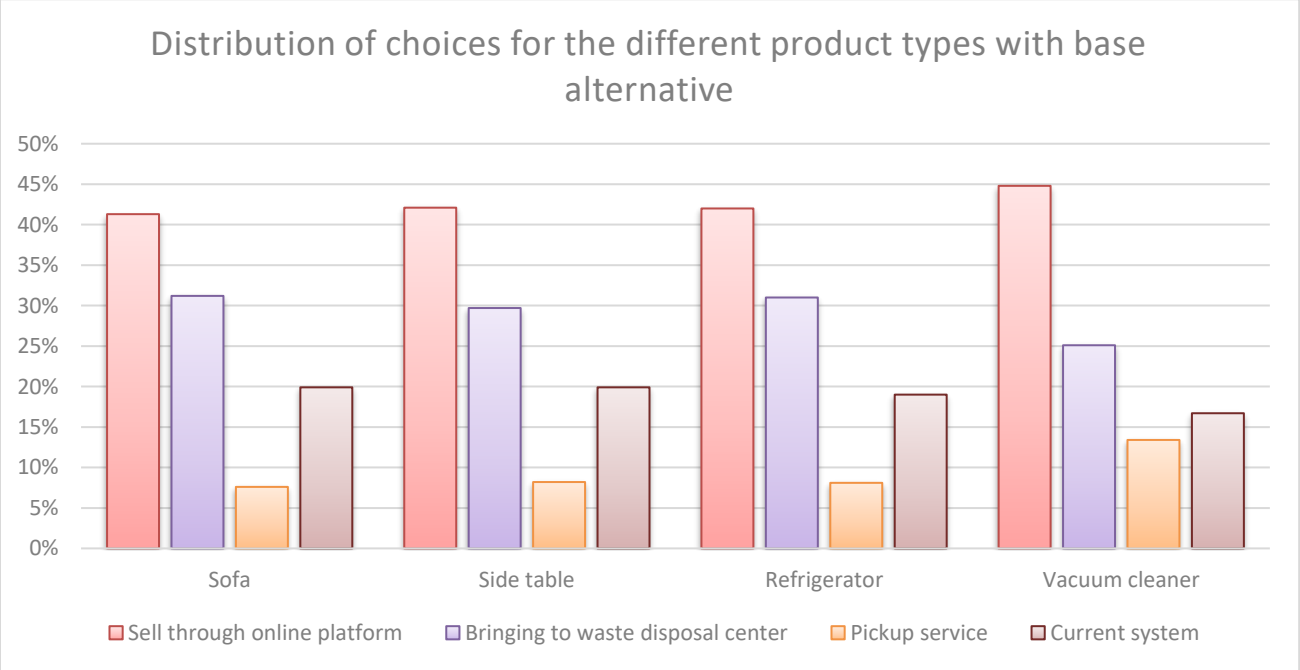

FIGURE 11: DISTRIBUTION OF THE CHOICES OF THE RESPONDENTS FOR THE DIFFERENT PRODUCT TYPES WITH BASE ALTERNATIVE

6.3. CHOICE MODEL ESTIMATES

Three types of models were estimated, the multinomial logit (MNL) model, the MNL model accommodating heterogeneity, and the latent class model (LCM). The models were estimated using Apollo, a package in the program R.

6.3.1. MNL BASE MODEL

First, a basic MNL model was estimated. This model was estimated with three alternatives, a base alternative, and four contexts (product types). In this model, the attributes of the alternatives, and the contexts were varied in the choice experiment, and thus were the variables of the model. The utility functions of the different alternatives are specified in equations 13, 14, 15 and 16.

As every alternative has its own set of attributes (see section 5.3.), the parameters were estimated alternative specific and have an alternative specific constant (ASC). The contexts were effect coded (see section 6.1.1.). Therefore, three variables for context were added (C1, C2 & C3). The context variables were interaction variables with the constant of the alternative and can affect the unobserved utility of the alternative. When adding the contexts to the model, the model fit increased significantly at the 99% significance level (LRS = 24.966, df = 9). The model estimates are presented in table 6, the estimates with a non-significant p-value were coloured red whereas the significant estimates were coloured green.

$$V_{platform} = ASC_{platform} + \beta_{PlatformType_{alt1}} * Alt1_{PlatformType} + \beta_{reward_{alt1}} * Alt1_{reward} + \beta_{Loyaltysystem_{alt1}} * Alt1_{loyaltysystem} + \beta_{C1} * C1 + \beta_{C2} * C2 + \beta_{C3} * C3$$

EQUATION 13

$$V_{bringToWasteCentre} = ASC_{bringToWasteCentre} + \beta_{Appointment_{alt2}} * Alt2_{Appointment} + \beta_{reward_{alt2}} * Alt2_{reward} + \beta_{LoyaltySystem_{alt2}} * Alt2_{LoyaltySystem} + \beta_{C4} * C1 + \beta_{C5} * C2 + \beta_{C6} * C3$$

EQUATION 14

$$V_{PickupService} = ASC_{PickupService} + \beta_{Appointment_{alt3}} * Alt3_{Appointment} + \beta_{cost_{alt3}} * Alt3_{cost} + \beta_{LoyaltySystem_{alt3}} * Alt3_{LoyaltySystem} + \beta_{C7} * C1 + \beta_{C8} * C2 + \beta_{C9} * C3$$

EQUATION 15

$$V_{base} = 0$$

EQUATION 16

There was one attribute with continuous levels, namely costs. Therefore, it was checked whether the costs attribute was linear or non-linear. This was done by estimating the MNL model with a quadratic component for costs. This quadratic component was not significant in the estimation and was therefore not included in the model.

TABLE 6: ESTIMATED PARAMETERS OF THE BASE MNL-MODEL

ESTIMATES BASE MNL-MODEL					
Parameters	Estimate	Std. err.	t-ratio	p-value	Relative importance
CONSTANTS					
PLATFORM ALTERNATIVE	0.82	0.05	15.30	0.00	-
BRINGING TO CENTER ALTERNATIVE	0.43	0.06	7.60	0.00	-
PICKUP SERVICE ALTERNATIVE	0.34	0.27	1.24	0.22	-
BASE ALTERNATIVE (FIXED)	0.00	NA	NA	NA	-
ATTRIBUTES PLATFORM ALTERNATIVE					
TYPE OF PLATFORM	-0.05	0.09	-1.30	0.19	0.10
REWARD SYSTEM	-0.01	0.04	-0.25	0.80	0.02
LOYALTY SYSTEM	-0.00	0.04	-0.07	0.95	0.01
ATTRIBUTES BRINGING TO CENTER ALTERNATIVE					
APPOINTMENT	-0.07	0.04	-1.64	0.10	0.14
REWARD SYSTEM	0.04	0.04	1.02	0.31	0.09
LOYALTY SYSTEM	0.09	0.04	2.06	0.04	0.18
ATTRIBUTES PICKUP SERVICE ALTERNATIVE					
APPOINTMENT	0.22	0.07	3.26	0.00	0.45
COSTS	-0.06	0.01	-4.12	0.00	*0.60
LOYALTY SYSTEM	-0.19	0.07	-2.81	0.01	0.38
CONTEXT VARIABLES (PRODUCT TYPES)					
C1 (COMPONENT 1 IN PLATFORM ALTERNATIVE)	-0.08	0.09	-0.90	0.37	0.16
C2 (COMPONENT 2 IN PLATFORM ALTERNATIVE)	0.17	0.09	1.83	0.07	0.35
C3 (COMPONENT 3 IN PLATFORM ALTERNATIVE)	-0.07	0.09	-0.73	0.47	0.13
C4 (COMPONENT 1 IN BRINGING TO CENTER ALTERNATIVE)	0.01	0.10	0.14	0.89	0.03
C5 (COMPONENT 2 IN BRINGING TO CENTER ALTERNATIVE)	-0.03	0.10	-0.27	0.79	0.06
C6 (COMPONENT 3 IN BRINGING TO CENTER ALTERNATIVE)	-0.04	0.10	-0.37	0.71	0.07
C7 (COMPONENT 1 IN PICKUP SERVICE ALTERNATIVE)	-0.23	0.14	-1.61	0.11	0.45
C8 (COMPONENT 2 IN PICKUP SERVICE ALTERNATIVE)	0.53	0.13	4.11	0.00	1.05
C9 (COMPONENT 3 IN PICKUP SERVICE ALTERNATIVE)	-0.16	0.14	-1.14	0.25	0.31
* COSTS IS A NON-CODED VARIABLE AND THEREFORE MULTIPLIED WITH 15 AND 25 TO CALCULATE THE RELATIVE IMPORTANCE					

The model has an adjusted ρ^2 of 0.0962, which means that the model does not explain the data very well. Only 9,6% of the initial uncertainty is explained by the estimated model. This might be the case because the model does not accommodate heterogeneity. To validate this, models which do accommodate heterogeneity were estimated in section 6.3.2. and 6.3.3. The syntax used to estimate the MNL base model can be found in appendix VIII.A. The non-significant parameters were kept included in the model. Non-significant parameters indicate that there is no significant effect on the total utility of the alternative by that variable, the effect is not generalizable to the population. However, because the sample was not representative of the population, the base variables of the alternatives were still considered in the model.

6.3.1.1. INTERPRETATION OF THE ESTIMATES

The parameter estimates of table 6 indicate the gain or loss in utils if the attribute level increases with one unit. For instance, costs have, as expected, a negative estimate of -0.06, meaning that if the price of pickup service increases with 1 euro, the total utility of the pickup service will decrease with 0.06 utils.

The sign of the estimates indicates if the parameter lowers or adds to the total utility of that alternative. Since the attribute levels were effect coded, it is important to interpret the results after the estimated parameters are multiplied with the effect coded attribute levels. The average utility contribution of each variable is set to zero, the utility contribution of each level expresses the utility derived from that level

compared to the average utility contribution of that variable if everything else is kept constant. The larger the utils range of an attribute, the more influence that attribute has on the total utility of the alternative. Therefore, the range is also called the relative importance of the attribute.

Parameter estimates constants

For each alternative, a constant is estimated. The estimates denote the preference of an alternative if all attributes would be set to zero, expressed as the difference in utility compared to the base alternative (current situation). The constant for all three alternatives have a positive estimate, indicating that citizens would overall prefer the re-use measures over the current situation. However, the parameter for the alternative "Pickup service" is not significant. Meaning that the utility is even to the base alternative (current situation). Overall, citizens have the strongest base preference for the "Platform" alternative, as this has the highest, positive constant.

Parameter estimates attributes

Not all parameter signs are as expected, the signs of the loyalty systems in the "Platform" alternative and the "Pick-up service" alternative are surprising. This indicates that a loyalty system would decrease the total utility of an alternative, which is contradicting to the literature. However, in the "Platform" alternative, this parameter is not significant, meaning that the alternative was equally attractive with or without a loyalty system. For the "Bringing to waste centre" alternative, a loyalty system would increase the attractiveness of the measure.

The parameters of the "Platform" alternative are all not significant, indicating that the attractiveness of the alternative is, overall, not determined by the combination of variables for this measure. For the "Bringing to waste centre" alternative, only the loyalty system parameter is significant, thus a loyalty system would increase the attractiveness of this measure. All parameters of the "Pick-up service" alternative are significant. Citizens are sensitive to the type of appointment. They prefer if the "pick-up service" would be on-demand instead of having to make an appointment for the near future. Increasing costs would decrease the attractiveness of this measure, however, citizens are not very sensitive for costs, smaller parameter, compared to appointment type and loyalty system.

Parameter estimates context variables

The parameters estimates of the context variables are, almost all not significant. Meaning that the citizens' choices are indifferent to different product types. Only the parameter for the second component in the "Pick-up" service alternative is significant. Indicating that when the product is a vacuum cleaner, citizens are more sensitive to choose for the "Pick-up service" alternative. When the product type is a refrigerator, citizens do, overall, not prefer the "Pick-up service" alternative.

6.3.2. MNL MODEL WITH ACCOMMODATION FOR HETEROGENEITY

After estimating the base model, it was tried to increase the model fit by accommodating for heterogeneity as it was assumed that preferences differ among citizens. This was done by adding interaction variables to the model. It was estimated what the effects of these variables were on the attributes of the different alternatives and the constant of the alternative. The variables used for these estimations were based on the additional questions included in the survey. Namely, the average New Ecological Paradigm (NEP) score, the average General Ecological Behaviour scale (GEBS) score, gender, age, income, education, drivers' license, family status, ability to go to the waste disposal centre, ability to

bring small products to the waste disposal centre, ability to bring big products to the waste disposal centre and the number of children in the household. Moreover, the context factors were added as interaction variables with the parameters because these can influence the parameters as well as the constants of the alternatives.

To include these variables into the model, most variables were effect coded. The coding is presented in section 6.1.1. The variables were added sequentially to the base model and checked if they were significant on a 95% confidence interval, the significant variables (p-value < 0.05) were incorporated in the final MNL model.

The syntax of this model is presented in appendix VIII.B. The utility functions for the different alternatives in the final MNL model were presented in equations 17, 18, 19 and 20. The estimates of the final MNL model are shown in table 7, the estimates with a non-significant p-value were coloured red whereas the significant estimates were coloured green. The interpretation of the estimates is given in section 6.3.2.1. The final MNL model has an adjusted ρ^2 of 0.1222, meaning 12.2% of the initial uncertainty is explained with the final MNL model. The increase in model fit compared to the base MNL model was significant at the 99% significance level (LRS = 213.322, df = 11). The final MNL model has a better fit with the data than the base model.

$$V_{platform} = ASC_{platform} + \beta_{PlatformType_{alt1}} * Alt1_{PlatformType} + \beta_{reward_{alt1}} * Alt1_{reward} + \beta_{Loyaltysystem_{alt1}} * Alt1_{loyaltysystem} + \beta_{C1} * C1 + \beta_{C2} * C2 + \beta_{C3} * C3 + \beta_{Ability2_{alt1}} * Ability2 + \beta_{gender_{alt1}} * Gender + \beta_{age_{alt1}} * Age + \beta_{income_{alt1}} * Income$$

EQUATION 17

$$V_{bringToWasteCentre} = ASC_{bringToWasteCentre} + \beta_{Appointment_{alt2}} * Alt2_{Appointment} + \beta_{reward_{alt2}} * Alt2_{reward} + \beta_{LoyaltySystem_{alt2}} * Alt2_{LoyaltySystem} + \beta_{C4} * C1 + \beta_{C5} * C2 + \beta_{C6} * C3 + \beta_{AbilityBigProduct_{alt2}} * Ability_{bigProcuct} + \beta_{AbilitySmallProduct_{alt2}} * Ability_{SmallProduct} + \beta_{DriversLicense_{alt2}} * DriversLicense + \beta_{income_{alt2}} * INC + \beta_{education1_{alt2}} * Eduction1$$

EQUATION 18

$$V_{PickupService} = ASC_{PickupService} + \beta_{Appointment_{alt3}} * Alt3_{Appointment} + \beta_{cost_{alt3}} * Alt3_{cost} + \beta_{LoyaltySystem_{alt3}} * Alt3_{LoyaltySystem} + \beta_{C7} * C1 + \beta_{C8} * C2 + \beta_{C9} * C3$$

EQUATION 19

$$V_{base} = 0$$

EQUATION 20

Most interaction variables were significant for the “Bringing to waste disposal centre” alternative. No interaction variable was significant for the “Pick-up service” alternative. Moreover, there were no significant interaction variables with the alternative specific variables, only on the constants of the alternatives. Ability to bring MSW to the centres, driver’s license, income, education, age and gender had significant components on one or two of the alternatives.

TABLE 7: ESTIMATED PARAMETERS OF THE FINAL MNL-MODEL

ESTIMATES FINAL MNL-MODEL					
Parameters	Estimate	Std. err.	t-ratio	p-value	Relative importance
CONSTANTS					
PLATFORM ALTERNATIVE	1.76	0.12	14.70	0.00	-
BRINGING TO CENTER ALTERNATIVE	0.54	0.08	6.92	0.00	-
PICKUP SERVICE ALTERNATIVE	0.36	0.28	1.28	0.20	-
BASE ALTERNATIVE (FIXED)	0.00	NA	NA	NA	-
ATTRIBUTES PLATFORM ALTERNATIVE					
TYPE OF PLATFORM	-0.05	0.04	-1.28	0.20	0.10
REWARD SYSTEM	-0.01	0.04	-0.20	0.84	0.02
LOYALTY SYSTEM	-0.00	0.04	-0.04	0.97	0.00
ATTRIBUTES BRINGING TO CENTER ALTERNATIVE					
APPOINTMENT	-0.07	0.04	-1.57	0.12	0.14
REWARD SYSTEM	0.04	0.04	1.01	0.31	0.08
LOYALTY SYSTEM	0.09	0.04	2.17	0.03	0.18
ATTRIBUTES PICKUP SERVICE ALTERNATIVE					
APPOINTMENT	0.23	0.07	3.29	0.00	0.46
COSTS	-0.06	0.01	-4.11	0.00	*0.60
LOYALTY SYSTEM	-0.20	0.07	-2.87	0.00	0.40
CONTEXT VARIABLES (PRODUCT TYPES)					
C1 (COMPONENT 1 IN PLATFORM ALTERNATIVE)	-0.07	0.09	-0.75	0.45	0.14
C2 (COMPONENT 2 IN PLATFORM ALTERNATIVE)	0.17	0.10	1.74	0.08	0.34
C3 (COMPONENT 3 IN PLATFORM ALTERNATIVE)	-0.06	0.09	0.61	0.54	0.12
C4 (COMPONENT 1 IN BRINGING TO CENTER ALTERNATIVE)	0.02	0.10	0.22	0.82	0.04
C5 (COMPONENT 2 IN BRINGING TO CENTER ALTERNATIVE)	-0.03	0.10	-0.33	0.74	0.06
C6 (COMPONENT 3 IN BRINGING TO CENTER ALTERNATIVE)	-0.02	0.10	-0.24	0.81	0.04
C7 (COMPONENT 1 IN PICKUP SERVICE ALTERNATIVE)	-0.23	0.14	-1.61	0.11	0.46
C8 (COMPONENT 2 IN PICKUP SERVICE ALTERNATIVE)	0.53	0.13	4.13	0.00	1.06
C9 (COMPONENT 3 IN PICKUP SERVICE ALTERNATIVE)	-0.15	0.14	-1.11	0.26	0.30
INTERACTION VARIABLES PLATFORM ALTERNATIVE					
ABILITY (COMPONENT 2)	0.00	0.00	2.44	0.02	0.00
INCOME	0.00	0.00	3.44	0.00	0.00
AGE	-0.02	0.00	-9.81	0.00	0.04
GENDER	-0.00	0.00	-8.19	0.00	0.00
INTERACTION VARIABLES BRINGING TO CENTER ALTERNATIVE					
ABILITY TO BRING BIG PRODUCTS	0.22	0.04	5.09	0.00	0.44
ABILITY TO BRING SMALL PRODUCTS	0.35	0.11	3.20	0.00	0.70
DRIIVERS' LICENSE	-0.57	0.11	-5.35	0.00	1.14
INCOME	0.00	0.00	5.10	0.00	0.00
EDUCATION (COMPONENT 1)	-0.00	0.00	-4.16	0.00	0.00
* COSTS IS A NON-CODED VARIABLE AND THEREFORE MULTIPLIED WITH 15 AND 25 TO CALCULATE THE RELATIVE IMPORTANCE					

Not all parameters estimates of the base MNL model were significant (p-value <0.05) implying that the respondents were indifferent in their choices despite the level of those attributes. As explained in section 6.3.1., these non-significant attributes were still considered in the final MNL-model.

6.3.2.1. INTERPRETATION OF THE ESTIMATES

Parameter estimates constants

As in the MNL base model (see section 6.3.1.1.), the constants for all three alternatives are positive and only the constant for the "Pick-up service" alternative is not significant. Indicating that the respondents did not favour the "Pick-up service" alternative more than the current situation. Overall, citizens have the

strongest basic preference for the “Platform” alternative as this constant is three times as large as for the “Bringing to waste disposal centre” alternative.

Parameter estimates attributes

The parameter estimates are comparable to those of the MNL-base model in sign and significance (see section 6.3.1.1.). The utility contributions of the attributes per alternative are shown in figure 12, 13 and 14. The parameters are multiplied with both attribute levels (see section 5.3.2.; 6.1.1). The attributes of the “Platform” alternative are not significant. Thus, the utility of the alternative is not influenced by these attribute levels. For the “Bringing to waste disposal centre” alternative, only the loyalty system is significant. This indicates that, overall, incorporating a loyalty system would increase the attractiveness of “Bringing to the waste disposal centre” significantly. For the “Pick-up service” alternative, citizens are sensitive for the combination of attribute levels. They favour the “Pick-up service” alternative most when they can make an on-demand appointment (on-call), logically, have to pay €15 instead of €25, and without a loyalty system. This last conclusion is unexpected, as it is contradicting with the literature findings where it is stated that every type of reward should probably encourage re-use behaviour. However, from these results, it seems to be depending on the type of measure if a loyalty system would add to the attractiveness of the measure.

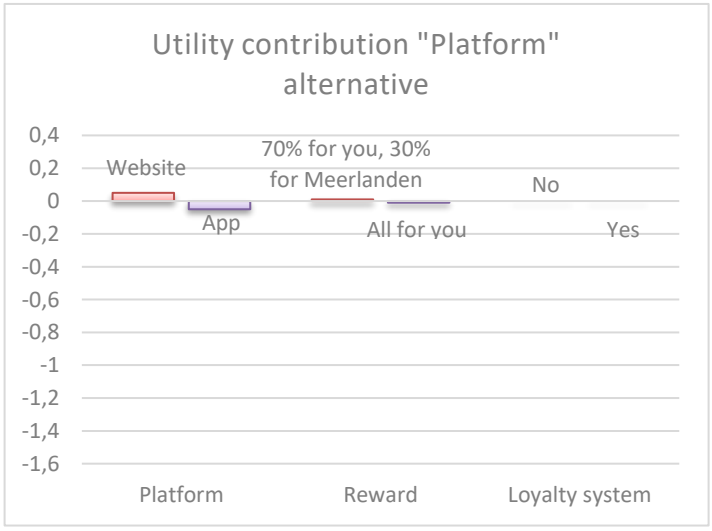

FIGURE 12: UTILITY CONTRIBUTION PLATFORM ALTERNATIVE

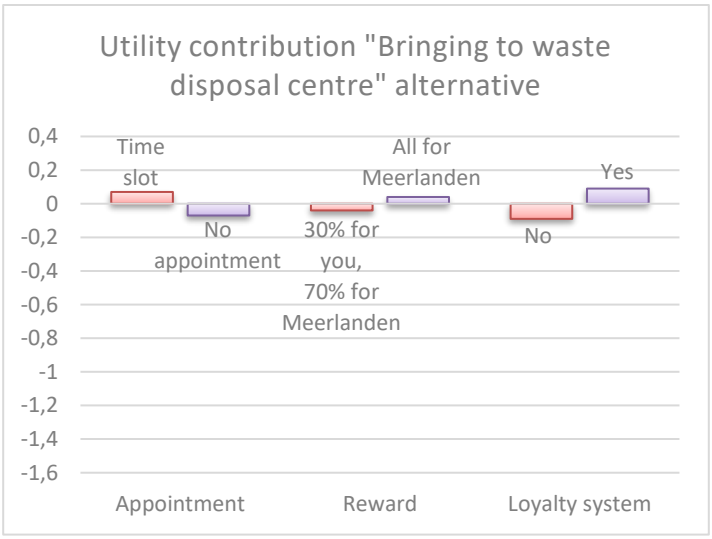

FIGURE 13: UTILITY CONTRIBUTION BRINGING TO WASTE CENTRE ALTERNATIVE

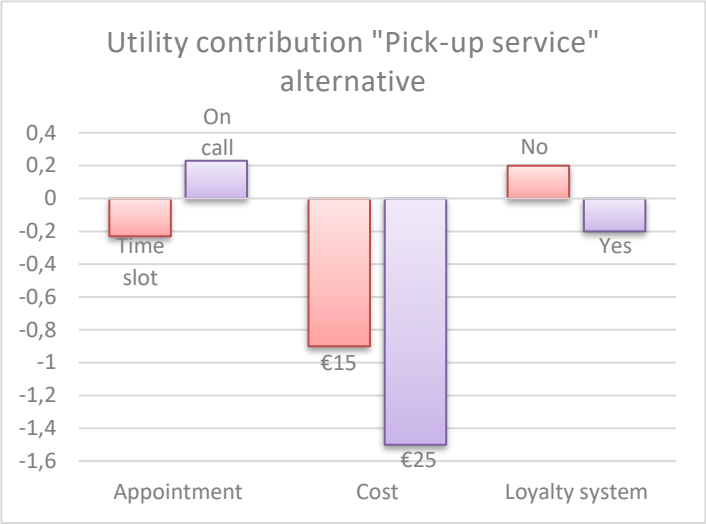

FIGURE 14: UTILITY CONTRIBUTION PICK-UP SERVICE ALTERNATIVE

Parameter estimates context variables

The parameter estimated for the context variables are in sign and significance comparable to the base MNL-model (see section 6.3.1.1.). The parameters estimates of the context variables are, except for one, all not significant. Indicating that the choices of the citizens for the different measures are not influenced by the product types. Only the parameter for the second component in the "Pick-up" service alternative is significant. Indicating that when the product is a vacuum cleaner, citizens are more sensitive to choose for the "Pick-up service" alternative. The utility contributions of the context variables (product types) are shown in figure 15. The attractiveness of the "Pick-up service" alternative is influenced most by the different products.

