DEVELOPING A WASTE JOURNEY METHOD

A qualitative research method for identifying barriers and opportunities for realizing inclusivity and circularity in a waste management process

By

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Preface

This research results from my thesis period, which marks the end of the master Construction Management and Engineering at Delft University of Technology. This research is written for everybody interested in qualitatively evaluating circularity and inclusivity in waste management processes.

I have received tremendous support from the graduation committee during this thesis research. I want to thank Daan Schraven for introducing me to the topic of inclusive waste management and for the thorough guidance during this research. Zhaowen Liu, I would like to thank you for all your time and effort in giving me feedback and for the many brainstorming and coffee meetings we had. As the final member of the committee, I would like to thank Tong Wang for all her critical feedback and for giving me extra insights into the research. Furthermore, I would like to thank all interviewees who supported me in completing this research. Lastly, I want to thank my parents and girlfriend for hearing me out and helping me through this process.

Kai Vaessen
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Abstract

Urbanization is putting more pressure on waste management infrastructures in cities, which could lead to "inadequate and overburdened infrastructure" according to the United Nations (United Nations Statistics Division, 2019). Because people play an important role in the performance of waste management systems, the systems should be inclusive to all people (Vasconcelos et al., 2021). Recent academic studies lack this focus on inclusivity because they have mostly focused on quantitively addressing waste management and how the waste follows a certain stream from generation to an end-state. To implement inclusivity in waste management processes, an exploration of inclusivity in this domain is required. Therefore, this research poses the following main research question:

How to identify barriers and opportunities for realizing inclusivity and circularity in a waste management process?

By reviewing academic literature, an inclusive circular waste management process is defined as a waste management process that is equally accessible for everybody in terms of location (spatial), gives an equal speech to everybody (political), divides the costs and benefits equally (economic), is circular (environmental) and is non-discriminatory to everybody (social). The process entails all steps from generation of waste to an end-state of that waste including all the actors that are involved in the process.

As currently no method suffices in studying both inclusivity and circularity in waste management processes this study proposes the waste journey method. The waste journey method combines the customer journey theory and the theory of planned behavior and can be graphically presented as in Figure 1. In the waste journey method, the waste is followed from a waste perspective from actor to actor. In this journey the waste interacts with people, called touch points, who take certain actions that influence the circular performance of the waste management process. By mapping the waste management process and analyzing the arguments actors have for their actions, with the theory of planned behavior, the barriers, and opportunities for realizing inclusivity and circularity in a waste management process can be identified. These gaps and barriers can then be used by practitioners and policy makers to improve the waste management process.

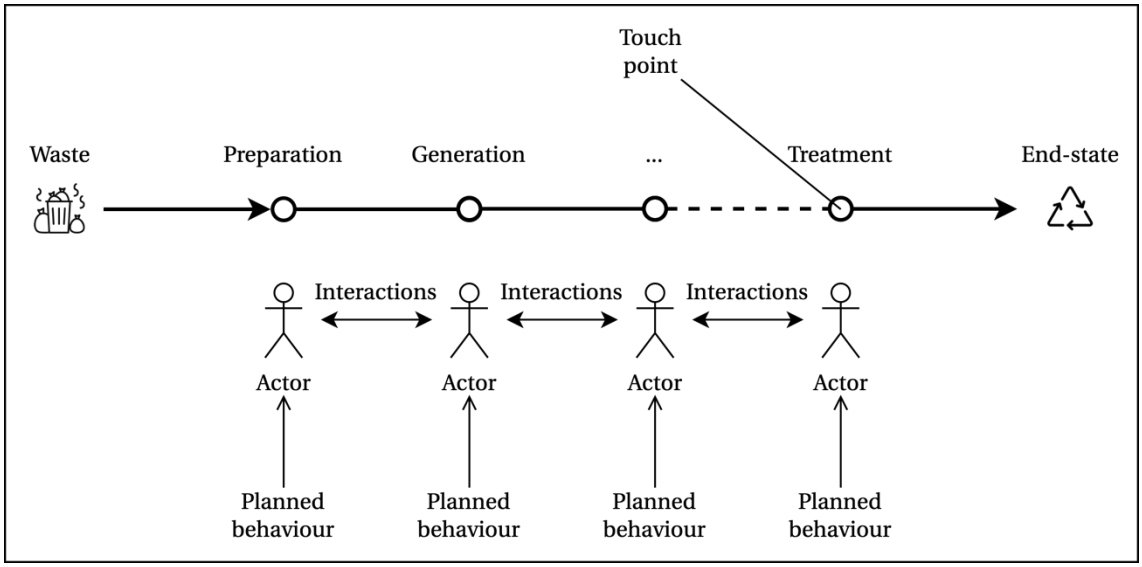

Figure 1: Graphic representation of the waste journey

From the application of the waste journey method in a case study in household renovation waste in the Netherlands, the following steps as presented in Figure 2 are identified for the application of the method. At first, a waste stream should be selected. Secondly, different waste sources in the waste stream should sought and selected. From these sources the waste should be followed to an end-state and all actors involved should be interviewed. From these interviews waste journey maps should be created. Finally, striking decisions in the process should be analyzed by with theory of planned behavior.

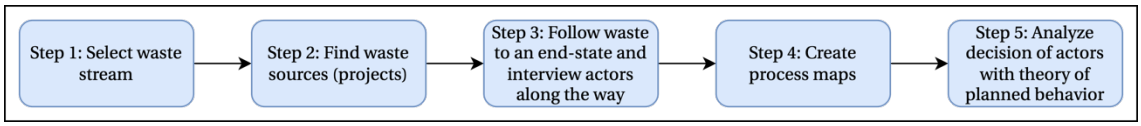

Figure 2: Steps for the waste journey method

The barriers and gaps that are identified with the waste journey method can contribute to the improvement of the waste management process. Besides, this method is one of the first to recognize the preparation phase as an important phase for the circular performance of the waste management process. A downside of the waste journey method is that it is a time-consuming method to use, and it requires the transparency and willingness of all actors in the waste management process. This was also experienced in the case study where one of the actors was not willing to cooperate and commercial actors were not transparent about their waste trading contracts. Furthermore, the interview protocol of this research could have been better specified for each actor. Future studies should focus on implementing this method on other waste streams and developing the definition of inclusivity and specifying it for each actor in the waste management process.

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1. Introduction

1.1. Background

The United Nations forecasts that the percentage of people living in urban areas will grow to 68% in 2050 from 56% in 2020 (United Nations Conference on Trade and Development, 2021). Urbanization has contributed to economic growth, but cities account for about 70 percent of global carbon emissions nowadays (United Nations Statistics Division, 2019). Besides their effect on greenhouse gas emissions (GHG), cities will also contribute to 60 percent of total waste generation in 2050, as projected by the Ellen MacArthur Foundation (Blasi et al., 2022). The impact of urbanization and the growth in waste generation will impact the infrastructure as the UN warns of "inadequate and overburdened infrastructure" in the waste collection (United Nations Statistics Division, 2019). Besides the growing amount of waste produced in cities, urbanization also plays a role in the increasing global inequality (Blasi et al., 2022).

In response to the world's challenges (e.g., climate change, inequality, and poverty), the United Nations formulated the Sustainable Development Goals (SDGs) in 2015. The SDGs are a global call to action to end poverty, safeguard the environment, and guarantee that everyone lives in peace and prosperity by 2030 (United Nations Development Programme, n.d.). As one of the goals of the SDGs, the Dutch government aims to reach a circular economy by 2050 (Ministry of Infrastructure and Environment & Ministry of Economic Affairs, 2016). In the circular economy strategy, the Dutch government has created a crucial role for waste management. The plans are presented in the National Waste Management Plan 3 (NWMP) (Ministry of Infrastructure and Environment & Ministry of Economic Affairs, 2016; Rijkswaterstaat, 2021a). This NWMP 3 should contribute to SDGs 9, 11, and 12, which focus on increasing resource efficiency and promoting the inclusivity and affordability of infrastructure (United Nations General Assembly, 2015). The first NWMP was established in 2003 and focused on preventing waste generation and promoting waste recovery by encouraging the separation of waste at source and the separation of waste streams (Bergsma et al., 2014). NWMP 2 raised the goals of NWMP 1 and focused more on the limitation of landfilling (Bergsma et al., 2014). NWMP 3 has three goals: the first is to limit the generation of waste; the second is to limit the environmental pressure of production chains by considering the environmental stress throughout the chain before reducing the environmental pressure in the waste phase; the third is to optimize the use of waste materials in a circular economy, i.e., raw materials and waste are used as high-quality as possible in the same or other chains to prevent these substances from being lost in the economy. Waste that cannot be adequately utilized should be incinerated (Rijkswaterstaat, 2021a).

Waste management is the collection, sorting, transport, recovery, and disposal of waste, including supervision of those operations and follow-up for landfills after closure and the activities of waste dealers and waste brokers (Rijksoverheid, 2016). This process in the Netherlands is done by different actors in various sub-processes and using various techniques. Therefore, this process can be seen as a system of systems consisting of subsystems, such as recycling, incineration, and transport, linked to each other through various processed waste streams (Chang et al., 2011). In waste management, the term "waste stream" defines the waste management process for different purposes based on the materials in the stream or the source of generation (Rijkswaterstaat, 2021b). These can, for example, be municipal solid waste, or construction and demolition waste, if categorized by how they are collected. A different example from a waste stream based on the material could be a paper waste stream or an organic waste steam.

1.2. Knowledge gap and research questions

Recent academic studies in waste management have focused on many different topics. For example, Wang et al. (2021) studied the flow of waste from decorations and renovations from the generation of waste to the end-state (e.g., recycling or landfilling) and estimated the different waste generation rates for different materials. This quantitative approach is also seen in the study of Ding, Gong et al. (2019), in which the waste generation rates of renovation waste are determined based on the reasons for renovating a house (e.g., carpentry or painting). Other studies focus on the role of informal waste collectors in a material flow analysis of the television waste management process (Tran et al., 2018). Other topics seen in recent studies are waste generation rates, waste collection methods, waste management, sustainable development goals, and waste composition studies (Hoornweg & Bhada-Tata, 2012). These studies primarily focus on quantitatively addressing waste management and how the waste follows a specific stream from generation to an end-state. These quantitative approaches lack consideration of the impact of different actors' interaction with waste, such as the behavior of households in the context of waste management processes.

The actors in waste management processes should be included in the waste management system, as this contributes to the whole system's performance (Vasconcelos et al., 2021). The amount of incorporation of actors is also known as inclusivity (Vasconcelos et al., 2021). The term inclusivity will be elaborated further on in the literature study, but what is seen in the NWMP 3 is that it currently focuses on the waste management process but lacks attention on how the waste interacts with the actors. In NWMP 3, the focus is now on the professional actors in the production chain of waste. It focuses more on separating waste after collection, which does not

involve the people who generate the waste itself in the process. All in all, this leads to the following problem statement:

Inclusivity has become increasingly important for the circular performance of waste management processes. In waste management, inclusivity has not been studied thoroughly yet because existing research focuses on the waste flow and waste generation rates in the waste management process. An exploration of inclusivity in this domain is required to implement inclusivity in waste management processes.

Currently, the research methods for studying inclusivity and circularity in a waste management process are limited. This research aims to develop a method that identifies barriers and opportunities for realizing inclusivity and circularity in waste management processes. The identification of these barriers and opportunities can help policy makers and academics in the development of inclusive and circular waste management processes. Currently no such method exists and therefore this research can be seen as a first step in the development of this method The method will analyze the whole waste management, the interactions of the waste with different actors, and the interactions between actors.

All this results in the following main research question:

How to identify barriers and opportunities for realizing inclusivity and circularity in a waste management process?

To further specify the main research question, four sub-questions are formulated:

RQ1: What are inclusivity and circularity in a waste management process?

RQ2: How to develop a method to identify barriers and opportunities for realizing inclusivity and circularity in a waste management process?

RQ3: How to apply the developed method to a case study?

RQ4: What are the implications (strengths, weaknesses, opportunities, and threats) of applying the developed method to a waste management process?

The next section will elaborate on the research design and structure of the remaining of this report.

1.3. Research design and structure

According to Doorewaard and Verschuren (2010, pp. 160–161), three key decisions should be made to set the research strategy. The first decision is whether the research has a broad or in-depth focus. A broad focus will result in generalizable results that limit the depth and details of these results. In-depth research will generate detailed results but limits the generalizability of the research. For this research, an in-depth approach is chosen because the results should be focused on the first step toward a generalizable result. This approach can be seen in the focus on the development of the method and not on the generalizability of the results for the inclusivity and circularity of the waste management. So, the details in the answers of this research will prevail above the generalizability of this research.

The second decision relates to whether the results are quantitative or qualitative. As this research is focused on developing a new method to identify barriers and opportunities for realizing inclusivity and circularity in a waste management process, a qualitative research method is chosen. This is chosen because this research can be seen as a first step in the development of this method. Besides, this study prevails the development of the method over the results of the application of the method, which also requires a qualitative approach.

The third and last decision is focused on the research approach. The decision is to be made between an empirical study or desk research. In this research, a combination of these approaches will be used. This decision is made because the research can be split into four parts. The first part of this research entails the introduction, which is done as desk research. The second part of this research is the initial research which will answer research questions 1 and 2 and will be done by applying a literature study. With this literature study, research question 1 will be answered by defining an inclusive and circular waste management process and defining inclusivity, and circularity. Research question 2 will be answered by using multiple academic articles. This will be done by reviewing different methods that can be used to identify barriers and opportunities for realizing inclusivity and circularity in a waste management process, after which a method will be presented, and the steps for the remaining of this research will be described. The third part of this research will be an empirical study in the form of interviews, which will be used to answer research questions 3. The empirical method that will be used will be a case study, which according to Williams (2011), is a good option because it is a suitable method to generate knowledge on a topic. Also, Doorewaard and Verschuren (2010, p. 183) agree that a case study is a suitable method to generate in-depth insight into an object or process. The final research question will be answered in the discussion of this research and will be done as desk research. The complete design of this research is presented in Figure 3.

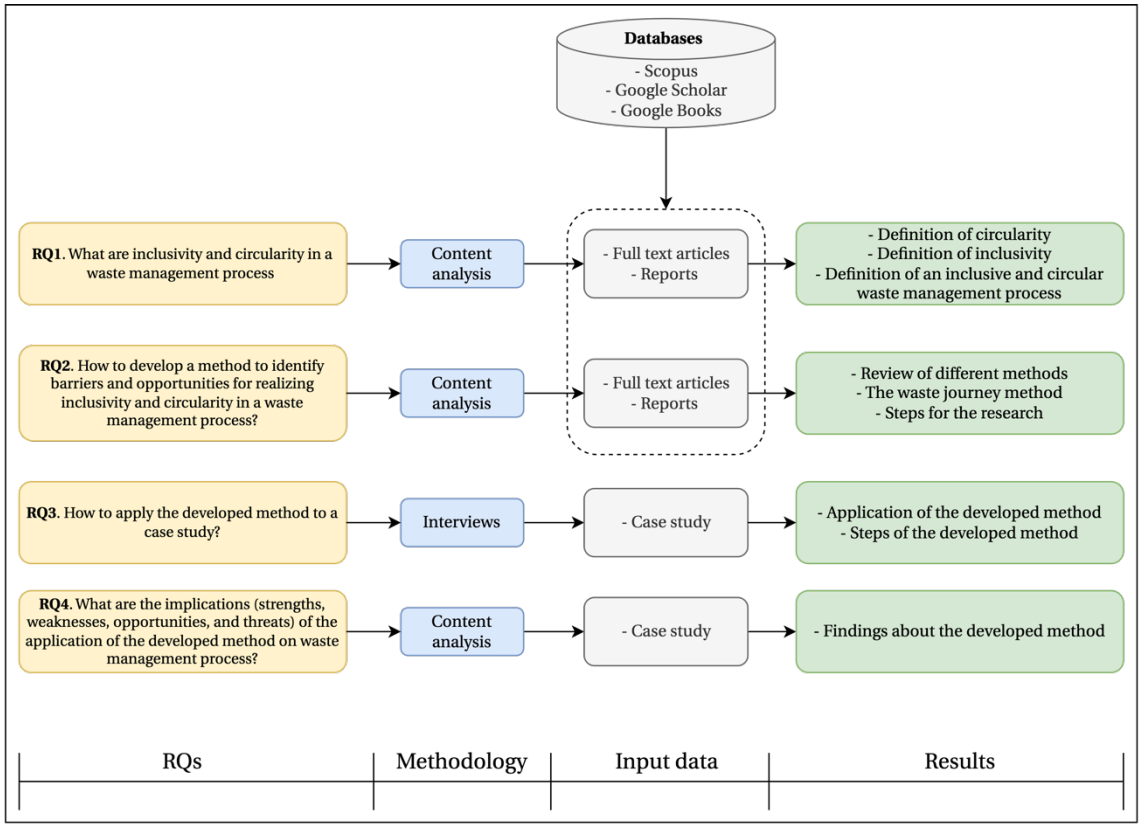

Figure 3: Research design

This chapter has so far introduced the topic of this research. An answer to the research questions will be given in the remainder of this research, which will be done according to the structure presented in Figure 4.

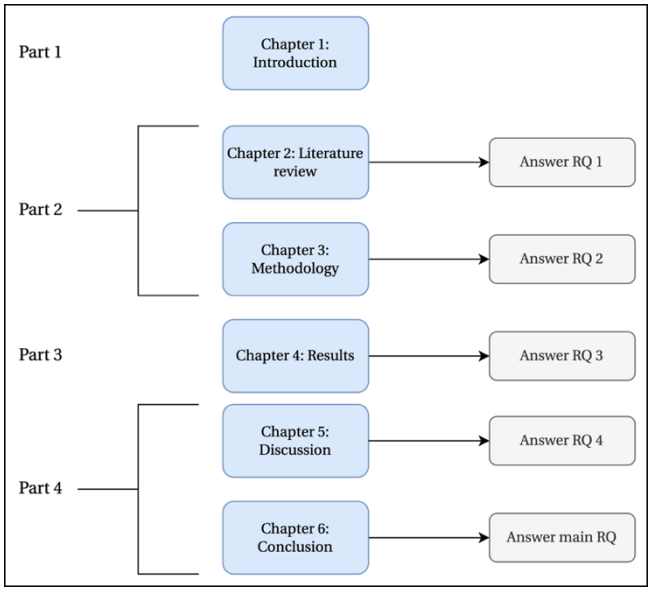

Figure 4: Thesis structure

As presented in Figure 4, this research will be done by applying the following steps. First, a literature review will present the current research on inclusivity in waste management and circular waste management. After this literature review, research question 1 will be answered. Secondly, desk research will be used to evaluate different methods for the identification of barriers and opportunities for realizing inclusivity and circularity and use these methods to develop a new method. This method's evaluation, selection, and presentation will answer research question 2. Thirdly this method will be applied in a case study, which will be used to answer research question 3. The results will be discussed in chapter 5, which concludes with an answer to research question 4. The research will end with a conclusion in chapter 6.

2. Literature review

This chapter presents the literature review for this research. This literature review examines the current state of the relevant academic literature (Hart, 1998). This chapter will end with answering research question 1. First, the terms circularity and circular economy will be conceptualized. After this, a conceptualization of inclusivity will be presented. Then the literature review on inclusive waste management will be given. With these steps, an understanding of these different topics is reached, which is then used to answer research question 1.

2.1. Circularity and the circular economy

In the world, fossil fuels and other limited natural resources have formed the basis for wealth and prosperity. As some of the materials currently used are depleting, the extraction of these materials should be limited to zero (IPCC, 2022). So far, most economies are based on a linear principle in which raw materials are used to produce products, which are disposed of as waste at the end of life. This linear economy is also known as the "take, make, and dispose" economy and has many negative effects on different aspects (e.g. environment) that, in the end, can threaten the survival of humanity (Ghisellini et al., 2016). A consensus is reached that a more sustainable economic model is needed. A simple representation of this transition by the Dutch government is presented in Figure 5.

