Smart waste stream collection in an inner-city environment

Master thesis Strategic Product Design TU Delft
Joppe de Waart

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There is no such thing as 'away.'
When we throw anything away, it must go somewhere.

Annie Leonard

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TU Delft

Preface

Dear reader,

With this graduation report, my time as a student of the faculty of Industrial Design Engineering in Delft comes to an end. It has been a wonderful time, and I proudly conclude it with the completion of this final project.

If you would have asked me at the beginning of my bachelor's what the topic of my master thesis would be, I can guarantee you that I would not have guessed it to be 'waste management.' Yet, looking at how my interests have developed over the years as a student, from a broad explorative interest, strongly converging towards topics with a positive environmental impact, it could not have been anything else.

The past twenty weeks have been an interesting dive into this fascinating industry and an interesting journey for me personally. Finding the right supervisory team to support me in this journey turned out to be harder than anticipated, so I am extremely glad that it was my chair Ellis who dared to take the dive with me, and that she suggested Sander as the ideal coach to guide me. At the start, I had a very strict planning and clear objectives for this project, and I want to thank Ellis and Sander for giving me the critical feedback, theoretical support, and subtle guidance to bring this project to successful completion.

Next, I want to thank Wouter and Wilco from PreZero Nederland for the design brief that formed the foundation of this project, and for the freedom they gave me to shape this project into what it has become today. The active involvement in my project and the support to develop an actual prototype to be tested by one of your customers formed the perfect environment for me to work with. I am excited to see how you reacted to the insights of my project, even when I was harsh in my conclusions, and I look forward to seeing the project be brought to further implementation.

Besides my supervisors, I want to thank all involved stakeholders for their time and efforts to share their insights with me and collaborate with me to bring the project to a higher level. I hope you recognize the insights in this report and can gain value from the final conclusions and recommendations. I want to give a special shout-out to Jerzy, for the fun days on the truck collecting waste together.

Finally, I want to thank my parents, brother, friends, and girlfriend for listening to my stories about waste, reading parts of my report, taking coffee breaks when needed, and supporting me in all other ways during the past months. Thank you!

All that remains now, is to wish you fun reading this report.

Joppe de Waart
August 2022

Executive summary

Challenged to innovate towards full circularity and sustainability, both the waste management and inner-city transport industry are drastically changing in the Netherlands. Being a waste management organization that operates in these markets, PreZero is looking for new waste collection solutions to facilitate the transition towards circularity.

An envisioned solution for this new context could be in collaboration with parcel delivers that operate via hubs on the outskirts of cities. By letting them collect waste streams from inner-city customers while also delivering parcels, the electric vehicles that would otherwise return to the hub empty would be cleverly used.

The client is piloting this system in The Hague but is looking for a custom solution to fit the needs and wishes of all involved stakeholders. Therefore, the research question of this master thesis is:

How can a scalable product-service system for smart return logistics of source-separated commercial waste streams in an inner-city environment be designed and implemented by the client?

With the project aiming to develop a new business model and product, the entrepreneurial theory of 'effectuation' is applied as the theoretical framework of this thesis, and co-creation and qualitative research methods are selected for the approach. In a series of interviews and case studies, insights about the existing pilot are gathered, resulting in a set of means and potential goals to work with. Additional exercises like customer journey mapping the waste stream and value flow modeling the complex stakeholder context, enable the means and goals to be translated into a set of six potential value propositions for the future.

A design intervention is used to rapidly prototype the next iteration toward these potential value propositions and show the client how the effectual approach can be implemented. This design phase focuses on the various stakeholder contexts and uses a compact waste container and an MVP version of the waste collection bin to pilot the envisioned product-service system. Using phenomenological research, the designs are evaluated, resulting in a rich set of insights about the requirements and wishes for the system, container, bin, and involved partners.

All gathered insights are combined into four future visions that describe the potential strategic positions that the client could aim for. By detailing the business model, needed partners, targeted customers, and steps to be taken, the client is enabled to start implementing tomorrow. Posters visualize each future vision to bring the business models to life and empower the client's project team to get the internal support needed to develop solutions towards one of these future roles.

Concluding the report, recommendations are given about what future vision to aim for and how to get there. With a drastically changing environment that is hard to predict, effectuation delivers a risk-limiting approach to co-create the future with involved stakeholders. Implements these insights from the report will support the client in its iterative journey towards the new business model.

List of definitions

Term	*Definition*
Client	The client for this graduation project: PreZero. More specifically: the Smart Collection team of PreZero Nederland.
Customer	B2B customer of PreZero, e.g., shop owner, facility management organ-ization, individual entrepreneur.
Disposer	The actual person using waste collection solutions to throw away (dispose of) their waste.
PreZero MSC	Envisioned waste management plant specifically designed for new waste streams (Dutch abbreviation for 'Monostromen Sorteer Centrum', which can be translated to 'Waste Stream Sorting Center')
PBD	A specific waste stream: plastic packaging, metal containers and drinking cartons.
Roll container	Distribution car (literally a cage on wheels) most used in the transport of consumer goods (like groceries in supermarkets, consumer products in warehouses, or parcels of postal services)
Swill	A specific waste stream: Organic kitchen waste, also defined as 'GFE', a Dutch abbreviation for vegetables, fruit, and food scraps.
User	See 'disposer'
Waste bin	Smaller waste collection units used inside the customer's building.
Waste container	Metal or plastic waste collection units in which the contents of waste bins (often garbage bags) are stored until collection by the waste col-lector. Traditionally these are the containers of 120L or more (also called 'wheely bins') placed outside the customer's building and pre-sented on the curbside on the day of collection.
Waste stream	A flow of specific waste (e.g., paper, coffee grounds, glass) from the source through all the steps in the waste management process ('Monostroom' in Dutch).