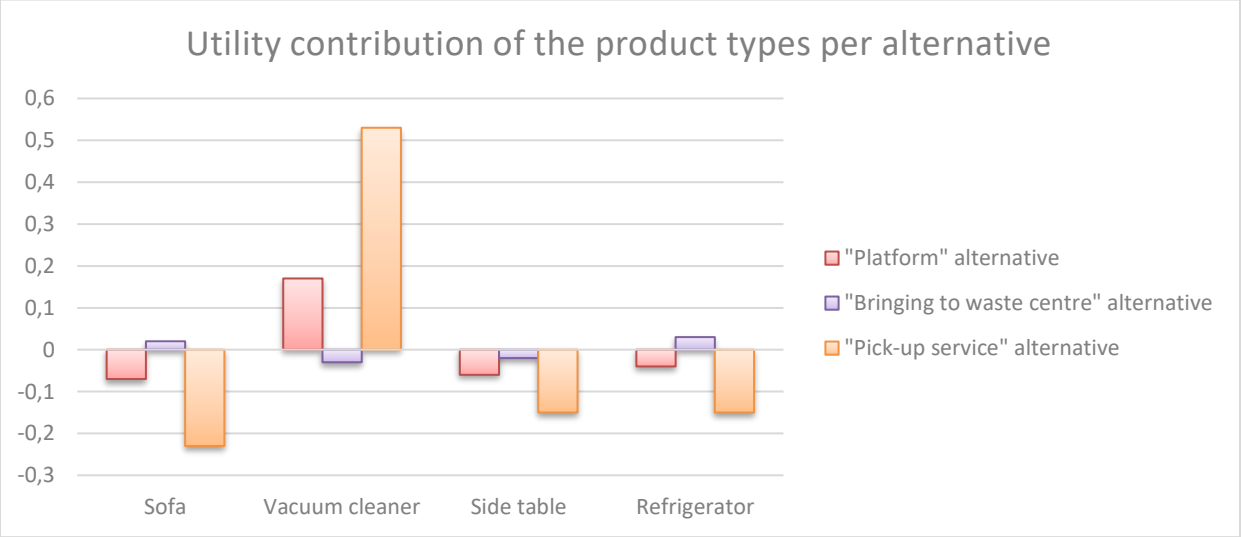

FIGURE 15: UTILITY CONTRIBUTION OF THE PRODUCT TYPES

Parameter estimates interaction variables

The signs of the parameter estimates for the interaction variables are almost all as expected. Only the parameter sign for drivers' license in the "Bringing to waste disposal centre" alternative is unexpected. The parameter for drivers' license is negative, which indicates that citizens with a drivers' license favour

the “Bringing to waste disposal centre” alternative less than citizens without a drivers’ license. Most of the interaction variables have little to no effect on the utility of the alternatives. Ability to go to the waste disposal centre, income, gender and education are significant but have an estimated parameter of <0.00 (figure 16). The older the citizens are, the less they are attracted to the “Platform” alternative. Citizens who are able to bring their products (small and big) to the waste disposal centre by themselves, are more attracted to the “Bringing to the waste disposal centre alternative”. Overall, the “Bringing to waste disposal centre” alternative is most influenced by the characteristics of citizens.

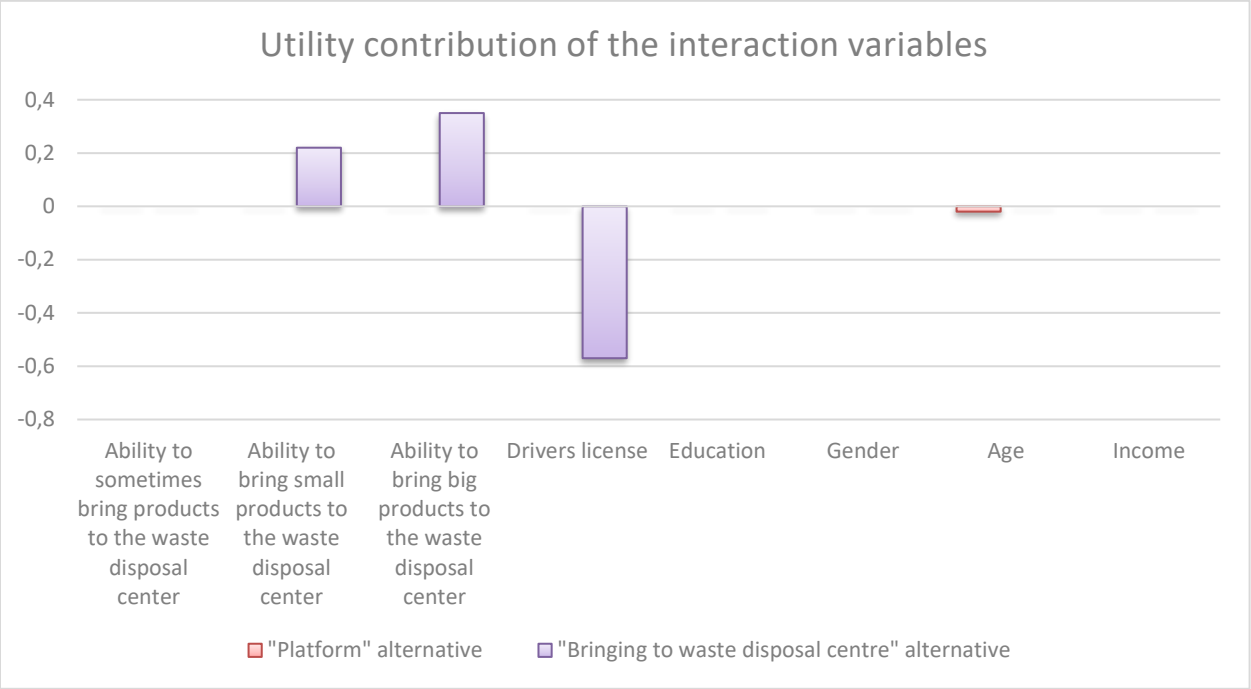

FIGURE 16: UTILITY CONTRIBUTION OF THE INTERACTION VARIABLES PER ALTERNATIVE

6.3.3. LATENT CLASS MODEL

Another model that tests for heterogeneity is the Latent Class (LC) model with a class membership function. The model was also estimated with the Apollo package in R, this package accommodates automatically for panel effects in the data. This means that the answers given by one respondent were clustered instead of treating each answer as from a new respondent. The robust standard error, t-ratio and p-value are considered, as these apply to the panel structure (Hess, & Palma, 2019).

To decide which number of classes provided the best fit for the data, multiple LC models with varying classes between 1 and 5 were estimated. To estimate this, only the measurement part of the model was assed (figure 17). As there is a possibility that the model finds a local maximum log-likelihood, different starting values are used for estimating the class membership parameter. The models are compared based on Log-likelihood (LL), Bayesian Information Criterion (BIC) and adjusted Rho-squared value (ρ^2). The model is chosen based on the lowest BIC-value as explained in section 3.3.2.3. The model fits are presented in table 8. The LC model with 2 classes, has the lowest BIC value and therefore has the best fit with the data. The adjusted ρ^2 of the LC model has also increased compared to the RUM model with interaction effects. Indicating that the LC model has the best fit of all three models estimated. 22.02% of the initial uncertainty can be explained.

TABLE 8: MODEL FIT FOR THE LATENT CLASS MODELS WITH VARYING NUMBER OF CLASSES

MODEL FIT OF LATENT CLASS MODELS			
Number of classes	LL	BIC	ρ^2
BASIC RUM MODEL (1 CLASS)	-3370.615	6907.21	0.0962
2 CLASSES	-2883.279	6106.41	0.2202
3 CLASSES	-3370.615	7254.96	0.0845
4 CLASSES	-3370.615	7428.84	0.0786
5 CLASSES	-3370.615	7602.72	0.0728
RUM MODEL WITH INTERACTION	-3263.954	6765.02	0.1222

After determining the number of classes, it was checked if these classes could be explained with the additional questions added in the survey. The socio-demographics, attitudes and exploratory factors, namely; the average New Ecological Paradigm (NEP) score, the average General Ecological Behaviour scale (GEBS) score, gender, age, income, education, drivers' license, family status, ability to go to the waste disposal centre, ability to bring small products to the waste disposal centre, ability to bring big products to the waste disposal centre and the number of children in the household, were added as covariates to the class membership model (figure 17). The variables were added sequentially to the model and checked if they were significant on a 95% confidence interval, the significant variables (p-value < 0.05) were incorporated in the final LC model. The syntax used to estimate the final LC model is shown in appendix VIII.C.

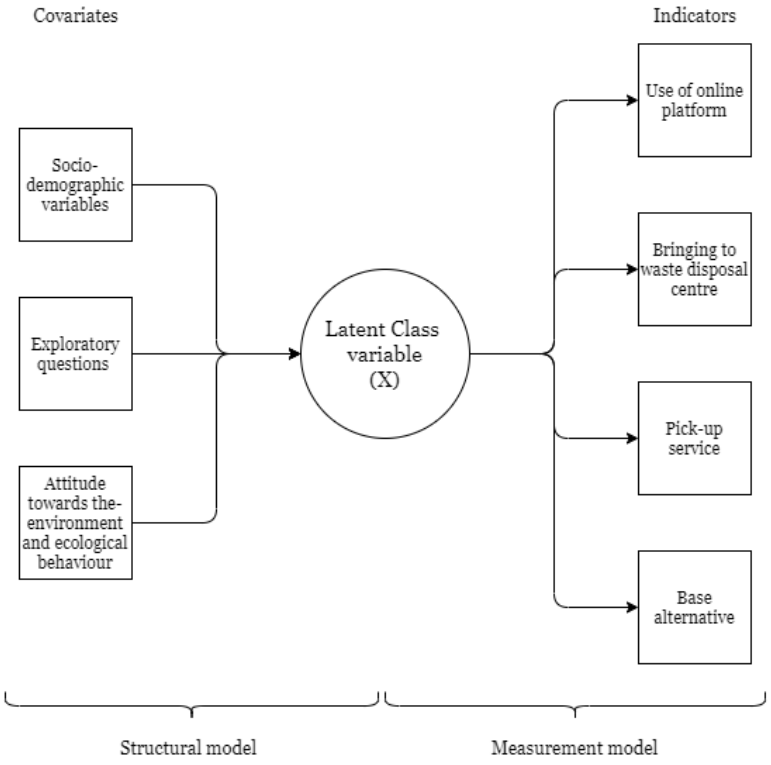

FIGURE 17: GRAPHICAL REPRESENTATION OF THE LATENT CLASS MODEL

After iteratively estimating the LCM, it appeared that the variable age could explain the allocation to the classes (was significant). The estimated parameters of the final LCM are shown in table 9. In section

6.3.3.1., an interpretation of the estimates is given. There is a 56% change respondents belonged to class 1, and 44% change a respondent belonged to class 2.

TABLE 9: ESTIMATED PARAMETERS OF THE LATENT CLASS MODEL

ESTIMATES FINAL LCM						
Parameters	CLASS 1			CLASS 2		
	Estimate class 1	Std. err.	t-ratio (p-value)	Estimate class 2	Std. err.	t-ratio (p-value)
CONSTANTS						
PLATFORM ALTERNATIVE	0.41	0.18	2.22 (0.03)	1.39	0.22	6.30 (0.00)
BRINGING TO CENTER ALTERNATIVE	0.38	0.19	2.03 (0.04)	0.56	0.22	2.51 (0.01)
PICKUP SERVICE ALTERNATIVE	0.49	0.34	1.47 (0.14)	0.07	0.47	0.15 (0.88)
BASE ALTERNATIVE (FIXED)	0.00	NA	NA	0.00	NA	NA
ATTRIBUTES PLATFORM ALTERNATIVE						
TYPE OF PLATFORM	-0.03	0.03	-0.99 (0.32)	-0.08	0.05	-1.69 (0.09)
REWARD SYSTEM	-0.01	0.32	-0.35 (0.73)	-0.01	0.04	-0.22 (0.83)
LOYALTY SYSTEM	0.02	0.30	0.70 (0.49)	-0.03	0.04	-0.80 (0.42)
ATTRIBUTES BRINGING TO CENTER ALTERNATIVE						-
APPOINTMENT	-0.07	0.04	-1.60 (0.11)	-0.07	0.06	-1.11 (0.27)
REWARD SYSTEM	0.07	0.04	1.85 (0.07)	-0.00	0.06	-0.06 (0.95)
LOYALTY SYSTEM	0.12	0.03	3.69 (0.00)	0.04	0.05	0.80 (0.42)
ATTRIBUTES PICKUP SERVICE ALTERNATIVE						
APPOINTMENT	0.21	0.05	4.37 (0.00)	0.23	0.08	2.95 (0.00)
COSTS	-0.07	0.01	-5.60 (0.00)	-0.04	0.02	-1.88 (0.06)
LOYALTY SYSTEM	-0.25	0.04	-6.02 (0.00)	-0.09	0.06	-1.49 (0.14)
CONTEXT VARIABLES (PRODUCT TYPES)						
C1 (COMPONENT 1 IN PLATFORM ALTERNATIVE)	-0.23	0.13	-1.82 (0.07)	0.14	0.15	0.90 (0.37)
C2 (COMPONENT 2 IN PLATFORM ALTERNATIVE)	0.10	0.13	0.81 (0.42)	0.31	0.17	1.83 (0.07)
C3 (COMPONENT 3 IN PLATFORM ALTERNATIVE)	0.02	0.12	0.14 (0.89)	-0.22	0.15	-1.41 (0.16)
C4 (COMPONENT 1 IN BRINGING TO CENTER ALTERNATIVE)	-0.05	0.13	-0.40 (0.69)	0.17	0.16	0.96 (0.34)
C5 (COMPONENT 2 IN BRINGING TO CENTER ALTERNATIVE)	-0.03	0.13	-0.24 (0.81)	-0.01	0.19	-0.08 (0.94)
C6 (COMPONENT 3 IN BRINGING TO CENTER ALTERNATIVE)	0.01	0.11	0.11 (0.92)	-0.15	0.16	-0.90 (0.37)
C7 (COMPONENT 1 IN PICKUP SERVICE ALTERNATIVE)	-0.34	0.21	-1.57 (0.12)	0.03	0.26	0.11 (0.91)
C8 (COMPONENT 2 IN PICKUP SERVICE ALTERNATIVE)	0.44	0.17	2.64 (0.01)	0.74	0.23	3.25 (0.00)
C9 (COMPONENT 3 IN PICKUP SERVICE ALTERNATIVE)	-0.17	0.21	-0.82 (0.42)	-0.14	0.23	-0.64 (0.52)

CLASS MEMBERSHIP						
CONSTANT	-709.42	1.58	-1221.95 (0.00)	0.00	NA	NA
AGE	17.51	0.57	299.17 (0.00)	0.00	NA	NA
CLASS PROPABILITY	0.56			0.44		

Not all parameter estimates of the LCM were significant (p-value <0.05) implying that the respondents were indifferent in their choices despite the level of those attributes.

6.3.3.1. INTERPRETATION OF THE ESTIMATES

The parameters are in the expected direction. The parameters sign for costs is negative for both classes, indicating that how higher the costs are, the less attractive the "Pick-up service" alternative becomes for the citizens. As in the MNL model, the parameters for the loyalty system in the "Pick-up service" alternative are negative of sign. This indicates that respondents do not prefer a loyalty system for this measure. Notable is, that only in the first class the loyalty system is significant for the "Bringing to waste disposal centre" alternative. The second class does, supposedly, not experience a change in attractiveness for this alternative regarding a loyalty system. Another difference between the two classes is that the attributes for the "Pick-up service" alternative are all significant for the first class, but only the appointment attribute is significant for the second class. For both classes, the estimated constant are all positive of sign. Only the constants for the "Platform" alternative and the "Bringing to waste disposal centre" alternative are significant for both classes. Overall, citizens have a basic preference for the re-use measures over the base alternative. The "Pick-up service" alternative, is not favoured more than the current situation. Hence, these findings suggest that citizens are attracted to certain re-use measures compared to the current situation. Last, both classes are indifferent in their choices regarding the different product types. Only the second component in the "Pick-up service" alternative is significant. This indicates that citizens are more likely to use the "pick-up service" alternative when the product is a vacuum cleaner. The classes are next explained in more detail.

Class 1 – Convenience seekers:

This class is the largest of the two classes (56%). The base preference of this group for the "Platform" alternative and the "Bringing to the waste disposal centre" alternative, are almost equal. There is no base preference for the "Pick-up service" alternative compared to the current situation. However, this class is sensitive for certain attribute levels of the "Pick-up service" alternative. They are more attracted to this alternative when there is an on-call appointment system, the costs are as low as possible and there is no loyalty system. This class is not very sensitive for costs as the parameter for costs is smaller than for appointment type and loyalty system. They do prefer a loyalty system for the "Bringing to the waste disposal centre" alternative. Indicating that when they need to deliver more effort, they like something in return. Most citizens in this class are over the age of 40. The older the citizens are, the more likely they are to belong in this class.

Class 2 – Online platform lovers:

Slightly less than half of the citizens belong to this class (44%). This class has a strong base preference for the "Platform" alterative. The "Pick-up service" alternative does not provide significantly more utility for the citizens as the current situation. Only one attribute parameter is significant for this class. Indicating

that this group is not sensitive for the chosen attributes, but bases their choices on the labels of the alternatives instead. The significant parameter is the appointment type for the "Pick-up service" alternative. The attractiveness of this measure is determined by the on-demand appointment possibility. Younger citizens have a greater chance to be part of this class. Until around 40 years old, citizens are more likely to be part of this class, and thus, have a strong preference for the "Platform" alternative.

6.4. CONCLUSION

Respondents considered the choice tasks and product types when answering the questions with slight homogeneity in their answers. The base alternative (current situation) was chosen in 20% of the times. Meaning, in 80% of the observations, a re-use alternative was preferred.

After analyzing the characteristics of the data, the choice models were estimated. The model fits are summarized in table 10. The LC model had the lowest BIC value and the highest adjusted ρ^2. Indicating that this model had the best fit with the data, 22.02% of the initial uncertainty was explained by the model, indicating that the model had a reasonable fit with the data.

TABLE 10: COMPARISON OF THE MODEL FITS

COMPARISON OF MODEL FITS			
Model	LL	BIC	ρ^2
BASIC MNL MODEL	-3383.098	6861.04	0.0953
BASIC MNL MODEL WITH CONTEXT	-3370.615	6907.21	0.0962
FINAL MNL MODEL	-3263.954	6765.02	0.1222
LC MODEL WITH 2 CLASSES	-2883.279	6106.41	0.2202

From the estimates of the final MNL model as of the LC model, it became apparent that the citizens have a strong base preference for the "Platform" alternative. However, from both models, it can be concluded that the citizens are overall indifferent in their choices regarding the different product types. Only one component is significant, indicating that citizens are more likely to prefer the "Pick-up service" alternative when the product is a vacuum cleaner.

Attitudes towards the environment are no indicator of the preferences of the citizens in the final MNL model. Moreover, the socio-demographics or explanatory variables, such as gender, age or ability are no indicator for the "Pick-up service" alternative either. The socio-demographics and explanatory variables are indicators for the "Platform" and "Bringing to waste disposal centre" alternative, although the ability to go to the waste disposal centre, income, gender and education are significant, the influence of the estimated parameter is neglectable (< 0.00). Citizen characteristics influence the "Bringing to waste disposal centre" alternative the most, of which the strongest are; having a drivers' license, ability to bring big products and ability to bring small products to the waste disposal centre.

Two classes are identified for the LC model of which the largest was the "Convenience seekers" (56%). Characteristics of this class are that the citizens are on average 40 years or older and the older the citizens, the more likely they belong to this class. They have an almost equal base preference for the "Platform" and the "Bringing to the waste disposal centre" alternative. Moreover, they are sensitive to the combination of attributes for the "Pick-up service" alternative. The utility of this alternative is the highest when there is an on-demand appointment system, low costs and no loyalty system. The "convenience seekers" would not mind to put in extra effort (going to the waste disposal centre) as long as they get something in return (loyalty system). The second class found is "Online platform lovers" (44%). This class

has a strong base preference for the “Platform” alternative. This group is not sensitive for the chosen attribute levels. Younger citizens (up to 40 years) have a greater chance to be part of this class.

The sample is not representative of this study. Therefore, it should be taken into account that the conclusion drawn in this section could be biased. However, only the socio-demographic variable age is significant and of influence on the estimated models. The conclusions drawn in this section based on the variable age are logically and supported by literature, and therefore assumed to be plausible. As the other socio-demographic variables are not significant or have a parameter estimate smaller than 0.00, it is assumed that this did not affect the results.

7. MODEL APPLICATION – SCENARIO ANALYSIS

To explore the choice behaviour of the citizens, the MNL model and LCM model were used to evaluate multiple scenarios. These scenarios will help indicate what measures will provide the highest utility compared to the base alternative (current situation) for the citizens and will be used to formulate recommendations to Meerlanden.

7.1. SCENARIOS ON RE-USE MEASURES

The models help evaluate what citizens state they would do when certain scenarios would be implemented. The choice probabilities are not definite results as citizens' behaviour is not always the same as their stated choice indicates. However, it does provide insights into the preferences of the citizens with regards to the proposed scenarios.

In this study, four scenarios are proposed, which are elaborated in the following heading. The design of the measures per scenario is shown in table 11. The base alternative (current situation) is not shown in the table as this is the reference measure and does not change over the different scenarios.

Scenario 1 – Support Meerlanden charity fund

Meerlanden has a charity fund to support local charities and sports clubs. The first scenario is about raising funds to donate, for which the proceeds of the re-use measures will be used. Therefore, in this design, the reward systems most beneficial for Meerlanden are chosen. There are no loyalty systems because the costs of this are for Meerlanden. To make sure all products are optimally re-used, citizens can make an appointment by reserving a time slot.

Scenario 2 – Citizens' reward maximisation

The second scenario is based on maximising the rewards for the citizens since it is a known possible driver for re-use behaviour. In this design, the reward systems chosen are most beneficial for the citizens. A loyalty system for each measure is included as this could give more incentive for the citizens to choose a re-use measure over the current situation. With this scenario, it is analysed if the reward incentives will lead to fewer citizens choosing for the current situation. The appointment systems are by reserving a time slot.