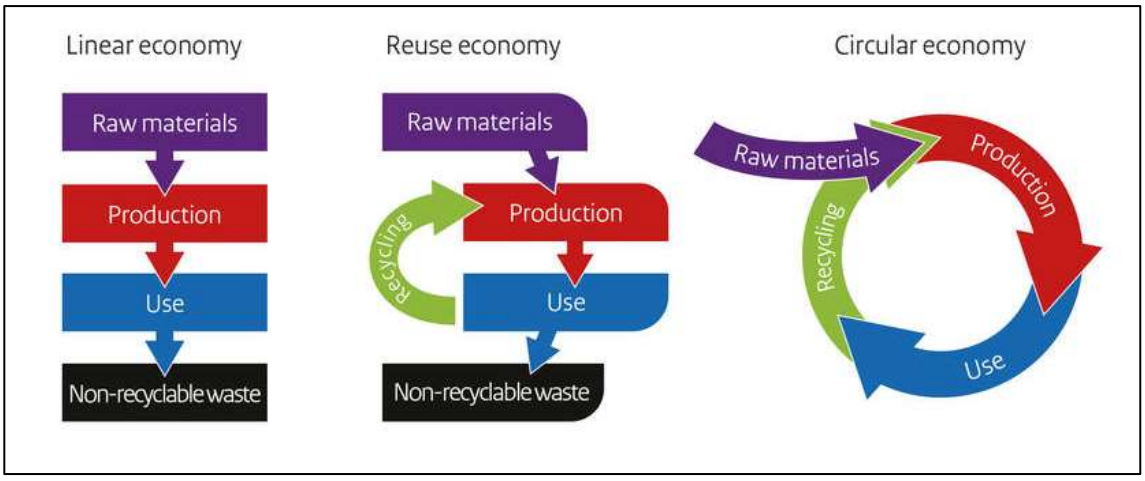

Figure 5: Representation of the circular economy (Government of the Netherlands, n.d.)

The term "circular economy" has gained much momentum in the academic literature in recent years (Kirchherr et al., 2017). The origin of the term circular economy (CE) cannot be pointed to one theory. According to Merli et al. (2018), CE originates in different scientific disciplines, such as industrial ecology, environmental science, and ecological economics. In 1989 the transition from the old open-ended economic system to the circular economic system was initially explained by environmental economists Paerce and Turner using the law of thermodynamics (Ghisellini et al.,

2016). They identified three different economic functions of nature, which should come with a price and a market. These functions are providing materials, a means of life, and a place for waste and emissions, which should be incorporated in the price of products. The second discipline is industrial ecology which examines the industrial system (the source) and its' environment (the affected) as a combined ecosystem defined by flows of material, energy, and information, together with the supply of resources and services from earth (Ghisellini et al., 2016). This system approach forms one of the key foundations for the circular economy, in which a holistic view of processes and systems is required.

The Chinese government was one of the first governments to develop a circular economy plan in 2008 and defined the circular economy as: "a general term for the activity of reducing, reusing and recycling in production, circulation, and consumption" (Shanghai Cooperation Organization Environmental Information Sharing Platform, 2009, p. 1). The European Union defined the CE in 2015 in their action plan for the circular economy – Closing the Loop - as: "an economy where the value of products, materials, and resources is maintained in the economy for as long as possible, and the generation of waste minimized" (European Commission, 2015, p. 2). Kirchherr et al. (2017) analyzed 95 different definitions found in 114 selected articles. They found that the circular economy is: "An economic system that replaces the end-of-life concept with reducing, reusing, recycling, and recovering materials in the production/distribution and consumption processes." (Kirchherr et al., 2017, p. 229). These definitions have some in common, which can be seen as the core principles of the CE. According to Kirchherr et al. (2017), the core principles of CE are the R-framework, the waste hierarchy, and the systems perspective. The Ellen MacArthur Foundation, a renowned research organization in the CE, also states three principles of the CE which are in line with the three principles of Kirchherr et al. (2017). These three principles are presented in the ReSOLVE-Framework, which is presented in Figure 6.

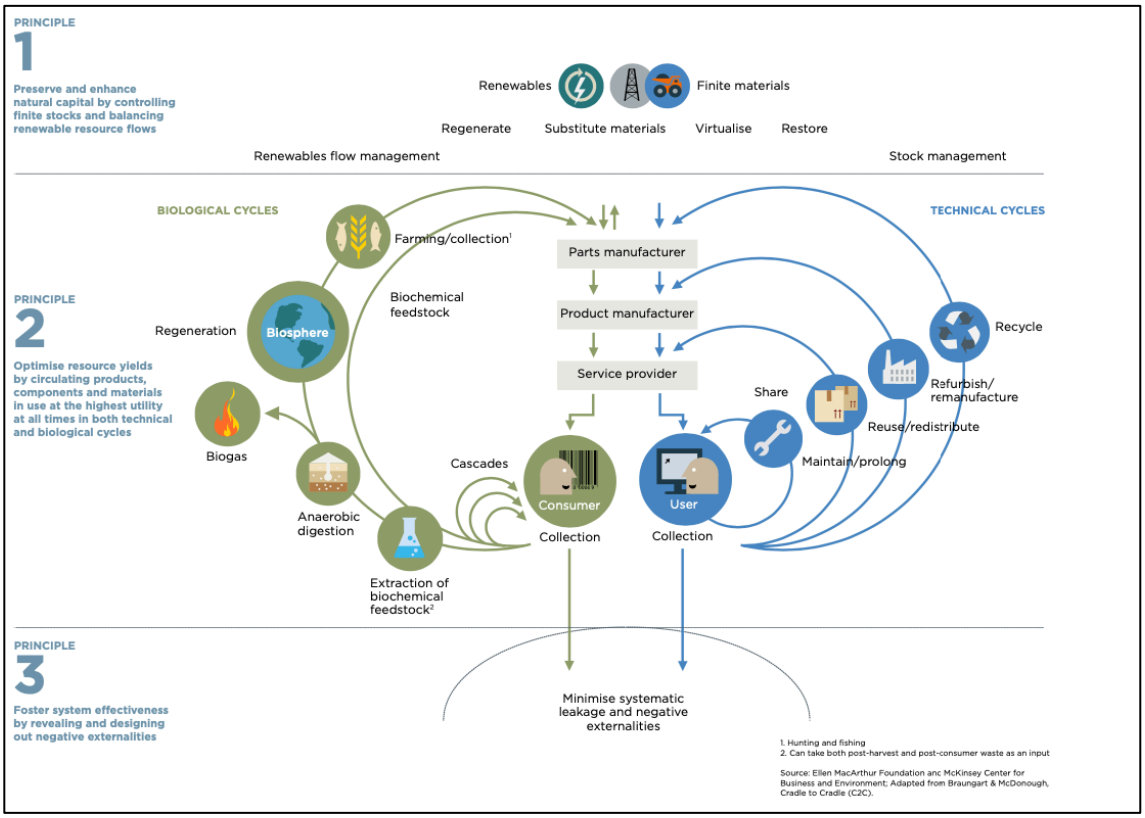

Figure 6: ReSOLVE-framework (Ellen MacArthur Foundation, 2015)

The ReSOLVE (regenerate, share, optimize, loop, virtualize, and exchange) framework presents six actions for governments and businesses that promote to the transition to a circular economy. First, regenerate the world by shifting to renewable energy and materials. Secondly, share, reuse, and maintain assets and products to prolong life. Thirdly, optimize the performance and efficiency of products. Fourthly, loop products and materials by remanufacturing and recycling materials. Fifthly, virtualize products, so dematerialization is realized, e.g., books. Lastly, exchange information and replace old materials with new renewable materials (Ellen MacArthur Foundation, 2015). According to Kirchherr et al. (2017), these six actions correspond to the R-framework, which is a framework that gives a hierarchy of different actions for the circular economy. There are multiple forms of the R-framework as the 3R framework, which the Chinese government used in 2008 (Shanghai Cooperation Organization Environmental Information Sharing Platform, 2009), the 4R framework, which was used in the waste directive of 2008 (European Commission, n.d.), others also introduced a 6R and 9R framework (Kirchherr et al., 2017). The most elaborate framework, according to Kirchherr et al. (2017), is the 9R framework from Potting et al. (2017), which is presented in Figure 7.

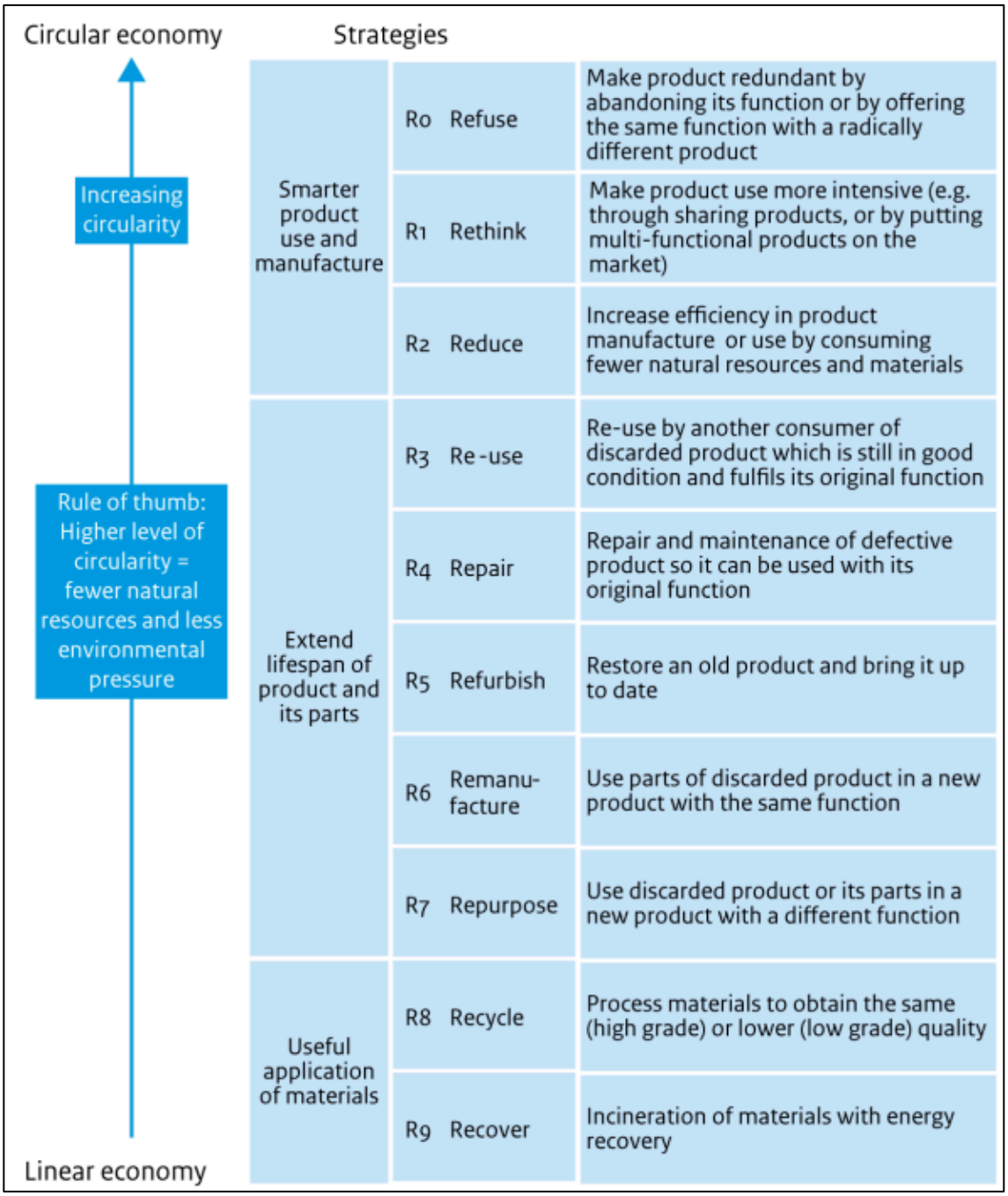

Figure 7: 9R framework (Potting et al., 2017)

This 9R framework presents ten strategies in a hierarchical order that contribute to the CE. Along with this hierarchical order of actions, the second principle of CE is the waste hierarchy, which states the preferred actions for waste management. In the European waste directive, these actions are (from top to bottom): prevention, preparing for reuse, recycling, recovery, and disposal (European Parliament, 2008). According to Kirchherr et al. (2017), this waste hierarchy is an essential principle for giving guidance to businesses as they tend to take the path of least resistance which would end up in minor changes in their business activities.

The last core principle is systems thinking, which prescribes that a complete system change is required to change to a circular economy. Not only waste management or a small change in a business process can make a change to an effective circular economy, but the whole system also must be evaluated and changed. In a circular economy, businesses, people, and plants are all part of a complex system and have links with each other (Ellen MacArthur Foundation, 2015). For example, optimizing a waste management process can contribute to the effectiveness of the process but may limit the accessibility of the process to people, which in the end, results in a less effective system. So, the links in the system and between people always matter and should always be considered.

To conclude this section: The circular economy is the goal of the transition from a linear, take, make, and dispose economy to a circular economy in which materials are endlessly reused, and new raw material use is limited or even zero. Waste management plays a big role in this economy because recycling is part of the waste hierarchy and the ReSOLVE-framework. In this, the waste hierarchy determines the preferred strategy for handling the waste, where it must be said that the best is to not produce waste, and if waste is produced, then treat it as circular as possible.

2.2. Inclusivity

The term inclusivity is derived from what is known as inclusion. The opposite of inclusion is exclusion, a state in which individuals cannot fully participate in their political, economic, and social lives (United Nations Department of Economic and Social Affairs, 2016). René Lenoir, a former minister in the French government in the 1980s, is seen as the author of the expression exclusion as he spoke of the excluded as: “mentally and physically handicapped, suicidal people, aged invalids, abused children, substance abusers, delinquents, single parents, multi-problem households, marginal, asocial persons, and other social ‘misfits’” (Rawal, 2008, p. 162). This term emerged after the European social welfare crisis and formed the basis for social studies on exclusion.

In 1995, the United Nations defined an inclusive society as “a society for all” (United Nations, n.d.). This inclusive society provides mechanisms for people to actively participate in their political, economic, and social lives. As a result, it transcends distinctions in gender, color, class, generation, and location and assures everyone the same possibilities to realize their full potential, regardless of where they are from (United Nations, n.d.). Social inclusion can be seen as a process and a goal, as it is about overcoming barriers and promoting opportunities. Gerometta et al. (2005) state that inclusion in social relations is formed by interdependence and participation and can be divided into five forms. Interdependence has two forms, in the form of formal relations in the division of labor and informal relations in social networks.

Participation is formed in material (ability to consume), political-institutional (political power), and cultural (education) forms.

Like an inclusive society, a city can also be an inclusive city that aims to reduce discrimination, inequality, and urban exclusion. Due to technological development in city services, a change from a techno-centric environment to a human-centric environment is required. In a techno-centric environment, vital services are only accessible to higher-educated people. In a human-centric environment, services are accessible to all people, and efforts are made to help people benefit from technological development (Liang et al., 2022). The World Bank states that “the concept of inclusive cities involves in a complex web of multiple spatial, social and economic factors." Spatial inclusion refers to providing affordable housing, water, and sanitation. Social inclusion promotes equal rights and participation for everybody, including the most disadvantaged. Economic inclusion relates to providing jobs and equal distribution of the benefits of economic growth (World Bank, n.d.). In a recent study by Liang et al. (2022), five dimensions are identified for the inclusive city. It must be said that these dimensions are interwoven and are conceptually based on the limitations of the study, but they give a first step towards defining the inclusive city. The five dimensions are: spatial, social, economic, environmental, and political. The spatial dimension ensures equal access to housing, services, and infrastructure. The social dimension focuses on equal access to social resources and creates ownership of these social resources. The economic dimension allows everybody, especially the disadvantaged, to share in rising prosperity, including labor and welfare services. The environmental dimension is to address the current generation's environment and natural resource demands without sacrificing future generations' interests. The political dimension grants citizens equal political rights and obligations and ensures a non-discriminatory relationship between the state and citizens (Liang et al., 2022).

All in all, inclusivity is the degree to which all people, including the most disadvantaged, can actively participate in, make use of, benefit from, and are affected by anything their live in a spatial, political, economic, environmental, and social dimension. This inclusivity can also be related to waste management because waste management is an important service in cities, and it requires participation and cooperation among different actors, including households, recycling companies, and waste collectors. Thus, it should be inclusive because granting everybody equal access to the waste management process is critical. Therefore, the next section will elaborate on inclusive waste management.

2.3. Inclusive waste management

For this literature study in inclusive waste management, the PRISMA method (Preferred Reporting Items for Systematic reviews and Meta-Analyses) is used, which was created to aid systematic reviewers in reporting why the review was conducted, what the authors did, and what they discovered in a transparent manner. (Page et al., 2021). The process of the literature study is presented in Figure 8. The search entry used in Scopus and executed on 27th of May 2022 is:

"Waste management" AND "inclusiv") AND (LIMIT-TO (LANGUAGE, "English")*

This entry resulted in 218 articles that were used for the selection. Reasons for articles that were rejected on the title focused on water waste management, water quality, electronic waste, or health care. The articles that were selected have a focus on renovation or construction and demolition waste.

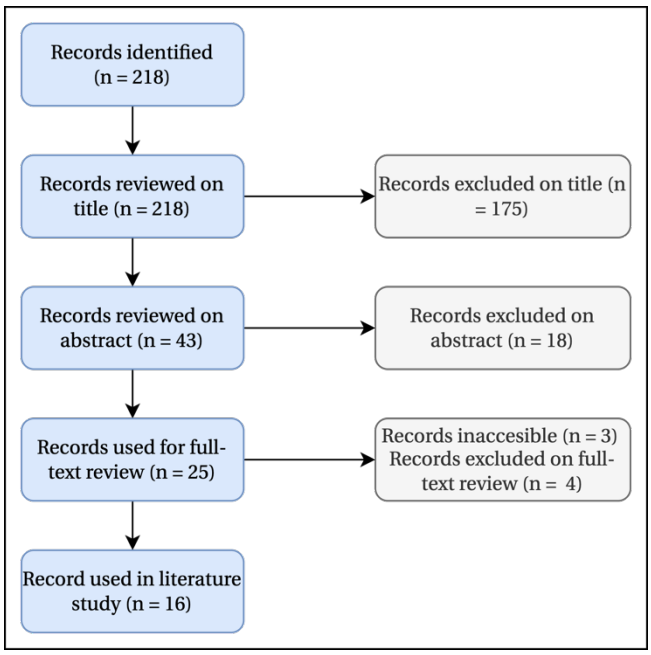

Figure 8: Literature selection inclusive waste management

Multiple findings can be made from the 16 articles selected in the literature study. These findings will be separated into what is inclusive waste management and why it is important. At first, most articles that are focused on waste management in less developed countries see inclusive waste management as a waste management system that incorporates traditional informal waste collectors in the system (Adama, 2012; Buch et al., 2021; Giovannini & Huybrechts, 2017; Gutberlet, 2015; Hartmann, 2018; Mbah & Nzeadibe, 2017; Oguntoyinbo, 2012; Sakamoto et al., 2021; Scheinberg & Simpson, 2015; Steuer, 2021; Tong & Tao, 2016). These articles found that in many cities around the world, the modernization of the waste management systems undermines the role of informal waste pickers/collectors as these are mostly not part of the new modernized waste management system. Therefore, their needs should be

recognized, and it is recommended to include them in the decision-making process of the modern waste management system by creating mutual benefits for all.

Furthermore, inclusivity means ensuring everybody is part of the system and the decision-making process. The UN-Habitat split this involvement into user and provider inclusivity. User inclusivity is “the extent to which users have a say in the waste management services in a city” (Ali et al., 2019; Masood et al., 2014). Provider inclusivity is "the degree to which service providers are involved in waste management planning and implementation processes" (Ali et al., 2019; Masood et al., 2014). Another definition for inclusivity found in the papers is: "Inclusivity is defined as ensuring a variety of perspectives through the involvement of various affected citizens groups” (Izdebska & Knieling, 2021, p. 121).