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INTRODUCTION

This first chapter explains the context and motivation for the graduation project and details the design problem by defining a general research question with four sub-questions. Afterwards, the outline of the thesis is explained as guide for readers.

1.1 A world of waste

What is waste? The dictionary defines waste to be "unwanted matter or material of any type, especially what is left after useful substances or parts have been removed" (Cambridge University Press, n.d.). It stays open for interpretation what is considered unwanted or useful and what not, and maybe more importantly, for whom something is unwanted. Globally, humans produce an increasing amount of over 2 billion tons of waste every year, so apparently, quite some materials are unwanted to us (Kaza et al., 2018).

Increasing effects of global climate change are confronting use that all this waste production might not be so wanted by nature as well. Only nineteen percent of the global waste is recovered through recycling and composting. With another eleven percent being incinerated, the remaining seventy percent of all waste is still being dumped on landfills or open dumpsites, of which halve are not managed properly for the environment. This results in the waste treatment industry being responsible for an estimated five percent of the total global greenhouse gas emissions (Kaza et al., 2018).

Next to its global impact on the world's climate, waste effect communities and nature on a local level too. Proper waste management is essential for the hygiene and cleanliness of communities, which influences the inhabitant's health and productiveness. If waste is managed poorly, it can contaminate the environment, spread diseases, and cause serious damage to the climate and biodiversity (Kaza et al., 2018). The existence of a growing Great Pacific Garbage Patch of seventy-nine tons plastic waste and debris floating in the North Pacific Ocean shows the negative impact humans can have on nature when our waste is not managed properly (Lebreton et al., 2018).

Reading these statistics, one might be surprised to hear some say that "waste doesn't exist". Yet, this is exactly what many Western companies are claiming on their websites (Jumbo, n.d., NS, n.d., Renewi, n.d.). Often, these campaigns state that waste can be seen as a source of raw materials that can be used to make new products. So why haven't we been doing that before already, and where does this idea come from?

1.2 Does waste exist?

For centuries, the world's current economy mainly followed a linear model, in which materials are extracted from nature to be used and discarded after use. With population and consumption increasing, we are exploiting the world's raw materials faster than nature can regenerate them. In 2022, the date on which humans had used all the biological resources that the earth can regenerate in one year fell on July 28, meaning that we would need approximately 1,75 globes to be able to sustain this linear consumption pattern in the future (Global Footprint Network, 2022).

Since we only have one globe, Braungart and McDonough envisioned a new, circular worldview, which they described in their book 'Cradle to Cradle: Remaking the Way We Make Things' (2002). Based on nature, their approach is to design products in a way that the raw materials could be endlessly reused after every use cycle, resulting in a circular system called 'Cradle to Cradle' or C2C. One of the chapters of the book stated that 'waste is food', changing the definition from waste as something to simply get rid of, to a valuable stream of materials that still have potential value.

Twenty years later, this vision of resource circularity finds itself in the center of the strategies and policies to limit global warming and the consequent natural disasters and permanent environmental changes. European legislation aims to transition to a more circular model and the Dutch government even aims to get the entire country to a circular economy by 2050 (Ministerie van Infrastructuur en Milieu & Ministerie van Economische Zaken, 2016).

Policies focus on reducing the need for raw resources by increasing the reuse and recycling of used materials. For waste management, this means reducing incineration and landfill, and increasing the source-separation and recycling of waste streams. More fundamental, however, is the changing definition of waste. Waste streams traditionally have special legislation that differs from those for raw materials. In the circular economy, a more flexible definition between the two is needed to be able to treat waste streams as potential material streams, without putting social hygiene at risk (Ministerie van Infrastructuur en Waterstaat, 2021).

Waste management organizations already rebranded themselves as material organizations, leaning in on the circular model in which waste does not exist since all materials are endlessly reused (PreZero, n.d., Renewi, n.d.). Recently, these industry statements were challenged by Teun van de Keuken in his documentary series 'De Vuilnisman', in which he researched the problems in the Dutch waste management industry. He concluded that – albeit a good goal to aim for – waste nowadays very well still exists, and that many claims of the industry could be considered greenwashing (KRO NCRV, 2021).

True fundamental change in our material flows has yet to come, as also visible in the beforementioned global waste statistics. A challenging transition is ahead of us, to reach the set climate goals and limit the impact on our climate. The public debate continues around the question of whether waste exists or not, but recent innovations and trends around the world have shown the great value that is hidden in waste, and the urgency to get rid of our linear consumption pattern.

1.3 Design brief

The waste industry is drastically changing, being challenged to innovate towards full circularity and sustainability. The main challenges for the Dutch waste management industry are the following:

1. Reduce waste production and emissions;
2. Improve the quality and quantity of waste stream recycling;
3. Increase transport efficiency and get to zero-emission.

One of the organizations contributing to these goals is PreZero, the client of this graduation project. PreZero is an international utility organization specializing in waste management (collection, sorting, and recycling). PreZero is part of the Schwarz Group, a multinational that also includes Lidl and Kaufland. By focusing on the entire value chain, their ambition is to close loops to reduce the consumption of natural resources. Operating at 430 locations in eleven countries, PreZero is active in the Netherlands since its acquisition of SUEZ Netherlands in 2021 – one of the Dutch waste management market leaders for decades (PreZero, n.d.).

The Smart Collection department of PreZero is aimed to innovate the collection of waste to meet the set industry challenges. Since last year, the team is piloting a new initiative called 'return logistics', to radically change the methods used for collecting waste. This initiative focuses on the smart collection of small, specific, source-separated waste streams (e.g., coffee grounds, paper cups, and plastics) of businesses in the city center, by using existing transport vehicles.