Scenario 3 – Citizens' convenience maximisation

From the literature, it became apparent that the choices citizens make are influenced by the level of convenience. Therefore, this scenario is based on maximising the convenience level for the citizens. Comparison of this scenario and scenario two will help determine if rewards or convenience is the most important for citizens when making their choice. The reward systems of scenario one are chosen. Important to notice is the inclusion of a loyalty system in this scenario. The appointment systems are based on convenience, so there is no appointment needed and the "Pick-up service" is on demand. The "Platform" alternative can be reached through an app.

Scenario 4 – No loyalty system

From the model estimates, the loyalty systems seemed to influence the utility of the re-use measures. Therefore, in the last scenario, the impact of a loyalty system was assessed by combining the known effective reward and appointment systems, but not incorporating a loyalty system. With this scenario, it

can be analysed what the influence of a loyalty system is on a measure when the other attributes are optimal for the citizens.

TABLE 11: SCENARIOS FOR THE SCENARIO ANALYSIS

SCENARIOS				
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
ATTRIBUTES PLATFORM ALTERNATIVE				
TYPE OF PLATFORM	Through Meerlanden website	Through Meerlanden website	Through Meerlanden app	Through Meerlanden app
REWARD SYSTEM	70% of the earnings is for you, 30% of the earnings are for Meerlanden	Earnings are all for you	70% of the earnings is for you, 30% of the earnings are for Meerlanden	Earnings are all for you
LOYALTY SYSTEM	There is no loyalty system	There is a loyalty system	There is a loyalty system	There is no loyalty system
ATTRIBUTES BRINGING TO CENTER ALTERNATIVE				
APPOINTMENT	Reserve a timeslot	Reserve a timeslot	No appointment	No appointment
REWARD SYSTEM	Earnings are all for Meerlanden	70% of the earnings are for Meerlanden, 30% of the earnings are for you	Earnings are all for Meerlanden	70% of the earnings are for Meerlanden, 30% of the earnings are for you
LOYALTY SYSTEM	There is no loyalty system	There is a loyalty system	There is a loyalty system	There is no loyalty system
ATTRIBUTES PICKUP SERVICE ALTERNATIVE				
APPOINTMENT	Reserve a timeslot	Reserve a timeslot	On-demand	On-demand
COSTS	€ 25,-	€ 15,-	€ 25,-	€ 15,-
LOYALTY SYSTEM	There is no loyalty system	There is a loyalty system	There is a loyalty system	There is no loyalty system

7.2. SCENARIO ANALYSIS WITH MNL MODEL

The scenarios described in section 7.1. were applied to a modified version of the final MNL model. This model only contained the attributes of the choice alternatives and no possible interaction effects and context factors (product types). The choice probabilities for the different contexts (product types) did not vary in a way worth mentioning, therefore, only the analysis without contexts was shown in this section. In Appendix IX.A. the analysis with context factors (product types) could be found. The interaction effects were excluded for several reasons. First, the sample was not representative of the population and this could lead to biased results (see section 6.2.1.). Second, most interaction effects had little to no influence on the total utility of a measure, indicating that their relevance was relatively small (see section 6.3.2.). Last, Meerlanden does not have exact knowledge about the demographics of the citizens visiting the waste disposal centres. Therefore, it is useful to examine the scenarios without these effects.

The MNL-model used for the scenario analysis is presented in table 12. The interpretation of the estimated parameters was equal to the interpretation given in section 6.3.1.1., the parameter estimates which were

not significant at a 95% confidence level are coloured red. Based on this choice model, the utility and choice probabilities for the different re-use measures, under all four scenarios were calculated. The calculations are shown in table 13.

TABLE 12: ESTIMATED PARAMETERS MNL MODEL FOR SCENARIO ANALYSIS

MNL-MODEL FOR SCENARIO ANALYSIS				
Parameters	Estimate	Std. err.	t-ratio	p-value
CONSTANTS				
PLATFORM ALTERNATIVE	0.81	0.05	15.29	0.00
BRINGING TO CENTER ALTERNATIVE	0.43	0.06	7.64	0.00
PICKUP SERVICE ALTERNATIVE	0.35	0.27	1.28	0.20
BASE ALTERNATIVE (FIXED)	0.00	NA	NA	NA
ATTRIBUTES PLATFORM ALTERNATIVE				
TYPE OF PLATFORM	-0.05	0.04	-1.30	0.20
REWARD SYSTEM	-0.01	0.04	-0.25	0.80
LOYALTY SYSTEM	-0.00	0.04	-0.06	0.95
ATTRIBUTES BRINGING TO CENTER ALTERNATIVE				
APPOINTMENT	-0.07	0.04	-1.62	0.11
REWARD SYSTEM	0.04	0.04	1.02	0.31
LOYALTY SYSTEM	0.09	0.04	2.05	0.04
ATTRIBUTES PICKUP SERVICE ALTERNATIVE				
APPOINTMENT	0.22	0.07	3.22	0.00
COSTS	-0.06	0.01	-4.08	0.00
LOYALTY SYSTEM	-0.19	0.07	-2.80	0.01

TABLE 13: PREDICTED CHOICE PROBABILITY UNDER FOUR SCENARIOS MNL MODEL

CHOICE PROBABILITIES				
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE				
TOTAL UTILITY	0.87	0.85	0.77	0.75
CHOICE PROBABILTY	45.4%	42.9%	42.2%	40.3%
BRINGING TO CENTER ALTERNATIVE				
TOTAL UTILITY	0.45	0.55	0.49	0.23
CHOICE PROBABILTY	29.8%	31.8%	31.9%	24.0%
PICKUP SERVICE ALTERNATIVE				
TOTAL UTILITY	-1.18	-0.96	-1.12	-0.14
CHOICE PROBABILTY	5.8%	7.0%	6.4%	16.6%
BASE ALTERNATIVE				
TOTAL UTILITY	0	0	0	0
CHOICE PROBABILTY	19.0%	18.3%	19.5%	19.1%

Over all four scenarios, the order of re-use measure popularity is the same. The "Platform" alternative shows the highest choice probability (e.g. 45.4%, 42.9%, 42.2% and 40.3%), whereas the "Pick-up service" has the lowest choice probability over all scenarios (e.g. 5.8%, 7.0%, 6.4% and 16.6%). Notable is the increase in choice probability for the "Pick-up service" alternative and decrease in choice probability for "Bringing to waste disposal centre" alternative in the fourth scenario "No loyalty system". This indicates

that citizens are sensitive for a loyalty system in the "Bringing to waste disposal centre" alternative, so when this alternative does not have a loyalty system, a part of the citizens who would normally choose this alternative would now go for the "Pick-up service" alternative.

The percentage of citizens who would prefer the current situation is almost equal over all scenarios. There is a small decrease in choice probability in the second scenario "Citizens' reward maximization", indicating citizens are most willing to re-use when they are rewarded for that behaviour. The choice probability for the "Platform" alternative and the "Bringing to waste disposal centre" alternative, are relatively equal between scenario two "Citizens' reward maximization" and scenario three "Citizens' convenience maximization". This indicated that citizens value both alternatives evenly based on convenience and rewards.

7.3. SCENARIO ANALYSIS WITH LATENT CLASS MODEL

The scenarios described in section 7.1. were also applied to both classes of the Latent Class model (LCM). The model without the context factors (product types) was used for this analysis because the conclusions of the analysis did not change over the different contexts (product types). Therefore, only the analysis without contexts (product types) is shown in this section. The analysis with context factors (product types) is described in Appendix IX.B.

The used LC-model is presented in table 14. The interpretation of the estimated parameters was equal to the interpretation given in section 6.3.3.1., the parameter estimates which were not significant at a 95% confidence level, are coloured red. Based on this choice model, the utility and choice probabilities for the different measures, under all four scenarios were calculated for both classes (table 15).

TABLE 14: ESTIMATED PARAMETERS LATENT CLASS MODEL FOR SCENARIO ANALYSIS

LATENT CLASS MODEL FOR SCENARIO ANALYSIS						
Parameters	CLASS 1			CLASS 2		
	Estimate	Std. err.	t-ratio (p-value)	Estimate	Std. err.	t-ratio (p-value)
CONSTANTS						
PLATFORM ALTERNATIVE	0.41	0.18	2.26 (0.02)	1.37	0.21	6.40 (0.00)
BRINGING TO CENTER ALTERNATIVE	0.37	0.18	2.07 (0.04)	0.56	0.22	2.55 (0.01)
PICKUP SERVICE ALTERNATIVE	0.49	0.31	1.56 (0.11)	0.13	0.43	0.29 (0.77)
BASE ALTERNATIVE (FIXED)	0.00	NA	NA	0.00	NA	NA
ATTRIBUTES PLATFORM ALTERNATIVE						
TYPE OF PLATFORM	-0.03	0.03	-1.00 (0.32)	-0.08	0.05	-1.72 (0.09)
REWARD SYSTEM	-0.01	0.03	-0.37 (0.71)	-0.01	0.04	-0.25 (0.81)
LOYALTY SYSTEM	0.02	0.03	0.70 (0.49)	-0.03	0.04	-0.83 (0.40)
ATTRIBUTES BRINGING TO CENTER ALTERNATIVE						
APPOINTMENT	-0.07	0.04	-1.56 (0.12)	-0.07	0.06	-1.13 (0.26)
REWARD SYSTEM	0.07	0.04	1.85 (0.07)	-0.00	0.06	-0.03 (0.98)
LOYALTY SYSTEM	0.12	0.03	3.70 (0.00)	0.04	0.05	0.85 (0.40)
ATTRIBUTES PICKUP SERVICE ALTERNATIVE						

APPOINTMENT	0.21	0.05	4.44 (0.00)	0.24	0.08	3.00 (0.00)
COSTS	-0.07	0.01	-5.74 (0.00)	-0.04	0.02	-2.13 (0.03)
LOYALTY SYSTEM	-0.24	0.04	-6.01 (0.00)	-0.10	0.06	-1.58 (0.12)
CLASS MEMBERSHIP						
CONSTANT	-765.02	0.35	-2156.04 (0.00)	0.00	NA	NA
AGE	18.86	0.61	333.57 (0.00)	0.00	NA	NA
CLASS PROBABILITY	0.56			0.44		

TABLE 15: PREDICTED CHOICE PROBABILITY UNDER FOUR SCENARIOS LC MODEL

CHOICE PROBABILITIES								
	CLASS 1 – CONVENIENCE SEEKERS				CLASS 2 – ONLINE PLATFORM LOVERS			
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE								
TOTAL UTILITY	0.43	0.45	0.41	0.35	1.49	1.41	1.27	1.31
CHOICE PROBABILTY	35.7%	34.4%	34.1%	32.0%	58.3%	54.6%	52.8%	51.8%
BRINGING TO CENTER ALTERNATIVE								
TOTAL UTILITY	0.39	0.49	0.49	0.11	0.59	0.67	0.53	0.45
CHOICE PROBABILTY	34.3%	35.8%	37.0%	25.2%	23.7%	26.1%	25.2%	21.9%
PICKUP SERVICE ALTERNATIVE								
TOTAL UTILITY	-1.23	-1.01	-1.29	-0.11	-1.01	-0.81	-0.73	-0.13
CHOICE PROBABILTY	6.8%	8.0%	6.2%	20.2 %	4.8%	5.9%	7.1%	12.3%
BASE ALTERNATIVE								
TOTAL UTILITY	0	0	0	0	0	0	0	0
CHOICE PROBABILTY	23.2%	21.9%	22.7%	22.6%	13.1%	13.3%	14.8%	14.0%

When comparing the "Convenience seekers" and "Online platform lovers", the first ones are more prone to choose for the current situation compared to the "Online platform lovers". However, the "Online platform lovers" are more willing to change their behaviour towards re-use. From section 6.3.3.1. it became apparent that the "Online platform lovers" are in general younger (< 40) than the "Convenience seekers" (>40). This could explain why the "Convenience seekers" are more prone to choose the "Bringing to waste disposal centre" alternative than the "Online platform lovers", as this is relatable to the current situation. The "Online platform lovers" value the option of a website ("Platform" alternative) and making an appointment ("Bringing to waste disposal centre" alternative). In case there is no loyalty system for any of the alternatives, the "Convenience seekers" are more prone to choose the "Pick up service" compared to other scenarios. Although there is a small increase for the "Pick-up service" for the "Online platform lovers" in the "No loyalty system" scenario, this is a lot smaller compared to the "Convenience

seekers". For the "Convenience seekers", the reward and loyalty system are the most determining for their choice between a re-use measure or the current situation. When these two design variables are not included, the number of citizens in this class who choose for the current situation increased.

7.4. CONCLUSION

The "Platform" and "Bringing to the waste disposal centre" alternatives are the most favourable over all scenarios, and thus the most robust. The "Online platform lovers", obviously preferred the "Platform" alternative most over the different scenarios. The "Convenience seekers" are more prone to choose for the current situation compared to the "Online platform lovers". "Convenience seekers" experience more incentive to choose a re-use measure when they are rewarded for their behaviour, established in this study by a loyalty system. Especially in the "Bringing to the waste disposal centre" alternative. "Online platform lovers" value an appointment system and website for re-use measures. In case no appointment is needed, there is an increase in choice probability for the current situation in the "Online platform lovers" group.

Recommended for Meerlanden based on the scenario analysis, is to implement an online platform and extent the waste disposal centres with re-use facilities. These two re-use measures should be optimally designed with an appointment system, rewards for the citizens, and a loyalty system included in the "Bringing to the waste disposal centre" alternative. By offering this, the main part of the "Convenience seekers" and the "Online platform lovers" should be willing to use a re-use measure.

8. CONCLUSION AND RECOMMENDATIONS

In the following section, each sub-question is answered based on the results of this research to answer the main questions. In section 8.2., recommendations are given based on the results of chapter 7.

The main research questions answered in this chapter are: *"What are the preferences of the citizens of the municipalities served by Meerlanden regarding re-use of municipal solid waste and how is this related to observed citizen characteristics?"*

8.1. CONCLUSION

The objective of this research was to analyze what the preferences of citizens living in the municipalities served by Meerlanden were regarding different re-use measures and if these preferences were influenced by certain characteristics. Insights in citizen preferences and trade-offs were obtained based on the choices made by respondents in the choice experiment. The results can be used to stimulate re-use and help to reduce waste levels and indirectly the negative effects associated with waste. The results can be used by Meerlanden, but also by other municipalities or waste disposal organizations.

The first sub-question formulated for this research was: *What are the preferences of the citizens regarding the re-use of municipal solid waste and to what factors or citizen characteristics are these related?*

In 80% of the choice tasks, the respondents stated to prefer the re-use options over the base alternative (current situation). This indicates that there is a willingness to change towards a re-use system. After estimating the choice models, it became apparent that the citizens have a base preference for the "Platform" and "Bringing to the waste disposal centre" alternative compared to the current situation. Where the preference for the "Platform" alternative is three times as large as for the "Bringing to the waste disposal centre" alternative. The "Pick-up service" alternative is, by the label, valued less than the current situation.

When the "Bringing to the waste disposal centre" alternative has a loyalty system, the attractiveness of this alternative increases for the citizens. The preferences of the citizens regarding the design of the "Platform" alternative is not generalisable towards the population, however, from the sample, it seems that citizens prefer a website over an app. The preference towards the "Pick-up service" is strongly determined by the design of the alternative. The preference increases when the alternative is on-demand, logically the alternative is preferred more when the costs are €15 instead of €25 and, unexpectedly, does not contain a loyalty system. This last design feature is contradicting with what was found in the literature, where it was named that a loyalty system would increase the attractiveness of an alternative.

It differed per measure to what characteristics the preferences are related. No characteristics are related to the "Pick-up service" alternative. The preference for the "Bringing to waste disposal centre" alternative is most influenced by citizen characteristics. However, most of these characteristics have an influence of less than 0.00. Citizens who have the ability to bring small and/or large products to the waste disposal centres are more attracted to the "Bringing to the waste disposal centres" alternative compared to citizens who are not able to do this. A notable finding is that citizens with a drivers' license have a slightly negative association towards the "Bringing to the waste disposal centre" compared to citizens who do not have a drivers' license. Last, age is an indicator of the preference of the citizens. Younger citizens (under the age of 40) do prefer the "Platform" alternative more than the older citizens (over the age of 40).

The second sub-question was: *What are different clusters among citizens of the municipalities served by Meerlanden and to what observed citizen characteristics are these related?*

The data fits best with a LC model with two classes, “Convenience seekers” and “Online platform lovers”. Both classes have a base preference for the “Platform” and “Bringing to the waste disposal centre” alternative. However, logically, the “Online platform lovers” have the highest base preference for the “Platform” alternative. This class is not very sensitive to the design of different measures. Whereas the “Convenience seekers” do become more attracted to a measure depending on the design of the measure. For instance, the “Convenience seekers” are more attracted to the “Bringing to the waste disposal centre” alternative when there is a loyalty system for this measure. Moreover, even though the “Pick-up service” alternative is, based on the label, valued less than the current situation, the attractiveness of this alternative could be improved for the “Convenience seekers” when there is an on-call appointment system, the costs are as low as possible and there is no loyalty system.

The “Convenience seekers” is the largest of the two classes with 56%. The older the citizens are, the more likely it is that a citizen belongs to this class. Most of the citizens in this class are forty years and older. The base preference of this group for the “Platform” alternative and the “Bringing to the waste disposal centre” alternative, are almost equal in contrast to the “Online platform lovers”. The “Convenience seekers” like a reward in return when they have to deliver more effort. The “Online platform lovers” (44%) is a relatively young class. Citizens under the age of 40 are more likely to belong to this class.

The third sub-question was: *How do preferences differ between different types of municipal solid waste?*

The choices citizens made were associated with the contexts that varied in the choice experiment. This means that different types of municipal solid waste were of influence on the preferences citizens had. However, the parameters for the contexts are not significant in the MNL model, except for the third product component, vacuum cleaner, in the “Pick-up service” alternative. In the LCM, both classes are indifferent in their choices regarding the different product types. Again, only the second product component in the “Pick-up service” alternative is significant. This indicates that citizens are more likely to use the “pick-up service” alternative when the product is a vacuum cleaner.

Based on the three sub-questions, the following main questions can be answered: *What are the preferences of the citizens of the municipalities served by Meerlanden regarding re-use of municipal solid waste and how is this related to observed citizen characteristics?*

The results of the research showed that citizens living in the municipalities served by Meerlanden are willing to change from the current system towards re-use of municipal solid waste. This is a positive result as re-use can diminish waste levels and indirectly the negative effects associated with waste. Citizens have a base preference for the “Platform” and “Bringing to the waste disposal centre” alternative. The preferences for the design of the “Platform” alternative is not generalizable to the population, however, the study sample prefers a website over an app and a combined reward system of keeping 70% of the rewards for themselves and donating 30% of the rewards to Meerlanden. The “Online platform lovers” do not prefer a loyalty system whereas the “Convenience seekers” do prefer a loyalty system. For the “Bringing to the waste disposal centre”, only the preference for a loyalty system is generalizable toward the population. Where the “Convenience seekers”, again, prefer a loyalty system, the preference of the “Online platform lovers” is not generalizable towards the population. However, the study sample does not prefer a loyalty system for this measure. The preferences of the “Convenience seekers” towards the

“Pick-up service” alternative is generalizable towards the population, for the “Online platform lovers” only the type of appointment preference is generalizable towards the population. Both classes prefer an on-demand appointment system. Moreover, low costs and no loyalty system are preferred for this measure.

The preferences are related to multiple citizen characteristics. Overall, the “Bringing to waste disposal centre” alternative is most influenced by the characteristics of citizens, then the “Platform” alternative, the “Pick-up service” alternative is not influenced by citizen characteristics. Most of the citizen characteristics found have little to no effect on the attractiveness of the measures. Ability to go to the waste disposal centre, income, gender and education are found as indicators but have an influence of <0.00. From the MNL model and the LC model, age is found as an indicator. The older the citizens are, the less they are attracted to the “Platform” alternative and the higher the chance they belong to the “Convenience seekers” class. Citizens who are able to bring their products (small and big) to the waste disposal centre by themselves, are more attracted to the “Bringing to the waste disposal centre alternative”. Last, citizens with a drivers’ license favour the “Bringing to waste disposal centre” alternative less than citizens without a drivers’ license.

The results found are based on a sample of the population served by Meerlanden. As this sample was not representative of the population served by Meerlanden or the population of the Netherlands, this should be taken into account when reading the conclusions. However, only the socio-demographic variable for age had a significant influence on the results. The conclusions based on this variable are in line with what was found in the literature and can, therefore, be considered as plausible. It is assumed that because the population served by Meerlanden is a variety of municipalities in the “Randstad” the results can be used for other waste collection and disposal companies in the “Randstad”. The results do slightly differ from the findings of the literature review and are therefore probably not generalizable towards Europe or the world as the dynamics and attitudes of the citizens do differ from those of the Netherlands.

8.2. RECOMMENDATIONS

The goal of this research was to advise Meerlanden about possible strategies for stimulating re-use among citizens living in the municipalities served by Meerlanden. To do this, different scenarios were computed with the estimated choice models.

When looking at the three proposed measures, the “Platform” alternative and the “Bringing to waste disposal centre” alternative are relatively easy for Meerlanden to implement. From the scenarios analysis, it seems that these two measures are most favourable by the citizens over all scenarios (most robust). The “Online platform lovers”, obviously prefer the “Platform” alternative most for all scenarios, whereas the “Convenience seekers”, are preferring both measures equally. As citizens already go to the waste disposal centre, a little adjustment could improve the utility of the citizens significant. This alternative is mostly preferred by citizens of 40 years and older who are able to bring their waste to the waste disposal centres by themselves. Both age and ability to bring products to the waste disposal centres are important characteristics to take into account.

Therefore, it is recommended for Meerlanden to upgrade the waste disposal centres towards re-use facilities and add an online platform possibility for citizens (preferably a website). It is advised to reward the citizens for their re-use behaviour as the larger part of the citizens are more prone to re-use when they are rewarded. This can be reached by adding loyalty systems in which citizens can use their points for purchasing products from the re-use stores or platform, or by giving citizens (a part) of the yields of their brought products. Moreover, it is advised to work with appointment systems. When the “Bringing to the waste disposal centre” had the option to make an appointment, there are fewer citizens who indicated to use the current system and more who indicated to use the re-use measure. For this reason, it is advised to add the possibility to reserve a timeslot or make an appointment. Last, it is advised to use the yields of the re-use measures for Meerlanden, for the Meerlanden charity fund and making sure that the citizens know what happens with these yields. This increases the positive view of the citizens towards Meerlanden and the re-use measures.

Citizens could add a comment at the end of the survey. From this, it is advised to Meerlanden to educate the citizens over re-use and what products can be used for re-use. This can be integrated into the online platform. Mostly for e-waste, citizens do not understand the added value of re-use. Also, there is a need for a safe, online environment as many citizens do not trust “Marktplaats” anymore. For instance, an option where the re-use facilities of Meerlanden can be used as a safe trading place could be of extra value. Citizens would like for Meerlanden to play an active role in keeping the online environment safe, trustworthy, monitored and practical.

9. DISCUSSION

In this chapter, a reflection on the research and the limitations of the chosen methods are discussed (section 9.1.; 9.2.). This discussion will contribute to creating an understanding of the research context. Also, recommendations for future research are given (section 9.3.). Last, a reflection on the use of a stated choice experiment is given (section 9.4.), since this method was not yet used to analyze the preferences of the citizens for re-use measures.

9.1. REFLECTION ON RESEARCH

This research was based on the conceptual framework shown in the introduction (figure 2). From the results, it seems that only the situational factors, extrinsic motivations and socio-demographics had a significant influence on the utility of the different measures. The other factors (Intrinsic motivations, context and habitual factors), known from the literature, did in this research not influence the total utility of the measures. It could be that there were too many factors to check the influence of each of the variables separately and thus, these factors are of influence but were not significant.