All in all, it can be stated that inclusive waste management is a waste management process that includes all people/actors in the process, including the decision-making process, the use process, and the improvement process, and ensuring that nobody is left.

There are multiple arguments found in the articles that promote why inclusive waste management is important:

- “People play an important role in effective waste management of cities and related circular economy.” (Izdebska & Knieling, 2021)
- Informal waste pickers see themselves as left-out and lower-class people (Giovannini & Huybrechts, 2017; Mbah & Nzeadibe, 2017)
- “Effective and inclusive waste management and prevention mechanism can contribute to long-term urban development sustainability.” (Vasconcelos et al., 2021)
- Technocratic waste management systems displace informal waste pickers (Hartmann, 2018)

The next section summarizes this chapter.

2.4. Summary

Based on the literature review presented in this chapter, research question 1 is answered. Research question 1 is formulated as follows:

What are inclusivity and circularity in a waste management process?

The answer to this question will be threefold. At first, a waste management process is defined as the process for the collection, sorting, transport, recovery, and disposal of waste, including supervision of those operations and follow-up for landfills after closure. So, the waste management process entails all steps from the waste generation to the end-state of that waste.

Secondly, the circular economy principles are a waste hierarchy, system thinking, and the R framework. From these principles, it can be concluded that waste management plays an important role in the circular economy as high-quality waste management contributes to the circular economy. So, a circular waste management process should follow the ReSOLVE-framework, have a waste hierarchy, and should be analyzed from a systems perspective.

Thirdly, inclusivity is defined as the degree to which all people, including the most disadvantaged, can actively participate in, make use of, benefit from, and are affected by anything in a spatial, political, economic, environmental, and social dimension.

So, an inclusive circular waste management process is a process that is equally accessible for everybody in terms of location (spatial), gives an equal speech to everybody (political), divides the costs and benefits equally (economic), is circular (environmental) and is non-discriminatory to everybody (social). The process entails all steps from the waste generation to an end-state of that waste, including all the actors involved in the process.

Now the answer to research question 1 is given, the next chapter will introduce the research methodology.

3. Research Methodology

This chapter will elaborate on the research method used in this study. This is done by reviewing different research methods that can be used to identify barriers and opportunities for realizing inclusivity and circularity in waste management processes. After different methods are evaluated, the method used for this research will be presented. Finally, the steps for the application of this method in this research will be presented. This chapter concludes with answering research question 2.

3.1. Review different research methods

The goal of this research is to develop a method that identifies barriers and opportunities for realizing inclusivity and circularity in waste management processes. This section will set out different methods that can be used for this study.

A method that is often used in waste management studies is material flow analysis (Gao et al., 2020; Zhang et al., 2021). This method is useful for quantifying waste generation rates of different sorts of waste streams as it analyses how waste from source to an end-state flows. In this flow analysis, the focus is on the quantification of the waste and how the waste travels through the different parts of the waste management process. This quantitative approach can be seen useful for the circularity part of this research, as seen in the studies of Gao et al. (2020), and Zhang et al. (2021). The method lacks focus on the role and the interaction of actors in the waste management process. Researching actors is important for the inclusivity part of this research. Because the main goal of this study is to identify barriers and opportunities for realizing inclusivity and circularity of a waste management process, the material flow analysis is not seen as useful because it lacks focus on the actors in the process.

The Wasteaware benchmark indicators can be used to identify weak spots in the municipal solid waste management system of a city, according to Ali et al. (2019). It is developed for quantitively measuring a waste system's performance and can be used to compare the performance of one city's system to the other's (Wilson et al., 2015). Besides, the goal of the Wasteaware benchmark indicators is to use existing data to make the indicators more easily useable. This quantitative and easy-to-use approach limits the conclusions of the results to numbers that are useable for comparisons but therefore lacks the qualitative arguments of the users and people in the evaluated waste management system. What can be used from the Wasteaware benchmark indicators are the criteria used for the degree of user and provider inclusivity, but these will be explained later in this chapter.

A method used to research inclusivity and circularity in waste management is the theory of planned behavior (Pongpunpurt et al., 2022). The theory of planned behavior is a theoretical framework that explains how intentions and behavior play a role in a person's decision-making process. Iczek Ajzen is seen as the founder of this theory and is an extension of the theory of reasoned action. In this behavior, according to Ajzen (1991), different constructs, like attitude, subjective norm, and perceived behavioral control, play a role that, in the end, determine the behavior of an individual (Ajzen, 1991). Pongpunpurt et al. (2022) proposed an extended version of the theory of planned behavior to research people's intentions for household waste separation at the source. This extended version added the situational factor and knowledge to the factors of attitude, subjective norm, and perceived behavioral control. The theory is applied to analyze household solid waste separation behavior and is presented in Figure 9 (Pongpunpurt et al., 2022). In this figure, the five different factors influence the intention of an actor to perform a certain behavior. The study tested 7 different hypotheses that influence the behavior of the actor, which are presented with an arrow that shows a positive relationship between the factor and the intention or behavior. In the study, the intention (H1), knowledge (H7), and subjective norm (H3) were found to significantly contribute to the positive separation behavior of residents in Bang Chalong, Thailand. The other hypotheses were rejected in the case study, but the authors did not conclude that this will be the case in other studies.

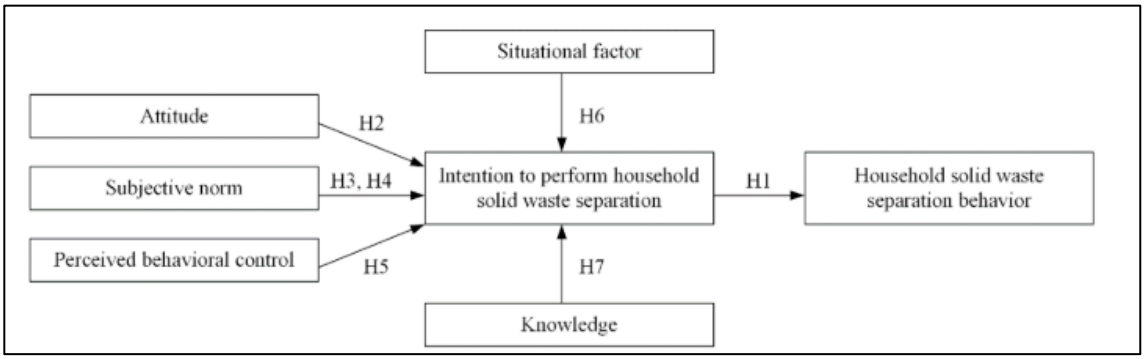

Figure 9: Extended theory of planned behavior (Pongpunpurt et al., 2022)

The extended theory of planned behavior can be used to research the intentions for people to separate waste at the source. What is lacking in the study of Pongpunpurt et al.(2022) is that they only consider the source, but there are other actors in the process that, with their behavior, influence the performance of the waste management process. By applying the theory of planned behavior on multiple decisions in a waste management process barriers and opportunities for realizing inclusivity and circularity can be identified. Therefore, multiple decisions of different actors in the waste management process should be analyzed.

The last method that is evaluated in this research is the customer journey mapping. Although customer journey mapping is not seen to be used in waste management studies it is proved to be useful for evaluating the customer experience in a business process (Towers & Towers, 2022). As inclusivity in a waste management process is strongly linked to the experience of an actor in a waste management process the customer journey can be useful for this research. Customer journey mapping is useful for mapping the business process and evaluating the experiences of different actors in the process evaluated.

Table 1: Comparison of different methods

Method	Positive	Gap
Material flow analysis	Useful for a quantitative flow analysis of a waste management process	Lacks focus on the behavior of actors
Wasteaware benchmark indicators	Useful for identifying weak spots in a waste management process	Only useful for the comparison of one process to others
Theory of planned behavior	Great for analyzing the behavior and motivations of actors	Focus on one step in the process
Customer journey mapping	Consider the whole process and experiences of actors in the process	Not used in waste management processes

Table 1 presents an overview of the different methods considered for this research. The positive point of the material flow analysis is that the methodology can be applied to the whole waste stream. The positive point of the theory of planned behavior is that it can give a detailed overview of what moves an individual to behave in a certain way. The gap to be filled is a methodology in which the whole waste stream is considered, and the inclusivity of all the actors in the process is involved. In the current inclusivity research methods, such a method is not found, so this study proposes a new research method. This method will be based on the customer journey mapping method and the customer journey theory, which will be presented in detail in the next chapter.

3.2. Customer Journey

The customer journey is selected as the basis for the methodology of this research because it follows how a customer goes through and interacts in a business process. By changing the perspective to waste, it can be seen as a waste journey in which the theory is used to follow how the waste goes through the process and interacts with the different actors. Besides the interaction of the waste with actors, the interaction between different and their arguments for their behavior can also be evaluated in this theory. A detailed overview of the waste management process can be constructed by evaluating these interactions, relationships, and arguments.

A literature review is conducted in Scopus to define the Customer Journey by searching for the following:

"Customer journey" AND "consumer journey" AND review AND (LIMIT-TO (LANGUAGE, "English")

The term consumer journey is added because customer and consumer journey are used interchangeably (Towers & Towers, 2022). The term review was added to focus on studies with a general approach. The search was done in Scopus on the 26th of May 2022 and resulted in 94 results, and the selection process is presented in Figure 10.

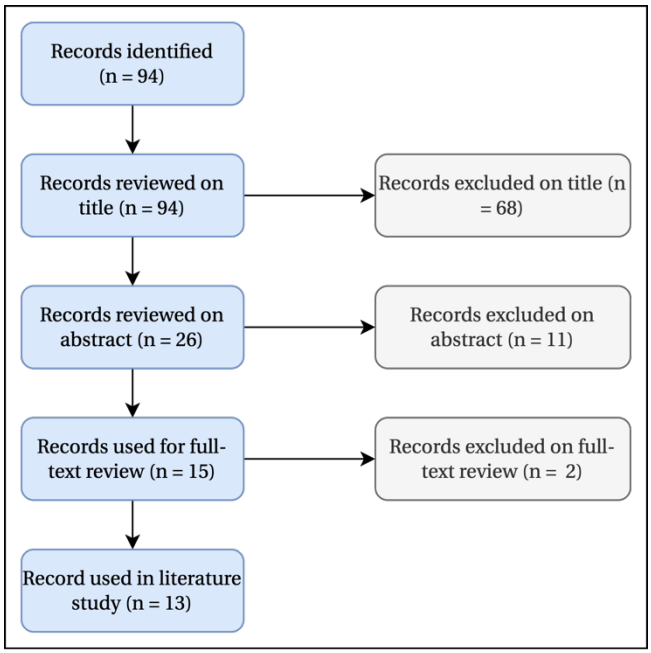

Figure 10: Literature selection of customer journey

Of the 13 articles selected in this literature review, 11 stated a customer journey definition. Currently, in the literature, there is still debate on what the best definition of the customer journey is. Therefore, an overview of the definitions used in the selected articles is presented in Table 2.

Table 2: Definitions of the customer journey

(Authors, year)	Definition
(Towers & Towers, 2022)	The process a customer goes through, across all stages and touch-points, makes up the customer experience.
(Helouani, 2021)	A way to represent a set of steps the customer needs to take toward product or service consumption
(Tueanrat et al., 2021)	A process or sequence that a customer goes through to access or use an offering of a company.
(Terra & Casais, 2021)	A sequence of events in which the customer goes to look for information and interacts with a certain product or service
(Rana et al., 2021)	The complete sum of experience a customer goes through when interacting with a brand.
(Gao et al., 2020)	The process the customer goes through with an organization across all stages (pre-purchase, purchase, and post-purchase)
(Santana et al., 2020)	The process through which consumers express the need or desire for a product/service through its selection, consumption, and retrospective evaluation.
(Varnali, 2019)	A service system composes of a network of agents and interactions that integrate resources for value co-creation.
(Følstad & Kvale, 2018)	The process of experiencing service through different touchpoints from the customer's point of view.
(Santos & Gonçalves, 2021)	The process that customers go through across all touchpoints and decision stages which adds up to the customer experience
(Shavitt & Barnes, 2020)	A series of touchpoints that "involves all activities and events related to the delivery of a service from the customer's perspective."

From Table 2, multiple conclusions can be drawn about the customer journey definition. At first, the customer journey can be used to visualize a business process from a customers' perspective. Figure 11, for example, presents the customer journey from a value creation perspective in which the customer journey is seen as a value transaction between the customer and the firm. In this, the customer starts the journey in a pre-purchase phase, to a purchase phase, and then a post-purchase phase. Each firm's goal is to find the customer in sector 3, as, at this point, the most profit can be made on a customer (Huang et al., 2022). Figure 12 presents a customer journey for a tourist destination in which a customer uses websites to gather information in the pre-service stage. In the service stage, the customer goes through different steps, and in the post-service stage, he evaluates the service.

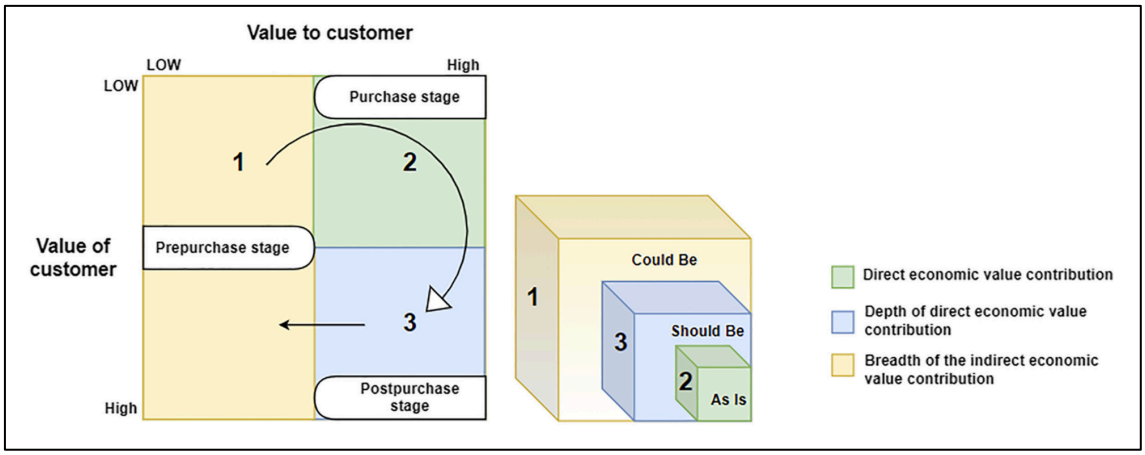

Figure 11: Customer journey example 1 (Huang et al., 2022)

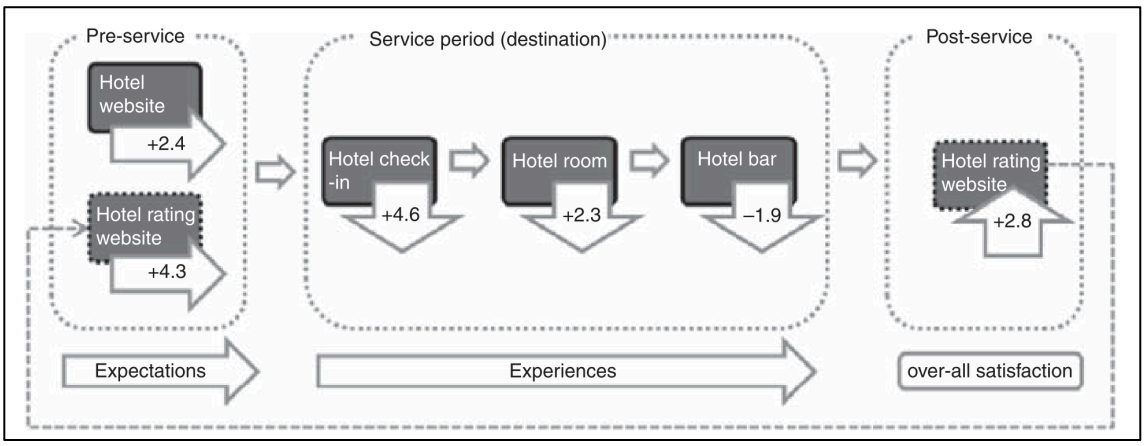

Figure 12: Customer journey example 2 (Følstad & Kvale, 2018)

Secondly, the customer journey represents some sort of phasing or sequence of steps the customer goes through. Two types of phasing are most seen in the literature review: i) a three-phase representation, including pre-purchase, purchase, and post-purchase, as in Figure 11 and Figure 12; ii) a four-phase representation, including recognition, information search and evaluation, purchase, and post-purchase evaluation. This four-phase representation is created from the purchase process (Gauri et al., 2021)

Lastly, the customer journey is always presented from a certain perspective, as seen in Figure 11. This presents a customer journey from a customer and firm's perspective, and Figure 12 uses a tourist's perspective. By selecting the right perspective, the customer journey can identify barriers and opportunities that can help improve the process and, therefore, the customer's experience.

So, the following conclusions can be drawn from the literature study, which forms the basis for developing the methodology in the next section:

1. A customer journey should consist of staged, sequential steps.
2. The interactions between customers and the company are defined as touchpoints.
3. The perspective in a customer journey can vary depending on its purpose.

Now the customer journey is defined and clearly explained, the next section will introduce the waste journey method and the approach for the remaining of this research.

3.3. Waste journey method

In this section, the waste journey method will be developed. This is done by first setting the goal of the method. Secondly, the components of the waste journey are explained. Thirdly, the application boundaries and steps of the method are set. Lastly, the observations of the method will be presented.

3.3.1. Goal of the waste journey method

The goal of the waste journey method is to identify barriers and opportunities for realizing inclusivity and circularity in waste management processes. For this, an open-ended research approach is required as the waste in the waste journey is followed from actor to actor. By mapping this process, the barriers, and opportunities for realizing circularity can be qualitatively examined. The barriers and opportunities for realizing inclusivity in the waste management process are identified by analyzing the decisions different actors have made with the theory of planned behavior. By evaluating these decisions, the barriers experienced by the actors will be found, and opportunities for improvements in the waste management process can be identified.

3.3.2. Overview of the components in a waste journey

Based on the customer journey theory, the waste journey is defined as the process waste goes through from waste to a certain (circular) end-state across all stages and touchpoints where it interacts with actors that make up the waste management process. In this process, actors will act in a way that should or should not contribute to the circular performance of the waste management process. This circular performance can be defined by the end-state of the waste, for example, prepared for reuse or incineration. Certain behavior of the actors makes the actions they do. Analyzing this behavior and finding the arguments people have for their actions contributes to the identification of barriers and opportunities for realizing inclusivity and circularity in the process. This behavior will be explained according to the theory of planned behavior. This can be graphically presented in Figure 13. What is seen is that people have a reason the generate their waste and will prepare themselves or others before generating the waste. People will take certain steps when the waste is generated, and

the waste will cross different actors before it is treated to a certain end-state. In this process, different actors will interact with the waste and will interact with each other about how the waste should be processed or consult other actors. For each action an actor takes, he will have certain arguments about why he chooses to act in a certain way. These actions can have direct influence on the circular performance of the waste management process. Understanding of these actions and therefore the behavior of actors is required for the improvement of the process. This understanding will be reached by the analysis of actions and decisions with the theory of planned behavior.