Return logistics builds upon the existing business of decreasing inner-city traffic and pollution by using hubs for the transshipment of goods that need to be delivered to businesses and consumers in city centers. If deliveries of several suppliers are collected and bundled at a logistical hub, instead of being delivered by each supplier individually, fewer trucks will drive in and out of city centers. These so-called 'stadshubs' are strategically located on the outskirts of cities, near highways for easy access by big trucks, and close enough to the city center to reach it with smaller electric vehicles.

This hub solution is already more efficient and sustainable than normal delivery, but the efficiency could still be increased. After delivery, the vehicles are returning to the hub with empty trucks. Garbage trucks do the opposite: they enter city centers empty and leave filled with waste. PreZero sees an opportunity to make smart use of the leftover space in delivery trucks for their waste collection. If these empty vehicles could collect specific waste streams on their way out of the city center, fewer garbage trucks of PreZero would be needed for the city's waste collection, resulting in even further traffic and pollution reduction.

The PreZero Smart Collection team has a provisional vision of how such a return logistics system would be operated (see Figure 1.1), but they have not designed and realized the complete solution yet. To test the viability of the system, the initiative is currently being piloted at stadshub The Hague with forty governmental offices as pilot client.

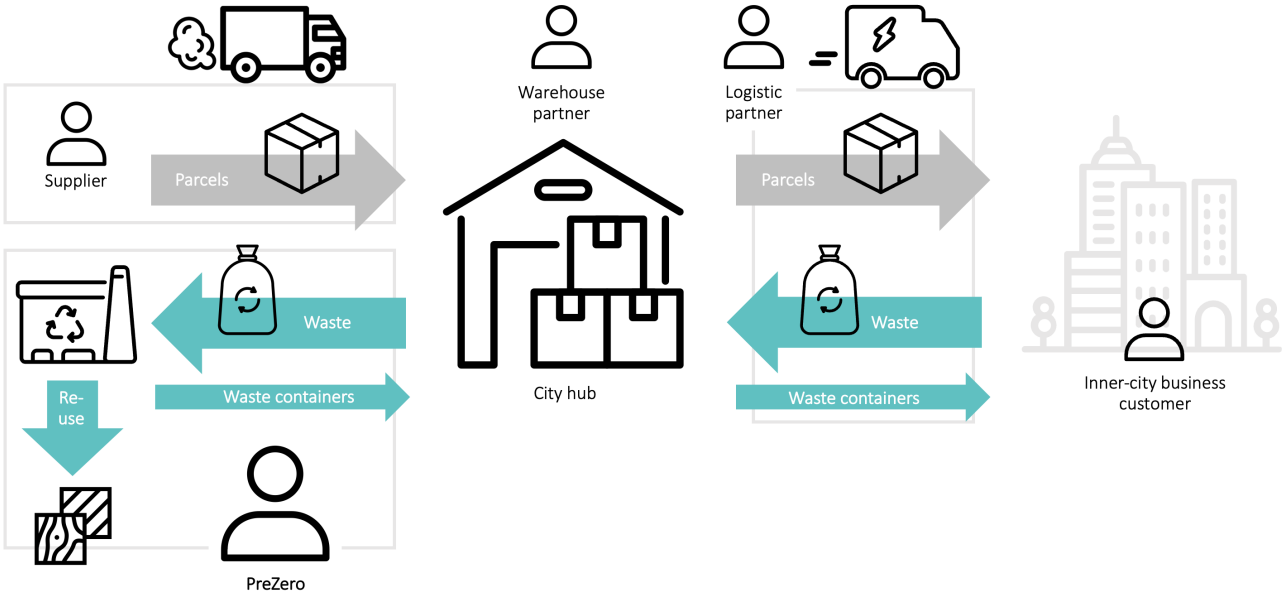


Figure 1.1 Visualization of the return logistics system operational at the Lidl distribution center

1.3.1 Problem definition

The problem-space of circular waste management and sustainable waste collection in an inner-city environment is a wicked problem, being positioned in a changing multi-stakeholder context. With regulations varying per region and the current administration, and the involved stakeholders all pushing for different kinds of innovations, the solutions space is constantly evolving.

With their system vision for the return logistics of specific waste streams, the Smart Collection team at PreZero might have found the next step towards circularity and sustainability, yet the details of the system still need to be designed and developed. An exploration of the possible value propositions of the system and a more detailed product-service system design are needed to determine what direction the team should head.

Collecting waste via return logistics creates a challenging new collaboration for PreZero, in which the operations of collection move from their current in-house solutions to being operated by a third party – one without waste collection experience. The pilot in The Hague helps to gain insights into this new collection system and its challenges, yet the needs and wishes of (potential) stakeholders are not yet researched and considered. An extensive stakeholder analysis is needed to gain a better understanding of whom to design the system for and what customers to focus on.

The current pilot only explores one specific configuration of the return logistics system in one location, but the possibilities for this system might be more extensive. To be able to economically scale up operations to other locations, a scalable solution is needed. Is this possible and if so, what

does a future-proof and scalable solution look like? On a product level, currently, off-the-shelf solutions are used in the pilot. Since these are evaluated as poor solutions, a solution that fits the needs and wishes of all stakeholders should be explored and designed.

The idea of return logistics is not new, so the question is why PreZero will be the right stakeholder to bring this concept to realization. What does the market look like, and what are PreZero's capabilities to gain a competitive advantage? The return logistics system encompasses a disruptive change for the organization, how can the support of the organization be gained to implement the designed solutions?

The goal of this 20-week graduation project for the Master Strategic Product Design of the Delft University of Technology is to research the above-mentioned problem space and propose a solution in the form of a product-service system design and a method for further development and implementation.