The first limitation was caused by the data gathering and non-representativeness of the sample. When analyzing the data, a high drop-out rate was found. This could be caused by the survey setup. Reactions of the respondents at the end of the survey revealed that some found the survey introduction complicated and hard to understand. This could also be a reason for the non-representativeness of the sample. The over-representativeness of certain categories, such as high income and high education level, in the sample, could also be since most respondents were gathered through the personal network of the researcher. Because the data were gathered with an online survey, there was a chance of self-selection among the respondents, which could induce selection bias. Respondents entered the survey voluntarily, which could probably cause citizens who like to express their opinion about re-use or Meerlanden to be overrepresented in the sample. This could also have as a result that not all citizens in the population were reached and therefore were not taken into account in the research. Not all citizens like to participate in online research or have an insufficient understanding of the Dutch language to understand and participate in the research. A non-representative sample can lead to biased results. It is possible that attributes that were not significant in these analyses would be significant if the sample was representative. Moreover, other citizen characteristics may be significant in a representative sample.

From the estimated choice models, it became apparent that most attributes were not significant in the models. A possibility is that not the most relevant attributes were chosen for this research. For instance, time and distance were not taken into account as attributes but were mentioned in the literature as important variables. Because the parameters were not significant, it is possible that the results are not representative of the preferences of the citizens. It is possible that the contexts (product types) were not significant because respondents did not take them into account when selecting the alternatives. It is possible that the three alternatives used in the choice experiment were not independent of each other but that two alternatives were more alike. This lead to a nesting effect. No analyses were performed to check for nesting effect in the models, which can lead to biased results.

It was expected that the “Pick-up service” alternative would be a popular alternative because it has high service levels and convenience for the citizens. However, this alternative was the least popular. Even for the large products such as a refrigerator and a sofa this measure was not attractive. This could be because

the expectations were different from the actual situation because of the non-representative sample or due to the setup of the experiment.

9.2. LIMITATIONS OF THE METHOD

When performing choice modelling a few limitations should be taken into account. Before creating a choice study, understanding of the characteristics of the research is critical. If the design is not applied properly, the results can be biased or wrongly interpreted (Louviere, Hensher & Swait, 2000; Hauber et al., 2016). To make sure the design was applied properly, an expert on choice modelling was consulted. Furthermore, there is a chance that the questioned citizens did not understand the questions fully, which can lead to flawed results. To prevent flawed results, a pilot study was done to make sure that the questionnaire was clear and unambiguous (section 4.6.; appendix III). In addition, an introduction was provided with an explanation about the different options and the goal of the study to provide all needed information to understand the questionnaire.

Moreover, there is always the possibility that there is a discrepancy between citizens state in the survey and how they behave in real life (Louviere, Hensher & Swait, 2000; Hauber et al., 2016). To cope with this, the survey was anonymous, so respondents did not feel like they need to choose the socially acceptable option. Also, there was an extra option to determine if the respondents would use the chosen option or not. The questions were accompanied by a scenario description to provide respondents with more knowledge and context about the questions. This helps in creating a more realistic choice setting for the respondents. Furthermore, not all characteristics could be included in the questionnaires, because the questionnaires would become too long and complicated to base choices on. The most important characteristics of the options were included. To identify these characteristics, literature research was performed (see chapter 4) and experts on the topic and research area were consulted (Louviere, Hensher & Swait, 2000; Hauber et al., 2016).

Another limitation of this research is the use of a five-point Likert scale. In the survey, respondents were asked to state to what end they agree with certain statements about the environment. To do this, a five-point Likert scale was used. A limitation thereof is that respondents choose the “safe” answer, the option in the middle. Respondents tend to avoid extremes because they want to avoid to be associated with extremism. Even though, this extreme choice would be most accurate. However, the Likert scale is one of the most used methods for measuring attitudes in surveys, and therefore well understood. Moreover, the responses are easily quantifiable and usable in mathematical analyses. It also provides respondents with the change to respond with a certain degree of agreement instead of only agree or disagree, which makes it easier to answer a question. Therefore, the method was still used in this survey. To cope with the limitations, validated lists of attitudinal statements were used (Likert, 1932).

To measure the attitudes of citizens towards the environment and towards ecological behaviour of garbage disposal, two validated and tested scales were used namely; NEP scale and GEBS. From the literature, there are some reservations on the NEP scale and ecological behaviour measurement scales in general. For the NEP scale, there are three categories of criticisms known. The first is that the NEP scale is missing certain elements to truly measure a pro-environmental world view, such as ecological behaviour. Therefore, the GEBS scale is also used in this research. Second, it is argued that the scale is not valid. And third, there are some reservations on the dimensionality of the NEP scale. However, the NEP scale is widely excepted and used to measure pro-environmental world views and is still considered as a valuable scale. Moreover, the NEP scale is updated frequently due to new research and therefore still chosen to

use for this research (Anderson, 2012). In general, it is argued that ecological behaviour cannot be measured due to the inconsistency of people in their ecological behaviour. Many attempts to measure ecological behaviour have failed in the past. The GEBS is known for giving acceptable results as it measures "general ecological behaviour" and accommodates for the inconsistency in behaviour by asking too specific types of behaviour as well to more general behaviour (Kaiser, 1998). However, it is still possible that these scales do not measure the latent variable for attitude towards the environment and pro-ecological behaviour properly. Due to the worldwide use of these scales, it is assumed that the scales could provide sufficient measurement of the attitudes for this research.

9.3. FUTURE RESEARCH RECOMMENDATIONS

Based on the reflection described above, different recommendations for future research are provided. It is recommended to:

1. further investigate the different design aspects for re-use measures. As most of the attributes did not become significant in the MNL model, the possibility exists that there are designs that better indicate the relevant attributes for the systems.
2. incorporate more citizens in the research. The study group was relatively small and not representative of the population. It could be useful to incorporate more citizens and make sure to incorporate all citizens to gain more representative results. This can be achieved by establishing different focus groups, distribute the surveys at citizens houses or ask people who visit the waste disposal centres to directly fill in the survey.
3. furtherly investigate the influence of the different types of municipal solid waste on the preferences of citizens by changing the survey setup (fewer questions per product type or only two product types per respondent). Now, the results were not significant in the estimated models. From the chi-square analyses, it is apparent that there is a relation between the context and the preferences but this should be investigated more thoroughly.
4. estimate mixed logit models for each cluster with extra error components instead of the MNL models. The current estimated models did not accommodate for nesting effects while two alternatives may be more alike, thus nested.
5. estimate a hybrid choice model to assess if the attitudes have influenced the preferences of the citizens. This model is developed as an extension of the MNL model to include attitude variables. Now, the attitudes were used in the MNL model as interaction effects and for the latent class model for allocating classes.
6. use a revealed preference experiment to investigate if citizens would use the stated preferences and re-use of MSW would increase. As mentioned in section 9.1., it is possible that the setup of the experiment was not sufficient to analyze the preferences of the citizens.
7. investigate why the founded results do differ from the literature research. Not all factors named in the literature research were of importance for determining the choices in the research. It could be interesting to investigate why.
8. investigate why the Pick-up service alternative was not preferred. It was expected to be a popular measure because of the high service levels and convenience for the citizens but was not.

9.4. REFLECTION OF USING A STATED CHOICE EXPERIMENT IN THIS RESEARCH

A stated choice experiment was, to the best knowledge of the researcher, not earlier performed to analyze the preferences of citizens towards re-use measurements. The analyses could not give certainty on the preferences of citizens regarding re-use since there were some limitations (see section 9.1.; 9.2.) in the research method and with the execution of the research. It was mentioned that researching the preferences of citizens towards the re-use of municipal solid waste (MSW) could be too complex to assess with a stated choice experiment. Respondents did mention that the information load was quite large and that this was sometimes confusing. Therefore, it could be possible that they were inconsistent in their choices.

However, the experiment did provide insides into the preferences of the citizens towards the labels of the measures. There was, for instance, a strong preference towards the “Platform” alternative. Moreover, the characteristics that were found as indicators for explaining choice heterogeneity by certain measures were logical. Also, the cofounder (age) found for the allocation model of the LC model was logical. Therefore, it is still assumed that a stated choice experiment is a useful technique for determining the preferences of citizens regarding re-use measures. The insights found can help Meerlanden, waste handling companies and municipalities in determining what direction they want to go with the implementation of re-use measures in their local waste management systems.

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APPENDIX

APPENDIX I – LITERATURE SEARCH

In chapter 4, a literature review is performed to find the needed background knowledge for creating a choice experiment and conducting this research. The literature research can be separated into three parts, namely; waste prevention behaviour, characteristics of citizens related to waste treatment behaviour, and current collection systems of municipal solid waste (MSW). The search strategies and used literature are discussed in this appendix.

APPENDIX I.A. – SEARCH STRATEGY LITERATURE

The literature was searched through Google Scholar and Scopus. The following terms were used to search the databases:

- Re-use municipal solid waste
- Household waste prevention
- Waste prevention behaviour
- Preferences recycling OR re-use OR waste prevention
- Municipal solid waste
- Pro-environmental behaviour
- Waste AND attitude
- Recycling AND attitude
- Re-use AND attitude
- Sustainable behaviour
- Theory of planned behaviour AND waste OR re-use OR recycling
- Preferences AND behaviour
- Choice modelling AND recycling OR re-use OR waste prevention
- Behaviour AND municipal solid waste OR recycling OR re-use OR waste prevention

The articles found with the literature search are scanned for importance towards the research, but also more important literature. This is also called the snowballing effect. From this, it became apparent who important researchers are in the different fields searched for useable literature. By using the articles of these authors the trustworthiness and reliability of the review increased. The articles were scanned by reading the abstract and conclusion of the article and by looking at the keywords.

APPENDIX I.B. – LITERATURE USED IN THE LITERATURE REVIEW

The literature used in the literature review is added in a table, the table is shown below (Table 16). The title of the paper is presented, the authors and the number of citations provided by Google Scholar. Last, two highlights are presented to indicate what information was used from the papers.

TABLE 16: ARTICLES USED IN THE LITERATURE REVIEW

LITERATURE REVIEW				
Title paper	Authors	Number of citations	Highlight 1	Highlight 2
Associations between pro-environmental behaviour and	Alcock, White, Pahl, Duarte-Davidson & Fleming, 2020	3	Study on pro-environmental behaviour	Study on the progress on changing human behaviour to meet the

neighbourhood nature, nature visit frequency and nature appreciation: Evidence from a nationally representative survey in England				challenges of regional and global sustainability
What influences an individual's pro-environmental behavior? A literature review	Li, Zhao, Ma, Shao & Zhang, 2019	27	A review that discusses the determinants of pro-environmental behaviour on recycling	A review that discusses the impact, relations, and mutual effects on pro-environmental behaviour of external and internal factors.
Behavioural attitudes towards waste prevention and recycling	Gilli, Nicolli & Farinelli, 2018	14	Investigating the relationship between individual motivations, recycling and minimisation behaviour.	The results of this research show that waste minimisation seems to be associated with intrinsic motivation only
Public preferences for improved urban waste management: A choice experiment	Tarfasa & Brouwer, 2018	11	A discrete choice experiment on improving urban waste management	Incorporating socio-demographics in the analysis for solid waste management
Social Norms, Morals and Self-interest as Determinants of Pro-environment Behaviours: The Case of Household Recycling	Czajkowski, Hanley & Nyborg, 2017	79	Consideration of the role of selfish, moral and social incentives and pressures in explaining to which extent stated choices over pro-environment behaviours vary across individuals	The results show that preferences are associated with moral/intrinsic motivations
Influence of recycling programmes on waste separation behaviour	Stoeva & Alriksson, 2017	76	Study on achieving high rates of waste reuse and recycling by using the theory of planned behaviour framework	The results of this research showed that when respondents were satisfied with the local conditions for waste disposal, their behaviour depended on their attitudes towards waste recycling
Distance and incentives matter: The separation of recyclable municipal waste	Struk, 2017	52	Study on the effect of an incentive system.	Findings of this study concluded that the less effort needed for waste separation and the less distance to the separation facility increased the willingness of separation significantly
Exploring social dimensions of municipal solid waste management around the globe – A systematic literature review	Ma & Hipel 2016	78	A literature review which evaluates and characterizes the literature published on the social dimensions of MSW management	A list of key references on social dimensions in MSW management

Preferred Attributes of Waste Separation Behaviour: An Empirical Study	Sheau-Ting, Sin-Yee, & Weng-Wai, 2016	23	This study tried to identify the preferred attributes for waste separation behaviour	The study research performs a choice-based conjoint analysis
Understanding the role of waste prevention in local waste management: A literature review	Zacho & Mosgaard, 2016	30	A literature review in which knowledge is gathered about the relevance of waste prevention in local waste management	The article provides an overview of previous scientific research on waste prevention in general and in local waste management.
Moving from recycling to waste prevention: A review of barriers and enables	Bartl, 2014	98	Description of the limitations of recycling as well as of waste prevention	Description of the barriers to transforming form a recycling driven society towards a waste prevention driven society
We want to sort! Assessing households' preferences for sorting waste	Czajkowski, Kadziela & Hanley, 2014	89	Use of stated choice modelling to analyse the preferences of citizens regarding recycling and waste separation	Use of latent class models to identify different classes in the sample
A moral basis for recycling: Extending the theory of planned behaviour	Chan & Bishop, 2013	256	The study tests how moral norms can extend the theory of planned behaviour	This study tries to explain the change in pro-environmental behaviour in citizens
Model development for household waste prevention behaviour	Bortoleto, Kurisu & Hanaki, 2012	129	This study claims that understanding waste prevention behaviour can help design more effective policies for local waste management to reduce the amount of waste	An extensive cognitive framework is provided which provides new and valuable insights about the involvement of individuals in waste prevention
"It's not Easy Being Green": Exploring Green Creeds, Green Deeds, and Internal environmental Locus of control	Cleveland, Kalamas, Laroche, 2012	127	List of different studies which research the link of pro-environmental variables on pro-environmental behaviour	Considers different recycling attitudes in the analysis and investigates the nature of the attitude-behaviour relationship
Pro-environmental behavior: Rational choice meets moral motivation	Turaga, Howarth & Borsuk, 2010	262	This paper reviews and compares the literature from two disciplines in social psychology regarding pro-environmental behaviour	Analyses what external factors do influence pro-environmental behaviour and what the strength of the norm-behaviour relationship is
Encouraging pro-environmental behaviour: An integrative review and research agenda	Steg & Vlek, 2009	2973	This paper analyses the potential of environmental psychology for understanding and promoting pro-environmental behaviour	This paper proposed a general framework for encouraging pro-environmental be

Motivational complexity of green consumerism	Moisander, 2007	747	This paper uses a simple model of motivation as an analytical tool for green consumerism	What are the challenges that environmentally concerned consumers may face and how can this be incorporated in policymaking
Financing electronic waste recycling Californian households' willingness to pay advanced recycling fees	Nixon and Saphores, 2007	90	Literature review on pro-environmental behaviour from different perspectives	Literature review on recycling behaviour
Human behavior and environmental sustainability: Problems, driving forces, and research topics	Vlek & Steg, 2007	473	An overview of worldwide developments in environmental quality and trends in resource use	Five general driving forces of global environmental change are distinguished in this paper
Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior	Kaiser, Hübner & Bogner, 2005	589	Elaboration on the theory of planned behaviour in contrast to the value-belief-norm theory	Introduction of the general ecological behaviour scale
Goal-directed conservation behavior: the specific composition of a general performance	Kaiser & Wilson, 2004	325	This research provided a framework for measuring behaviours more generally	Elaboration of specific behaviour measures compared to multidimensional behaviour scales, as specific behaviours are highly correlated
Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation	Diamantopoulos, Schlegelmilch, Sinkovics & Bohlen, 2003	1552	This paper explores whether socio-demographics still have a role to play in profiling green consumers	A review of measuring environmental consciousness and the relation between environmental consciousness and socio-demographic variables
New trends in measuring environmental attitudes: measuring endorsement of the new ecological paradigm: a revised NEP scale	Dunlap, Van Liere, Mertig & Jones, 2000	5387	Revised New Environmental Paradigm scale	Explanation of the revision of the NEP
New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior	Stern, 2000	6675	In this article, a conceptual framework is developed about advising theories of environmentally significant individual behaviour	This article advises on principles for further research and informed about the design of behavioural programs for environmental protection
A survey of recycling behaviour in	Vencatasawmy, Öhman & Brännström, 2000	71	This research researched various socio-economic	This study tried to explain recycling

households in Kiruna, Sweden			variables to examine if they are of effect on recycling behaviour or not	behaviour for multiple types of waste
A value-belief-norm theory of support for social movements: The case of environmentalism	Stern, Dietz, Abel, Guagnano, & Kalof, 1999	3245	The value-belief-norm theory explained in light of environmentalism	Comparison between value-belief-norm theory and other environmentalism measurements
Normative influences on altruism	Schwartz, 1997	4396	Norm valuation theory	A book about the influences of social variables on behaviour
Who recycles and when? A review of personal and situational factors	Schultz, Oskamp & Mainieri, 1995	802	A review of the empirical studies of recycling behaviours and the differentiation between attitudes and intentions	This review summarizes the personal and situational variables affecting recycling behaviour
Value orientations, Gender, and Environmental concerns	Schwarz, Stern, Dietz & Kalof, 1993	2452	This article developed a social-psychological model to examine the proposition that environmentalism represents a new way of thinking	From this model, it is assumed that action in support of environmental quality may be derived from three value orientations
The Theory of planned behaviour	Azjen, 1991	74871	Important theory in behaviour science	Ground theory for all other papers
Consumer preferences for environmental quality and other social goals	Uusitalo, 1990	60	Environmental preferences and behaviour are reasons for inconsistency in choices	Preference rankings regarding social goals

APPENDIX II – CONSTRUCTING A CHOICE EXPERIMENT

In the report, the construction of the choice experiment is described in chapter 5. Some steps are named but not explained. The additional information on creating a choice experiment is given in this appendix.

APPENDIX II.A. MASTERPLAN 4

When constructing choice sets, there are three methods a researcher can choose from. Creating a random design, an orthogonal design or an efficient design. By a random design, the choice sets are randomly chosen from a full factorial design. By an orthogonal (fractional factorial) design, the correlations between attributes are zero. This is the traditional way of constructing choice sets. Last, with an efficient design, the standard errors (of logit parameters) are minimized. To construct an efficient design, priors are needed (Molin, 2019a).

For this research, an orthogonal (fractional factorial) design is chosen. There are published fractional factorial design schemes. These allow for combining attribute levels into alternatives without the need of creating them by yourself. These designs are orthogonal, if well applied, and there is attribute levels balance. To select a basic plan, the researcher should first determine the number of attributes and attribute levels. Next, the researcher should select the smallest design that accommodates for all the attributes selected. Last, the researcher should assign each attribute to a free column with the appropriate number of attribute levels. A remark when doing this is to not choose columns with the same column numbers (Molin, 2019a).

As this research contains 9 attributes (3 per alternative), with 2 levels each, the smallest basic plan is Masterplan 4. Masterplan 4 is shown in figure 18.

Masterplan 4: 2^{11}

1	2	3	4	5	6	7	8	9	10	11
0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	1	1	0	0	0	1	0
0	1	1	0	1	1	1	0	0	0	1
1	0	1	1	0	1	1	1	0	0	0
0	1	0	1	1	0	1	1	1	0	0
0	0	1	0	1	1	0	1	1	1	0
0	0	0	1	0	1	1	0	1	1	1
1	0	0	0	1	0	1	1	0	1	1
1	1	0	0	0	1	0	1	1	0	1
1	1	1	0	0	0	1	0	1	1	0
0	1	1	1	0	0	0	1	0	1	1
1	0	1	1	1	0	0	0	1	0	1

FIGURE 18: MASTERPLAN 4

APPENDIX II.B. – EXPERIMENTAL DESIGN IN NGENE

There are two methods for constructing the choice sets, sequential construction and simultaneous construction. By sequential construction, the researcher constructs alternatives and places these alternatives randomly in a choice set. As for simultaneous construction, the alternatives and choice sets are constructed simultaneously. For this research, the simultaneous construction method is chosen. This construction method is chosen because there are labelled alternatives with alternative specific attributes. On the plus side, there are no within and no between alternative correlations. However, on the downside, this construction method needs typically more choice sets (Molin, 2019b).

In figure 17, masterplan 4 is shown. The design is based on this plan. Each attribute is assigned to a column, as there are nine attributes, the first nine columns of the masterplan are used. The first three columns are for alternative one, column four, five and six are for alternative two and column seven, eight and nine are for alternative three. The masterplan has twelve rows, meaning there will be twelve choice sets. The number in the cell indicates which attribute level should be used in that choice set. In table 17, the coding of the attributes and attribute levels is shown.

TABLE 17: CODING FOR THE CHOICE EXPERIMENT

SELLING THROUGH ONLINE (MEERLANDEN) PLATFORM			
ATTRIBUTES	COLUMN	LEVELS	CODING
ONLINE PLATFORM	1	• Through Meerlanden app • Through Meerlanden website	0 1
REWARDS	2	• Earnings are all for you • 70% of the earnings is for you, 30% of the earnings are for Meerlanden	0 1
LOYALTY SYSTEM	3	• There is a loyalty system • There is no loyalty system	0 1
BRINGING IT TO THE WASTE DISPOSAL CENTRES BY YOURSELF			
ATTRIBUTES	COLUMN	LEVELS	CODING
APPOINTMENT	4	• No appointment • Reserve a timeslot	0 1
REWARDS	5	• Earnings are all for Meerlanden • 70% of the earnings are for Meerlanden, 30% of the earnings are for you	0 1
LOYALTY SYSTEM	6	• There is a loyalty system • There is no loyalty system	0 1
PICK-UP SERVICE DRIVEN BY CITIZENS THEMSELVES			
ATTRIBUTES	COLUMN	LEVELS	CODING
APPOINTMENT	7	• On-demand • Reserve a timeslot	0 1
COSTS	8	• € 15,- • € 25,-	15 25
LOYALTY SYSTEM	9	• There is a loyalty system • There is no loyalty system	0 1

The licensed software package NGene is used to construct the experimental design. To obtain the design, a syntax has to be written. The following syntax was used:

```
Design
; Alts = OnlinePlatform, Bring, Pickup, Base
; rows = 12
; orth = sim
; block = 4
; model :
U(OnlinePlatform) = b0 + b1*pltf[0,1] + b2*rew[0,1] + b3*ls[0,1] /
U(Bring) = b4 + b5*app[0,1] + b6*rew[0,1] + 73*ls  /
U(Pickup) = b8 + b9*app[0,1] + b10*cost[15,25] + b11*ls
$
```

All alternatives have an alternative specific constant (ASC) (b0, b4 & b8). In the survey, there was a separate alternative to determine the willingness to change, the "base" alternative. Meaning, respondents chose an alternative and second choice if they would use the chosen alternative or would prefer the current system. The ASC contains the utility of the alternative if all variables would be set to zero and is the difference in utility compared to the current situation (which is set to zero). The attribute levels are coded according to the coding scheme shown in table 5. In the actual design, the codes are replaced with the actual attribute levels. The design is blocked into four blocks to keep attribute level balance. The blocks are not orthogonal. However, the full design is (Molin, 2019b). The design is given in figure 19.

Design										
Choice situation	onlineplatform.pltf	onlineplatform.rew	onlineplatform.ls	bring.app	bring.rew	bring.ls	pickup.app	pickup.cost	pickup.ls	Block
1	1	1	1	1	1	1	1	25	1	4
2	1	0	0	0	1	1	1	15	1	1
3	0	0	0	1	1	1	0	25	0	2
4	0	0	1	1	1	0	1	15	0	3
5	0	1	1	1	0	1	0	15	1	1
6	1	1	1	0	1	0	0	25	0	1
7	1	1	0	1	0	0	1	15	0	2
8	1	0	1	0	0	1	0	15	0	4
9	0	1	0	0	1	0	0	15	1	4
10	1	0	0	1	0	0	0	25	1	3
11	0	0	1	0	0	0	1	25	1	2
12	0	1	0	0	0	1	1	25	0	3

FIGURE 19: CHOICE EXPERIMENT DESIGN

Blocking is used to vary the different products among the respondents. Each version of the questionnaire contains all four products, but the blocks are shuffled per version. Therefore, each product contains each block of questions once and all respondents answer one block per product. The construction of the versions is shown in figure 20.