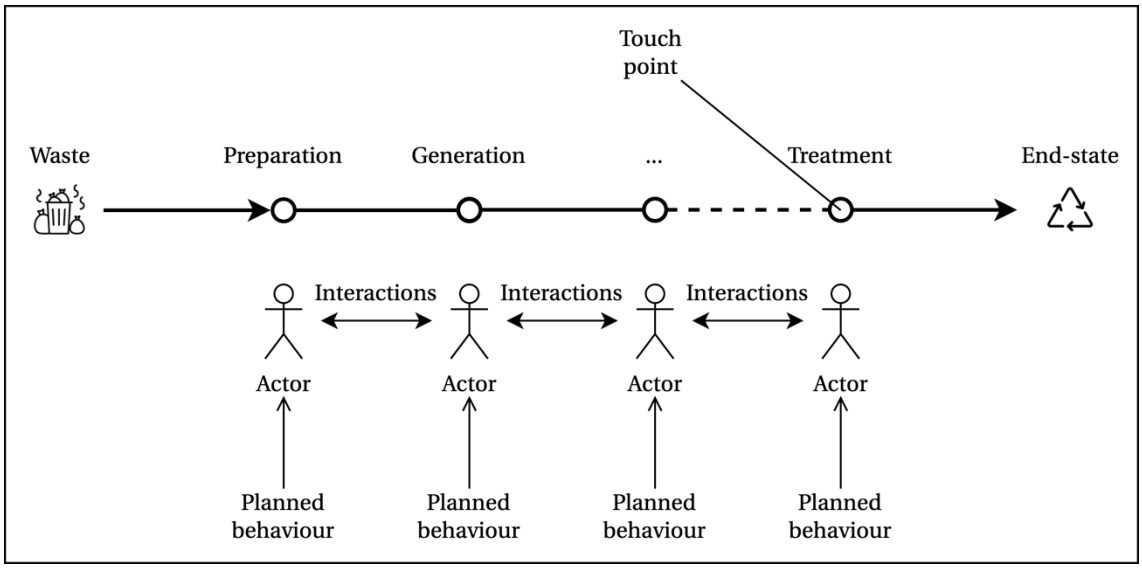

Figure 13: Graphic representation of the waste journey

In this waste journey, each touchpoint represents a step in the waste management process. In these steps, actors hand over the waste from one actor to the other. In this touchpoint, the actor does a certain action, which is the result of his attitude, subjective norm, situational factor, knowledge, and perceived behavioral control. The individual action of an actor can determine the circular performance of the waste management process. To set an example, a house owner hands in his waste at the municipal recycling center completely separated. This action can have different reasons from the theory of planned behavior. So, it can be because the actor has a positive attitude towards circularity, or because his neighbor also does it this way, which forms a subjective norm, or because his previous experience was good, which is a form of Perceived behavioral control.

The theory of planned behavior can also be used to explain the inclusivity of this process, as by identifying people's arguments to act in a certain way, the barriers in an inclusive process can be identified. For example, a household does not separate plastic from municipal solid waste because there is no plastic container nearby. So, it is from an accessibility point of view (spatial inclusive) that this actor does not contribute to the circular performance of the waste management process. By using this

theory as a framework for data analysis, a thorough analysis of the decisions of actors can be made. This analysis can then help identify barriers and opportunities for improvements of the waste management process.

3.3.3. System boundaries

For the development of this method, it is important to set the boundaries of the systems on which it can be applied. The method is developed to identify barriers and opportunities for realizing inclusivity and circularity of a waste management process. Therefore, the system boundaries are determined by the waste management process or waste stream the method is applied on. In general, the process begins with someone who tends to generate waste. For example, somebody is willing to renovate his bathroom and ends with an end state of the waste, which for example, can be ready for recycling or incineration.

3.3.4. Observations

The method is designed to be used for an investigative and open-ended method because it follows the waste through the process. The waste should be followed from phase to phase, where the phases are determined by the actions of the actors generating or handling the waste. In this investigation of the waste flow, the actions, and the arguments for the behavior of the actors and their interactions are the key focus points in the observations of this method. So why do people act in a certain way, and what are their arguments? This should be explained according to the theory of planned behavior. What comes out of these observations will be a storyline of the waste traveling from actor to actor with the goal of being treated in a circular way. These observations can then be used to find the gaps and opportunities for interventions in the waste management process to optimize for inclusivity and/or circular performance.

3.4. Case selection

Now the waste journey method has been introduced, a certain type of waste is selected for this research. As this research is done as part of the Master Construction Management and Engineering, a focus on construction and demolition waste seems obvious. Most of the construction and demolition projects are done by professionals. The recycling rate of the waste produced in these professional projects in the Netherlands is more than 95% (Ministry of Infrastructure and Environment & Ministry of Economic Affairs, 2016). Besides that, a lot of research into this type of waste is already done (Ashraf, 2018; Obaid et al., 2019; Villoria-Sáez et al., 2020; Yazdani et al., 2021).

The projects that have had less attention in the literature are renovation projects, especially single-house renovation projects. These are the small renovations of a bathroom, living room, or complete house. The waste related to these projects is called Household Renovation Waste (HRW). HRW can be brought to a municipal recycling center and will then be considered as Construction and Demolition waste or as bulky waste (Rijkswaterstaat, 2021b). Another option for this waste to be managed is by using a container that is placed in front of the house. There are containers in different sizes and for different materials, like wood, metals, bulky waste, and construction and demolition waste (Bouwbakkie.nl, n.d.). From this, it can be concluded that HRW is now not seen as a separate waste stream. In HRW management, citizens make use of municipal recycling centers, contractors, and professional recycling companies for the processing of their waste. Because the role of citizens in this system is so big, the system should be inclusive to function at its full potential.

It is expected that HRW is to grow in the Netherlands in the coming years due to the Dutch governments' goal to insulate 1.5 million houses in the coming years (Rijksoverheid, 2019). The estimations of the amount of waste that is produced during renovations vary from 5 to 10 percent of the total construction and demolition waste (Mália et al., 2013; Marrero et al., 2020)

3.4.1. Defining household renovation waste

A literature study is conducted to define what household renovation waste is. Because multiple definitions for renovation waste are used in academic papers, the search entry is broadened by also searching for retrofitting and refurbishing. Next to that, the search for waste management resulted in a minimum number of articles. Therefore, the search is widened by adding the terms treatment and disposal. This resulted in the following entry used for the search and executed on the 6th of June 2022:

(Renovat OR refurbish* OR retrofit* OR r&r) AND (waste AND (management OR treatment OR disposal)) AND (hous* OR dwell*)) AND (LIMIT-TO (LANGUAGE,"English")*

The process of the literature study is presented in Figure 14. This entry resulted in 341 articles that were used for selection. Reasons for articles that were rejected focused on water waste management, water quality, electronic waste, and lack of focus on renovation waste. The articles that were selected have a focus on renovation or construction and demolition waste.

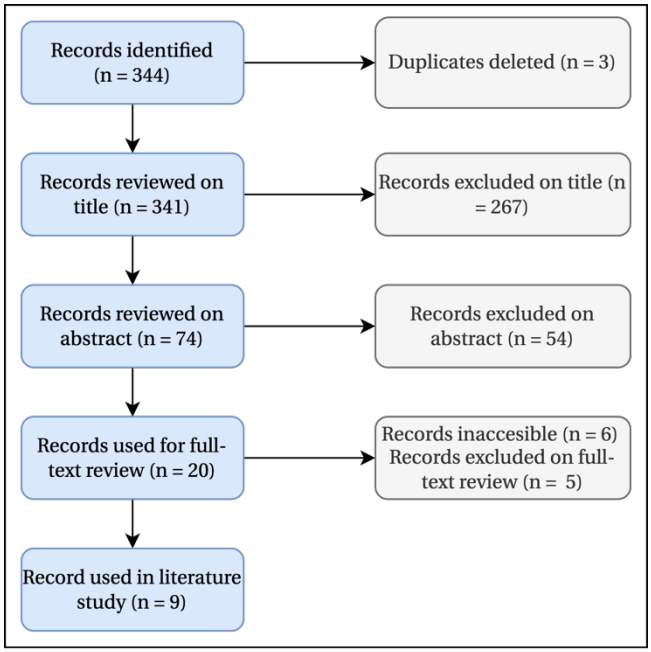

Figure 14: Literature selection of household renovation waste management

The first finding that can be drawn from the selected articles is that most studies do not see renovation waste as a separate waste stream but as part of the total construction and demolition waste. Ding et al. (2019), Mália et al. (2013), Marrero et al. (2020), and Wang et al. (2021) study renovation waste as a separate waste stream, and all mention that this is required in the future to improve the reusability and recyclability. Based on this study, two different definitions of renovation waste can be distinguished, which are presented in Table 3.

Table 3: Definitions of renovation waste

Authors, year	Definition
(Ding, Shi, et al., 2019)	Waste that is related to the modification or improvement of the residential building
(Marrero et al., 2020)	Waste that is related to the work needed in the building due to obsolescence or deterioration of some of its elements

Wang et al. (2021) recognize renovation waste as part of the decoration and renovation waste, which includes the decoration of new buildings. In the study by Malia (2013), renovation waste is not specifically defined, but it is estimated to be about 5% of the total construction and demolition waste of a building's life cycle. It is unclear if this incorporates only necessary renovation and retrofits or also esthetical renovation by homeowners. For the remaining of this paper, the definition of Ding et al. (2019) will be used with the exclusion of new house decorations. So, household renovation waste is waste that is generated during the modification or improvement of a residential building that was already built. The study of Ding et al. (2019) also defined 6 stages of renovation waste generation, which are: "layout transformation", "installation engineering", "mason engineering", "carpentry engineering", and

"paint engineering", "related installation". These stages all relate to the reason for generation, and in their study, they estimated that about 75% of the waste is generated during the layout transformation stage, which mostly consists of bricks, concrete, and tiles.

To conclude this section, HRW is the waste that is generated during a modification or improvement of a residential house. This can be either for layout transformation, installation engineering, mason engineering, carpentry engineering, or paint engineering.

3.4.2. Stages in the HRW waste journey

Besides the definition of HRW, phasing of the waste management process can be found in the literature. The customer journey theory showed that touchpoints are crucial in the design of customer journeys. These touchpoints related to renovation waste can be seen as the different points in the process where the waste is generated, treated, or moved. From Buch et al. (2021), a standard waste management process has at least the following stages: collection, transport, sorting, treatment, and final disposal or reprocessing. If this standard procedure is combined with the customer journey 4 phase representation (need recognition, information search and evaluation, purchase, and post-purchase evaluation), Buch et al.'s definition lacks a preparation and a generation stage. So, in this research, it is proposed to incorporate a preparation and generation stage in the standard waste management process. The theoretically formed HRW management process that will be used as the basis for this research will then look as presented in Figure 15. This process can be used to determine which actors are to be interviewed.

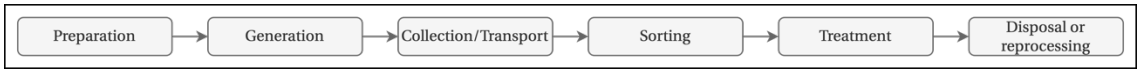

Figure 15: Theoretical phasing in the HRW waste journey

To further define these stages, a brief description will be given:

- Preparation: Before the waste is generated, certain steps will be taken by the household to start their renovation. At first, the household will have different arguments for generating waste. Besides the arguments for the generation, the household will also inform how the waste should be handled. This can also involve hiring a contractor to do the renovation for them. The different decisions made in this phase will have an impact on the remaining waste journey.

- Generation: the renovation waste is generated either by the household itself or by a professional influenced by their intentions. In this generation phase, also different decisions will be made that influence the remaining of the waste journey. For example, a renovation of a bathroom wall can be done by separating each tile with care, which makes them reusable, or by smashing the wall, which lowers the circular potential of these tiles.
- The collection/transport: in the Netherlands, people can bring their waste to the municipal recycling center themselves, or the waste will be collected by a recycling/waste disposal company.
- Sorting: the waste will be sorted and prepared for future purposes.
- Treatment: the waste will be treated for the end-of-process purpose.
- Disposal or reprocessing: the waste can be disposed of or will be reused, recycled, or repurposed.

3.4.3. Actors in the HRW management process

An actor in the HRW management process is seen as a person or entity that takes part in the HRW management process. In the previous parts of this research, multiple actors are already mentioned. The actors and their roles are presented in Table 4

Table 4: Actors in the HRW management process

Actors	Roles
Household	Tend to generate waste by renovating something in their house. Can generate the waste themselves or hire a contractor. Can transport the waste to a municipal recycling center.
Contractor	Generate HRW. Can do the transport, but not necessarily.
Municipality	Set regulations for the waste management process. Supply the municipal recycling center.
Waste disposal company (e.g., GP Groot)	Offer containers for HRW collection and transports them to the sorting facility. Can do the sorting itself but not necessarily.
Waste sorting company (e.g., Renewi, PreZero)	Treat the waste into different waste streams for the purpose of recycling. Can also do the collection of waste.

The first in a HRW management process is the household itself. He generates the waste himself if he decides to renovate the house by himself or he will hire a contractor to do it for him. The contractor or household can bring the waste to a recycling, or they can use a container that is placed by a waste disposal company. The municipality is the policy maker in the HRW management process. The waste disposal

company owns, places and transports containers. They can do a first sorting by themselves in which they cherry pick the waste, or they bring the container to a waste sorting company. The waste sorting company sorts and trades the waste in different waste streams.

To conclude this section, this research will focus on the HRW management process in a case study to test the developed waste journey method. To gather different insights about this method, data must be collected. How this data is collected will be explained in the next section.

3.5. Data collection

As explained in the research design of this study, a case study method will be used for this research. From the literature review in section 3.4, different techniques are found to collect data in HRW research, such as site inspections, data analysis, interviews, and literature studies (Ding, Gong, et al., 2019; Zhang et al., 2021).

One of the most used methods, according to King (2004), for collecting data in case studies is interviews. The purpose of a qualitative research interview is to look at the topic from the perspective of the respondent and to understand how and why they come to this perspective (King, 2004). Interviews can be held in different forms and by using different techniques. For example, interviews can be done face-to-face or by using an online call application like Microsoft Teams. Besides, how the interview is formed also influences the outcomes, for example, semi-structured, exploratory, or unstructured. For this research, a semi-structured approach is chosen as it is a versatile and flexible technique for interviewing (Kallio et al., 2016). Besides, the topic of this research focuses on the perceptions and opinions of the respondents towards inclusivity and circularity, for which semi-structured interviews are useful (Kallio et al., 2016).

The goal of the interviews in this research is to create the waste journey as carried out by the respondent. This will be done by creating a process map of the decisions and actions of the interviewed actor that will then be questioned by the interviewer. The waste journey will be created by writing the actions and decisions down on pieces of paper and put in chronological order. In the interview, the motivations of these actions and their decisions are the key points to focus on, as these form the arguments for the behavior of the interviewee. As the waste journey for every interviewee is different, the actions and decisions cannot be written down beforehand. The interviews are preferably conducted face-to-face, as this gives the opportunity to read the interviewee's facial expressions. As it is chosen to do semi-structured interviews, an interview protocol is set up in Appendix A. This is used as a guide for the interviews

and contains background information on the renovation project or the waste generated and focuses on the arguments of the interviewee. The interviews are different for each actor, as they have different roles in the waste management process. In the waste journey the waste is followed from actor to actor.

Waste journey 1 starts with a house owner, interviewee 2, who is doing a renovation project himself in his house in Rotterdam. The house owner brought his waste to a recycling center, interviewee 8. The interview with the operator at the recycling center was not that useful. Therefore interviews 1 and 3 were added to retrieve extra information about the practices in a recycling center. The waste from the recycling center could be brought to interviewee 4, which is a waste sorting company for construction and demolition waste. This waste sorting company was contacted and selected by the author because the recycling centers were not open about the partners for their waste sorting. Table 5 presents the interviews held for waste journey 1.

Table 5: Interviews for waste journey 1

No.	Actor	Action
1	Recycling center and waste collecting company	Operate recycling center and trade waste
2	House owner	Remove a wall in a house in Rotterdam
3	Recycling center company	Operate 12 recycling centers in Noord-Holland and trade waste
4	Waste sorting company	Sorting C&D waste
8	Municipal recycling center	Operate recycling center and trade waste

For waste journey 2 the starting point is formed by a contractor who did a complete renovation of an appartement in Amsterdam. The contractor was selected randomly and was willing to participate. The house owner is asked to participate in the research but was not willing to. The contractor uses a container broker for the container management, who in his turn has asked a waste sorting and waste collector company for the handling, sorting and treatment of the waste. This led to a full waste journey and the interviews held for this waste journey 2 are presented in Table 6.

Table 6: Interviews for waste journey 2

No.	Actor	Action
5	Contractor	Completely renovate a house in Amsterdam
6	Waste sorting company and waste collector	Pick up containers, sort waste, and trade waste
7	Container broker	Arrange the container for the contractor

Now the formation of the waste journeys is explained, Appendix B presents extra details and a small description of each interview. The next section will present how the data gathered in the interviews is processed.

3.6. Data Processing

The data collected from the interviews will be two-fold. At first, during the interview, a process map of the steps and decisions the actor went through will be constructed. During the interviews, these process maps will be constructed with post-it notes in case of a face-to-face interview and in Mural in case of an online interview. These process maps will be used for reconstructing the waste journeys, which will be produced in Draw.io, an online free to use online diagram software.

The second part of the data is recordings of the interviews. These records are fully transcribed and used for the text coding of the interviews, which is presented in the next section.

3.7. Data analysis

The transcripts and the process maps created in the interviews are used to create the waste journeys. This is done by interpreting the transcripts and finding the arguments the actors have for their actions. A method that helps interpret interviews is coding the transcripts. There are two approaches to coding interviews: data-driven coding and concept-driven coding. In concept-driven coding, the codes are predefined in the research (Gibbs, 2012). So, they represent categories or concepts that are retrieved earlier on in the research, for example, from the literature study (Gibbs, 2012). In data-driven coding, the data is coded with an open mind, and there is no starting list of codes to be used in the coding (Gibbs, 2012). In essence, the difference between concept-driven and data-driven coding is the difference between induction and deduction.

Although the results of the interviews are unknown, and the interviews have a semi-structured approach, it is chosen to use the concept-driven approach for the coding of the interviews. This is done because the goal of the interviews is twofold; firstly, creating the process maps and secondly, finding the arguments the actors have for their actions. The theory of planned behavior is used to label the arguments the actors gave in the interviews for the actions they did in the waste journey. This theory can help understand what moved the actor to act in a certain way. The labels that will be used are based on Figure 9:

- Attitude
- Subjective norm
- Perceived behavioral control
- Situational factors
- Knowledge

For each label, a description will be presented.

Attitude

The attitude label is used for arguments that relate to the attitude the actor has towards sorting or recycling waste. The label will be applied to quotations that state that actors think that sorting or recycling waste is seen as a useful or useless activity or a good or bad activity.

Subjective norm

The subjective norm is used for arguments that relate to any form of social pressure. So, is the actor influenced by his neighbor or by politicians to sort his waste correctly? So, the label will be applied to all arguments that relate to any influence from others that have an influence on the behavior of the actor considered.

Perceived behavioral control

Perceived behavioral control refers to the reflection of an actor on their own ability and willingness to perform a given behavior. Statements that refer to waste sorting as being an easy or hard task or statements that refer to the own ability to sort waste will be labeled as perceived behavioral control.

Situational factors

The situational factors relate to the elements that form the actor's contextual situation in which it should behave. This situation is formed by, for example, the location, which determines the access to infrastructure or the space someone has to sort waste. Also, time to sort waste is part of the situational factors. So, all arguments that have some reference to the time or location for sorting waste will be labeled.

Knowledge

Knowledge refers to the actor’s knowledge of sorting waste. Examples of this are the knowledge benefits of sorting behavior or knowledge on how to sort waste. So, all arguments that relate to how people think sorting waste is done or what the goal of sorting waste is will be labeled.

Now the labels are given the next section will summarize the methodology chapter

3.8. Summary

Based on the research methodology section in this chapter, research question 2 can be answered:

How to develop a method to identify barriers and opportunities for realizing inclusivity and circularity in a waste management process?

Currently, no such research method exists. Different methods are analyzed in this chapter, but non focus on both inclusivity and circularity, as presented in Table 1. Therefore, this research proposes the developed waste journey method, which is a customer journey-based research method. The waste journey method is an open-ended method in which the waste is followed from actor to actor, and the interactions of the actors with each other are observed. By changing the perspective from one individual in a customer journey to waste in the waste journey, the whole waste management process can be observed. The main goal of the method is to find the behavioral arguments of each actor for its actions, so how and why they treat the waste in a certain way. By using following the waste through the waste management process a complete journey of the waste past all the different actors involved is constructed. This will give a detailed overview of all steps and actions in the waste management process. By interviewing each actor along the waste journey, the arguments for their arguments will be retrieved. These arguments will be labeled with the 5 labels of the theory of planned behavior. Analysis of the actors' arguments and decisions with the theory of planned behavior will give insights in what moved and actor to take a certain action. These insights will expose different barriers and opportunities for realizing inclusivity and circularity in the waste management process. Also, by using interviews even, new opportunities for improvements in the waste management process can be identified.