1.3.2 Research questions

This graduation project focuses on smart waste collection in an inner-city environment by mapping the complex stakeholder environment and designing a strategic product-service solution using return logistics for the collection of specific waste streams. The main research question for the projects is defined as follows:

"How can a scalable product-service system for smart return logistics of source-separated commercial waste streams in an inner-city environment be designed and implemented by PreZero?"

Furthermore, four sub-questions are defined to help answer the main research question:

1. *Who are the current and potential stakeholders of the return logistics system and what are their needs and wishes?*

2. *How should the client position itself in the complex stakeholder context of inner-city waste collection?*

3. *How can a product-service system for return logistics of source-separated commercial waste streams be designed and validated?*

4. *How can the client apply the insights from this project to realize and implement the proposed product-service system?*

1.4 Project outline

This graduation project is structured in nine chapters, that build up to explore and answer the defined research questions. Figure 1.2 shows this outline and acts can act as a reading guide for this report.

Figure 1.2 Quick overview of the nine chapters of the project.

2

APPROACH

To structure the master thesis, the theoretical framework of effectuation was selected, which is explained in this second chapter. To detail this approach, the used methodologies are described and explained.

2.1 Theoretical framework

As the introduction shows, this graduation project focuses on the design of a solution for a product-service system with multiple stakeholders, placed in a complex context of changing regulations and business models. The solution cannot simply be designed for the current context but should consider the variable future in which the system will be operated. That is what makes this a strategic design challenge.

In designing for the future, different logic and methods can be applied. Sarasvathy recognizes four types of logic that differ in their notion of prediction and control over the future, see Figure 2.1 (Sarasvathy, n.d.). The most common logic is causal logic, which gets taught in business schools and universities around the world to build businesses. This logic assumes that the future is uncertain, but that it can be predicted to such an extent, that tools like market segmentation, targeting, and positioning can be used to reach a predefined goal. The amount of control on the environment is deemed outside the businesses' control.

On the opposite of both axes, the lesser known 'effectual logic' can be found. This logic builds upon the control of one's direct environment and assumes the future to be uncertain and unknown. By working with the things within direct control, and by learning from changing circumstances, the future does not need to be predicted, it will be co-created by one's actions. This is called non-predictive control, which forms the basis of the theory of effectuation (Sarasvathy, 2008).

Since this project aims to design a solution for a yet unknown future, which is heavily influenced by human actions, the theory of effectuation is used as a theoretical framework for this project.

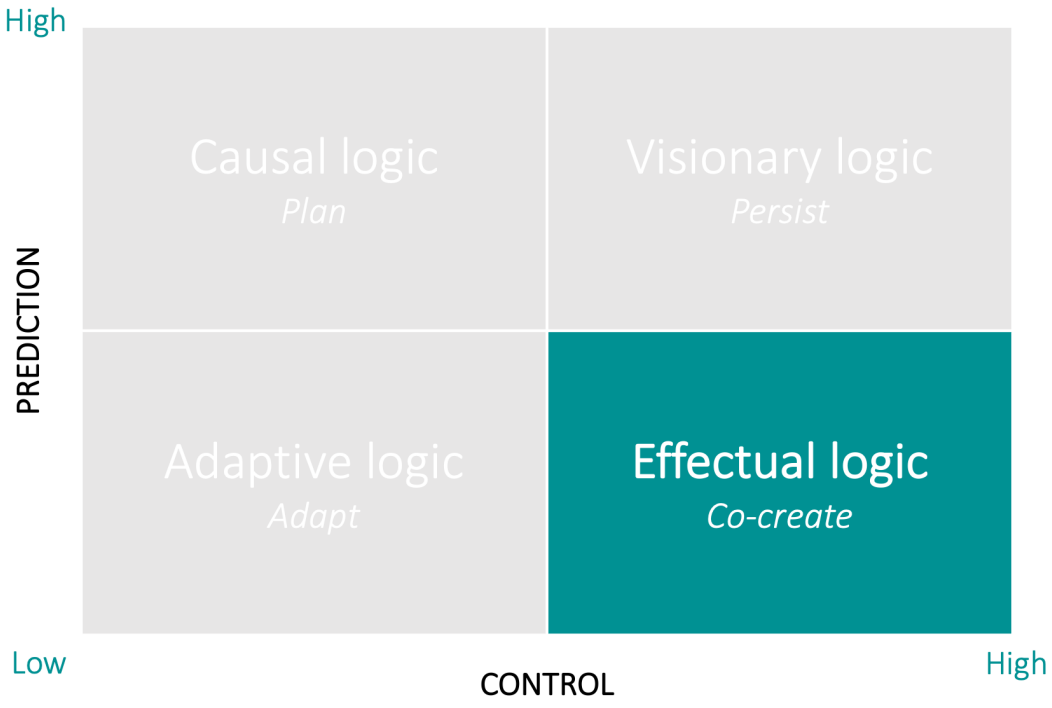


Figure 2.1 Prediction versus control – four types of logic (adapted from Sarasvathy, n.d.)

2.1.1 The theory of effectuation

The theory of effectuation is based on entrepreneurial reasoning and their way of dealing with the uncertainties of the future and was first defined by Sarasvathy in 2001. This chapter summarizes the theory to build the theoretical framework of the project.