Block	Product	Version 1
1	Sofa	1
2	Vacuum cleaner	2
3	Side table	3
4	Refrigerator	4

Block	Product	Version 2
1	Refrigerator	4
2	Sofa	1
3	Vacuum cleaner	2
4	Side table	3

Block	Product	Version 3
1	Side table	3
2	Refregirator	4
3	Sofa	1
4	Vacuum cleaner	2

Block	Product	Version 4
1	Vacuum cleaner	2
2	Side table	3
3	Refrigerator	4
4	Sofa	1

FIGURE 20: CONTEXT AND BLOCKS PER VERSION OF THE SURVEY

APPENDIX III – SURVEY

After the choice experiments are designed, the survey is made. The survey does not only contains the choice experiment, but also additional questions. Moreover, an introduction and explanation of the research, survey and choice experiment are provided.

APPENDIX III.A. – PILOT SURVEY FEEDBACK

In this section is mentioned which improvements to the survey were made based on the feedback of the pilot groups. The pilot was done in two groups. The first group consisted of eight persons. The second group consisted of 4 new persons and 4 persons who already filled in the pilot. This was done to check if they experienced the pilot as improved. The new persons had an unbiased view as they made the pilot for the first time. The pilot groups were diverse in terms of gender, education level, education background and age. Providing a well-tested survey which is probably understandable for everyone.

Changes made to the survey:

- Most comments were about the amount of text. As most of the information is needed to understand the concepts of the survey this could not be changed. However, by making the spacing between the sentences smaller, the text was visually shorter. By the second pilot, the respondents mentioned perceiving the text as shorter.
- There were some comments about the visuality of the text. Some respondents experienced that the text was hard to read due to the background of the survey. To deal with this, there is now a textbox instead of text on a background, and the colour of the letters in black instead of grey.
- Some respondents did a grammar check and the mistakes they corrected are implemented in the survey.
- There was a mistake in choice set 10. The attribute level was 30%, 30% instead of 30%, 70%. This is corrected.
- Some respondents made suggestions for better formulations of some questions. They were now oddly formulated and ambiguous. These questions are re-formulated or changed.
- In the last question, the options for “both platforms” was not given. By multiple respondents, this was experienced as a missing option. This choice option is added now.
- For some respondents, it was not clear what was going to change in the choice sets. They gave feedback that the questions were the same every time. This is made more clear now. In the second pilot this remark was not mentioned anymore.
- The general questions caused some confusion. The questionnaire is also filled in by respondents who are 18 years and older but still live with their parents. This was not an option in the general questions. Moreover, they could not fill in their income and got questions about their children. This is changed now. The option “living at home” is added, and the other questions are adapted to the different respondents.
- First, it was mentioned that the following questions were about sustainable behaviour. This could be experienced as leading. As respondents can feel the need to answer as if they are very sustainable. This is changed now to questions about current behaviour.
- In the general questions, there is a question about travel time to the waste facilities. As people do not always read carefully, it was suggested to type minutes in bold. This way it is more clear. This suggestion is implemented
- The layout of the figures was not neat. This is also changed.

- The layout of the questions was changed. The tables were merged within the questions instead of providing the question underneath the tables.
- Some additional questions were added to provide more context

APPENDIX III.B. – FINAL SURVEY

Geachte heer, mevrouw,

Hartelijk dank dat u wilt deelnemen aan deze vragenlijst over het hergebruik van grof huishoudelijk afval. Bij grof huishoudelijk afval moet u denken aan oude spullen zoals televisies, bankstellen of tafels. Grof huishoudelijk afval wordt nu vaak weggebracht naar de milieustraat, waarna de grondstoffen worden gerecycled. Dit terwijl het product vaak nog in zijn geheel hergebruikt kan worden. Het doel van dit onderzoek is om de voorkeuren van inwoners over het aanbieden van grof huishoudelijk afval voor hergebruik in kaart te brengen.

Deze vragenlijst is onderdeel van mijn afstudeeronderzoek en wordt uitgevoerd vanuit de TU Delft in samenwerking met Meerlanden (bedrijf in afvalinzameling en -verwerking). De verzamelde gegevens worden gebruikt om aanbevelingen te doen aan Meerlanden over hergebruik. Daarnaast helpt u mij met het uitvoeren van het onderzoek en het afronden van mijn master opleiding. Uw deelname is daarom belangrijk en wordt zeer gewaardeerd.

De vragenlijst is bedoeld voor personen van 18 jaar en ouder die in gemeentes wonen waar Meerlanden actief is. Deze gemeentes zijn: Aalsmeer, Bloemendaal, Diemen, Haarlemmermeer, Heemstede, Hillegom, Lisse, Noordwijk en Zandvoort. De vragenlijst zal ongeveer 15 minuten van uw tijd vragen. Wanneer u doorgaat met het invullen van de vragenlijst geeft u toestemming om de data te gebruiken voor wetenschappelijk onderzoek en wetenschappelijke publicaties. Ook geeft u toestemming om de resultaten op te slaan in de TU Delft database en op de server van Meerlanden. Uw deelname aan deze studie is volledig vrijwillig. De gegevens worden anoniem verwerkt, er worden dus geen gegevens opgeslagen die naar u herleid kunnen worden. U kunt zich op ieder gewenst moment terugtrekken uit de vragenlijst zonder hiervoor een reden te geven. U bent ook vrij om vragen niet te beantwoorden.

Mocht u vragen of opmerkingen hebben over het onderzoek of de vragenlijst kunt u contact opnemen met mij, Esmee Rusman, via e.rusman@student.tudelft.nl

Let op: Als u de vragenlijst op uw telefoon maakt, houd dan uw telefoon horizontaal. U kunt de tabellen eventueel inzoomen als het nodig is. U kunt de vragenlijst ook op de computer, tablet of laptop maken.

Nogmaals dank voor uw deelname!

Introductie

Grof huishoudelijk afval is het huishoudelijke afval dat niet in de afvalbakken past zoals oude televisies, bankstellen of tafels. Maar ook kleinere producten zoals oude stofzuigers vallen hieronder. In het **huidige systeem** is het afhankelijk van de gemeente waar u woont hoe u dit kunt weggooien. In sommige gemeentes kunt u onbeperkt grof huishoudelijk afval naar de milieustraat brengen en zitten hier geen kosten aan verbonden. In andere gemeentes is er een limiet op het aantal kubieke meters of zitten er kosten aan verbonden.

Het grof huishoudelijk afval dat op de milieustraat komt, wordt door Meerlanden gerecycled. **Recyclen** houdt in dat ingeleverd materiaal wordt afgebroken in diverse, gescheiden grondstoffen die worden gebruikt voor de productie van nieuwe producten. De overgebleven grondstoffen worden verbrand.

Bij **hergebruik** daarentegen, wordt het product in zijn geheel opnieuw gebruikt. Dit kan door middel van reparatie of het product krijgt een andere functie, er wordt bijvoorbeeld van een oude deur een tafel gemaakt. Er zijn al plekken waar spullen voor hergebruik aangeboden kunnen worden. Denk hierbij aan een tweedehandswinkel of het verkopen van spullen via een online platform.

De huidige milieustraten zijn verouderd en beperkt in ruimte en capaciteit. Het investeren in de milieustraten leidt tot ontwikkelingskansen voor hergebruik. Er is op dit moment nog weinig kennis bij Meerlanden om hergebruik in te zetten in lokaal afval-management. Meerlanden wil dit graag veranderen en beleid maken gericht op hergebruik. Hiervoor hebben zij meer kennis nodig over de voorkeuren van de inwoners.

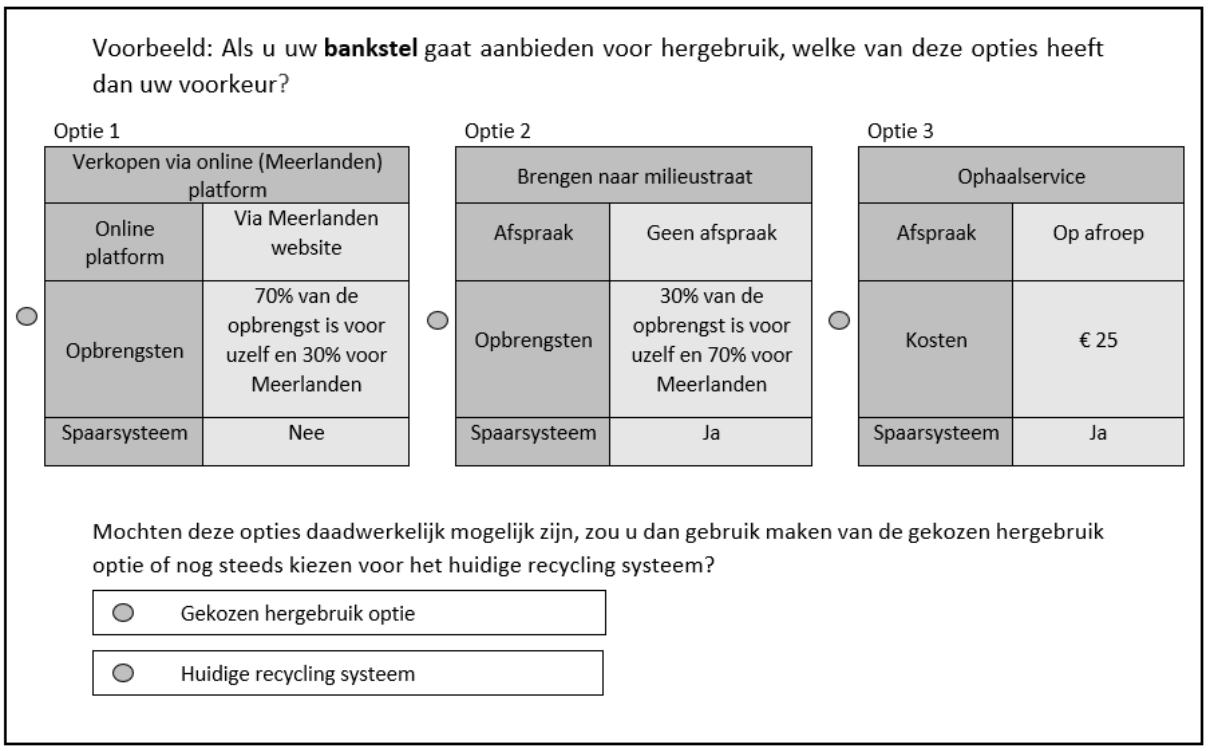
Uitleg voor het eerste deel van de vragenlijst
Voor de vragenlijst is het belangrijk dat u uitgaat van de volgende situatie: Uw wilt uw oude product vervangen. In plaats van het product weg te gooien, overweegt u om het product te laten hergebruiken.

U krijgt in deze vragenlijst 12 situaties voorgelegd die te maken hebben met hergebruik van grof huishoudelijk afval. De 12 situaties zijn opgedeeld in 4 verschillende producttypes: bankstel, stofzuiger, bijzettafel en koelkast. Per producttype krijgt u 3 verschillende situaties om het product te laten hergebruiken. Per situatie krijgt u 3 opties voor hergebruik:

1. **Verkopen via online (Meerlanden) platform:** Vanuit huis spullen aanbieden op online platforms kan via een bestaande platform zoals Marktplaats, maar dit zou ook kunnen via een nog niet bestaand, online platform gefaciliteerd door Meerlanden. Spullen worden aangeboden aan andere gebruikers, tegelijk kunnen er ideeën opgedaan worden over hergebruik en zullen er tips gegeven worden over hoe u afgedankte spullen kunt opruimen. De spullen blijven bij u thuis staan tot het moment dat u ze via een platform verkocht, geruild of weggegeven hebt.
2. **Het zelf brengen naar de milieustraat:** Samen met een gastheer wordt bij de ingang gekeken welke spullen geschikt zijn voor hergebruik en wat gerecycled kan worden. Zo bent u in één keer van alle oude spullen af en wordt alles optimaal verwerkt. Bij de milieustraat is een tweedehands bouwmarkt en een kringloopwinkel die gevuld worden met de gebrachte spullen. Verder zit er een repair-café waar uw spullen voor u gerepareerd kunnen worden voordat deze voor hergebruik aangeboden worden. U kunt meteen eventuele nieuwe spullen meenemen of uw spullen laten repareren.
3. **Laten ophalen door een ophaalservice:** De ophaalservice haalt de spullen die zijn aangemeld via de Meerlanden app, website of telefonisch bij u thuis op en brengt deze tegen een vergoeding voor u naar de milieustraat. De ophaalservice wordt door inwoners van de regio georganiseerd. U kunt alleen de aangemelde en geaccepteerde spullen meegeven in verband met de beschikbare ruimte in het voertuig.

Per situatie wordt u gevraagd de volgende twee vragen te beantwoorden:
1. Welke hergebruik optie heeft uw voorkeur?
2. Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan van de gekozen hergebruik optie gebruik maken of nog steeds kiezen voor het huidige recycling systeem?

Hieronder is een voorbeeldvraag gegeven.



Voorbeeld: Als u uw **bankstel** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1	
Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden website
Opbrengsten	70% van de opbrengst is voor uzelf en 30% voor Meerlanden
Spaarsysteem	Nee

Optie 2	
Brengen naar milieustraat	
Afspraak	Geen afspraak
Opbrengsten	30% van de opbrengst is voor uzelf en 70% voor Meerlanden
Spaarsysteem	Ja

Optie 3	
Ophaalservice	
Afspraak	Op afroep
Kosten	€ 25
Spaarsysteem	Ja

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Uitleg attributen:

Let op! De kenmerken van deze drie opties zullen per vraag verschillen in de volgende kenmerken:

Verkopen via online (Meerlanden) platform:

1) Online platform:
   - Via Meerlanden app
   - Via Meerlanden website
2) Opbrengsten:
   - 70% van de opbrengst is voor uzelf en 30% voor Meerlanden
   - De opbrengsten zijn volledig voor uzelf
3) Aanwezigheid spaarsysteem:
   - Ja: Per verkocht product ontvangt u 50 spaarpunten, wat gelijk staat aan € 5,-. Deze spaarpunten zijn inwisselbaar bij de winkels bij de milieustraat, op het online platform of voor de ophaalservice.
   - Nee

Wegbrengen naar de milieustraat:

1) Afspraak:
   - Geen afspraak: U gaat langs wanneer het u uitkomt met het risico dat u bij aankomst moet wachten tot er een gastheer beschikbaar is om u verder te helpen.
   - Tijdslot reserveren: U reserveert van tevoren een tijdslot zodat u meteen aan de beurt bent en de gastheer van tevoren weet met welke spullen u komt zodat u snel geholpen kunt worden.
2) Opbrengsten:
   - Opbrengsten zijn volledig voor Meerlanden
   - 30% van de opbrengst is voor uzelf en 70% voor Meerlanden
3) Aanwezigheid spaarsysteem:

- Ja: Per verkocht product ontvangt u 50 spaarpunten, wat gelijk staat aan € 5,-. Deze spaarpunten zijn inwisselbaar bij de winkels bij de milieustraat, op het online platform of voor de ophaalservice.
- Nee

Ophaalservice:

1) Afspraak:
   - Op afroep: De spullen gaan met de eerstvolgende beschikbare rit mee. De chauffeur zal aangeven wanneer hij of zij van plan is te gaan. In overleg kunnen jullie tot een tijd en datum komen.
   - Tijdslot reserveren: u kunt van tevoren zelf plannen wanneer de spullen opgehaald zullen worden
2) Kosten ophaalservice:
   - € 15,-
   - € 25,-
3) Aanwezigheid spaarsysteem:
   - Ja: Per verkocht product ontvangt u 50 spaarpunten, wat gelijk staat aan € 5,-. Deze spaarpunten zijn inwisselbaar bij de winkels bij de milieustraat, op het online platform of voor de ophaalservice.
   - Nee

Keuze experiment:

Stelt u zich bij de volgende vragen voor dat u uw **bankstel** wilt vervangen

Mocht u de uitleg nog een keer willen lezen, kunt u de "Informatie" file hieronder aanklikken. Een Word bestand met de uitleg wordt gedownload en deze kunt u openen.
Informatie

Keuze 1: Als u uw **bankstel** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden website
Opbrengsten	Opbrengsten zijn volledig voor uzelf
Spaarsysteem	Ja

Optie 2

Brengen naar milieustraat	
Afspraak	Geen afspraak
Opbrengsten	30% van de opbrengst is voor uzelf en 70% voor Meerlanden
Spaarsysteem	Nee

Optie 3

Ophaalservice	
Afspraak	Tijdslot reserveren
Kosten	€ 15
Spaarsysteem	Nee

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Keuze 2: Als u uw **bankstel** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden app
Opbrengsten	70% van de opbrengst is voor uzelf en 30% voor Meerlanden
Spaarsysteem	Nee

Optie 2

Brengen naar milieustraat	
Afspraak	Tijdslot reserveren
Opbrengsten	Opbrengsten zijn volledig voor Meerlanden
Spaarsysteem	Nee

Optie 3

Ophaalservice	
Afspraak	Op afroep
Kosten	€ 15
Spaarsysteem	Nee

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Keuze 3: Als u uw **bankstel** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden website
Opbrengsten	70% van de opbrengst is voor uzelf en 30% voor Meerlanden
Spaarsysteem	Nee

Optie 2

Brengen naar milieustraat	
Afspraak	Geen afspraak
Opbrengsten	30% van de opbrengst is voor uzelf en 70% voor Meerlanden
Spaarsysteem	Ja

Optie 3

Ophaalservice	
Afspraak	Op afroep
Kosten	€ 25
Spaarsysteem	Ja

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Stelt u zich bij de volgende vragen voor dat u uw **stofzuiger** wilt vervangen

Mocht u de uitleg nog een keer willen lezen, kunt u de "Informatie" file hieronder aanklikken. Een Word bestand met de uitleg wordt gedownload en deze kunt u openen.

Informatie

Keuze 4: Als u uw **stofzuiger** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden website
Opbrengsten	Opbrengsten zijn volledig voor uzelf
Spaarsysteem	Ja

Optie 2

Brengen naar milieustraat	
Afspraak	Tijdslot reserveren
Opbrengsten	30% van de opbrengst is voor uzelf en 70% voor Meerlanden
Spaarsysteem	Nee

Optie 3

Ophaalservice	
Afspraak	Op afroep
Kosten	€ 25
Spaarsysteem	Ja

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Keuze 5: Als u uw **stofzuiger** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden website
Opbrengsten	70% van de opbrengst is voor uzelf en 30% voor Meerlanden
Spaarsysteem	Ja

Optie 2

Brengen naar milieustraat	
Afspraak	Tijdslot reserveren
Opbrengsten	Opbrengsten zijn volledig voor Meerlanden
Spaarsysteem	Ja

Optie 3

Ophaalservice	
Afspraak	Tijdslot reserveren
Kosten	€ 15
Spaarsysteem	Ja

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Keuze 6: Als u uw **stofzuiger** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden app
Opbrengsten	Opbrengsten zijn volledig voor uzelf
Spaarsysteem	Nee

Optie 2

Brengen naar milieustraat	
Afspraak	Geen afspraak
Opbrengsten	Opbrengsten zijn volledig voor Meerlanden
Spaarsysteem	Ja

Optie 3

Ophaalservice	
Afspraak	Tijdslot reserveren
Kosten	€ 25
Spaarsysteem	Nee

Stelt u zich bij de volgende vragen voor dat u uw **bijzettafel** wilt vervangen

Mocht u de uitleg nog een keer willen lezen, kunt u de "Informatie" file hieronder aanklikken. Een Word bestand met de uitleg wordt gedownload en deze kunt u openen.
Informatie

Keuze 7: Als u uw **bijzettafel** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden app
Opbrengsten	Opbrengsten zijn volledig voor uzelf
Spaarsysteem	Nee

Optie 2

Brengen naar milieustraat	
Afspraak	Tijdslot reserveren
Opbrengsten	30% van de opbrengt is voor uzelf en 70% voor Meerlanden
Spaarsysteem	Ja

Optie 3

Ophaalservice	
Afspraak	Tijdslot reserveren
Kosten	€ 15
Spaarsysteem	Ja

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Keuze 8: Als u uw **bijzettafel** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden Website
Opbrengsten	Opbrengsten zijn volledig voor uzelf
Spaarsysteem	Ja

Optie 2

Brengen naar milieustraat	
Afspraak	Tijdslot reserveren
Opbrengsten	Opbrengsten zijn volledig voor Meerlanden
Spaarsysteem	Ja

Optie 3

Ophaalservice	
Afspraak	Op afroep
Kosten	€ 25
Spaarsysteem	Nee

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Keuze 9: Als u uw **bijzettafel** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden app
Opbrengsten	70% van de opbrengst is voor uzelf en 30% voor Meerlanden
Spaarsysteem	Ja

Optie 2

Brengen naar milieustraat	
Afspraak	Geen afspraak
Opbrengsten	Opbrengsten zijn volledig voor Meerlanden
Spaarsysteem	Nee

Optie 3

Ophaalservice	
Afspraak	Tijdslot reserveren
Kosten	€ 25
Spaarsysteem	Ja

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Stelt u zich bij de volgende vragen voor dat u uw **koelkast** wilt vervangen

Mocht u de uitleg nog een keer willen lezen, kunt u de "Informatie" file hieronder aanklikken. Een Word bestand met de uitleg wordt gedownload en deze kunt u openen.

Informatie

Keuze 10: Als u uw **koelkast** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden website
Opbrengsten	70% van de opbrengst is voor uzelf en 30% voor Meerlanden
Spaarsysteem	Nee

Optie 2

Brengen naar milieustraat	
Afspraak	Tijdslot reserveren
Opbrengsten	30% van de opbrengst is voor uzelf en 70% voor Meerlanden
Spaarsysteem	Nee

Optie 3

Ophaalservice	
Afspraak	Tijdslot reserveren
Kosten	€ 25
Spaarsysteem	Nee

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Keuze 11: Als u uw **koelkast** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden website
Opbrengsten	Opbrengsten zijn volledig voor uzelf
Spaarsysteem	Nee

Optie 2

Brengen naar milieustraat	
Afspraak	Geen afspraak
Opbrengsten	Opbrengsten zijn volledig voor Meerlanden
Spaarsysteem	Nee

Optie 3

Ophaalservice	
Afspraak	Op afroep
Kosten	€ 15
Spaarsysteem	Ja

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

Keuze 12: Als u uw **koelkast** gaat aanbieden voor hergebruik, welke van deze opties heeft dan uw voorkeur?

Optie 1

Verkopen via online (Meerlanden) platform	
Online platform	Via Meerlanden app
Opbrengsten	70% van de opbrengst is voor uzelf en 30% voor Meerlanden
Spaarsysteem	Ja

Optie 2

Brengen naar milieustraat	
Afspraak	Geen afspraak
Opbrengsten	30% van de opbrengst voor uzelf en 70% voor Meerlanden
Spaarsysteem	Ja

Optie 3

Ophaalservice	
Afspraak	Op afroep
Kosten	€ 15
Spaarsysteem	Nee

Mochten deze opties daadwerkelijk mogelijk zijn, zou u dan gebruik maken van de gekozen hergebruik optie of nog steeds kiezen voor het huidige recycling systeem?

- Gekozen hergebruik optie
- Huidige recycling systeem

- U heeft minstens 1x aangegeven voor recyclen te kiezen en niet hergebruiken. Kunt u kort uw voorkeur voor recyclen uitleggen?
    - [open veld]

Duurzaam gedrag en milieubewust gedrag:

Er wordt u nu nog een aantal stellingen voorgelegd. Deze stellingen gaan over uw huidige recycle gedrag en uw kijk op het milieu.