Now the answer to research question 2 is given, the next chapter will present the results of the case study on household renovation waste.

4. Results

This chapter will present the results retrieved from the case study. The case study resulted in 2 waste journeys that were partially completed. The results retrieved from the case study are twofold. First section 4.1 will present the completed waste journeys in narratives and maps which present all the steps in the waste management process. In section 4.2, the application of the theory of planned behavior will be presented on multiple decisions of different actors. Section 4.3 will conclude by answering research question 3.

4.1. Waste journeys

This section presents the two waste journeys that are completed in the case study on HRW management. This is done by first presenting the narrative of the waste journey in a text manner, after which a graphical representation is given in two forms. The first is a graphical representation of the waste journey narrative, which shows how the waste flows from actor to actor. In each step the action of the actor and its arguments for these actions are given. This representation gives a detailed overview of the actors' actions and the arguments they had for their actions but lacks details in all the steps in the waste management process. Therefore, it is chosen to also present the waste journey in a swim lane diagram. Swim lane diagrams are a form of flowchart that clearly presents which actor takes which action and the interactions between the actors (Lucidchart, n.d.). Furthermore, the swim lane diagram gives the opportunity to show the steps in the process in detail, which gives the opportunity to identify possible bottlenecks (Lucidchart, n.d.).

The main differences between the two presentation forms are, at first, that the swim lane presentation form shows more detail in the exact steps the waste went through, which can be useful for the analysis of the circularity of the waste management process. Secondly, the narrative presentation form shows clearly what moved an actor to take a certain action, which can be useful for identifying the barriers and opportunities in relation to the inclusivity of the waste management process. The remaining of this section will describe the waste journeys.

4.1.1. Waste journey 1: removal of a wall

The waste journey maps for waste journey 1 are presented in Figure 16 and Figure 17. The project in waste journey 1 is a removal of a wall to connect a living room to an old bedroom. This project was initiated by interviewee 2, which is a house owner that saw this project as a nice challenge and thought that doing the project himself would be cheaper. Before starting the removal of the wall, the house created a plan based on old pictures and conducted a handyman for advice on and confirmation of his plan. After this, the plan was executed. This was done by first cutting

off the power and starting with a small step to see if reality met the expectations. As this was the case, the whole wall was demolished. The wall consisted of a wooden frame with insulation material in it that was closed with OSB and gypsum panels. The waste was made into smaller pieces and put in bags to make it easier to transport. The house owner chose to bring the waste himself to the recycling as this was free in his municipality. For transportation, he made use of his own car and a trailer which he rented.

At the recycling center, the house owner's waste was inspected by the host of the recycling center. The house owner indicated that his credentials were not checked, whereas interviewee 8 stated that this should be done. After the waste was inspected, the host gave instructions to the house owner on where to place what waste. At this point, the house owner regrets that he did not separate his waste in the bags because he put everything together and now was asked to put the wooden beams in the wood container and the panels in the contaminated gypsum container. He also indicates that the waste sorting done by the house owner is not checked by the supervisor of the recycling center. Interviewee 2 stated that this is the case. It is unknown from the interviews when this check was done, but it could be the case that the house owner did not recognize that the host observed him but that he did not experience it in that way. Untill this point, the waste in this waste journey could be followed directly, but from now things have become a little fuzzy because interviewee 2 was not able to state where the waste went when the containers were full.

The interviews with interviewees 1 and 3 were used to fulfill waste journey 1. When the container is full, it will be collected by a waste disposal company. They will collect the container and then inspect and weigh the container. For the wood container, the waste disposal company will sort the wood waste in different sizes. These different sizes will then be traded. The bigger pieces can be used for woodchips in chipboard; other applications are compressing the wood for pellets which will then be used in biomass power plants or for heating in houses. The C&D container consists of many different sorts of materials because it is used as the container to put in the waste that cannot be placed in the other containers in the recycling center. This container is picked up by a waste disposal company, which will then inspect and weigh the container. When the container is accepted, the waste disposal company will try to pick out the most valuable materials from the pile of waste, like metals and big chunks of wood. The remaining waste will be sorted in a C&D waste sorting machine from interviewee 4.

When the waste arrives at interviewee 4, the waste is inspected for contamination and dangerous materials. The materials that are focused on are especially the materials that can harm the machine, like gas cylinders and batteries. Also, video decks are seen as highly unwanted material although they should not be delivered in this

container, they are seen and strap around the machine. Before the waste is fed into the machine, a gripper picks the biggest wooden and metal materials out of the waste as. The waste sorting machine makes use of different techniques to automatically sort the waste. First, the waste is sorted into different sizes by using different sieves. Then the high-caloric materials are sorted out by using wind shifters. Wind shifters are automated machines that blow the lightest materials away from the stream. These high-caloric materials are traded in different sizes and are mostly used as fuel for industries where high heat is required, like the cement industry. After the wind shifters, NIR (Near infra-red) sorting machines are used to separate wood materials from the stream. After the automatic sorting, the different-sized streams go into a handpicking station. In this station, 8 to 12 people sort the waste by hand into containers that are placed underneath them. This leads to different streams that are used for different purposes.

The wood waste will be, as mentioned earlier, used for the woodchip industry or for biomass power plants. The rubble waste that comes out of the machine will be shredded and, if it is of good enough quality, traded as granulates or otherwise immobilized and then traded as granulates. The plastics can be traded in the high caloric waste fraction or be traded as plastic waste materials. The metals will be traded as scrapped metals.

The contaminated gypsum container that comes from the recycling center is not mentioned by one of the other interviewees. Therefore, it is unknown what happens with this container. It will probably be shredded and sorted and then traded as granulates, but this cannot be confirmed from the interviews.

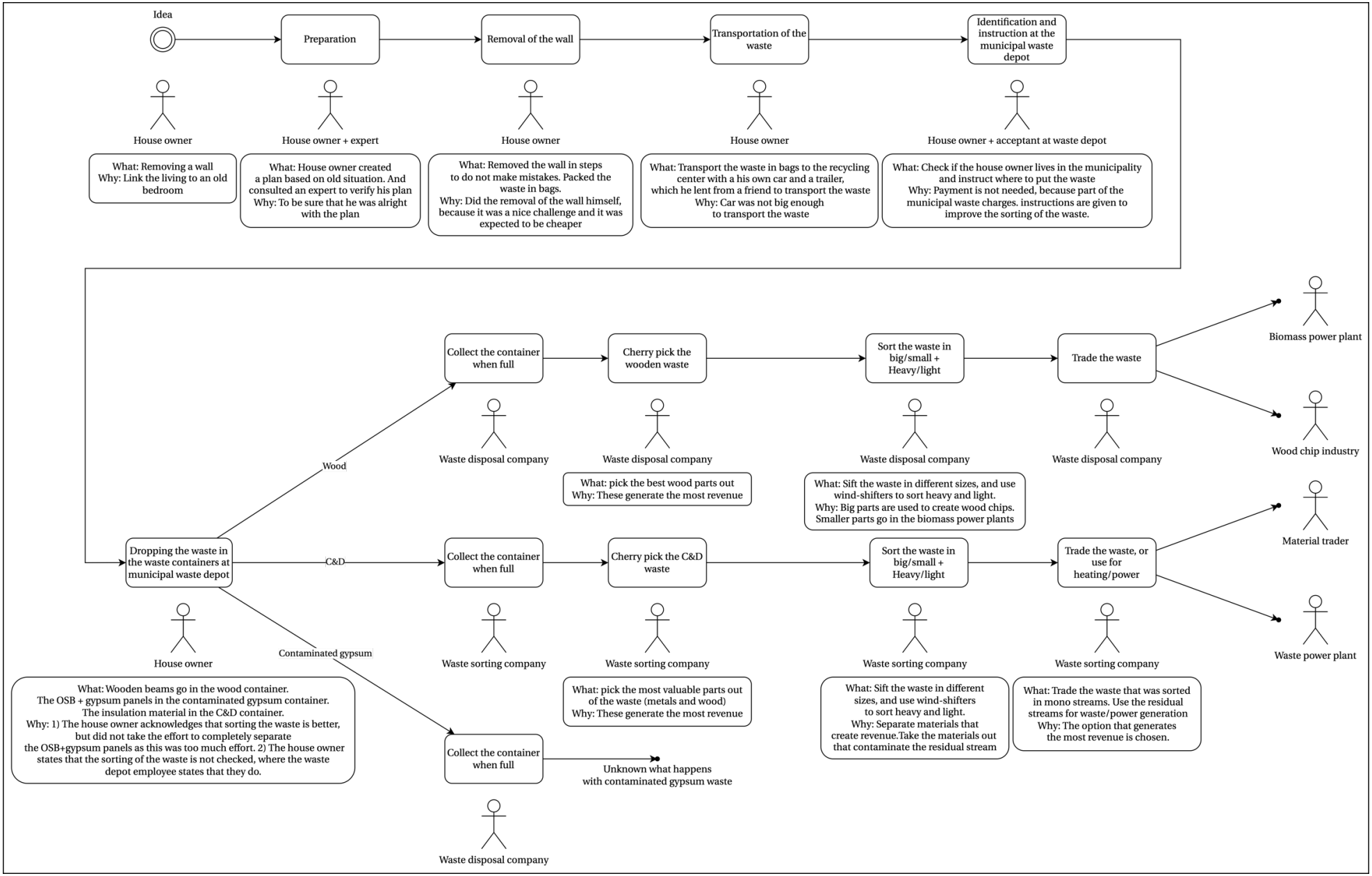

Figure 16: Waste journey 1 - narrative presentation

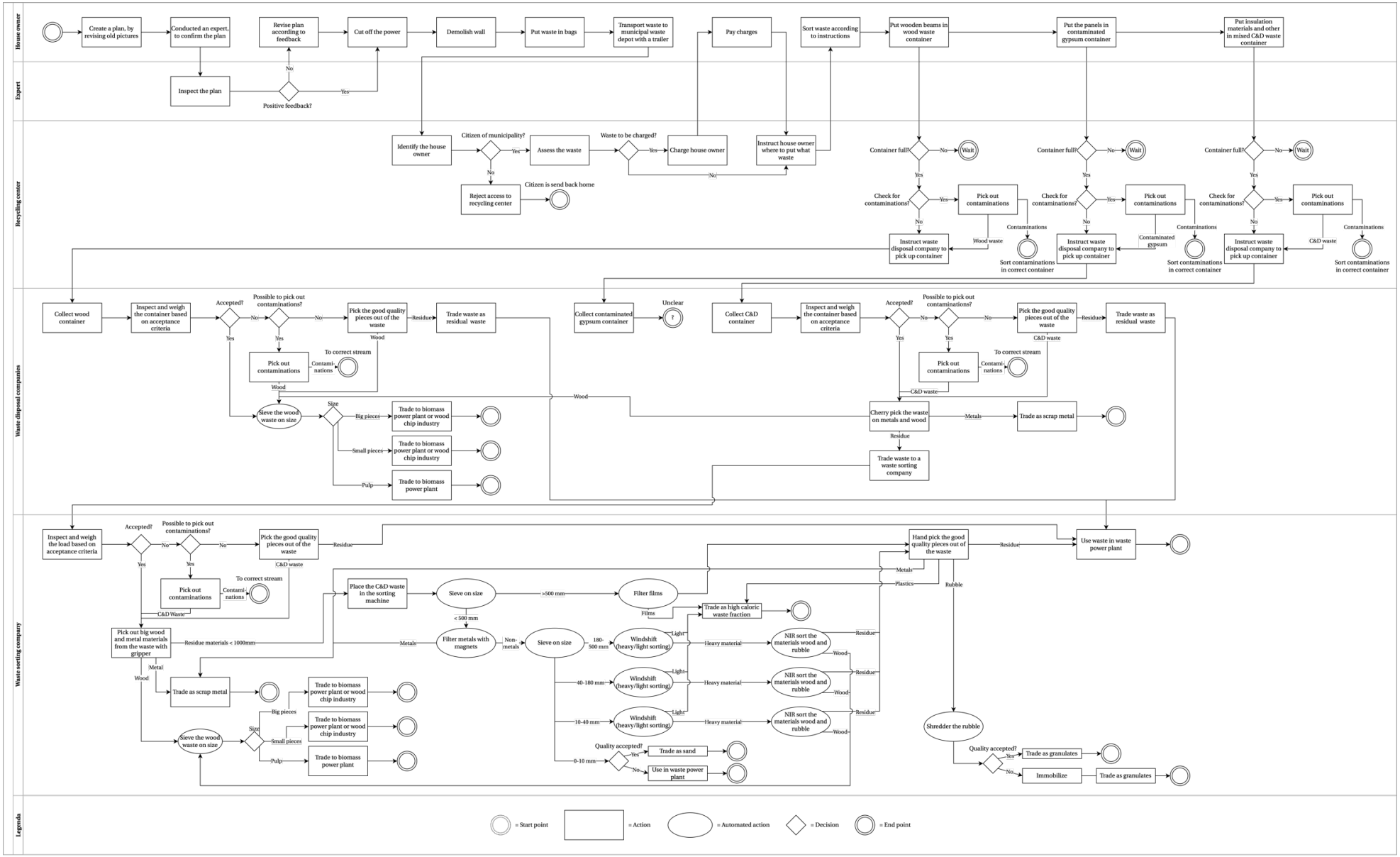

Figure 17: Waste journey 1 - swim lane presentation

4.1.2. Waste journey 2: complete apartment renovation

The waste journey maps of waste journey 2 are presented in Figure 18 and Figure 19. The project in waste journey 2 is a complete renovation of an apartment in the center of a big city. The apartment itself is in an old building and is just bought by the house owner, according to the contractor, interviewee 5. It was attempted to get into contact with the house owner, but unfortunately, he was not willing to participate in this research. So, the start of the project is the initiation of the house owner to renovate the house, but the reasoning for why and how is unknown. After this initiation, the contractor and client meet to make sure the expectations between the client and contractor are known. After this, they finalize the plans for the renovations and start the project.

The contractor has a preference to completely strip an apartment and not reuse materials from the old apartment because the quality of reused materials cannot be guaranteed and preparing materials for reuse requires a lot of effort from his employees. Also, a margin is made on new materials that are bought in by the contractor, so there is an incentive to use new materials over reusing materials. For the renovation itself, a permit was required, which also included reserving a parking spot for a container. The acquisition of this permit is made by the house owner. When this permit is acquired, the contractor contacts the container broker, which is a platform operator for arranging containers for construction, demolition, and renovation projects. The contractor prefers to use mixed C&D waste containers because sorting waste requires more effort from his employees. Besides, the contractor is skeptical about what is done with the waste by the sorting companies.

The container broker guarantees the service of handling containers for contractors and for waste disposal companies. In his opinion, communication between the different parties is key for this service, and the contractors and waste disposal companies cannot provide this communication because of negative attitudes towards each other and language barriers. The container broker makes sure the container is placed and picked up at the right moment for the contractor. The pickup of the container is done by a waste disposal company. This waste disposal company also has a waste sorting machine, but that is a separate company, and in the interview, the installation was not described. Therefore, it is chosen to show the same process in Figure 19 as in waste journey 1.