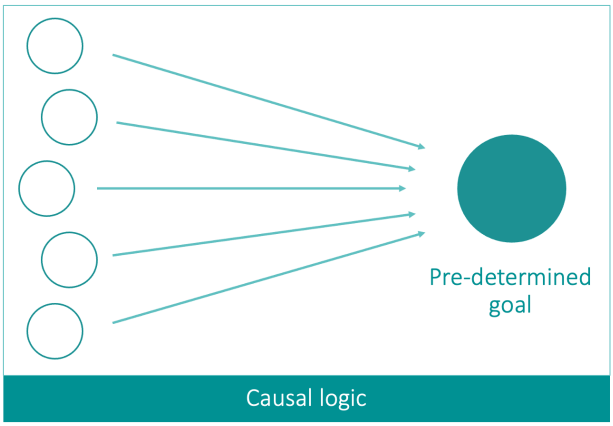
In designing for the future, three types of uncertainties constitute the effectual problem space. The first is called 'Knightian uncertainty', which is the notion that it is impossible to calculate probabilities for consequences in the future with certainty. The second is 'goal ambiguity', which is the fact that goals and preferences are not given and well-ordered in advance. The third and last is 'isotropy', which describes that during the process of designing for the future, it is not clear what elements or trends to pay attention to and what to ignore.

Effectuation copes with these uncertainties by using the same principles as the logic of design. By understanding that the future is not given or predicted but made, probabilities of the future are not needed. Effectual logic understands that goals and preferences are not given, but that these will evolve and change over time. The environment in which you operate is not something you must adapt to, but that you can shape and influence with your actions.

Where causal 'managerial' logic starts with a predetermined goal and tries to select the right means to reach this goal, effectual 'entrepreneurial' logic starts with the current means available and does not begin with a specific goal. Instead, it uses the current means to imagine possible new ends, used to set goals that will evolve over time (see Figure 2.2). Where causal logic helps to choose in problems of decision, effectual logic helps to construct in problems of design. This active and open approach to the problem space and its possible solutions is inherently creative (Sarasvathy, 2008).

The theory of effectuation is based on five main principles (see Figure 2.3).

The first is the 'bird in the hand' principle, which emphasizes the before-mentioned logic to start with your current means and design possible outcomes, instead of starting with a predetermined goal. This diverging approach is more likely to lead to novelty than the converging approach of choosing the right means to reach a set effect. There are three categories of means: identity (who am I?), knowledge base (what do I know?), and the social network (whom do I know?). These means can be mapped and addressed to generate new possible goals to aim for.



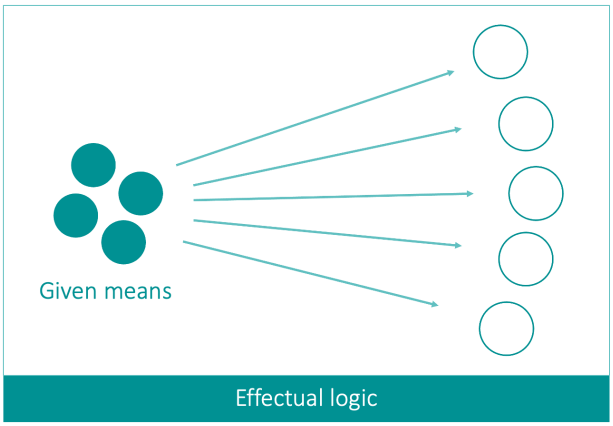


Figure 2.2 Causal logic vs. Effectual logic (adapted from Sarasvathy, n.d.)

The second principle 'Affordable loss' is about the way risk and loss are defined during a project. Instead of aiming at a specific target return and limiting the risks for that aimed return, effectuation starts with defining the loss that is affordable and tries to maximize the results that can be reached with this loss. Based upon the notion that the future is not predictable; this principle needs no advanced models of future income streams and risks. All that is needed to start a new venture, is the current financial condition and the defined reasonable loss that you are willing to take. This can be repeated in every decision along the journey.

The third principle is called 'Crazy quilt', referencing the analogy between starting a new venture using effectuation and building a crazy quilt patchwork. Instead of spending time and effort on extensive competitive analysis, the theory of effectuation limits possible competition by building alliances and pre-commitments with all self-selecting stakeholders that are willing to join. By building upon each other's means, the possible future can be co-created with minimal investments needed. Sharing revenues, instead of collecting investments, limits the risks and increases stakeholder commitments.

The fourth principle is based on the saying 'if life gives you lemons, make lemonade.' Where traditional models try to limit obstacles in their path towards the predetermined goal, effectuation exploits these contingencies. The unexpected is an opportunity to test your control over the situation and possibly adjust the set goals. As mentioned in the first principle, the final goal is not set, so if contingencies occur, these might be a sign to change path to another goal.

The fifth and last principle is the 'pilot in the plane principle', which is about the logic of non-predictive control explained before. As Sarasvathy explains it, the logic of causation is: "To the extent that we can predict the future, we can control it", while the effectual logic is: "To the extent that we can control the future, we do not need to predict it". Since designing for the future brings great uncertainties, the pilot in the plane is a metaphor for being ready to exercise control over the unexpected on the path of entrepreneurship.

Bird-in-the-hand	Start with your means: Who am I? What do I know? Whom do I know? What do I have?
Affordable loss	Focus on the downside risk and limit it. Don't try to predict the upside.
Crazy quilt	Form partnerships. Co-create, share revenues, and limit investments.
Lemonade	Leverage contingencies and adjust your value proposition.
Pilot in the plane	Focus on activities within control. The future is made, not found or predicted.