Hoe vaak onderneemt u de volgende acties? (niet van toepassing, nooit, af en toe, vaak, altijd)

1. Ik gooi lege batterijen in de vuilnisbak

2. Na het eten, gooi ik de restjes in het toilet
3. Ik breng ongebruikte medicijnen terug naar de apotheek
4. Ik verzamel en recycle papier en karton
5. Ik breng lege flessen naar de recyclebak (glas in de glasbak en plastic bij het plastic)
6. Ik koop drinken in blikjes
7. In de supermarkt koop ik groente en fruit van de versafdeling
8. Als ik in de winkel een tasje nodig heb voor mijn aankopen en alleen een plastic tasje kan kopen, neem ik deze
9. Als ik ga shoppen en ik kan kiezen tussen een papieren en een plastic tasje, neem ik een papieren tasje
10. Ik koop melk in retourneerbare flessen

Attitude naar het milieu:

In welke mate bent u het eens met de volgende stellingen? (helemaal mee oneens, een beetje mee oneens, niet mee eens maar ook niet mee oneens, een beetje mee eens, helemaal mee eens)

1. We bereiken de grens van het aantal mensen dat de wereld kan onderhouden
2. Mensen hebben het recht om de natuur te veranderen voor hun eigen behoeftes
3. Wanneer mensen zich bemoeien met de natuur, heeft dit vaak rampzalige gevolgen
4. De menselijke vindingrijkheid zal ervoor zorgen dat we de aarde NIET onleefbaar maken
5. Mensen misbruiken het milieu ernstig
6. De aarde heeft genoeg natuurlijke grondstoffen als we leren hoe we ze kunnen ontwikkelen
7. Planten en dieren hebben evenveel bestaansrecht als mensen
8. De balans van de natuur is sterk genoeg om de gevolgen van de moderne industrialisatie het hoofd te bieden
9. Ondanks onze speciale vermogens zijn mensen nog steeds onderworpen aan de wetten van de natuur
10. De zogenoemde “ecologische crisis” waarmee de mensheid wordt geconfronteerd, is zwaar overdreven
11. De aarde is zoals een ruimteschip met erg weinig ruimte en grondstoffen
12. De mensen zijn bedoeld om over de natuur te regeren
13. De balans van de natuur is erg gevoelig en makkelijk te verstoren
14. Mensen zullen uiteindelijk genoeg over de natuur leren om deze te beheersen
15. Als we zo doorgaan, zullen we binnenkort met een grote ecologische catastrofe te maken krijgen

Heeft de huidige corona crisis invloed gehad op uw antwoorden op de boven gevraagde stellingen?

- Ja
- Een beetje
- Nee

Als u bij de vorige vraag “Ja” of “een beetje” heeft ingevuld, hoe heeft de huidige corona crisis invloed gehad op uw antwoorden?

- [open veld]

Algemene vragen:

- Wat is uw geslacht?
    - Man
    - Vrouw
    - Anders, namelijk [open veld]
    - Wil ik niet zeggen
- Wat is uw geboortejaar?
    - [open veld]
    - Wil ik niet zeggen
- Wat is het hoogste opleidingsniveau dat u hebt voltooid?
    - Basisschool of geen diploma
    - Vmbo-kader / vmbo-basis / mbo 1
    - Vmbo gemengd / vmbo -t / havo (onderbouw) / vwo (onderbouw)
    - Mbo 2 / Mbo 3 / Mbo 4
    - Havo (bovenbouw) / vwo (bovenbouw)
    - HBO- bachelor / wo -bachelor
    - HBO-master / wo-master / doctor (PhD)
    - Anders namelijk [open veld]
    - Wil ik niet zeggen
- Wat is het bruto jaarinkomen van uw huishouden in euro's?
    - Minder dan € 20.000
    - € 20.001 – € 30.000
    - € 30.001 – € 40.000
    - € 40.001 – € 50.000
    - € 50.001 – € 60.000
    - € 60.001 – € 70.000
    - € 70.001 – € 80.000
    - € 80.001 – € 90.000
    - € 90.001 – € 100.000
    - € 100.001 of meer
    - Wil ik niet zeggen / weet ik niet
- Hoe is uw huidige gezinssituatie?
    - Alleenstaand zonder thuiswonende kinderen
    - Alleenstaand met thuiswonende kinderen
    - Alleenstaand met huisgenoten
    - Samenwonend/getrouwd zonder thuiswonende kinderen
    - Samenwonend/getrouwd met thuiswonende kinderen
    - Thuiswonend kind
    - Anders, namelijk [open veld]
    - Wil ik niet zeggen
- Hoeveel thuiswonende kinderen heeft u?
    - 1
    - 2
    - 3
    - 4 of meer

    - Wil ik niet zeggen
- Hoeveel thuiswonende kinderen onder de 18 jaar heeft u?
    - Geen
    - 1
    - 2
    - 3
    - 4 of meer
    - Wil ik niet zeggen
- In welke gemeente woont u?
    - Aalsmeer
    - Bloemendaal
    - Diemen
    - Haarlemmermeer
    - Heemstede
    - Hillegom
    - Lisse
    - Noordwijk
    - Zandvoort
    - Anders, namelijk [open veld]
    - Wil ik niet zeggen
- Heeft u een autorijbewijs?
    - Ja
    - Nee
    - Wil ik niet zeggen
- Hoe lang doet u er, met de auto, over om bij de dichtstbijzijnde milieustraat te komen in **minuten**? (als u dit niet exact weet, geef dan een schatting. Mocht u deze vraag niet willen beantwoorden vul dan 000 in)
    - [open veld]
- Beschikt u altijd over de mogelijkheid om kleine spullen, zoals een stofzuiger, zelf te vervoeren naar de milieustraat?
    - Ja, wanneer ik maar wil
    - Nee, dat gaat in overleg met mensen binnen mijn huishouden
    - Nee, dat gaat in overleg met mensen buiten mijn huishouden
    - Nee, (vrijwel) nooit
    - Wil ik niet zeggen
- Beschikt u altijd over de mogelijkheid om grote spullen, zoals een bankstel, zelf te vervoeren naar de milieustraat?
    - Ja, wanneer ik maar wil
    - Nee, dat gaat in overleg met mensen binnen mijn huishouden
    - Nee, dat gaat in overleg met mensen buiten mijn huishouden
    - Nee, (vrijwel) nooit
    - Wil ik niet zeggen
- Als u spullen naar de milieustraat zou brengen, brengt u de spullen dan zelf naar de milieustraat of vraagt u mensen uit uw omgeving om dit voor u te doen?
    - Ik breng ze zelf weg
    - Ik vraag of mensen in mijn omgeving dit voor mij willen doen

    - Ik breng ze soms zelf weg en soms vraag ik aan mensen in mijn omgeving of ze dit voor mij willen doen
    - Wil ik niet zeggen
- Wanneer bent u voor het laatst op de milieustraat geweest om spullen weg te brengen?
    - Tijdens de coronacrisis
    - Voor de coronacrisis
    - Ik ben nog nooit op de milieustraat geweest om spullen weg te brengen
    - Wil ik niet zeggen
- U heeft aangegeven dat u tijdens de coronacrisis op de milieustraat bent geweest, heeft u ervaren dat het drukker was dan voor de coronacrisis?
    - Ja
    - Nee
    - Wil ik niet zeggen / weet ik niet
- Wat voor spullen heeft u naar de milieustraat gebracht tijdens uw laatste bezoek aan de milieustraat?
    - [open veld]
    - Wil ik niet zeggen / weet ik niet meer
- Zou u gebruik maken van een online verkoop platform gefaciliteerd door Meerlanden of zou u de huidige platforms zoals Marktplaats blijven gebruiken?
    - Bestaande online verkoop platforms
    - Online Meerlanden platform
    - Zowel bestaande online verkoop platforms, als online Meerlanden platform
    - Ik zou beide niet gebruiken
    - Geen mening/ wil ik niet zeggen
- Heeft u nog tips voor wat betreft het online verkoopplatform? (Mocht u geen tips hebben, kunt u “nee” invullen)
    - [open veld]
- U bent aan het einde gekomen van de vragenlijst, mocht u nog opmerkingen hebben over deze vragenlijst kunt u die hieronder kwijt. Zo niet, kunt u op [-->] klikken.
    - [open veld]

APPENDIX III.C. – FLYER DISTRIBUTED AT THE WASTE DISPOSAL CENTRES

To include as many citizens as possible, the survey was also promoted at the waste disposal centres of Meerlanden. When citizens entered the waste disposal centres, they were asked to participate in the research. If they wanted to, a flyer was handed to them. The flyer contained a shortened link to the survey and a QR code which the citizens could scan with their mobile phones to access the survey. If they did not want to participate, they would not get a flyer. This way it was tried to limit the side effect of flyers been disposed on the street. The flyer is shown in figure 21.

FIGURE 21: FLYER DISTRIBUTED AT THE WASTE DISPOSAL CENTRES OF MEERLANDEN TO PROMOTE THE SURVEY

APPENDIX IV – DATASET CLEANING AND PREPARATION

In this appendix, data cleaning and preparation are discussed. Before the data can be used for data analysis, multiple steps need to be taken. The data from the survey was delivered in a format where every respondent was one row. The data was exported from Qualtrics (the program used to create the survey in) as an Excel file with answers as text. From there the following actions were taken:

- In Qualtrics, the respondents who only clicked on the link but did not answer any of the questions were already deleted from the respondents. The Excel file only contained respondents who answered at least the first block of the choice experiment.
- Four respondents answered for all questions in the choice experiment the first option and did not answer/chose the “do not want to say” option for all other questions. These are also deleted from the data
- Because the four versions were all shown for every respondent in the data, but each respondent filled out only one version, a separate file for each version was created.
- Each file was restructured. The choice tasks were placed in a separate row each. The other data was copied so the respondents' ID was corresponding for all choice tasks done by that respondent.
- To all four files, 2 columns were added. One for the version number and one for the product the questions was about.
- Four each choice task, the attribute levels corresponding with that choice task were added to the data files.
- After that, the files were combined again to one file
- From this file two versions are created, one with base alternative and one without the base alternative. In the file without base alternative, the choices are re-coded with 1, 2 & 3. The column containing the base alternative was deleted. In the file with base alternative, the choices are replaced for 0,1,2,3 & 4. Some respondents did not fill out a choice for the alternatives but did however answer the question if they would go for the current system or the base alternative. In this data set, 0 represents the choice for “chosen re-use system” and 4 represents “current system”
- After restructuring and recoding the choice tasks, all rows which were empty in the column “choice task” were deleted from the data set. Keeping only the rows with data for the column “choice task”.
- For multiple questions, there was a choice option “other, namely:”. These answers were checked to see if they could still be classified in one of the given answer categories for that question. If a non-existing or a not serious answer was given, the answer was replaced with a missing value.
- For all questions it was possible to choose the answer “I do not want to say”, these answers were replaced with missing values.
- The blanks in the NEP and GEBS statements are replaced with a ‘0’.
- 23 respondents did only fill out the choice experiment and no additional questions.
- When estimating the choice models, the NA values are replaced with 9999

APPENDIX V – CHI-SQUARE TABLE

For the analysis, the chi-square table is used to identify the statistical significance of the results. Depending on the degrees of freedom and the chosen confidence interval (in this research 0.95), the corresponding value can be looked up in the chi-square table. If the value in the table is higher than the p-value of the analysis, the results are statistically significant. The chi-square table is shown in figure 22.

Percentage Points of the Chi-Square Distribution

Degrees of Freedom	Probability of a larger value of x^2								
	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
6	0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
7	1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.48
8	1.647	2.733	3.490	5.071	7.344	10.22	13.36	15.51	20.09
9	2.088	3.325	4.168	5.899	8.343	11.39	14.68	16.92	21.67
10	2.558	3.940	4.865	6.737	9.342	12.55	15.99	18.31	23.21
11	3.053	4.575	5.578	7.584	10.341	13.70	17.28	19.68	24.72
12	3.571	5.226	6.304	8.438	11.340	14.85	18.55	21.03	26.22
13	4.107	5.892	7.042	9.299	12.340	15.98	19.81	22.36	27.69
14	4.660	6.571	7.790	10.165	13.339	17.12	21.06	23.68	29.14
15	5.229	7.261	8.547	11.037	14.339	18.25	22.31	25.00	30.58
16	5.812	7.962	9.312	11.912	15.338	19.37	23.54	26.30	32.00
17	6.408	8.672	10.085	12.792	16.338	20.49	24.77	27.59	33.41
18	7.015	9.390	10.865	13.675	17.338	21.60	25.99	28.87	34.80
19	7.633	10.117	11.651	14.562	18.338	22.72	27.20	30.14	36.19
20	8.260	10.851	12.443	15.452	19.337	23.83	28.41	31.41	37.57
22	9.542	12.338	14.041	17.240	21.337	26.04	30.81	33.92	40.29
24	10.856	13.848	15.659	19.037	23.337	28.24	33.20	36.42	42.98
26	12.198	15.379	17.292	20.843	25.336	30.43	35.56	38.89	45.64
28	13.565	16.928	18.939	22.657	27.336	32.62	37.92	41.34	48.28
30	14.953	18.493	20.599	24.478	29.336	34.80	40.26	43.77	50.89
40	22.164	26.509	29.051	33.660	39.335	45.62	51.80	55.76	63.69
50	27.707	34.764	37.689	42.942	49.335	56.33	63.17	67.50	76.15
60	37.485	43.188	46.459	52.294	59.335	66.98	74.40	79.08	88.38

FIGURE 22: CHI-SQUARE TABLE

APPENDIX VI – TESTING REPRESENTATIVENESS OF THE SAMPLE

In this appendix, the representativeness of the sample is checked. This is done with a non-parametric chi-squared test. The representativeness is checked for gender, age, income and educational level. Chi-squared tests are used to check if the distribution in the sample is statistically different from the distribution in the population. This is the case if the significance value (P-value) is lower than 0.05 and thus, the chi-squared test is statistically significant. As the population is defined as the citizens living in the municipalities served by Meerlanden, not all values are found. Therefore, also the representativeness with the population of the Netherlands is checked. Moreover, this is useful to check how the results will hold compared to the population of the Netherlands.

Appendix VI.A. – Representativeness gender

There are 225 values for gender found in the data, meaning that 24 respondents did not (want to) answer the question related to gender. This is 9.6% of the respondents. The sample is not representative for the variable gender, for both the population of the municipalities, as for the population of the Netherlands. The P values are respectively 0.026 and 0.017, both are less than 0.05 and therefore, the chi-square test is statistically significant for gender.

TABLE 18: DISTRIBUTION OF GENDER SOURCE: OOZO.NL & CIA WORLD FACTBOOK

GENDER				
Municipalities	Man		Woman	
AALSMEER	15477	49.4%	15822	50.6%
BLOEMENDAAL	10692	48.0%	11604	52.0%
DIEMEN	13166	49.0%	13674	51.0%
HAARLEMMERMEER	71827	49.7%	72691	50.3%
HEEMSTEDE	12517	46.8%	14249	53.2%
HILLEGOM	10453	49.6%	10635	50.4%
LISSE	11107	49.1%	11499	50.9%
NOORDWIJK	12908	50.1%	12852	49.9%
ZANDVOORT	8095	48.2%	8697	51.8%
TOTAL	166242	49.2%	171723	50.8%
NETHERLANDS	8581000	49.7%	8701000	50.3%

TABLE 19: EXPECTED AND OBSERVED VALUES FOR GENDER

MUNICIPALITIES			
	Observed amount in the sample	Expected amount based on population	Difference
MAN	94	110.7	-16.7
WOMAN	131	114.3	16.7
NETHERLANDS			
	Observed amount in the sample	Expected amount based on population	Difference
MAN	94	111.8	-17.8
WOMAN	131	113.2	17.8

TABLE 20: RESULTS CHI-SQUARE TEST GENDER

Gender	
Municipalities	
CHI-SQUARE VALUE	4.959[a]
DF	1
P-VALUE	0.026
Netherlands	
CHI-SQUARE VALUE	5.649[b]
DF	1
P-VALUE	0.017

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 110.7
b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 111.8

APPENDIX VI.B. – REPRESENTATIVENESS AGE

There are 216 values for age found in the data, meaning that 33 respondents did not (want to) answer the question related to age. This is 13.3% of the respondents. The sample is not representative for the variable age, for both the population of the municipalities, as for the population of the Netherlands. The P values are respectively 0.002 and 0.000, both are less than 0.05 and therefore, the chi-square test is statistically significant for gender.

TABLE 21: DISTRIBUTION OF AGE SOURCE: OOZO.NL & CIA WORLD FACTBOOK

AGE								
Municipalities*	18-25		25-45		45-65		65+	
AALSMEER*	1300	12.6%	2577	25.0%	3343	32.4%	3087	30.0%
BLOEMENDAAL*	2296	12.5%	2703	14,7%	6934	37,7%	5886	32.0%
DIEMEN*	4536	19.8%	6952	30.4%	7193	31.5%	4187	18.3%
HAARLEMMERMEER*	17053	14.5%	34973	29.7%	43211	36.7%	22400	19.0%
HEEMSTEDE*	2355	10.7%	4818	21.8%	7816	35.4%	7066	32.0%
HILLEGOM*	2193	12.4%	4956	28.0%	6263	35.4%	4281	24.2%
LISSE*	2509	13.2%	5086	26.9%	6646	35.1%	4679	24.7%
NOORDWIJK*	2782	12.7%	6002	27.4%	7805	35.6%	5332	24.3%
ZANDVOORT*	1578	10.8%	3510	24.1%	5155	35.4%	4316	29.6%
TOTAL	36602	13.9%	71577	27.1%	94366	35.8%	61234	23.2%
NETHERLANDS*	2064067	14.4%	6720293	46.8%	2299575	16.0%	3275770	22.8%

*The percentages are calculated to add up to 100%. As the original percentages take also the 18- category into account.

TABLE 22: EXPECTED AND OBSERVED VALUES FOR AGE

MUNICIPALITIES			
	Observed amount in the sample	Expected amount based on population	Difference
18-25	24	30.0	-6.0
25-45	72	58.5	13.5

45-65	90	77.3	12.7
65+	30	50.1	-20.1
NETHERLANDS			
	Observed amount in the sample	Expected amount based on population	Difference
18-25	24	31.1	-7.1
25-45	72	101.1	-29.1
45-65	90	34.6	55.4
65+	30	49.2	-19.2

TABLE 23: RESULTS CHI-SQUARE TEST AGE

Age	
Municipalities	
CHI-SQUARE VALUE	14.454[a]
DF	3
P-VALUE	0.002
Netherlands	
CHI-SQUARE VALUE	106.450[b]
DF	3
P-VALUE	0.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 30.0
b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 31.1

APPENDIX VI.C. - REPRESENTATIVENESS INCOME

There are 165 values for age found in the data, meaning that 84 respondents did not (want to) answer the question related to income. This is 33.7% of the respondents. There was no data available for all municipalities separately to perform the chi-square test. Therefore, only the representativeness for the population of the Netherlands is tested. The sample is not representative of the variable income for the population of the Netherlands. The P values are respectively 0.000, this is less than 0.05 and therefore, the chi-square test is statistically significant for income.

TABLE 24: DISTRIBUTION OF INCOME SOURCE: CBS.NL

INCOME								
# Household	€ 0 – € 30.000		€ 30.001 – € 50.000		€ 50.001 - € 100.000		€ 100.000 +	
NETHERLANDS	4703800	60.7%	2478900	32.0%	516900	6.7%	55400	0.7%

TABLE 25: EXPECTED AND OBSERVED VALUES FOR INCOME

NETHERLANDS			
	Observed amount in the sample	Expected amount based on population	Difference
€ 0 – € 30.000	29	100.1	-71.1
€ 30.001 –	47	52.7	-5.7

€ 50.000			
€ 50.001 – € 100.000	72	11.0	61.0
€ 100.000 +	17	1.2	15.8

TABLE 26: RESULTS CHI-SQUARE TEST INCOME

INCOME	
Netherlands	
CHI-SQUARE VALUE	605.418[a]
DF	3
P-VALUE	0.000

a. 1 cell (25.0%) have expected frequencies less than 5. The minimum expected cell frequency is 1.2.

APPENDIX VI.D. - REPRESENTATIVENESS EDUCATION

There are 222 values for education found in the data, meaning that 27 respondents did not (want to) answer the question related to education. This is 10.8% of the respondents. The data for educational level per municipality was not found for every municipality. Therefore, the data for the Netherlands was taken and only this was checked for representativeness. The sample is not representative of the variable education for the population of the Netherlands. The P-value is respectively 0.000, which is less than 0.05 and therefore, the chi-square test is statistically significant for gender.

TABLE 27: DISTRIBUTION OF EDUCATION SOURCE: CBS.NL

EDUCATION						
	Low		Medium		High	
NETHERLANDS	4351000	30.6%	5306000	37.4%	4547000	32.0%

TABLE 28: EXPECTED AND OBSERVED VALUES FOR EDUCATION

NETHERLANDS			
	Observed amount in the sample	Expected amount based on population	Difference
LOW	19	67.9	-48.9
MEDIUM	83	83.0	0.0
HIGH	120	71.0	49.0

TABLE 29: RESULTS CHI-SQUARE TEST EDUCATION

EDUCATION	
Netherlands	
CHI-SQUARE VALUE	68.989[a]
DF	2
P-VALUE	0.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 67.9

APPENDIX VII – DESCRIPTIVE STATISTICS OF THE SURVEY

There were multiple descriptive statistics in the survey. The summary is given in the main text. The tables with more detail are shown in this appendix.

APPENDIX VII.A. DESCRIPTIVE STATISTICS OF THE DEMOGRAPHIC AND EXPLORATORY VARIABLES

In table 30, the percentage of respondents (N=249) per category is shown for the socio-demographic variables and exploratory variables. This is also done for each product type (context) separately. The missing values are also shown. From the table, it becomes apparent that the distribution of the citizens over the different product types is among equal. This indicates that all contexts are answered with by a comparable selection of respondents.