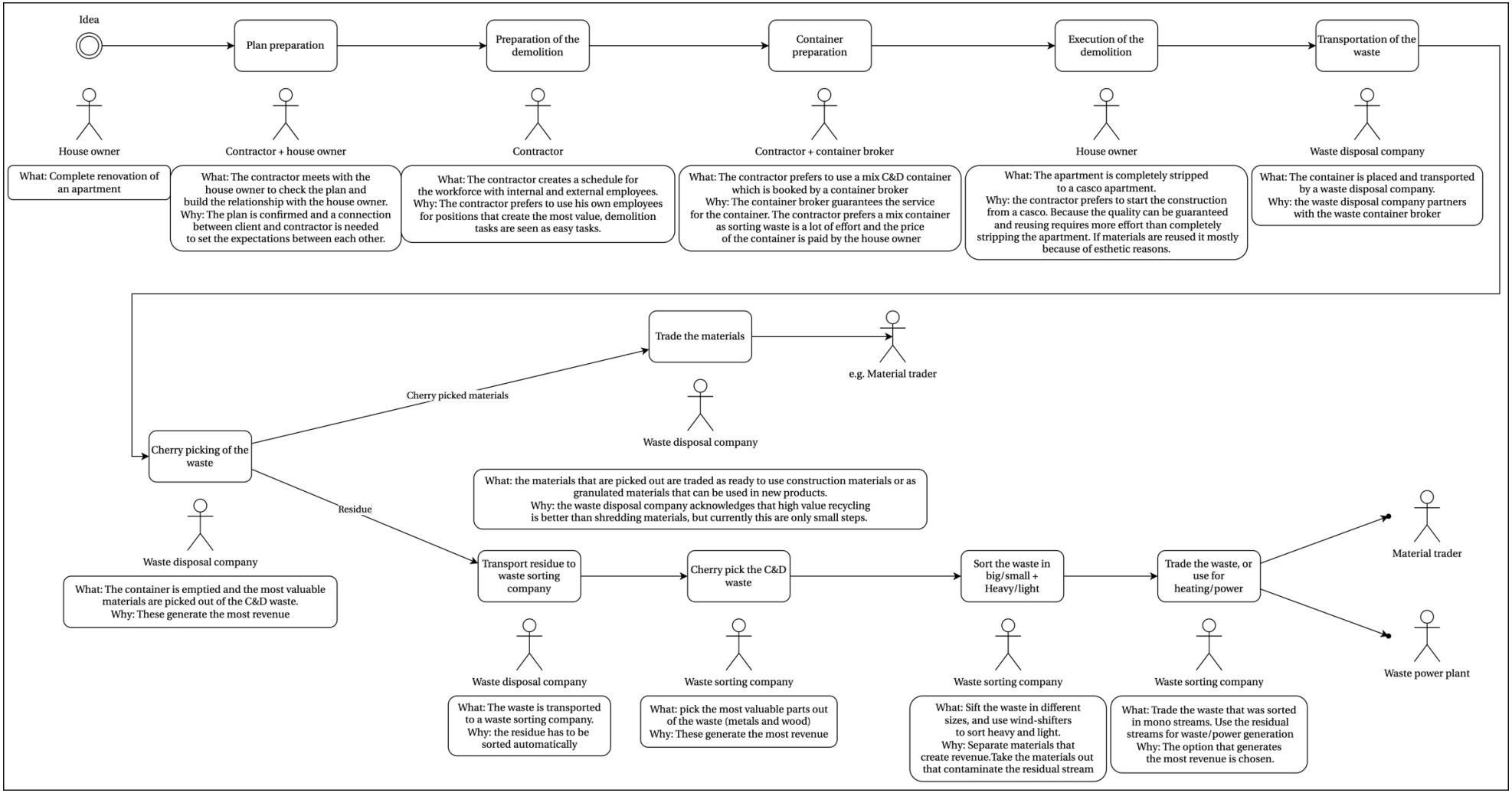

Figure 18: Waste journey 2 - narrative presentation

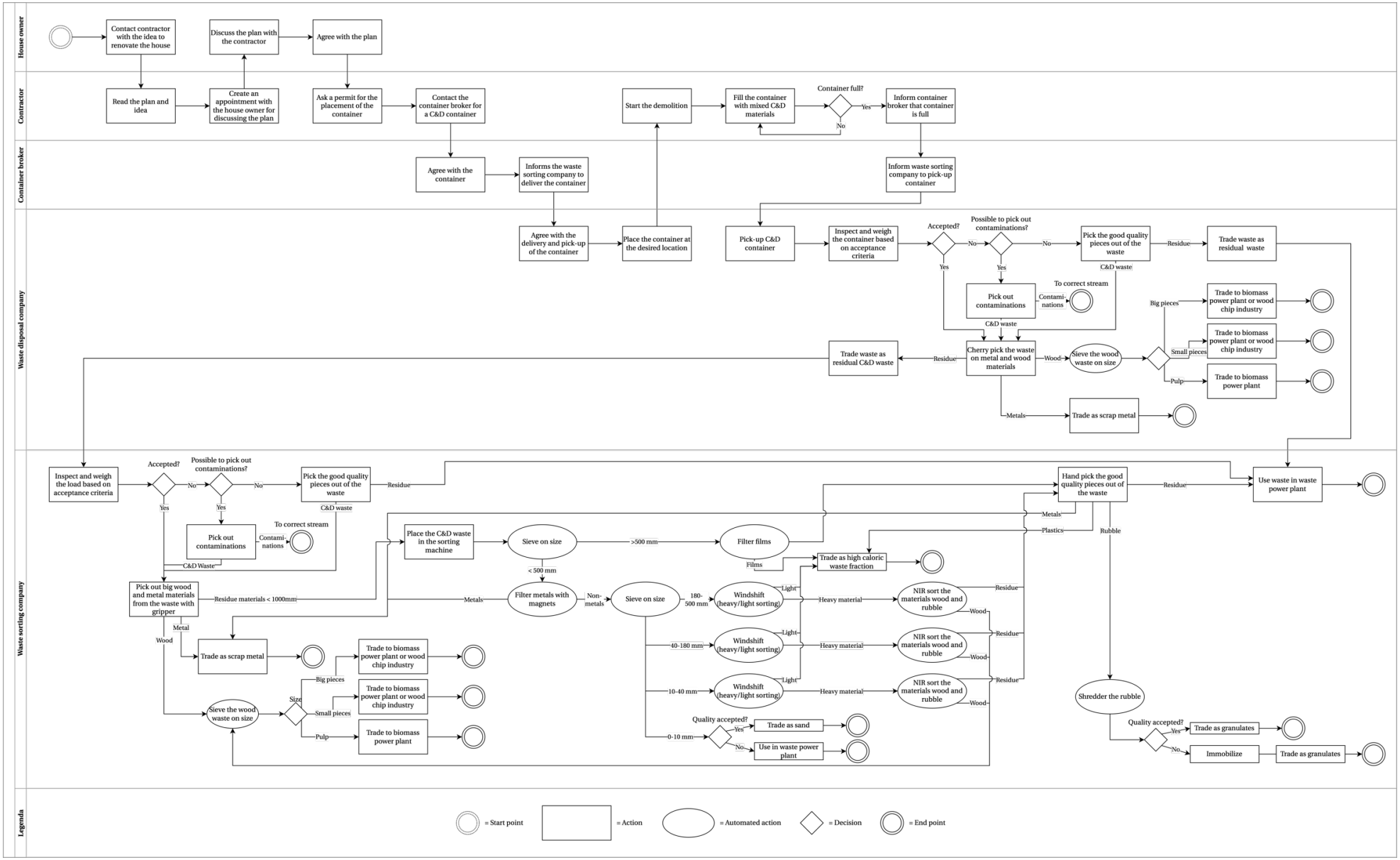

Figure 19: Waste journey 2 - swim lane presentation

4.1.3. Reflection on waste journey maps

The waste journey maps presented in this section give a detailed overview of the different steps the waste passes through in the waste management process. Besides that, the different actors the waste passes through, and their interactions are presented clearly. The maps are presented in two ways, and both have a different focus with their advantages and disadvantages.

First, the narrative presentation used in Figure 16 and Figure 18 is focused on the handling of waste from actor to actor. The presentation clearly presents the start and end-state of the waste and shows in each step which actors are involved, what their action was and why they did it. By identifying these steps and the motivations of these actions, multiple conclusions can be drawn from the case. For example, in waste journey 1, the house owner decided not to separate the gypsum from the OSB panels because the effort was too much. This shows that the waste management process can be improved from a circular perspective by encouraging the house owner to separate the materials. For waste journey 2, an interesting example is that the contractor prefers to completely demolish the insides of the apartment and not to sort the waste on-site. The contractor chooses to do so because he wants to guarantee the quality of the delivered project and sees sorting waste as a big effort. Besides that, the price of a mixed C&D waste container which is higher than a wood container is charged to the client, so the contractor himself does not have the incentive to sort the waste. A disadvantage of the presentation is that the detailed steps of the waste management process within an actor is hard to show clearly in this presentation. For example, the waste sorting company takes multiple steps in sorting the waste but putting all these steps in the narrative presentation would make the figure chaotic.

Secondly, the swim lane presentation gives a detailed overview of all steps and decisions in the waste management process. This presentation fills in the disadvantage of the narrative presentation to show the handling of the waste within an actor because each swim lane shows all the actions an actor takes. Besides that, the swim lane presentation also clearly shows the interaction between the different actors in the waste management process. What is lacking in the swim lane presentation is that the motivations for the actions of the actors are not presented, which makes it hard to draw conclusions about the inclusivity of the waste management process. From a circular perspective, the swim lane presentation can contribute because it shows in detail what steps are taken in the handling and treatment of the waste and can therefore show where there are opportunities for improvement of the process.

4.2. Application of the theory of planned behavior

In this section, multiple actions of different interviewees will be analyzed by using the theory of planned behavior. The supporting quotations for this analysis are presented in Appendix C. The in-text references to these quotes will be made by making use of square brackets in which a reference is made to the quotations. The first number refers to the interview number, and the second number is the index number that refers to specific quotations. The decisions will be graphically presented according to Figure 20, which makes use of green, yellow, and red arrows to show a positive, neutral, or negative relationship between the factor and the intention, respectively. In this case, a positive relationship means that the factor contributes to or is in line with the intention, whereas a negative relation means that the factor is conflicting with the intention.

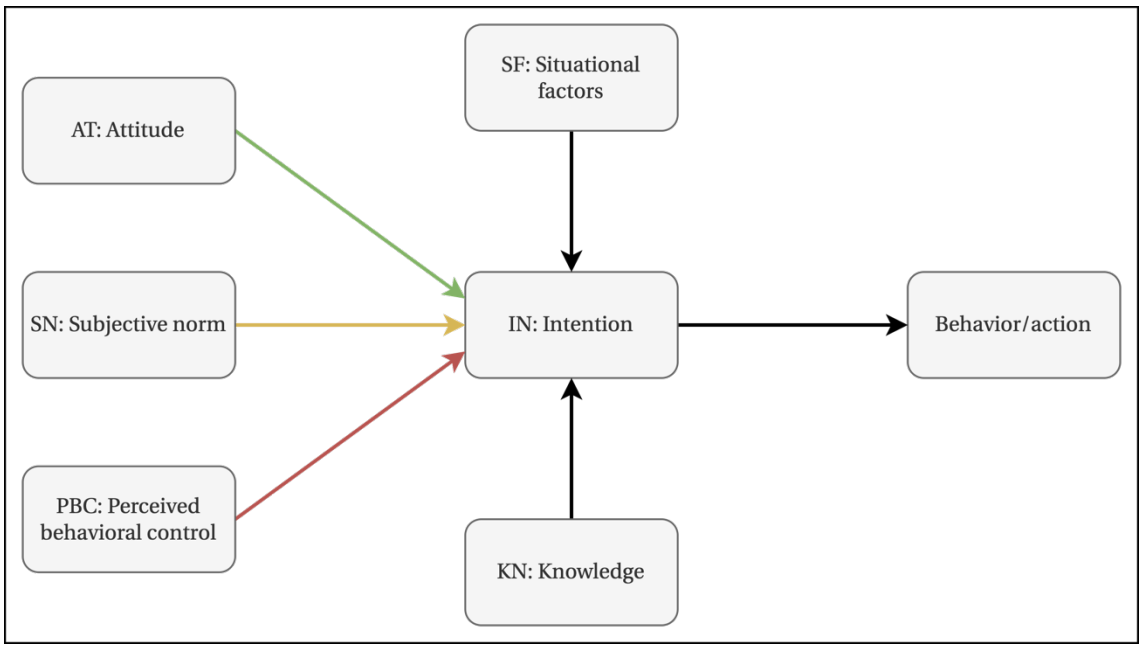

Figure 20: General decision analysis presentation

4.2.1. Decisions made by contractors

The project in waste journey 2 is executed by the contractor, interviewee 7. The contractor made multiple decisions that influenced the circular performance of the project. The first decision that is analyzed is the decision to completely demolish the insides of the apartment. The second decision is about applying source separation.

Contractor decision 1: Complete demolition over selective demolition

The contractor decided to demolish all the insides of the apartment instead of applying selective demolition [Q7.1]. This decision is made to raise the quality for the client [Q7.6] and because selective demolition or preparing materials for reuse takes much more time and effort [Q7.5 & Q7.8]. The first argument can be qualified as a subjective norm because the contractor believes that the client is willing to receive a high-quality project, so it is, in a way, pressured by the client, which is also stated in Q7.9. The second argument is a situational factor that relates to the attitude of the contractor to acknowledge circularity but that the business case should be right [Q7.21, Q7.22]. It is interesting that the contractor makes the decision to completely strip the apartment because he acknowledges that selective demolition does save a lot of material [Q7.4], which can be qualified as perceived behavioral control. Besides, he acknowledges that he has the knowledge to do so [Q7.7 & Q7.10], but he is not willing to because of the business case where the customer is not willing to pay for it [Q7.8, Q7.11 & Q7.12]. This can be graphically presented in Figure 21.

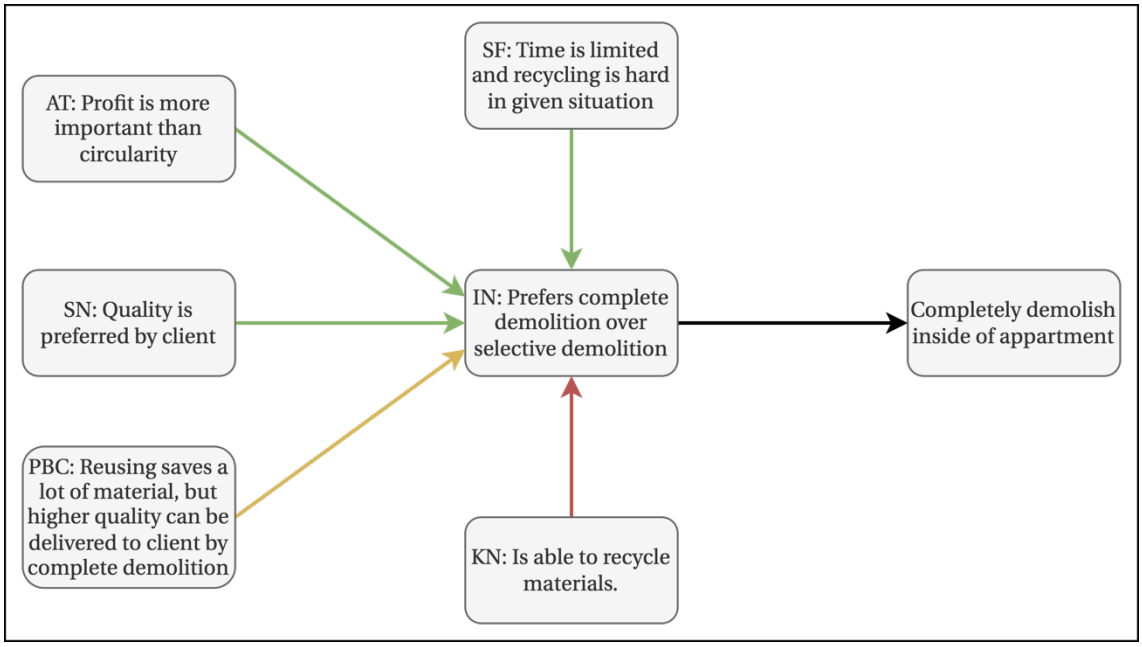

Figure 21: Analysis of the decision to demolish the inner apartment

Contractor decision 2: applying source separation or not

The second decision of the contractor related to his waste management practice is the choice of applying source separation or not. The contractor has the choice to sort the waste on-site in different containers, but he prefers to use a mixed C&D container. This is chosen because sorting waste takes more time and effort and requires more containers to be placed on site, which in a city center is a challenge [not recorded in the interview]. The attitude of the contractor towards waste sorting is formed by skepticism about what is done with the waste when it is collected [Q7.16 & Q7.17]. This can also be defined as a knowledge gap because the contractor acknowledges that he is able to sort the waste, but he does not know what happens

with the waste. The perceived behavioral control, in this case, is formed by the fact that the contractor earns money on the price of the container. A wood container is cheaper than a mixed C&D container, and the contractor takes a percentual margin on the container. Therefore, his earnings will be lower on a cheaper container [Q7.18, Q7.19]. What is missing from the interviews is a subjective norm, except for the fact that the clients are not moved by circularity in the material flow of their project. So, the contractor is not pressured from the outside to choose a more circular practice than he does now. This can be graphically presented in Figure 22.

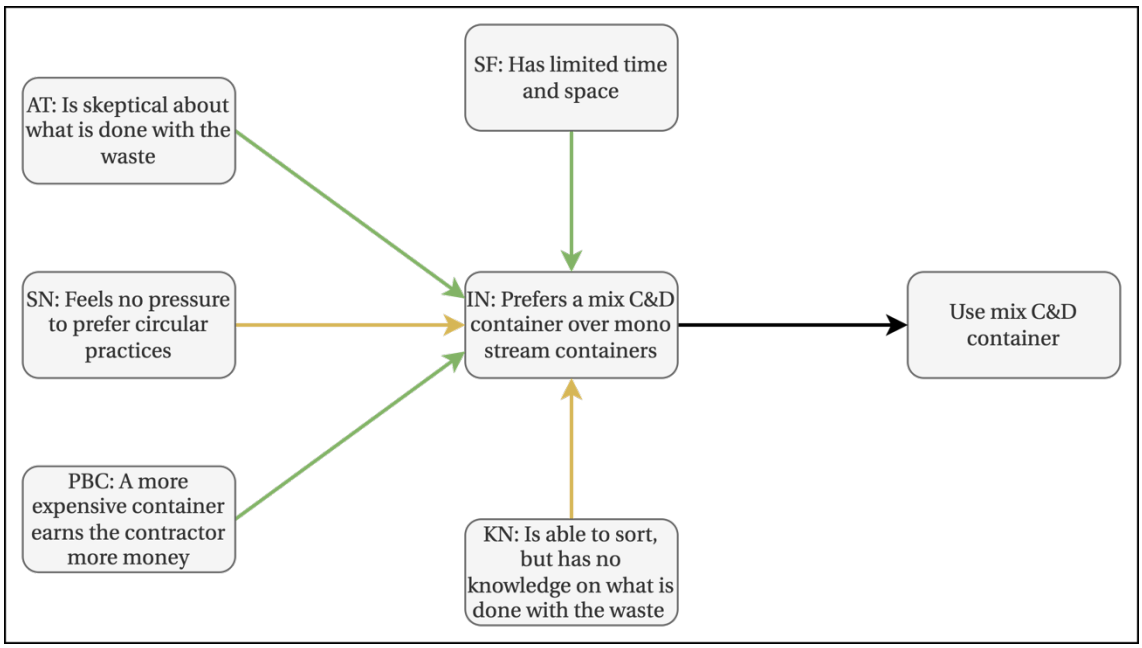

Figure 22: Analysis of the decision to use mixed C&D container

4.2.2. Decisions made by house owners

The project in waste journey 1 is initiated and executed by the house owner, interviewee 2. The first decision is about separating materials that are used in the wall. The second decision is about doing the project himself or not.

House owner decision 1: Separate materials or not.

The house owner has decided that he is not willing to separate the composite gypsum/OSB panels that were used in the wall he removed. This decision is interesting as separating these materials does contribute to the circular potential of the project because the OSB panels can be recycled by using them for new OSB panels. The gypsum, if delivered separately, can be recycled, and used in new gypsum panels. The main reason for the house owner not to do this separation is that it takes a lot of time and effort, and besides that, the gypsum will create a lot of dust [Q2.7, Q2.8 & Q2.13]. This argument can be defined as the situational factor. It is interesting that this decision is made because the interviewee knows that separated materials are easier to recycle [Q2.6] and that contaminated waste streams are not useful [Q2.4]. On the

other hand, the interviewee does not know what is done with his waste specifically [Q2.11]. So, separating the materials is better, according to the interviewee's knowledge, but the rewards of the waste separation are unknown. This leads to the attitude of the interviewee because, from Q2.12 and Q2.10, a certain skepticism about what is done with the waste can be found, which moves him to not sorting the waste. The subjective norm, in this case, is found in the marketing campaigns from the municipality, which promotes recycling behavior and circularity, according to the interviewee [Q2.3]. The actor does not see himself separating the materials because of the effort that it requires, which can be classified as his perceived behavioral control [Q2.9 & Q2.10]. So, in the end, the interviewee is not willing to separate the materials, and he, therefore, decides not to do so. This is all graphically presented in Figure 23.

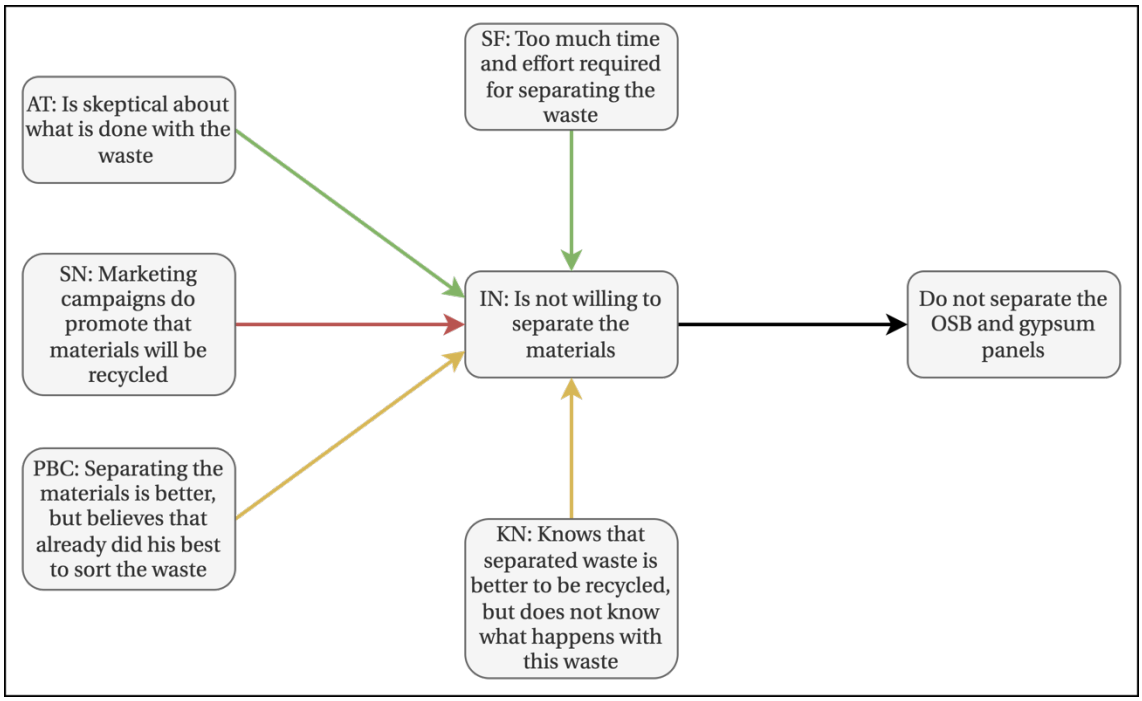

Figure 23: Analysis of the decision to separate materials

House owner decision 2: Do the project himself or not

The second decision that is analyzed using the theory of planned behavior is the decision of the house owner to do the project himself. Although this decision is not directly related to the waste management process, it can give insights from an inclusivity perspective, as the main reason for the interviewee to do the project himself is that it is cheaper than hiring an expert to do it. The house owner's attitude towards doing this project himself is also positive, as he sees it as a fun challenge [Q2.5]. The situational factor that relates to this decision is not directly mentioned in the interview, but the house owner does have the materials and time to do so [Q2.2]. The house owner used the opinion of an expert that did something else in his house for

the approval of his plan, which can be seen as a subjective norm. The perceived behavioral control that is the main motivation for this decision is the belief of the actor that he can do it cheaper himself than an expert [Q2.5]. The actor believes that he has the knowledge to do the demolition himself but still wants the approval of the handyman. The decision is presented in Figure 24.