Figure 2.3 The five principles of effectuation (adapted from Sarasvathy, 2008)

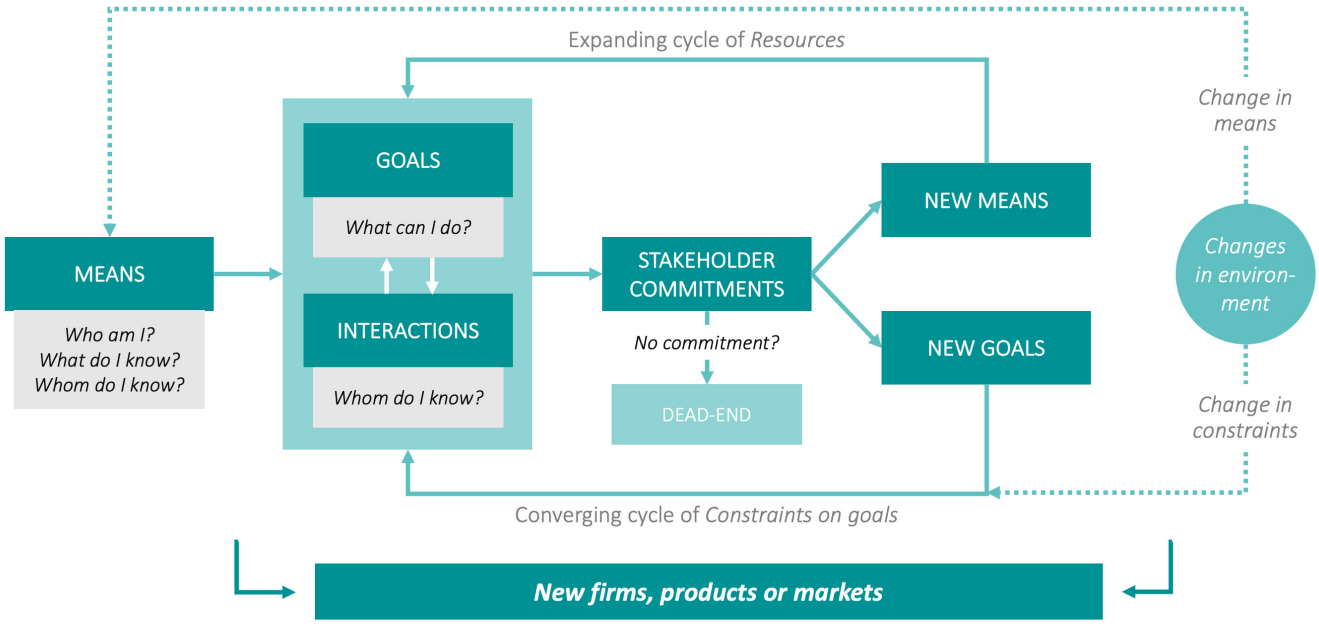


Figure 2.4 Effectuation in action (adapted from Sarasvathy, n.d.)

2.1.2 Effectuation in action

To bring the theory of effectuation into action, Sarasvathy built a model which illustrates the process of effectuation, see figure 2.4.

Following the five principles described before, the starting point is at "means" on the left side of the diagram. After the means have been explored and mapped, they can be used to define the goals and select the people to interact with. With these both set, stakeholder commitments can be explored. If stakeholders do not want to commit, the opportunity is placed on hold. If stakeholders do commit, this leads to new means and new goals, which loops back to the goals and interactions step. Since the process of effectuation will not be placed in a vacuum, the environment will also influence the means and the (constraints on) goals. By iteratively repeating the steps from this process, new firms, products, and markets can be built (Sarasvathy, n.d.).

The theory of effectuation is built upon the research of the behavior and logic of expert entrepreneurs. However, this does not mean that following the theory of effectuation will bring success. Just as causal logic, effectual logic can still lead to poor decisions and bad outcomes. What can be guaranteed, however, is that by following the steps of effectuation, stakeholders will be involved from the very first stages onwards, co-creating the to-be-designed solutions or markets.

Since effectuation is built upon entrepreneurial reasoning, bringing the theory to enterprises can be challenging. With set management practices, internal funding, and stakeholder commitments, the open and exploratory approach can be difficult to apply within a firm. In their paper about this topic, Duening, Shepherd, and Czaplewski (2012) theorize that the basic principles can very

well be implemented in both the traditional new product development and system development process.

The most important lesson that intrapreneurial managers (called 'Enterprise-Entrepreneurs' in the paper) could learn from the effectual logic, is that the focus should not be on controlling the process to reach certain results, but on controlling the current resources to utilize them as well as possible to reach valuable unknown outcomes. This means that goals will change and that projects should be terminated if needed. A model to use the effectual logic in the traditional Stage-Gate new product development (NPD) process is illustrated in Figure 2.5.

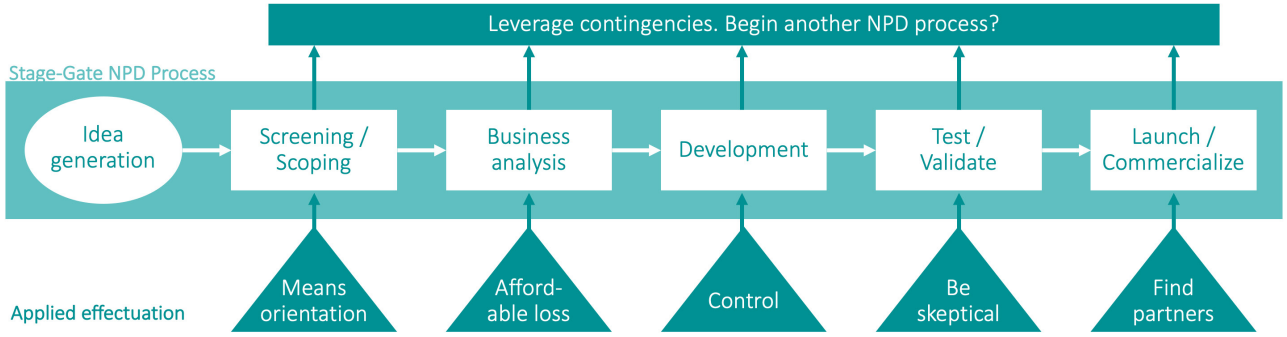


Figure 2.5 Applying effectual logic to the traditional Stage-Gate New Product Development process (adapted from Duening, Shepherd & Czaplewski, 2012).