TABLE 30: PERCENTAGE OF RESPONDENTS IN THE SAMPLE FOR THE DEMOGRAPHIC AND EXPLORATORY VARIABLES

DEMOGRAPHIC VARIABLES						
Variable	Variable level	% of respondents in total sample	% of respondents for context sofa	% of respondents for context side table	% of respondents for context vacuum cleaner	% of respondents for context refrigerator
GENDER	Man	37.8%	40.7%	40.3%	41.4%	56.8%
	Woman	52.6%	54.9%	54.5%	55.4%	41.4%
	Missing values	9.6%	4.4%	5.2%	3.3%	1.8%
AGE	18-25	9.6%	9.9%	10.1%	10.0%	10.6%
	26-45	28.9%	31.2%	30.6%	31.5%	32.0%
	46-65	36.1%	38.7%	38.2%	39.1%	39.4%
	65+	12.0%	16.3%	16.3%	16.5%	16.6%
	Missing values	13.3%	4.0%	4.8%	2.8%	1.4%
EDUCATION	Low	7.6%	7.8%	7.5%	7.7%	8.2%
	Medium	33.3%	36.0%	35.2%	36.0%	36.4%
	High	48.2%	50.0%	50.4%	51.6%	52.3%
	Missing values	10.8%	6.2%	6.9%	4.6%	3.2%
INCOME	€ 0 - € 30.000	11.6%	7.2%	7.5%	7.3%	7.9%
	€ 30.001 – € 50.000	18.9%	20.4%	19.8%	20.2%	20.5%
	€ 50.001 - € 100.000	28.9%	31.0%	31.0%	31.8%	32.3%
	€ 100.000+	6.8%	7.5%	7.4%	7.6%	7.7%
	Missing values	33.7%	33.8%	34.3%	33.0%	31.6%
FAMILY STATUS	Living with children	38.5%	41.9%	41.4%	42.6%	43.1%
	Living without children	37.3%	38.5%	38.1%	38.8%	39.3%
	Others	12%	12.4%	12.3%	12.5%	12.7%
	Missing values	12.2%	7.2%	8.2%	6.1%	5.0%
MUNICIPALITY	Aalsmeer	2.8%	2.6%	2.6%	2.7%	2.7%
	Bloemendaal	2.4%	2.6%	2.6%	2.7%	2.7%
	Diemen	1.6%	1.7%	1.7%	1.8%	1.8%
	Haarlemmermeer	34.1%	36.0%	35.6%	36.2%	36.7%
	Heemstede	1.6%	1.7%	1.7%	1.8%	1.8%
	Hillegom	21.3%	22.8%	22.7%	23.4%	23.5%
	Lisse	12.4%	13.5%	12.9%	13.3%	13.4%
	Noordwijk	1.2%	1.0%	1.3%	1.0%	1.3%
	Teylingen	4.8%	5.2%	5.2%	5.3%	5.4%

	Zandvoort	0.4%	0.4%	0.4%	0.4%	0.4%
	Others	4.0%	4.1%	4.3%	4.3%	4.5%
	Missing values	13.2%	8.3%	9.1%	7.2%	5.8%
EXPLORATORY VARIABLES						
Variable	Variable level	% of respondents in total sample	% of respondents for context sofa	% of respondents for context side table	% of respondents for context vacuum cleaner	% of respondents for context refrigerator
DRIVERS LICENSE	Yes	85.9%	91.9%	90.9%	93.3%	94.0%
	No	4.1%	3.2%	3.5%	3.0%	3.8%
	Missing values	10.0%	4.9%	5.6%	3.7%	2.3%
BRINGING PRODUCTS YOURSELF	Yes	65.1%	74.7%	69.0%	67.7%	69.6%
	Sometimes	15.7%	14.6%	16.0%	18.8%	16.5%
	No	9.2%	7.6%	9.7%	8.6%	10.7%
	Missing values	10.0%	3.0%	5.3%	4.9%	3.2%
ABLE TO BRING SMALL PRODUCTS	Yes	86.0%	91.5%	90.5%	92.9%	93.5%
	No	4.4%	4.1%	4.3%	3.9%	4.7%
	Missing values	9.6%	4.4%	5.2%	3.3%	1.8%
ABLE TO BRING BIG PRODUCTS	Yes	42.2%	44.6%	44.4%	45.1%	45.9%
	No	47.4%	50.1%	49.5%	50.7%	51.4%
	Missing values	10.4%	5.3%	6.1%	4.2%	2.7%
TRAVEL TIME TO CENTER	0-10	40.8%	41.0%	40.4%	41.6%	42.0%
	10-15	31.1%	30.9%	30.5%	31.3%	31.1%
	15+	19.9%	15.2%	15.3%	15.4%	17.8%
	Missing values	11.2%	12.8%	13.7%	11.7%	10.7%
LAST VISIT CENTER	Never	6.8%	6.7%	7.0%	6.8%	7.3%
	Before COVID-19	47.4%	50.2%	50.1%	51.3%	52.2%
	During COVID-19	35.7%	38.3%	37.3%	38.3%	38.3%
	Missing values	10.0%	4.8%	5.6%	3.6%	2.2%
INFLUENCE CORONA	Yes	6.0%	6.5%	6.4%	6.6%	6.7%
	A bit	13.7%	13.6%	14.2%	13.8%	14.9%
	No	71.1%	75.9%	74.7%	76.7%	77.0%
	Missing values	9.2%	3.9%	4.7%	2.8%	1.3%
USE MEERLANDEN PLATFORM	Yes	11.2%	12.0%	12.0%	12.4%	12.5%
	Would use both	54.6%	58.1%	58.1%	59.1%	60.1%
	No	21.3%	22.6%	21.7%	22.2%	22.5%
	Missing values	12.9%	4.8%	5.6%	6.4%	4.9%
ACCESS METHOD	Anonymous link	63.1%				
	QR code	7.6%				
	Social media link	29.3%				

ATTITUDE VARIABLES						
Variable	Variable level	respondents in total sample	respondents for context sofa	respondents for context side table	respondents for context vacuum cleaner	respondents for context refrigerator
NEP SCALE	Mean score	3.8	3.8	3.8	3.8	3.8
GEBS SCALE	Mean score	3.6	3.6	3.6	3.6	3.6

APPENDIX VII.B. – DESCRIPTIVE STATISTICS OF THE NEP AND GEBS STATEMENTS

In this appendix, the frequencies of the answers chosen for the different NEP and GEBS statements are shown. The actual statements are used and not the reversed statements as used for the summated scale construction. In table 31, the frequencies of the NEP statements are shown. In table 32, the frequencies of the GEBS scale are shown.

TABLE 31: FREQUENCY OF CHOICES PER NEP STATEMENTS

VALUATION OF THE NEP STATEMENTS					
NEP statement	Totally disagree	Somewhat disagree	Neutral	Somewhat agree	Totally agree
WE ARE APPROACHING THE LIMIT OF THE NUMBER OF PEOPLE THE EARTH CAN SUPPORT.	143	115	468	965	929
HUMANS HAVE THE RIGHT TO MODIFY THE NATURAL ENVIRONMENT TO SUIT THEIR NEEDS.	901	911	381	358	68
WHEN HUMANS INTERFERE WITH NATURE IT OFTEN PRODUCES DISASTROUS CONSEQUENCES.	24	249	570	1159	572
HUMAN INGENUITY WILL ENSURE THAT WE DO NOT MAKE THE EARTH UNLIVABLE.	237	342	662	1066	312
HUMANS ARE SERIOUSLY ABUSING THE ENVIRONMENT.	36	120	158	1249	1056
THE EARTH HAS PLENTY OF NATURAL RESOURCES IF WE JUST LEARN HOW TO DEVELOP THEM.	115	341	522	1057	584
PLANTS AND ANIMALS HAVE AS MUCH RIGHT AS HUMANS TO EXIST.	119	153	204	585	1558
THE BALANCE OF NATURE IS STRONG ENOUGH TO COPE WITH THE IMPACTS OF MODERN INDUSTRIAL NATIONS.	879	920	452	260	108
DESPITE OUR SPECIAL ABILITIES, HUMANS ARE STILL SUBJECT TO THE LAWS OF NATURE.	47	60	284	936	1292
THE SO-CALLED "ECOLOGICAL CRISIS" FACING HUMANKIND HAS BEEN GREATLY EXAGGERATED.	986	787	514	249	83
THE EARTH IS LIKE A SPACESHIP WITH VERY LIMITED ROOM AND RESOURCES.	297	622	832	618	238
HUMANS WERE MEANT TO RULE OVER THE REST OF NATURE.	1473	707	269	110	60
THE BALANCE OF NATURE IS VERY DELICATE AND EASILY UPSET.	83	168	400	1077	891
HUMANS WILL EVENTUALLY LEARN ENOUGH ABOUT HOW NATURE WORKS TO BE ABLE TO CONTROL IT.	396	546	760	789	128
IF THINGS CONTINUE ON THEIR PRESENT COURSE, WE WILL SOON EXPERIENCE A MAJOR ECOLOGICAL CATASTROPHE.	118	261	548	1163	529

TABLE 32: FREQUENCY OF CHOICES PER GEBS STATEMENTS

VALUATION OF THE GEBS STATEMENTS					
GEBS statement	Not applicable	Never	Sometimes	Often	Always
I PUT DEAD BATTERIES IN THE GARBAGE	60	1895	450	84	142
AFTER MEALS, I DISPOSE OF LEFTOVERS IN THE TOILET	46	2308	265	12	0
I BRING UNUSED MEDICINE BACK TO THE PHARMACY	605	531	362	295	838
I COLLECT AND RECYCLE USED PAPER	35	72	96	417	2011
I BRING EMPTY BOTTLES TO A RECYCLE BIN	12	48	72	334	2165
SOMETIMES I BUY BEVERAGES IN CANS	93	529	1737	249	23
IN SUPERMARKETS, I USUALLY BUY FRUITS AND VEGETABLES FROM THE OPEN BINS	0	34	220	1376	1001
IF I AM OFFERED A PLASTIC BAG IN A STORE, I WILL ALWAYS TAKE IT	110	545	1464	336	176
FOR SHOPPING, I PREFER PAPER BAGS TO PLASTIC ONES	226	156	358	558	1333
I USUALLY BUY MILK IN RETURNABLE BOTTLES	559	1903	97	12	60

APPENDIX VII.C. – DESCRIPTIVE STATISTICS OF THE CHOICES TO THE CHOICE TASKS

To determine if there is an association between the choices made by the citizens, the questions and the contexts. Four crosstabulation analyses are performed. The crosstabulation is computed by choosing a row variable and a column variable. Each chosen variable should at least contain two categories. Each cell in the column is the count of the number of observations for that combination of categories. To check whether there is an association between the variables, a nonparametric test is used. The chi-square test of association. If the Pearson chi-squared has a p-value smaller than 0.05, the H1 hypothesis is accepted, meaning variable 1 is associated with variable 2. If the p-value is larger than 0.05, the H0 hypothesis is accepted, meaning variable 1 is not associated with variable 2.

Each cell should have an expected frequency of at least 1, and the expected frequencies of the total table should be at least 5 for the majority (80%) of the cells. To compute the crosstabulation, each row in the data set should represent a distinct combination of the categories. These requirements are met for all four tests. The tests are executed with SPSS.

In table 33, the frequencies of the chosen alternatives per questions are shown. This is without the base alternative. In table 34 the results of the Pearson chi-squared are given. The p-value is 0.000, meaning that the H1 hypothesis is accepted and the chosen alternatives are associated with the questions.

TABLE 33: CROSSTABULATION OF THE CHOICE COUNTS ON THE CHOICE TASKS

(COUNT) TASK * CHOICE CROSSTABULATION				
	Alternative 1	Alternative 2	Alternative 3	Total
Q1	120	61	38	219
Q2	122	53	47	222
Q3	107	66	44	217
Q4	93	123	7	223
Q5	105	108	9	222
Q6	80	120	14	214
Q7	123	92	7	222
Q8	124	92	7	223
Q9	105	102	13	220
Q10	100	78	42	220
Q11	109	59	49	217
Q12	105	63	47	215
TOTAL	1293	1017	324	2634

TABLE 34: PEARSON CHI-SQUARE TEST OF THE CHOSEN ALTERNATIVES AND CHOICE TASKS

Pearson Chi-square	
CHI-SQUARE VALUE	238.139[a]
DF	22
P-VALUE (2-SIDED)	0.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 26.32

In table 35, the base alternative is included in the analysis. This made no difference in the results. In table 36, the results of the Pearson chi-squared are shown. Here, the p-value is 0.000. Meaning that the H1 hypothesis is accepted and there is an associated assumed between the questions and the chosen alternatives per question.

TABLE 35: CROSSTABULATION OF THE CHOICE COUNTS ON THE CHOICE TASKS INCLUDING THE BASE ALTERNATIVE

(COUNT) TASK * CHOICE CROSSTABULATION					
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Total
Q1	110	46	32	35	223
Q2	108	41	39	38	226
Q3	97	56	34	34	221
Q4	78	97	5	48	228
Q5	89	71	13	57	230
Q6	72	92	10	48	222
Q7	110	77	6	36	229
Q8	110	76	5	38	229
Q9	98	84	8	37	227
Q10	93	58	31	44	226
Q11	95	45	37	47	224
Q12	92	49	32	49	222
TOTAL	1152	792	252	511	2707

TABLE 36: PEARSON CHI-SQUARE TEST OF CHOICES ON THE CHOICE TASKS WITH BASE ALTERNATIVE

Pearson Chi-square	
CHI-SQUARE VALUE	197.305[a]
DF	33
P-VALUE (2-SIDED)	0.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.57

In table 37, the frequencies of the chosen alternatives per context are shown. This is without the base alternative. In table 38 the results of the Pearson chi-squared are given. The p-value is 0.097, meaning that the H0 hypothesis is accepted and the chosen alternatives are not associated with the questions. The H1 hypothesis is rejected.

TABLE 37: CROSSTABULATION OF THE CHOICE COUNTS ON THE CONTEXTS

(COUNT) CONTEXT * CHOICE CROSSTABULATION				
	Alternative 1	Alternative 2	Alternative 3	Total
SOFA	325	255	81	661
SIDE TABLE	327	277	67	671
REFRIGERATOR	310	260	81	651
VACUUM CLEANER	331	225	95	651
TOTAL	1293	1017	324	2634

TABLE 38: PEARSON CHI-SQUARE TEST OF CHOICES ON THE CONTEXTS

Pearson Chi-square	
CHI-SQUARE VALUE	10.732[a]
DF	6
P-VALUE (2-SIDED)	0.097

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 80.08

In table 39, the base alternative is included in the analysis. This made a difference in the results. In table 40, the results of the Pearson chi-squared are shown. Here, the p-value is 0.003. Meaning that the H1 hypothesis is accepted and there is an associated assumed between the questions and the contexts.

TABLE 39: CROSSTABULATION OF THE CHOICE COUNTS ON THE CONTEXTS WITH BASE ALTERNATIVE

(COUNT) CONTEXT * CHOICE CROSSTABULATION					
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Total
SOFA	281	212	52	135	680
SIDE TABLE	292	206	57	138	693
REFRIGERATOR	278	205	53	126	662
VACUUM CLEANER	301	169	90	112	672
TOTAL	1152	792	252	511	2707

TABLE 40: PEARSON CHI-SQUARE TEST OF CHOICES ON THE CONTEXT WITH BASE ALTERNATIVE

Pearson Chi-square	
CHI-SQUARE VALUE	25.180[a]
DF	9
P-VALUE (2-SIDED)	0.003

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 61.63

APPENDIX VIII – MODEL ESTIMATIONS

APPENDIX VIII.A. – MNL MODEL

Syntax

```
#### LOAD LIBRARY AND DEFINE CORE SETTINGS
### Clear memory
rm(list = ls())
### Load Apollo library
library(apollo)

### Initialise code
apollo_initialise()

### Set core controls
apollo_control = list(
 modelName  ="Apollo_MNL_withBase",
 modelDescr ="Simple MNL model with base alternative",
 indivID    ="ID"
)

#### LOAD DATA AND APPLY ANY TRANSFORMATIONS
database = read.csv("DataTotalComplete_effect_codedforchoicemodelling.csv",header=TRUE, sep =';')

#### ANALYSIS OF CHOICES
choiceAnalysis_settings <- list(
 alternatives = c(platform=1, bring=2, pickup=3, base=4),
 avail       = list(platform=database$AV_Alt1, bring=database$AV_Alt2, pickup=database$AV_Alt3, base=database$AV_Alt4),
 choiceVar    = database$Choice,
 explanators  = database[,c("Gender","Age","Education","Income")],
 rows        = database$income>30000
)

apollo_choiceAnalysis(choiceAnalysis_settings, apollo_control, database)

#### DEFINE MODEL PARAMETERS
### Vector of parameters, including any that are kept fixed in estimation
apollo_beta=c(asc_platform   = 0,
          asc_bring   = 0,
          asc_pickup   = 0,
          asc_base  = 0,
          b_plf_alt1  = 0,
          b_rew_alt1  = 0,
          b_ls_alt1  = 0,
          b_app_alt2 = 0,
          b_rew_alt2  = 0,
          b_ls_alt2    = 0,
          b_app_alt3 = 0,
          b_cost_alt3 = 0,
          b_ls_alt3 = 0,
          b_C1 = 0,
          b_C2 = 0,
          b_C3 = 0,
          b_C4 = 0,
          b_C5 = 0,
          b_C6 = 0,
          b_C7 = 0,
          b_C8 = 0,
```

```
          b_C9 = 0)

### Vector with names (in quotes) of parameters to be kept fixed at their starting value in apollo_beta, use apollo_beta_fixed =
c() if none
apollo_fixed = c("asc_base")

#### GROUP AND VALIDATE INPUTS
apollo_inputs = apollo_validateInputs()

#### DEFINE MODEL AND LIKELIHOOD FUNCTION
apollo_probabilities=function(apollo_beta, apollo_inputs, functionality="estimate"){

 ### Attach inputs and detach after function exit
 apollo_attach(apollo_beta, apollo_inputs)
 on.exit(apollo_detach(apollo_beta, apollo_inputs))

 ### Create list of probabilities P
 P = list()

 ### List of utilities: these must use the same names as in mnl_settings, order is irrelevant
 V = list()
 V[['platform']]  = asc_platform + b_plf_alt1 * Alt1_PLF + b_rew_alt1 * Alt1_REW + b_ls_alt1 * Alt1_LS + b_C1 * C1 + b_C2 * C2
+ b_C3 * C3
 V[['bring']]  = asc_bring + b_app_alt2 * Alt2_APP + b_rew_alt2 * Alt2_REW + b_ls_alt2 * Alt2_LS + b_C4 * C1 + b_C5 * C2 +
b_C6 * C3
 V[['pickup']]  =  asc_pickup + b_app_alt3 * Alt3_APP + b_cost_alt3 * Alt3_COST + b_ls_alt3 * Alt3_LS + b_C7 * C1 + b_C8 * C2 +
b_C9 * C3
 V[['base']] = asc_base

 ### Define settings for MNL model component
 mnl_settings = list(
  alternatives  = c(platform=1, bring=2, pickup=3, base=4),
  avail        = list(platform=AV_Alt1, bring=AV_Alt2, pickup=AV_Alt3, base=AV_Alt4),
  choiceVar     = Choice,
  V            = V
 )

 ### Compute probabilities using MNL model
 P[['model']] = apollo_mnl(mnl_settings, functionality)

 ### Take product across observation for same individual
 P = apollo_panelProd(P, apollo_inputs, functionality)

 ### Prepare and return outputs of function
 P = apollo_prepareProb(P, apollo_inputs, functionality)
 return(P)
}

#### MODEL ESTIMATION
model = apollo_estimate(apollo_beta, apollo_fixed, apollo_probabilities, apollo_inputs)
saveOutput_settings = list(printPVal = TRUE)

#### MODEL OUTPUTS

#---- FORMATTED OUTPUT (TO SCREEN)
apollo_modelOutput(model)
#---- FORMATTED OUTPUT (TO FILE, using model name)
apollo_saveOutput(model, saveOutput_settings)
```

TABLE 41: MODEL FIT OF THE BASE MNL MODEL

MODEL FIT BASE MNL-MODEL					
	LL (0)	LL(final)	Rho-square	Adj. Rho-square	BIC
BASE MNL MODEL	-3752.6999	-3370.615	0.1018	0.0962	6907.21

APPENDIX VIII.B. – MNL MODEL WITH INTERACTION EFFECTS

Syntax:

```
#### LOAD LIBRARY AND DEFINE CORE SETTINGS
### Clear memory
rm(list = ls())
### Load Apollo library
library(apollo)

### Initialise code
apollo_initialise()

### Set core controls
apollo_control = list(
 modelName  ="Apollo_MNL_withBase_final04",
 modelDescr ="Simple MNL model with base alternative final04",
 indivID    ="ID"
)

#### LOAD DATA AND APPLY ANY TRANSFORMATIONS

database = read.csv("DataTotalComplete_effect_codedforchoicemodelling.csv",header=TRUE, sep =';')
database[is.na(database)] = 9999

#### ANALYSIS OF CHOICES

choiceAnalysis_settings <- list(
 alternatives = c(platform=1, bring=2, pickup=3, base=4),
 avail       = list(platform=database$AV_Alt1, bring=database$AV_Alt2, pickup=database$AV_Alt3, base=database$AV_Alt4),
 choiceVar    = database$Choice,
 explanators  = database[,c("Gender","Age","Education","Income")],
 rows        = database$income>30000
)

apollo_choiceAnalysis(choiceAnalysis_settings, apollo_control, database)

#### DEFINE MODEL PARAMETERS

### Vector of parameters, including any that are kept fixed in estimation
apollo_beta=c(asc_platform   = 0,
          asc_bring   = 0,
          asc_pickup   = 0,
          asc_base  = 0,
          b_plf_alt1  = 0,
          b_rew_alt1  = 0,
          b_ls_alt1  = 0,
          b_app_alt2 = 0,
          b_rew_alt2  = 0,
          b_ls_alt2    = 0,
          b_app_alt3 = 0,
          b_cost_alt3 = 0,
```

```
            b_ls_alt3 = 0,
            b_C1 = 0,
            b_C2 = 0,
            b_C3 = 0,
            b_C4 = 0,
            b_C5 = 0,
            b_C6 = 0,
            b_C7 = 0,
            b_C8 = 0,
            b_C9 = 0,
            b_AB2_alt1 = 0,
            b_AbBig_alt2 = 0,
            b_AbSmall_alt2 = 0,
            b_DL_alt1 = 0,
            b_DL_alt2 = 0,
            b_income1_alt2 = 0,
            b_education1_alt2 = 0,
            b_gender_alt1 = 0,
            b_gender_alt2 =0,
            b_age1_alt1 = 0,
            b_age3_alt1 = 0
            )

### Vector with names (in quotes) of parameters to be kept fixed at their starting value in apollo_beta, use apollo_beta_fixed =
c() if none
apollo_fixed = c("asc_base")

#### GROUP AND VALIDATE INPUTS

apollo_inputs = apollo_validateInputs()

#### DEFINE MODEL AND LIKELIHOOD FUNCTION

apollo_probabilities=function(apollo_beta, apollo_inputs, functionality="estimate"){

 ### Attach inputs and detach after function exit
 apollo_attach(apollo_beta, apollo_inputs)
 on.exit(apollo_detach(apollo_beta, apollo_inputs))

 ### Create list of probabilities P
 P = list()

 ### List of utilities: these must use the same names as in mnl_settings, order is irrelevant
 V = list()
 V[['platform']]  = asc_platform + b_plf_alt1 * Alt1_PLF + b_rew_alt1 * Alt1_REW + b_ls_alt1 * Alt1_LS + b_C1 * C1 + b_C2 * C2
+ b_C3 * C3 +
   b_AB2_alt1 * AB2 +  b_DL_alt1 * Driverslicence + b_gender_alt1 * Gender + b_age1_alt1 * AGE1 + b_age3_alt1 * AGE3

 V[['bring']]  = asc_bring + b_app_alt2 * Alt2_APP + b_rew_alt2 * Alt2_REW + b_ls_alt2 * Alt2_LS + b_C4 * C1 + b_C5 * C2 +
b_C6 * C3 +
   b_AbBig_alt2 * Ability_big +  b_AbSmall_alt2 * Ability_small  +  b_DL_alt2 * Driverslicence + b_income1_alt2 * INC1 +
   b_education1_alt2 * ED1 + b_gender_alt2 * Gender

 V[['pickup']]  =  asc_pickup + b_app_alt3 * Alt3_APP + b_cost_alt3 * Alt3_COST + b_ls_alt3 * Alt3_LS + b_C7 * C1 + b_C8 * C2 +
b_C9 * C3

 V[['base']] = asc_base
```

```
 ### Define settings for MNL model component
 mnl_settings = list(
  alternatives  = c(platform=1, bring=2, pickup=3, base=4),
  avail        = list(platform=AV_Alt1, bring=AV_Alt2, pickup=AV_Alt3, base=AV_Alt4),
  choiceVar     = Choice,
  V           = V
 )

 ### Compute probabilities using MNL model
 P[['model']] = apollo_mnl(mnl_settings, functionality)

 ### Take product across observation for same individual
 P = apollo_panelProd(P, apollo_inputs, functionality)

 ### Prepare and return outputs of function
 P = apollo_prepareProb(P, apollo_inputs, functionality)
 return(P)
}

#### MODEL ESTIMATION

model = apollo_estimate(apollo_beta, apollo_fixed, apollo_probabilities, apollo_inputs)
saveOutput_settings = list(printPVal = TRUE)

#### MODEL OUTPUTS
#---- FORMATTED OUTPUT (TO SCREEN)

apollo_modelOutput(model)

#---- FORMATTED OUTPUT (TO FILE, using model name)

apollo_saveOutput(model, saveOutput_settings)
```

TABLE 42: MODEL FIT IS THE FINAL MNL MODEL

MODEL FIT FINAL MNL-MODEL					
	LL (0)	LL(final)	Rho-square	Adj. Rho-square	BIC
FINAL MNL MODEL	-3752.699	-3251.464	0.1336	0.1250	6566.93