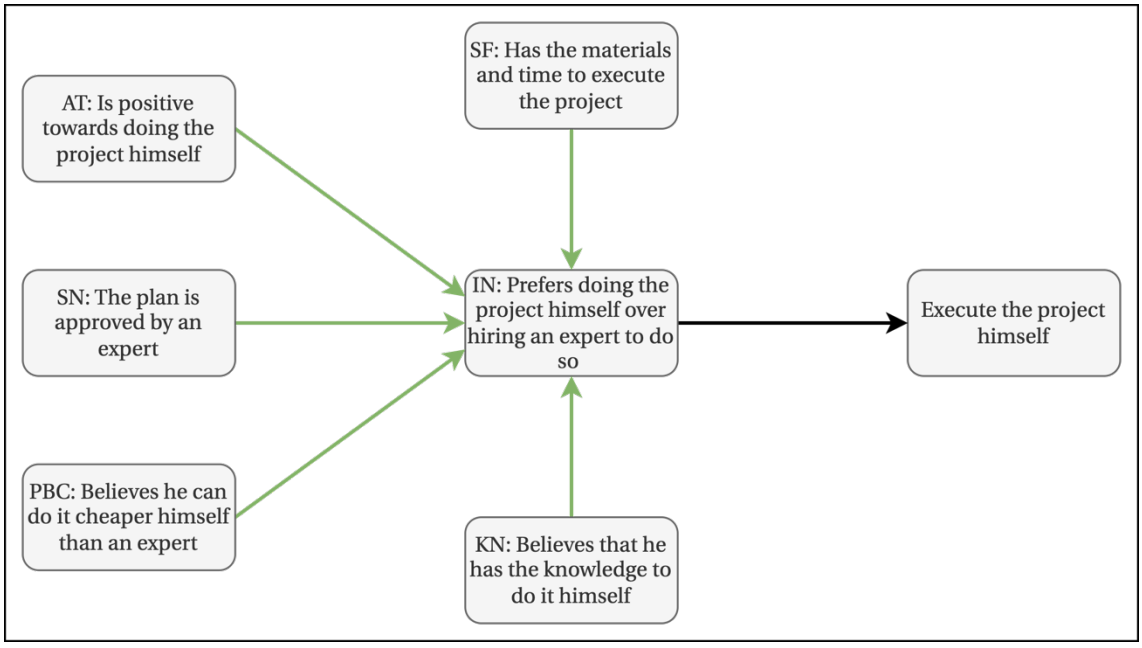

Figure 24: Analysis of the decision to execute the project himself

4.2.3. Reflection on the application of the theory of planned behavior

The 4 different decisions that are analyzed using the theory of planned behavior in section 4.2 give a detailed view of what moved an actor to take a certain action. In these decisions, actors can have conflicting arguments for their actions. This is, for example, seen in the decision of the house owner not to separate the Gypsum panels from the OSB panels because of the effort it will cost him to do so. The conflict is that the house owner does not and acknowledges that it is better to separate the materials, but the rewards of doing so are unknown to him, which makes that, in the end, he did not separate the materials. Also, the house is influenced by a marketing campaign of the municipality, but he is not convinced that the materials are properly recycled. This shows that from an inclusivity point of view, the house owner is not completely involved in the waste management process because the process is not transparent to him.

In the decisions of the contractor, it is interesting to see that he acknowledges that his attitude in the decisions he made conflicts with his personal attitude on circularity, as stated in Q7.22. The contractor calls it paradoxical, but as a contractor, he is mostly moved by the business case, but in his personal life, he makes more sustainable decisions. Also, what is interesting to see is that the contractor also has a knowledge gap on what is done with the waste after he hands it in, which is also seen

in the house owner's case. This shows that the contractor is not fully involved in the waste management process.

Other decisions of actors that were interviewed were not used for the analysis with the theory of planned behavior because the interviewees were not in a position where they had influence over the decisions made. The decisions that relate to how the waste is managed are made in higher positions, and therefore it is not possible to use the interviews for the analysis with the theory of planned behavior.

4.3. Summary

To conclude the results chapter, an answer to research question 3 is given in this section. Research question 3 is formulated as follows:

How to apply the developed method to a case study?

The waste journey method is applied to two cases of household renovation waste management processes. This is done by first selecting household renovation waste as the specific waste stream. Then, two projects were selected to conduct case studies by interviewing related actors and analyzing their decisions with the theory of planned behavior. The two completed waste journeys are presented in two different ways, and both have different focuses. The waste journey maps in the swim lane presentation give a detailed presentation of what steps are taken in the waste management process and by which actor they are executed. These maps can be used to identify barriers and opportunities for realizing inclusivity and circularity in the waste management process. The narrative presentation gives more detail about the actions taken by different actors and the arguments they had for their actions but gives a less detailed presentation of each step, so it is higher level on the process side. By adding the theory of planned behavior, the arguments of an actor for a certain decision can be presented in more detail. By analyzing these decisions with the theory of planned behavior, barriers, and opportunities for realizing inclusivity and circularity in the waste management process can be identified. The combination of these three different presentations can give enhanced insight into a waste management process and can also point out problems with the inclusivity and circularity of the waste management process, as seen in the case of the contractor and the house owner. The steps for applying the waste journey method can be graphically presented in Figure 25.

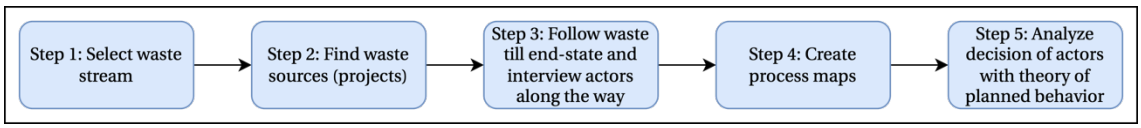

Figure 25: Steps for the waste journey method

5. Discussion

This chapter discusses the research design, results, and limitations of this study. First the implications related to the development of the method will be presented in section 5.1. Then section 5.2 discusses the implementation of the method on the process and the results. Section 5.3 summarizes the research limitations. Lastly an answer to research question 4 will be given.

5.1. Implications related to the development of the method

This section discusses the development of the method, which is divided into the implications in relation to the scope, goals, and theories used in this research.

5.1.1. Scope

The waste journey method is developed to examine the procedures of processing specific waste streams from generation till an end-state. The scope of applying the method is determined by the selected waste stream because in the waste journey method, the waste is followed from actor to actor. The endpoint of the waste management process is unknown at the start of the research. This research has completed two waste journeys in the household renovation waste stream. The management of this waste stream is regional policy. In this research, no barriers were found for the waste journey method to be used in other waste streams or different regions. It needs to be emphasized that the preparation phase for the waste generation should also be included in the process. In the preparation phase actors already make decisions that influence the circular performance of the waste management process. For example, the decision of the contractor to not separate the waste at the sources but to only use a C&D container.

5.1.2. Goals

The main goal of the waste journey method is identifying barriers and opportunities for realizing inclusivity and circularity in a waste management process. As no current method found in literature review fulfilled in researching both inclusivity and circularity, the waste journey method is developed. The goal of researching both aspects is obtained in the waste journey method.

First, identifying the barriers and opportunities for realizing inclusivity in a waste management process is obtained by using interviews, waste journey maps and analyzing actors' decision with the theory of planned behavior. The combination of these three different tools, makes it possible to identify the barriers and opportunities for realizing inclusivity in the waste management process. The analysis of the

actors' behavior helps to find what arguments an actor has to express certain behavior. The identification of these arguments and barriers creates opportunities for policymakers and practitioners to improve the waste management process.

The second aspect, identifying the barriers and opportunities for realizing circularity is obtained by the interviews and mapping the waste management process in swim lane diagrams. These two sources make it possible to fully reconstruct the waste journey and see where the waste went to and what is done with it. A requirement for this to be successful is the complete transparency of the actors about where they traded or send their waste to, which has been a challenge in this research project.

So, the waste journey method is a method that identifies barriers and opportunities for realizing inclusivity and circularity in a waste management process. The identification of these barriers and opportunities will be useful for practitioners and policymakers in the improvement of the waste management process.

5.1.3. Theories

The two theories that form the basis for the development of the waste journey method are the customer journey theory and the theory of planned behavior. By moving the perspective of the customer to waste, guided by the actors, a waste journey method is developed in this research. This shift of perspective showed that this is useful for determining the steps in a waste management process and identifying all actors involved. This can be seen as a form of systems perspective as described in the circular economy theory, as the whole waste management system is analyzed.

The extended theory of planned behavior as proposed by Pongpunpurt et al. (2022) showed to be useful for the identification of barriers and opportunities for realizing inclusivity and circularity in the waste management process. The definition used for inclusivity in this research, presented in section 2.2. is currently not linked with the theory of planned behavior or with the decision analysis in section 4.2. By creating a decision analysis method that combines the two different definitions, the identification of the barriers and opportunities for realizing inclusivity will be better structured.

Furthermore, in relation to the theory of planned behavior, this study proposes to move the situational factor away from the intention and should be seen as a separate factor influencing the behavior of the actor. So, the intention of an actor could be positive towards recycling behavior, but sometimes the situational factors do not give room to do so.

Based on customer journey theory, this study added the preparation phase of waste generation to the waste management process proposed by Buch et al. (2021). As

stated already in Section 3.4.2., most research focuses on the waste management process from the moment the waste is generated. However, in the preparation phase, important decisions are made that influence the circular outcome of the waste management process, and these steps should be part of the scope of research.

5.2. Implications related to the implementation of the method

This section discusses the results of the implementation of the waste journey method. This discussion is split into the process and results-related implications.

5.2.1. Process

In this study, household renovation waste is chosen as the waste stream to conduct case studies for testifying the waste journey method. Two waste journeys are completed with a source in Amsterdam and Rotterdam. The case study on household renovation waste was chosen because of the various actors involved, the lack of attention on household renovation waste in policy documents and academic literature, and the personal interest of the author. The waste journey method can be applied to other waste streams as well as in other countries if the waste is researched open-ended and the actors involved are willing to cooperate.

In the interviews for this study, the focus has been put on people that are part of the waste journey. From these interviews, it was not possible to analyze their decisions with the theory of planned behavior if they did not have ownership of the decisions made. For example, in the waste sorting company, the interviewees did not make the decisions on how the waste was sorted or treated because these decisions were made on a higher level. Therefore, the analysis with the theory of planned behavior could not be made because they just accepted the fact that it was done in this way. For future use of the waste journey method, this should be considered.

In the development of the method, the definition of inclusivity is formulated to be the same for each actor. From the application of the waste journey method, it is concluded that this definition is too general for the actors in the waste sorting and disposal companies. This can be overcome by defining what inclusivity means for these actors and using this in the interview protocol.

The data collection in the waste journey method is experienced as time-consuming because the waste is followed from actor to actor. The next interview can only be planned after the interview is executed. This means that for future use of the waste journey method, enough should be taken for the interview phase. Also, asking in the interview planning already what the next actor in the waste journey is can contribute to an application of the waste journey method in a smaller period. Also, this research applied a semi-structured interview approach for the data collection. To limit the

workload of the application of the waste journey, other data collection methods can be considered in the future, such as surveys.

5.2.2. Results

One of the interesting observations in the decision analysis with the theory of planned behavior is the conflicting arguments actors have that form their intention. It is seen that some factors positively contribute to the intention, whereas other factors negatively contribute. This presentation contributes to identifying the gaps in the inclusivity and circularity of the waste management process. It is also seen that knowledge, which can be seen as an inclusivity factor, can contribute to the circular performance of the waste management process, and therefore it can be concluded that circularity and inclusivity are dependent on each other.

In this study the decision is made to use the theory of planned behavior for the labeling of the interviews, which is proven to be useful for the decisions analysis done in section 4.2. but the link with the inclusivity definition presented in section 2.2. is missing. A striking observation in relation to the inclusivity is that the waste journey method in the case study showed that the household renovation waste management process is not transparent. Not all actors were willing to participate in the research and the waste disposal and sorting companies were not willing to openly speak about where they traded their waste to, because of commercial contracts and business interests.

5.3. Limitations

Like all research, this study does have its limitations. At first, the theories applied in this research proved to be potentially useful for the identification of barriers and opportunities for realizing circularity and inclusivity in single waste management process. For the waste journey method to be used for generalizable results, multiple waste journeys should be completed in a neighborhood, city, or country. Because the analysis with the theory of planned behavior gives detailed insights into the specific decision, the comparability of these decisions between different waste journeys is challenging, which asks for other theories to be used. Besides, the waste journey method proved to be applicable for a snapshot state of a waste management process, but other theories are required or should be developed to analyze or evaluate the waste journeys over time.

Secondly, the time used for the data collection in this study was limited, and therefore it was challenging to speak to the people that are in the position that make decisions, which is why the interviews of the waste sorting companies and waste disposal companies were not used for the analysis of the theory of planned behavior.

The third limitation is that the interview protocol could have been better to match the theory of planned behavior. Now the analysis of the interviews is done by interpretation of the author, which could have been improved by directly asking about the different aspects of the theory of planned behavior. The decision to use the theory of planned behavior for labeling the interviews has been made after the interviews have been held. The labeling has proven its' value in the decision analysis, but the interview protocol could have been better.

Lastly, the waste sorting and waste disposal companies were not transparent about where they traded their waste, which limits the conclusions that can be made about the circularity of the waste management process because it is now unclear where the materials are used for. In future studies, publicly available data from national datasets or news could be used to supplement this data.

5.4. Answering research question 4

In this section, research question 4 will be answered, which is formulated as follows:

What are the implications (strengths, weaknesses, opportunities, and threats) of applying the developed method to a waste management process?

The answer to this question will be given by presenting the strengths, weaknesses, opportunities, and threats of the waste journey method.

Strengths

The waste journey method gives a detailed overview of the waste management process and the decisions made by all actors involved. A complete and detailed overview of the waste management process is best presented in the swim lane presentation, but to improve the inclusivity of the waste management process, the narrative presentation gives more detail on the arguments for each action of each actor. By analyzing notable decisions with the theory of planned behavior, more detailed observations of these decisions can be made. These detailed analyses help identify the barriers and opportunities for realizing inclusivity and circularity in the waste management process. These gaps and opportunities can be used by practitioners and policymakers to improve the waste management process.

Weaknesses

The waste journeys' biggest weakness is that the results of the application of the method results in highly case-specific results. This makes that the generalizability of the results for a complete waste stream is challenging and to create generalizable results multiple waste journeys should be completed. Furthermore, the method is developed to create a snapshot of the barriers and opportunities for realizing inclusivity and circularity in a waste management process of specific actors. In this

snapshot different actors will have different perspectives on these barriers and opportunities and changing perspectives over time. This should be considered when the method is applied over a longer period.

Opportunities

The results of this study show that the waste journey method can contribute to the identification of barriers and opportunities for realizing inclusivity and circularity in a household renovation waste management process in the Netherlands. The waste journey method can be applied in other regions and to other waste types, such as food waste or mixed solid waste.

Threat

The biggest threat to the waste journey method is that the process of following waste from actor to actor is highly time-consuming. Besides, to create complete waste journeys, the participation of all actors in the waste management process is required. Lastly, the actors' transparency is required to make it possible to follow the waste and to do the decision analyses with the theory of planned behavior.

6. Conclusions

This chapter answers the main research question. This answer will be given in section 6.2 after the answers to the 4 sub-questions are presented in section 6.1. This chapter concludes with recommendations for future studies.

6.1. Answer to research questions

The sub-questions presented in Chapter 1 are answered in the four previous chapters. In this section the conclusions of each chapter will be presented.

Literature

The focus of the literature review was answering sub-question 1:

What is inclusivity in a circular waste management process?

The answer to this question is given by reviewing the literature on circular economy, inclusivity, and inclusive waste management. The conclusion is that inclusivity in a circular waste management process is the degree to which all people actively participate, make use of, benefit from and are affected by a waste management process. An inclusive circular waste management process is a process that is equally accessible for everybody in terms of location (spatial), gives an equal speech to everybody (political), divides the costs and benefits equally (economic), is circular (environmental), and is non-discriminatory to everybody (social). The waste management process entails all steps from the generation of waste to the end-state of that waste, including all the actors that are involved in the process.

Methodology

The second sub-question is answered in the methodology chapter, Chapter 3:

How to develop a method to identify barriers and opportunities for realizing inclusivity and circularity in a waste management process?

From a literature review of different research methods, the conclusion is drawn that no current research method succeeds in identifying barriers and opportunities for realizing inclusivity and circularity in a waste management process. This research proposes a new research method, the waste journey. The waste journey method combines the customer journey theory and the theory of planned behavior and is presented in Figure 26. In the waste journey method, the waste is followed from actor to actor, and the focus is placed on the actions these actors take, and the arguments actors have for their actions. By analyzing the actions of the actors with the theory of planned behavior, new insights about the inclusivity and circularity of the waste management process can be obtained. These insights lead to the identification of the

barriers and opportunities for realizing inclusivity and circularity in a waste management process, which can be used by policy makers and practitioners to improve the waste management process.

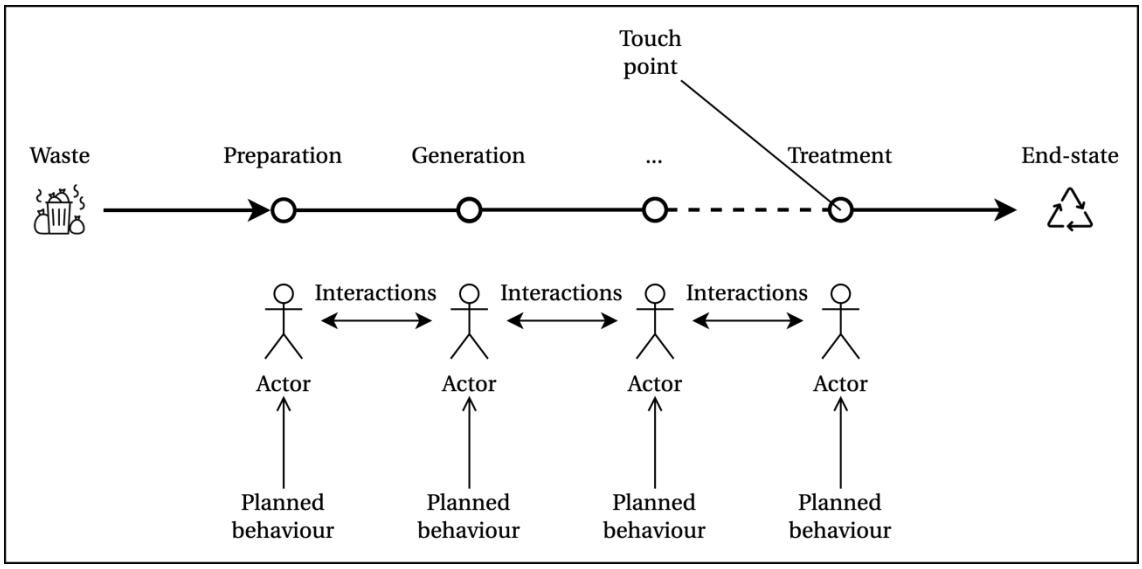

Figure 26: Graphic representation of the waste journey

Results

The results chapter, Chapter 4, answers sub-question 3:

How to apply the developed method to a case study?