2.2 Methods

The iterative and variable characteristic of effectuation makes it a creative process, which builds on the same logic as designers do (Sarasvathy, 2018). This makes the theory of effectuation a very suitable theoretical framework for this graduation project. With the theory as the outline, specific research methods can be selected to perform during the project. See Figure 2.6 for an overview of the selected methods that are explained in this section.

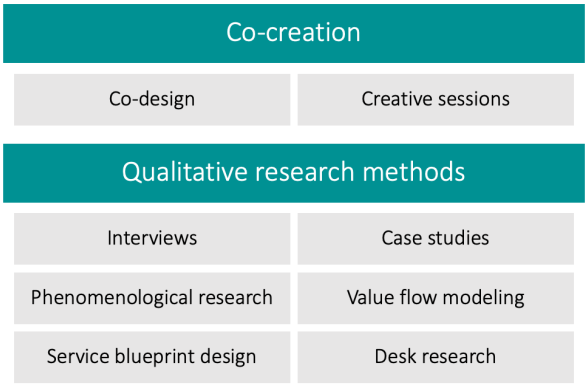


Figure 2.6 Overview of the methods used in this project.

2.1.3 Co-creation

The main method applied in this graduation project is co-creation. This interactive design method involves multiple people in any form of collaborative creativity (Sanders & Stappers, 2008). As the chapter about effectuation showed, co-creation is an integral part of the effectual method. Stakeholders are involved throughout the entire process of effectuation, collaborating towards the desired outcome. In this project, co-creation is used to involve the client, potential users, and other stakeholders in the design process.

Within the broad term of co-creation, different types and tools of co-creation exist, like participatory design and lead-user design. One term often used interchangeably with co-creation is called 'co-design.' Although this method is part of co-creation, it is used for instances in which collaborative creativity is used over the whole span of the design process (Sanders & Stappers, 2008).

Co-creation is used throughout this project in three ways:

1. The two project supervisors from the client (PreZero) are involved during the entire project in a form of co-design, using regular meetings (once every two weeks) in which small creative sessions are held. By sharing key insights or questions, using interactive tools to map interests, and collaboratively making decisions, the meetings are used to invite the client to co-create the direction of the project in every phase of the design process.
2. Other stakeholders, like the logistical partner (PostNL Stadslogistiek), the warehouse partner (Djinny Logistiek), the current customer (FMH), potential customers, and the prototype manufacturer (KarTent) are involved in the project with small creative sessions during specific crucial phases of the design process, like the initial analysis, the ideation, concept selection, and concept validation phases. The insights of these stakeholder sessions help to get the complex context of the design problem included in the outcomes of the project and increase the chance of successful implementation.
3. At last, a creative session is held with a group of managers of PreZero, to focus on the implementation of the found insights and collaboratively decide on the actions to take. This session is used to share the value of using the effectual approach to get the most out of the current means and increase the chance of successful implementation.

2.1.4 Qualitative research methods

Next to co-creation, several qualitative research methods were used during this project. Qualitative methods were preferred over quantitative methods since the design problem has many dimensions and layers that needed to be discovered to their full complexity, instead of being simplified or generalized like quantitative research is used for (Muratovski, 2022).

Interviews

A series of semi-structured, exploratory, open interviews was conducted with potential commercial customers for the return logistics system in the inner-city of The Hague. The goal of these interviews was to gain a wide array of in-depth insights into the context of different types of possible commercial customers, like restaurants, bars, hotels, retail shops, and personal care providers. The use of a semi-structured interview guide made sure that all relevant topics were covered while maintaining an open style of conversation with the participants of the interviews. This qualitative, accessible method was chosen to gain rich data about personal real-life experiences in a short amount of time. The method and insights of these interviews are discussed in Section 5.1.

To explore another perspective, another semi-structured interview was conducted with the CCO of a Dutch startup that is the direct competitor to the PreZero return logistics system. The purpose of this interview was to learn about the perspective from a new market entrant, evaluating the current and future market of source-separated waste collection and the position of different types of organizations in this market. The qualitative method of an interview was chosen to gain in-depth insights into the complex topic at hand and the participant's thoughts and interpretations about this topic. A semi-structured interview guide was used to be sure all relevant topics were covered while maintaining room for deviations and new insights from the participant. The interview guide was pre-approved by the client's project supervisors to make sure that no confidential information about the status of the return logistics project from PreZero was accidentally leaked by the interviewee. The results of the interview can be found in Section 5.3.

Case studies

Next to the interviews, two single-case studies were performed during the project. Case studies are very well suitable for the study of complex phenomena within a set context. Using a variety of data, an in-depth understanding of a yet unknown situation or occurrence can be quickly gained with this form of qualitative research. To avoid performing a case study with too many objectives, the parameters of the research were clearly defined in the preparation of the case studies. The form of single case studies was selected to investigate the unique properties of both cases. Furthermore, in the case study of the pilot in The Hague, a multiple case study was impossible since only one pilot is yet operational. For the Lidl pilot, a multiple case study could have been possible, but given the objective of the case study to investigate the characteristics of the return logistics system as an example of what is yet possible, a comparison study was not needed to reach the objective (Muratovski, 2022).

The first case study was performed at the very beginning of the project, to study the return logistics pilot in The Hague. The goal of this case study was to gain a clear understanding of PreZero's current means, being detailed to the current system flow, the roles of the involved

stakeholders, the used solutions, and the preferred improvements. Several data gathering methods were used to execute this case study. In preparation, desk research was performed to understand the context of the pilot, detailing the history, location, involved stakeholders, and theoretical system flow. After this desk research was finished, a site visit was performed to research the activities at the hub for the predetermined timespan of one morning. The parameters were fixed on location and time: being the hub for one morning. During this morning, the hub location was visited, the Stadslogistiek planner was interviewed about her operation, and a Stadslogistiek driver was joined for a morning in its activities during a round of delivering parcels and collecting waste. By taking part in these activities and interviewing the driver along the way, I gained rich data about the current state of the return logistics system. During this site visit, data were gathered using notetaking and photography. The insights of this case study are discussed in Section 4.2.