APPENDIX VIII.C. – LC MODEL

Syntax:

```
#### LOAD LIBRARY AND DEFINE CORE SETTINGS

### Clear memory
rm(list = ls())

### Load Apollo library
library(apollo)

### Initialise code
apollo_initialise()

apollo_control = list(
 modelName  ="Lc model with class allocation 2 total05",
 modelDescr ="LC model with class allocation model 2 total05",
 indivID    ="ID",
```

```
  nCores    = 7
)

#### LOAD DATA AND APPLY ANY TRANSFORMATIONS

database = read.csv("DataTotalComplete_effect_codedforchoicemodelling.csv",header=TRUE, sep =';')
database[is.na(database)] = 9999

#### DEFINE MODEL PARAMETERS

### Vector of parameters, including any that are kept fixed in estimation
apollo_beta = c(asc_platform   = 0,
                asc_bring   = 0,
                asc_pickup   = 0,
                asc_base = 0,
                b_plf_alt1_a  = 0,
                b_rew_alt1_a  = 0,
                b_ls_alt1_a  = 0,
                b_app_alt2_a = 0,
                b_rew_alt2_a  = 0,
                b_ls_alt2_a    = 0,
                b_app_alt3_a = 0,
                b_cost_alt3_a = 0,
                b_ls_alt3_a = 0,
                b_C1_a = 0,
                b_C2_a = 0,
                b_C3_a = 0,
                b_C4_a = 0,
                b_C5_a = 0,
                b_C6_a = 0,
                b_C7_a = 0,
                b_C8_a = 0,
                b_C9_a = 0,
                b_plf_alt1_b  = 0,
                b_rew_alt1_b  = 0,
                b_ls_alt1_b  = 0,
                b_app_alt2_b = 0,
                b_rew_alt2_b  = 0,
                b_ls_alt2_b    = 0,
                b_app_alt3_b = 0,
                b_cost_alt3_b = 0,
                b_ls_alt3_b = 0,
                b_C1_b = 0,
                b_C2_b = 0,
                b_C3_b = 0,
                b_C4_b = 0,
                b_C5_b = 0,
                b_C6_b = 0,
                b_C7_b = 0,
                b_C8_b = 0,
                b_C9_b = 0,
                delta_a = 0,
                delta_b = 0
                )

### Vector with names (in quotes) of parameters to be kept fixed at their starting value in apollo_beta, use apollo_beta_fixed =
c() if none
apollo_fixed = c("asc_base","delta_b")
```

```
#### DEFINE LATENT CLASS COMPONENTS

apollo_lcPars=function(apollo_beta, apollo_inputs){
  lcpars = list()
  lcpars[["b_plf_alt1"]] = list(b_plf_alt1_a,  b_plf_alt1_b)
  lcpars[["b_rew_alt1"]] = list(b_rew_alt1_a, b_rew_alt1_b)
  lcpars[["b_ls_alt1"]] = list(b_ls_alt1_a, b_ls_alt1_b)
  lcpars[["b_app_alt2"]] = list(b_app_alt2_a,  b_app_alt2_b)
  lcpars[["b_rew_alt2"]] = list(b_rew_alt2_a, b_rew_alt2_b)
  lcpars[["b_ls_alt2"]] = list( b_ls_alt2_a,  b_ls_alt2_b)
  lcpars[["b_app_alt3"]] = list( b_app_alt3_a,  b_app_alt3_b)
  lcpars[["b_cost_alt3"]] = list( b_cost_alt3_a,  b_cost_alt3_b)
  lcpars[["b_ls_alt3"]] = list(  b_ls_alt3_a,   b_ls_alt3_b)
  lcpars[["b_C1"]] = list(b_C1_a, b_C1_b)
  lcpars[["b_C2"]] = list(b_C2_a, b_C2_b)
  lcpars[["b_C3"]] = list(b_C3_a, b_C3_b)
  lcpars[["b_C4"]] = list(b_C4_a, b_C4_b)
  lcpars[["b_C5"]] = list(b_C5_a, b_C5_b)
  lcpars[["b_C6"]] = list(b_C6_a, b_C6_b)
  lcpars[["b_C7"]] = list(b_C7_a, b_C7_b)
  lcpars[["b_C8"]] = list(b_C8_a, b_C8_b)
  lcpars[["b_C9"]] = list(b_C9_a, b_C9_b)

  V=list()
  V[["class_a"]] = delta_a

  V[["class_b"]] = delta_b


  mnl_settings = list(
    alternatives = c(class_a=1, class_b=2),
    avail       = 1,
    choiceVar    = NA,
    V           = V
  )
  lcpars[["pi_values"]] = apollo_mnl(mnl_settings, functionality="raw")

  lcpars[["pi_values"]] = apollo_firstRow(lcpars[["pi_values"]], apollo_inputs)

  return(lcpars)
}

#### GROUP AND VALIDATE INPUTS

apollo_inputs = apollo_validateInputs()

#### DEFINE MODEL AND LIKELIHOOD FUNCTION

apollo_probabilities=function(apollo_beta, apollo_inputs, functionality="estimate"){

  ### Attach inputs and detach after function exit
  apollo_attach(apollo_beta, apollo_inputs)
  on.exit(apollo_detach(apollo_beta, apollo_inputs))

  ### Create list of probabilities P
  P = list()
```

```
 ### Define settings for MNL model component that are generic across classes
 mnl_settings = list(
  alternatives  = c(platform=1, bring=2, pickup=3, base=4),
  avail        = list(platform=AV_Alt1, bring=AV_Alt2, pickup=AV_Alt3, base=AV_Alt4),
  choiceVar     = Choice
 )

 ### Loop over classes
 s=1
 while(s<=2){

  ### Compute class-specific utilities
  V=list()
  V[['platform']]  = asc_platform + b_plf_alt1[[s]] * Alt1_PLF + b_rew_alt1[[s]] * Alt1_REW + b_ls_alt1[[s]] * Alt1_LS + b_C1[[s]]
* C1 + b_C2[[s]] * C2 + b_C3[[s]] * C3
  V[['bring']]  = asc_bring + b_app_alt2[[s]] * Alt2_APP + b_rew_alt2[[s]] * Alt2_REW + b_ls_alt2[[s]] * Alt2_LS + b_C4[[s]] * C1 +
b_C5[[s]] * C2 + b_C6[[s]] * C3
  V[['pickup']]  =  asc_pickup + b_app_alt3[[s]] * Alt3_APP + b_cost_alt3[[s]] * Alt3_COST + b_ls_alt3[[s]] * Alt3_LS + b_C7[[s]] *
C1 + b_C8[[s]] * C2 + b_C9[[s]] * C3
  V[['base']] = asc_base

  mnl_settings$V = V
  mnl_settings$componentName = paste0("Class_",s)

  ### Compute within-class choice probabilities using MNL model
  P[[paste0("Class_",s)]] = apollo_mnl(mnl_settings, functionality)

  ### Take product across observation for same individual
  P[[paste0("Class_",s)]] = apollo_panelProd(P[[paste0("Class_",s)]], apollo_inputs ,functionality)

  s=s+1}

 ### Compute latent class model probabilities
 lc_settings   = list(inClassProb = P, classProb=pi_values)
 P[["model"]] = apollo_lc(lc_settings, apollo_inputs, functionality)

 ### Prepare and return outputs of function
 P = apollo_prepareProb(P, apollo_inputs, functionality)
 return(P)
}

#### MODEL ESTIMATION

apollo_beta=apollo_searchStart(apollo_beta, apollo_fixed,apollo_probabilities, apollo_inputs)
apollo_outOfSample(apollo_beta, apollo_fixed,apollo_probabilities, apollo_inputs)

### Estimate model
model = apollo_estimate(apollo_beta, apollo_fixed,
                 apollo_probabilities, apollo_inputs,
                 estimate_settings=list(writeIter=FALSE))
saveOutput_settings = list(printPVal = TRUE)

### Show output in screen
apollo_modelOutput(model)

### Save output to file(s)
apollo_saveOutput(model, saveOutput_settings)
```

TABLE 43: MODEL FIT LCM

MODEL FIT LCM					
	LL (0)	LL(final)	Rho-square	Adj. Rho-square	BIC
FINAL MNL MODEL	-3752.699	-3072.208	0.1813	0.1707	6460.56

APPENDIX IX – SCENARIO ANALYSIS

The summary of the scenario analysis is provided in the main text (chapter 7), the analysis with more the context factors (product types) is given in this appendix.

APPENDIX IX.A. – MNL MODEL SCENARIO ANALYSIS

The MNL-model used for the scenario analysis with context factors is presented in table 44. The interpretation of the estimated parameters was equal to the interpretation given in section 6.3.1.1., the parameter estimates which were not significant at a 95% confidence level are coloured red. Based on this choice model, the utility and choice probabilities for the different re-use measures, under all four scenarios and for all four contexts (product types) were calculated. The calculations are shown in table 45.

TABLE 44: ESTIMATED PARAMETERS MNL MODEL WITH CONTEXT FOR SCENARIO ANALYSIS

ESTIMATES MNL-MODEL WITH CONTEXT SCENARIO ANALYSIS				
Parameters	Estimate	Std. err.	t-ratio	p-value
CONSTANTS				
PLATFORM ALTERNATIVE	0.82	0.05	15.30	0.00
BRINGING TO CENTER ALTERNATIVE	0.43	0.06	7.60	0.00
PICKUP SERVICE ALTERNATIVE	0.34	0.27	1.24	0.22
BASE ALTERNATIVE (FIXED)	0.00	NA	NA	NA
ATTRIBUTES PLATFORM ALTERNATIVE				
TYPE OF PLATFORM	-0.05	0.09	-1.30	0.19
REWARD SYSTEM	-0.01	0.04	-0.25	0.80
LOYALTY SYSTEM	-0.00	0.04	-0.07	0.95
ATTRIBUTES BRINGING TO CENTER ALTERNATIVE				
APPOINTMENT	-0.07	0.04	-1.64	0.10
REWARD SYSTEM	0.04	0.04	1.02	0.31
LOYALTY SYSTEM	0.09	0.04	2.06	0.04
ATTRIBUTES PICKUP SERVICE ALTERNATIVE				
APPOINTMENT	0.22	0.07	3.26	0.00
COSTS	-0.06	0.01	-4.12	0.00
LOYALTY SYSTEM	-0.19	0.07	-2.81	0.01
CONTEXT VARIABLES (PRODUCT TYPES)				
C1 (COMPONENT 1 IN PLATFORM ALTERNATIVE)	-0.08	0.09	-0.90	0.37
C2 (COMPONENT 2 IN PLATFORM ALTERNATIVE)	0.17	0.09	1.83	0.07
C3 (COMPONENT 3 IN PLATFORM ALTERNATIVE)	-0.07	0.09	-0.73	0.47
C4 (COMPONENT 1 IN BRINGING TO CENTER ALTERNATIVE)	0.01	0.10	0.14	0.89
C5 (COMPONENT 2 IN BRINGING TO CENTER ALTERNATIVE)	-0.03	0.10	-0.27	0.79
C6 (COMPONENT 3 IN BRINGING TO CENTER ALTERNATIVE)	-0.04	0.10	-0.37	0.71
C7 (COMPONENT 1 IN PICKUP SERVICE ALTERNATIVE)	-0.23	0.14	-1.61	0.11
C8 (COMPONENT 2 IN PICKUP SERVICE ALTERNATIVE)	0.53	0.13	4.11	0.00
C9 (COMPONENT 3 IN PICKUP SERVICE ALTERNATIVE)	-0.16	0.14	-1.14	0.25

TABLE 45: PREDICTED CHOICE PROBABILITY UNDER FOUR SCENARIOS MNL MODEL WITH CONTEXT

CHOICE PROBABILITIES SOFA CONTEXT				
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE				
TOTAL UTILITY	0.80	0.78	0.70	0.68
CHOICE PROBABILTY	44.1%	41.7%	40.9%	40.0%
BRINGING TO CENTER ALTERNATIVE				
TOTAL UTILITY	0.46	0.56	0.50	0.24
CHOICE PROBABILTY	31.4%	33.5%	33.5%	25.8%
PICKUP SERVICE ALTERNATIVE				
TOTAL UTILITY	-1.42	-1.20	-1.36	-0.38
CHOICE PROBABILTY	4.8%	5.8%	5.2%	13.9%
BASE ALTERNATIVE				
TOTAL UTILITY	0	0	0	0
CHOICE PROBABILTY	19.8%	19.1%	20.3%	20.3%
CHOICE PROBABILITIES VACUUM CLEANER CONTEXT				
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE				
TOTAL UTILITY	1.05	1.03	0.95	0.93
CHOICE PROBABILTY	48.5%	45.7%	45.2%	40.8%
BRINGING TO CENTER ALTERNATIVE				
TOTAL UTILITY	0.42	0.52	0.46	0.20
CHOICE PROBABILTY	25.8%	27.4%	27.7%	19.6%
PICKUP SERVICE ALTERNATIVE				
TOTAL UTILITY	-0.66	-0.44	-0.60	0.38
CHOICE PROBABILTY	8.8%	10.5%	9.6%	23.5%
BASE ALTERNATIVE				
TOTAL UTILITY	0	0	0	0
CHOICE PROBABILTY	17.0%	16.3%	17.5%	16.1%
CHOICE PROBABILITIES SIDE TABLE CONTEXT				
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE				
TOTAL UTILITY	0.81	0.79	0.71	0.69
CHOICE PROBABILTY	44.8%	42.4%	41.7%	40.4%
BRINGING TO CENTER ALTERNATIVE				
TOTAL UTILITY	0.41	0.51	0.45	0.19
CHOICE PROBABILTY	30.1%	32.1%	32.2%	24.5%
PICKUP SERVICE ALTERNATIVE				
TOTAL UTILITY	-1.35	-1.13	-1.29	-0.31
CHOICE PROBABILTY	5.2%	6.2%	5.6%	14.9%
BASE ALTERNATIVE				
TOTAL UTILITY	0	0	0	0
CHOICE PROBABILTY	19.9%	19.3%	20.5%	20.3%
CHOICE PROBABILITIES REFRIGERATOR CONTEXT				

	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE				
TOTAL UTILITY	0.86	0.84	0.76	0.74
CHOICE PROBABILTY	44.6%	42.2%	41.5%	40.5%
BRINGING TO CENTER ALTERNATIVE				
TOTAL UTILITY	0.51	0.61	0.55	0.29
CHOICE PROBABILTY	31.5%	33.5%	33.6%	25.8%
PICKUP SERVICE ALTERNATIVE				
TOTAL UTILITY	-1.33	-1.11	-1.27	-0.29
CHOICE PROBABILTY	5.0%	6.0%	5.5%	14.4%
BASE ALTERNATIVE				
TOTAL UTILITY	0	0	0	0
CHOICE PROBABILTY	18.9%	18.2%	19.4%	19.3%

APPENDIX IX.B. – LC MODEL SCENARIO ANALYSIS

The MNL-model used for the scenario analysis with context factors is presented in table 46. The interpretation of the estimated parameters was equal to the interpretation given in section 6.3.1.1., the parameter estimates which were not significant at a 95% confidence level are coloured red. Based on this choice model, the utility and choice probabilities for the different re-use measures, under all four scenarios and for all four contexts (product types) were calculated. The calculations are shown in table 47.

TABLE 46: ESTIMATED PARAMETERS LC MODEL WITH CONTEXT FOR SCENARIO ANALYSIS

ESTIMATES FINAL LCM						
Parameters	CLASS 1			CLASS 2		
	Estimate class 1	Std. err.	t-ratio (p-value)	Estimate class 2	Std. err.	t-ratio (p-value)
CONSTANTS						
PLATFORM ALTERNATIVE	0.41	0.18	2.22 (0.03)	1.39	0.22	6.30 (0.00)
BRINGING TO CENTER ALTERNATIVE	0.38	0.19	2.03 (0.04)	0.56	0.22	2.51 (0.01)
PICKUP SERVICE ALTERNATIVE	0.49	0.34	1.47 (0.14)	0.07	0.47	0.15 (0.88)
BASE ALTERNATIVE (FIXED)	0.00	NA	NA	0.00	NA	NA
ATTRIBUTES PLATFORM ALTERNATIVE						
TYPE OF PLATFORM	-0.03	0.03	-0.99 (0.32)	-0.08	0.05	-1.69 (0.09)
REWARD SYSTEM	-0.01	0.32	-0.35 (0.73)	-0.01	0.04	-0.22 (0.83)
LOYALTY SYSTEM	0.02	0.30	0.70 (0.49)	-0.03	0.04	-0.80 (0.42)
ATTRIBUTES BRINGING TO CENTER ALTERNATIVE						-
APPOINTMENT	-0.07	0.04	-1.60 (0.11)	-0.07	0.06	-1.11 (0.27)
REWARD SYSTEM	0.07	0.04	1.85 (0.07)	-0.00	0.06	-0.06 (0.95)
LOYALTY SYSTEM	0.12	0.03	3.69 (0.00)	0.04	0.05	0.80 (0.42)
ATTRIBUTES PICKUP SERVICE ALTERNATIVE						
APPOINTMENT	0.21	0.05	4.37 (0.00)	0.23	0.08	2.95 (0.00)
COSTS	-0.07	0.01	-5.60 (0.00)	-0.04	0.02	-1.88 (0.06)
LOYALTY SYSTEM	-0.25	0.04	-6.02 (0.00)	-0.09	0.06	-1.49 (0.14)
CONTEXT VARIABLES (PRODUCT TYPES)						
C1 (COMPONENT 1 IN PLATFORM ALTERNATIVE)	-0.23	0.13	-1.82 (0.07)	0.14	0.15	0.90 (0.37)
C2 (COMPONENT 2 IN PLATFORM ALTERNATIVE)	0.10	0.13	0.81 (0.42)	0.31	0.17	1.83 (0.07)
C3 (COMPONENT 3 IN PLATFORM ALTERNATIVE)	0.02	0.12	0.14 (0.89)	-0.22	0.15	-1.41 (0.16)
C4 (COMPONENT 1 IN BRINGING TO CENTER ALTERNATIVE)	-0.05	0.13	-0.40 (0.69)	0.17	0.16	0.96 (0.34)
C5 (COMPONENT 2 IN BRINGING TO CENTER ALTERNATIVE)	-0.03	0.13	-0.24 (0.81)	-0.01	0.19	-0.08 (0.94)
C6 (COMPONENT 3 IN BRINGING TO CENTER ALTERNATIVE)	0.01	0.11	0.11	-0.15	0.16	-0.90

			(0.92)			(0.37)
C7 (COMPONENT 1 IN PICKUP SERVICE ALTERNATIVE)	-0.34	0.21	-1.57 (0.12)	0.03	0.26	0.11 (0.91)
C8 (COMPONENT 2 IN PICKUP SERVICE ALTERNATIVE)	0.44	0.17	2.64 (0.01)	0.74	0.23	3.25 (0.00)
C9 (COMPONENT 3 IN PICKUP SERVICE ALTERNATIVE)	-0.17	0.21	-0.82 (0.42)	-0.14	0.23	-0.64 (0.52)
CLASS MEMBERSHIP						
CONSTANT	-709.42	1.58	-1221.95 (0.00)	0.00	NA	NA
AGE	17.51	0.57	299.17 (0.00)	0.00	NA	NA
CLASS PROPABILITY	0.56			0.44		

TABLE 47: PREDICTED CHOICE PROBABILITY UNDER FOUR SCENARIOS LC MODEL WITH CONTEXT

CHOICE PROBABILITIES SOFA CONTEXT								
	CLASS 1				CLASS 2			
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE								
TOTAL UTILITY	0.2	0.22	0.18	0.12	1.65	1.57	1.43	1.47
CHOICE PROBABILTY	31.7%	30.6%	30.2%	29.3%	59.9%	56.1%	54.6%	54.1%
BRINGING TO CENTER ALTERNATIVE								
TOTAL UTILITY	0.35	0.45	0.45	0.07	0.76	0.84	0.70	0.62
CHOICE PROBABILTY	36.8%	38.5%	39.6%	27.9%	24.6%	27.0%	26.3%	23.1%
PICKUP SERVICE ALTERNATIVE								
TOTAL UTILITY	-1.56	-1.36	-1.64	-0.44	-1.04	-0.82	-0.76	-0.18
CHOICE PROBABILTY	5.5%	6.3%	4.9%	16.8%	4.1%	5.1%	6.1%	10.4%
BASE ALTERNATIVE								
TOTAL UTILITY	0	0	0	0	0	0	0	0
CHOICE PROBABILTY	26.0%	24.6%	25.3%	26.0%	11.5%	11.7%	13.1%	12.4%
CHOICE PROBABILITIES VACUUM CLEANER CONTEXT								
	CLASS 1				CLASS 2			
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE								
TOTAL UTILITY	0.53	0.55	0.51	0.45	1.82	1.74	1.60	1.64
CHOICE PROBABILTY	36.9%	35.4%	35.5%	30.9%	63.8%	59.8%	57.7%	54.8%
BRINGING TO CENTER ALTERNATIVE								
TOTAL UTILITY	0.37	0.47	0.47	0.09	0.58	0.66	0.52	0.44
CHOICE PROBABILTY	31.4%	32.7%	34.1%	21.6%	18.5%	20.3%	19.6%	16.5%
PICKUP SERVICE ALTERNATIVE								

TOTAL UTILITY	-0.78	-0.58	-0.86	0.34	-0.33	-0.11	-0.05	0.53
CHOICE PROBABILTY	10.0%	11.4%	9.0%	27.7%	7.4%	9.4%	11.1%	18.1%
BASE ALTERNATIVE								
TOTAL UTILITY	0	0	0	0	0	0	0	0
CHOICE PROBABILTY	21.7%	20.4%	21.3%	19.7%	10.3%	10.5%	11.6%	10.6%
CHOICE PROBABILITIES SIDE TABLE CONTEXT								
	CLASS 1				CLASS 2			
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE								
TOTAL UTILITY	0.45	0.47	0.43	0.37	1.29	1.21	1.07	1.11
CHOICE PROBABILTY	36.3%	35.0%	34.7%	33.3%	56.0%	52.3%	50.5%	49.8%
BRINGING TO CENTER ALTERNATIVE								
TOTAL UTILITY	0.41	0.51	0.51	0.13	0.44	0.52	0.38	0.30
CHOICE PROBABILTY	34.8%	36.4%	37.6%	26.2%	23.9%	26.3%	25.3%	22.2%
PICKUP SERVICE ALTERNATIVE								
TOTAL UTILITY	-1.39	-1.19	-1.47	-0.27	-1.21	-0.99	-0.93	-0.35
CHOICE PROBABILTY	5.8%	6.7%	5.2%	17.5%	4.6%	5.8%	6.8%	11.6%
BASE ALTERNATIVE								
TOTAL UTILITY	0	0	0	0	0	0	0	0
CHOICE PROBABILTY	23.1%	21.9%	22.6%	23.0%	15.4%	15.6%	17.3%	16.4%
CHOICE PROBABILITIES REFRIGERATOR CONTEXT								
	CLASS 1				CLASS 2			
	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system	Scenario 1 - Support Meerlanden charity fund	Scenario 2 - Citizens' reward maximisation	Scenario 3 - Citizens' convenience maximization	Scenario 4 - No loyalty system
PLATFORM ALTERNATIVE								
TOTAL UTILITY	0.54	0.56	0.52	0.46	1.28	1.07	1.06	1.10
CHOICE PROBABILTY	37.0%	35.7%	35.5%	33.3%	53.8%	48.0%	49.7%	50.2%
BRINGING TO CENTER ALTERNATIVE								
TOTAL UTILITY	0.47	0.57	0.57	0.19	0.58	0.66	0.52	0.44
CHOICE PROBABILTY	34.5%	36.0%	37.3%	25.4%	26.7%	31.8%	29.0%	26.0%
PICKUP SERVICE ALTERNATIVE								
TOTAL UTILITY	-1.15	-0.95	-1.23	-0.03	-1.21	-1.48	-1.42	-0.84
CHOICE PROBABILTY	6.8%	7.9%	6.2%	20.4%	4.5%	3.7%	4.2%	7.2%
BASE ALTERNATIVE								
TOTAL UTILITY	0	0	0	0	0	0	0	0
CHOICE PROBABILTY	21.6%	20.4%	21.1%	21.0%	15.0%	16.5%	17.2%	16.7%