The application of the waste journey method creates two outputs. At first, the waste journey maps give a detailed presentation of what steps are taken in the waste management process and by which actor they are executed. These steps can be presented in a narrative presentation which gives more detail about the actions taken by different actors and the arguments they had for their actions but gives a less detailed presentation of each step, so it is a higher level on the process side. The waste journey can also be presented in a swim lane presentation which presents in detail the steps in the waste management process, the interactions of the actors, and the decision they made but lacks focus on the arguments for their actions. By adding the theory of planned behavior, the arguments of an actor for a certain decision can be presented and analyzed in more detail. The combination of these three different presentations can give enhanced insight into a waste management process and can identify barriers and opportunities for realizing inclusivity and circularity in a waste management process.

Discussion

By presenting the implications of this research, the answer to sub-question 4 is given:

What are the implications (strengths, weaknesses, opportunities, and threats) of applying the developed method to a waste management process?

The waste journey method can present the waste management process in detail and analyses the decisions that are of relevance for realizing inclusivity and circularity in a waste management process with the theory of planned behavior. This makes it possible to identify the barriers and opportunities for realizing inclusivity and circularity in the waste management process. These barriers and opportunities can help practitioners and policymakers with improving the waste management process. A downside of the method is that the application of the waste journey method is a time-consuming task and requires the transparency and cooperation of each actor in the waste journey. The waste journey method can be applied in other regions and on other waste streams. This research was limited by the amount of time that was available and encountered problems with the cooperation of the actors in the waste management process. Besides, the interview protocol could have been improved to be a better match with the theory of planned behavior.

6.2. Conclusion to the main research question

The main research question of this research is formulated in the introduction:

How to identify barriers and opportunities for realizing inclusivity and circularity in a waste management process?

Because current research methods found in the literature study fail to research both inclusivity and circularity in waste management process, this research proposes a new method called the waste journey method. By combining the customer journey method and theory of planned behavior, detailed insights into the barriers and opportunities for realizing inclusivity and circularity of a waste management process can be identified. This should be done by studying the waste management process from start to an end with an open end. So, the research starts at the beginning of the waste journey, from which the waste is followed to the next actor and so on. After the waste is followed from actor to actor, waste journey maps can be created in a swim lane presentation which clearly presents all steps and interactions between actors, and in a narrative presentation form which gives detail in the arguments actors have for their actions. The analysis of decisions with the theory of planned behavior gives more insights into the barriers experienced by the actors and opportunities for improvement of the waste management process. A limitation of the waste journey method is that it requires the cooperation and transparency of all actors to be able to complete the waste journey. In this research, this was found as one of the biggest challenges because not all actors are willing to participate in the research or cannot be transparent about where the waste goes to.

6.3. Recommendations

This section presents some of the recommendations for future research. First, the waste journey method should be applied to more cases to prove the potential of the method seen in this study. Besides, more cases in household renovation waste management make it possible to create general conclusions about the household renovation waste management process. Secondly, the definition for inclusivity should be given for each actor because inclusivity for a household is different than, for example, a waste disposal company. The conclusions of these definitions should also be incorporated into the interview protocol. Thirdly, to further develop the method, the labeling of the interviews should be improved and a combination between the theory of planned behavior and definition of inclusivity should be created. Finally, the waste journey method should consider the characteristics of different waste streams when being applied to them and go beyond the indicators of circularity and inclusivity to evaluate more aspects of the waste journey (such as resistance).

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Appendix A. Interview protocol

During the interview a (re)construction of the different steps and decisions that are taken in this waste management process will be made. These steps will function as a guide for finding the motivations and arguments for the actions and decisions made in these steps. Questions will be asked to deepen the arguments and motivations for the actions are taken. The questions are split into general questions and role specific questions.

General questions:

1. Can you give a description of the project?
2. Can you tell me what type of waste you are dealing with?
3. Can you define the steps that you have taken?
    a. What did you do in the waste management process? Did you take any preparations steps for what you do in the HRW management process? What decisions lay in front of these steps? Can you explain with who you interact in these steps?
4. Can you explain or set out the steps that will be done after you have handed over the waste?
    b. Can you explain what you think will happen with the waste after you have done you part in the waste management process? On what is based that you think that these are the steps? To what extent can you influence these steps?
5. Can you for each step explain why you took this step/action?
    c. What moved you to act in the way you did? Can you explain why you acted in a certain way? Were you influenced by your environment in this action or decision?
6. Can you explain any problems or hurdles you had in the process?
    d. Did you encounter any problems in this step? What was found the hardest part of this step?
7. Are there any steps that you did not take, because you encountered any problem?

Some role specific questions:

1. For a household:
    a. What parts of the project did you do yourself? And what were your motivations for these decisions?
    b. How was the waste transported? And why did you choose to do so?
    c. How did you experience the waste management process? Can you give examples of positives and negatives?
2. For a contractor:

a. What do you take into consideration for the decision of how to manage the waste?
b. Do you also reuse materials in other projects?
c. How did you experience the waste management process? Can you give examples of positives and negatives?
d. What are regulations that you must obey to regarding the waste management process, and do you feel that you can influence these regulations?

3. For a recycler?
    a. Can you give number of the amount of waste that is processed here?
    b. What are the process steps you do and what do others do?
    c. What are regulations that you must obey to regarding the waste management process, and do you feel that you can influence these regulations?

Appendix B. Interviewee description

To generate a better understanding of the interviewees, a brief description of the interview and the interviewee is given in this appendix. For the overview, Table B1 presents the interviewees, and what they did in or contributed to the waste journey. The statements made about the interviews cannot be cited from websites, as this would breach the anonymity of the interviewees.

Table B1: Overview of interviews

No.	Actor	Waste journey	Action
1	Recycling center and waste disposal company	Extra information for 1	Operate recycling center and collect and trade waste
2	House owner	1	Remove a wall in a house in Rotterdam
3	Recycling center company	Extra information for 1	Operate 12 recycling center in Noord-Holland and trade waste
4	Waste sorting company	1	Sort C&D waste
5	Contractor	2	Completely renovate a house in Amsterdam
6	Waste sorting and disposal company	2	Pick up container, sort waste and trade waste
7	Container broker	2	Arrange the container for the contractor
8	Municipal recycling center	1	Operate recycling center and trade waste

Interview 1 is held at location of the company on the 28th of September 2022 with the coordinator of the recycling center. The company is responsible for the collection and processing of household waste in 8 municipalities in the east of the Netherlands, which also own the company. Besides, the company has 4 recycling centers at which citizens can bring their waste. If this is household waste the waste will be accepted for free as citizens already pay for it in their yearly waste charges. For construction and demolition waste, which includes HRW people are charged. In these charges price differentiation is used, and these vary from 5 euro per cubic meter for clean stone debris to 22 euros per cubic meter for mixed construction and demolition waste.

Interview 2 is held digitally with a house owner in Rotterdam who has removed a wall inside his house on the 28th of September 2022. The house owner removed a wall between the living room and an old bedroom. The house owner did the project himself as this was a nice challenge and he is experienced handyman.

Interview 3 is held with a manager recycling centers in a company that owns 12 recycling centers in the North of the Netherlands. Besides operating these 12 recycling centers, the company also consults municipalities on how to operate their recycling centers. Payments for the waste delivered at recycling centers differs between the recycling centers as they are in different municipalities, but most of them use price differentiation by using lower charges construction and demolition waste in mono streams like wood and metals and higher charges for mixed construction and demolition waste.

Interview 4 is held at the location of the company in the East of the Netherland with a manager of the sorting division construction and demolition waste and a team lead of the sorting plant. At the location construction and demolition waste from contractors in the region and waste disposal companies is sorted in machine. In this machine a combination of different techniques is used to sort the waste on small/big with sieves, on light and heavy with wind shifters, by handpicking and by using magnets to sort out metals. The different streams that come out of the machine are used for different purposes. Useful materials are recycled and materials that cannot be recycled are used for energy generation.

Interview 5 is held in a café near the project location in Amsterdam with the owner of the contracting company on the 5th of October 2022. The contractor is responsible for a complete renovation of a single floor apartment in the center of Amsterdam. This means completely stripping the apartment and start building up from a casco apartment. The contractor mainly uses mix construction and demolition waste containers as waste sorting requires a lot of effort and time. The container is ordered by the container broker of interview 7.

Interview 6 is held at the office in the waste collection and sorting company in Noord-Holland with an account manager construction and demolition waste. The container used in the project in Amsterdam by the contractor of interview 5 is placed and picked up by this company. When the container comes in the waste is sorted by the company by taking out the most valuable materials. After this cherry picking is done, the waste goes through a sorting machine. In this machine a combination of different techniques is used to sort the waste on small/big with sieves, on light and heavy with wind shifters, by handpicking and by using magnets to sort out metals. The different streams that come out of the machine are used for different purposes. Useful materials are recycled and materials that cannot be recycled are used for energy generation.

Interview 7 is held with the manager of the container broker platform in a café in Delft on the 18th of October 2022. The container broker operates a platform on which contractors and privates can order a container. This container is then placed and

picked up by one of the partnering waste sorting companies. So, the waste container broker does not own any containers, but only manages the placement, payment, and handling of the container.

Interview 8 is held at a municipal waste recycling center with a supervisor on the recycling center on 18th of October 2022. The supervisor is responsible for welcoming the citizens that come to the recycling center and instructing them how to waste should be sorted in the recycling center. Besides the supervisor also controls the container for any contaminating materials that could lead to rejections by the container collection company. The recycling center is used by the house owner in interview 2 to deliver his waste to.

Appendix C. Interview codes

In this appendix the different quotations and labels from different interviews will be presented. The quotes are presented in blue and marked with a code and label. The quotations are labeled with a Q following two numbers. The first number refers to the interview number and the second is an index number for the quotation in that interview.

Interview 2 quotes:

Interviewee: Well, I started with the idea of adding the bedroom, which is adjacent to the living room, to the living room. Before that, we did a little bit of drawing and measuring to see if that made sense, if that opening could be big enough, and a little bit of planning. Then I started looking through a set of old pictures I still had of the house when it was remodeled, initially. A couple of years ago. To see if I could figure out how the ductwork ran in the house.

Interviewer: Yes.

Interviewee:
Finally, as best as I could, I was able to get an estimate of how that runs. And I felt like I could not think of any logical reason why there would be any piping still running through that piece of wall. So, then I thought: well, I think it is pretty safe to start except for a power outlet. Well, then I: there was a handyman in the house for a job other than that. So, I was able to get a quick five minutes of advice from hey: how would you go about this? And yes, who also said ram them through [Q2.1, Subjective norm]. So, I started by drilling a small peephole in the wall to see what I could expect to find in the surrounding area, before starting the complete demolition. Then I found out that that whole wall, it's a plaster wall so in the middle was a hollow space, it was completely filled with insulation material. So really, I couldn't see very much with the peephole. So yeah, then, just cut a big hole in it with the Recipro saw and cut a slightly bigger peephole in it [Q2.2, Situational factor]. Insulation pulled out. Double checked that there was no piping and how that outlet was connected. With the Power off, by the way.

Interviewer: Okay, that's quite a clear process, already. To what extent can you indicate what you think will happen to the waste after you turn it in to the recycling center?

Interviewee: I know the city of Rotterdam likes to advertise, with how circular it is. So you would have a certain expectation of everything being neatly separated [Q2.3, Subjective Norm]. But I also do have the knowledge from studies that a very large

part of the waste, once it's contaminated, actually cannot be neatly separated anymore and a very large part probably just gets burned [Q2.4, Knowledge]. So, a lot of it, also well yes, will be incinerated and I hope a that some of it can be recycled. Well, I don't know, of this particular waste I don't know very well what they can do with it, but things like glass, that can be reused. And I know that they collect a lot of things separately and then you have a certain expectation. And if it is so specifically collected separately, that they also have a specific treatment process for it.

Interviewer: Then let's go back to the beginning for a moment. What moved you to do it yourself and not actually have it done?

Interviewee: I found it a fun challenge, and it costs me a lot less money that way [Q2.5 , Attitude & Perceived Behavioral Control].

Interviewer: Okay, and then maybe the last question: are there things that you say: could I have done this more sustainably or better? In the waste management process.

Interviewee: I would suspect, it would be better to separate plaster and wood from each other as much as possible. The purer you can make one, a residual stream, the better [Q2.6, Knowledge] but that would have taken me a lot of time and a lot of screwing [Q2.7, Situational factor]. And a lot of mess because that plaster, it's going to swirl everywhere [Q2.8, Situational factor]. Purely hypothetically, I think that would have been better. I doubt I would have ever done that [Q2.9., Perceived Behavioral Control]

Interviewer: Exactly and so then it is because it is more effort for you than it is rewarding for you to put it that way?

Interviewee: Yes, and with a little bit of the idea. I already deliver it fairly separated and there's a garbage can for contaminated plaster. Yes, I do throw it in there, then it is somebody else's problem [Q2.10, Perceived Behavioral Control]. I do not know what they are going to do with it [Q2.11, Knowledge]. If it all gets flicked into the incinerator anyway. I do not know how useful the work would be to me [Q2.12, Attitude]. Yeah, if it all does end up going up in flames, I will have spent eight hours there screwing out screws for nothing and my whole house will be one big white dust mess [Q2.13, Situational Factor]. So, it is indeed it. It costs me and a lot of time and I'm unsure of how much it will yield.

Interview 7 quotes:

Interviewee:

Indeed, we get requests from almost always privates. They actually always come in via-via and then we make a quote for those people, or then we first see if it's a match, by phone or through the mail. And then we come by, and we make a custom quote and then we include the demolition work and the disposal of what is being demolished. And that's usually demolition, rather than dismantling and then we reserve, usually a little bit depending on how much time we have but two or sometimes even three weeks for that. And then our preference is to take an apartment or a house/building completely empty, so that then we're not building on someone else's work, but that it's really almost casco. And that within an old building, because we usually work in old buildings, we can make a new home again. But that does create a lot of waste [Q7.1, Perceived Behavioral Control & Knowledge]

Interviewee: Yes, for example, someone we sometimes ask to do concrete drilling or demolition work is coming tomorrow. He will help out for two days in the hope that it will all be finished by Friday. And now we have an intern here and another one of our youngsters because we have room for them. It's kind of a waste to put a full carpenter there [Q7.2, Attitude]

Interviewer: Yes exactly. You actually want that one to just do carpentry.

Interviewee: Yes, then it generates the added value for us. Almost everybody can demolish, just a tap drill or a crowbar in your hand and then you often come a long way [Q7.3. Attitude]

Interviewer: Because in demolition. Now for example, here we are talking about a renovation, just the whole house being pulled out. Are there any choices made in that, are we dismantling this maybe because we can still reuse it or is it just pulling everything out?

Interviewee: The latter. Sometimes we have, if there is a, they used to build for example directly against the floor beams ceiling, with battens and you could basically leave those battens and make your new ceiling against that. That saves a whole lot of wood [Q7.4, Perceived Behavioral Control]. But the buildings have all subsided a bit, so the battens are no longer level, they undulate everywhere. If you put plaster against it, you must plaster very thickly to get it straight again. That's just not possible, we don't do it like that [Q7.5, Situational Factor].

Interviewer: No, okay, so do you choose to increase quality?

Interviewee: Yes, yes definitely. And then when we do, we also often hang the ceiling on vibration damping hangers so to speak. That you have less impact sound from your upstairs neighbors [Q7.6, Subjective norm]. So that, and you could reuse those battens that are often on the ceiling, but then you must take them all out in one piece, which will already be a challenge [Q7.7, Knowledge]. But you might still be able to do that with the proper attention and then you must start taking out all the nails. So, then you're just, that just takes too much time [Q7.8, Situational Factor].

Interviewer: Actually, buying new then is easier and cheaper?

Interviewee: Yes, and the customer who also expects that a bit and pays for it [Q7.9, Subjective Norm]. So, to put it very flat, if we just look at the money, it is also 'chiller' for us to buy materials, because we also earn something on that. Yeah, and then the guys who are busy putting those materials on, we make money on that. So then maybe we should change our whole business model a little bit, that you have people with you who are paid by the customer to make those materials usable again. But then those people actually have to earn so much for you that they also earn what you normally earn on new materials. Because otherwise it's more financially attractive for us to just put new material in.

Interviewer: Yes, exactly so basically, it's: The business gets better if you do both the demolition and the new putting in. Because then you have more to do than if you wouldn't do it.

Interviewee: Well, no, you can if, for example, you dismantle that stuff out that could some materials still be reasonable, but then you must make them usable again [Q7.10, Knowledge]. Yes, and then that must make at least as much money as buying for new materials, where we already pick up margin, and putting the new materials in. So, then it becomes for the customer, because otherwise it's for us and we lose out financially. So, then it becomes unattractive to the customer very quickly [Q7.11, Subjective Norm] Because then they must start paying an awful lot of money and then they have old materials back in there that in themselves are just as good as the new materials. But yes, I think we can offer it cheaper by not doing it [Q7.12, Perceived Behavioral Control].

Interviewer: Do you see that this desire arises, that there are people who say we want you to reuse as much as possible.

Interviewee: No, I think it's kind of jarring, but I do see that that desire is growing, but really only for the benefit of the wallet [Q7.13, Attitude]. So that people want a

heat pump, better insulation, but whether that's from used material or newly reclaimed material, that desire I don't hear.

Interviewer: Is that that is not being spoken out right now?

Interviewee: There are people who do [Q7.14, Attitude]. We do sometimes install renovated panel doors and things like that. Then we get those renovated, then they get sandblasted and repainted but then people only buy those because they like that classic look. Often not so much because those doors will last a hundred years and get a new life. And there are sometimes people who ask: if we just demolish, can't we still sell the doors, because then they do get reused and they still often do that for the money, I believe. If you have beautiful, old panel doors, people are willing to give 50 bucks for each door, and if you have ten doors, they will get five hundred euros. Well, they won't win the war with that, but they do it anyway because they like the idea of reusing those doors [Q7.15, Subjective Norm]

Interviewer: And is it then also he, so the disposal for that. Do you guys order a construction container or do you have a partner that you work with?

Interviewee: No-yes, we always order bins from the same supplier, and they change them when they are full, and they dispose of them. In that, I think some things are separated. And I got a question about that the other day for a permit, some things are separated in there but to what extent is that reused [Q7.16, Attitude]?

Interviewer: And do you separate things beforehand in the bin as well, or is it really just nodding in?

Interviewee: Yes, the latter man.

Interviewer: And you say, I got a question from the permit or from the processing? So, the by the waste service?

Interviewee: No, from. Someone was working on the permit, and they asked us what with us and where our waste is recycled. Because then apparently the municipality of Amsterdam wants to know that.

Interviewer: Okay, but that's just asking the question and not that much happens with it?

Interviewee: Well, I then put that question to the person where we always order our bins. And there's a recycling company in there.... I can check it out for you, I'll just

forward the email to you. Some churchy village near the Randmeren. They say some things are recycled there. But I don't believe it that much. But they say it does happen [Q7.17, Attitude].

Interviewer: No, because you arrange the bin for the customer and say we also take margin on that.

Interviewee: We also earn something on that, and we also arrange the permit for that. So, I think that's also reasonable that we earn something from that [Q7.18. Perceived Behavioral Control]. But the more bins and the more expensive bins we put away, the more we earn. So, I would rather if we just look at the money, have one container that I can throw everything in than have a container that I can only throw wood in [Q7.19, Perceived Behavioral control]. Then we must start sorting it ourselves [Q7.20, Situational factor].

Interviewer: So basically, the choices to do things more circular or more sustainable or not, then those are driven by the business case? Or the money behind it?

Interviewee: Yes, if we can make more money by separating waste, and recycling or reusing most stuff then we will, yes [Q7.21, Attitude].

Interviewer: But right now, that's not actually the case?

Interviewee: No

Interviewer: Yes, because ultimately, it's the customer. They are actually guided by just the financial picture, and they don't necessarily see to it that something is done with it, while, for example, quite a lot of customers are now making sustainable choices but are not necessarily working on it here.

Interviewee: No-yes, in my opinion. It's very paradoxical, because I think sustainability is pretty important, I don't eat meat, I'm in the Triodos bank, at least I pretend that I think it's important [Q7.22, Attitude] The idea I have with it is that people just need a financial incentive. Then they go! People do want a sustainable home, but where the materials come from. I think they really don't care about that. They want them to have low energy bills.