The second case study was performed at a supermarket's distribution center, to research an example of a currently operational return logistics system and gain in-depth insights into how this system is operated. The case study consisted of a site visit of one afternoon together with a PreZero supervisor to the 'Lidl' distribution center in Etten-Leur, where a presentation and extensive tour throughout the facilities were given by the facility manager and the waste collection manager. During the site visit, every step of the return logistics process of waste streams from their supermarkets to the distribution center was shown and explained. Data was gathered using notetaking and photography, and the insights of this case study are discussed in Section 5.2.

Phenomenological research

In the final phase of the design project, phenomenological research was used to understand the stakeholders' perspectives and views of the designed bin prototype in the context of the actual return logistics system. The focus of this type of research is on people's experiences with certain phenomena, and the aim is to gain rich data about these experiences in the form of opinions and user stories (Muratovski, 2022).

This type of qualitative research was chosen to evaluate the prototype with all involved stakeholders. In collaboration with an enthusiastic customer, a pilot was set up to test the prototype in an actual user context. A custom prototype was designed to fit the customer's needs and wishes, after which the system was set up to be able to run a pilot for ten days. With all stakeholders performing in their designated roles, the system was operated in a real-world setting.

Different types of research methods and data gathering can be used for phenomenological research. For this case, interviews, participant observations, and action research were used. For data gathering, different tools were used. Live interviews were performed with the driver and customer during the setup of the prototype, during the first waste-collection moment, and at the closure of the pilot during the collection of the prototypes. To fill the gaps between these moments, online text messages (WhatsApp) were used to ask the customer to evaluate the prototype continuously. Participant observation was performed by joining a Stadslogistiek driver for a day, after which the driver was interviewed about his experiences. Action research was used to a minor extent, in the sense that the cleaning

of the used containers had to be performed by myself since the solution for this was not yet operational. This created the opportunity to experience this step of the process first-hand and evaluate the needs and wishes that employees performing this task might have. Further details about this research can be found in Section 7.4.

Value flow modeling

The 'crazy quilt' principle of effectuation involves collaboration and value sharing with all involved stakeholders, to collaboratively build the new product or business. This act of collaboration is also called networked innovation, in which multiple actors form a system of products and services that are developed together (Den Ouden & Valkenburg, 2011).

In their paper about mapping value in networked innovations, Den Ouden and Valkenburg (2011) explain how these networked innovations can create greater value than organizations on their own. However, the complex dynamics of multiple stakeholder organizations bring new difficulties and ask for new value propositions, value constellations, and profit calculations. One of the steps of the five-step approach that Den Ouden and Valkenburg suggest helping networked innovations is the so-called 'value flow model,' in which the value streams between all involved stakeholders are mapped. Looking at the theory of effectuation, this value flow map could help to understand and map the stakeholder commitments, as well as the current means.

Four different types of value flows between organizations and people are distinguished in the value flow model: 'information,' 'physical goods,' 'money,' and 'intangible value.' For the clarity of this project, the 'physical goods' value flow is further detailed into two types: 'waste' and 'goods.' The results of these value flow modeling exercises can be found in Sections 4.3.2 and 7.2.5.

Service blueprint design

Since this project is about the design of a product-service system, the use of a customer journey map and service blueprint design was very appropriate. These design tools are used to explore and map all specific user experiences, by zooming in on each step of the system and detailing the actions, experiences, touchpoints, and front- and back-end system.

In the beginning phase of the project, the exercise of customer journey mapping was used to analyze the pilot system and compare it to traditional and envisioned systems. Although traditionally used to map the perspective and experiences of the customer, I used the customer journey map to explore the system from the perspective of the waste stream that flows through the return logistics system. This decision was made because the customer is only involved in one step of the system, which applies to the other involved stakeholders too, who only see a specific part of the entire process. By modeling the journey from the perspective of the waste stream, all steps of the process could be illustrated in one flowchart, which was the objective of the journey map in this specific phase of the project. The decision was made to only focus on the physical streams in the journey maps, excluding the beforementioned value flows of information (data), money, and intangible value. Including all these streams would have made the journey maps too complicated for this stage of the project. The results can be found in Section 4.2.

This higher rate of complexity was covered in a later stadium of the project, by using the format of a service blueprint to map the flow of both physical and data streams. Service blueprints are more extensive than customer journey maps because they also include several layers of back-end systems needed to create the user experience. The objective of the service blueprint design was to explore and design the envisioned return logistics system from the perspective of the waste disposer, including all responsibilities of the different involved stakeholders (Stadslogistiek and PreZero) and the systems needed to create this customer journey. The results of this service blueprint design can be found in Section 7.1.

Desk research

Next to the practical, real-world research methods used in this project, desk research was performed to place the research in context and fill possible knowledge gaps where needed. The main insights of this desk research can be found in Chapter 3 (the context analysis of the project), in Section 4.1 (the analysis of PreZero and its competitors), and in Section 4.3 (the stakeholder analysis).

3

CONTEXT ANALYSIS

In this chapter the context of the project is analyzed. First, waste is explained more in detail, by defining waste types and waste streams. Next, waste management methods and the Dutch market are researched, to better understand the market in which the client operates. Thirdly, the Dutch transition to a circular economy, and policies to enable this transition, are explained, and the the implications for the inner-city logistics are analyzed. Lastly, the pilot in The Hague is explained.

3.1 Types of waste

Waste can be divided into different types and streams. As these definitions can get very detailed and technical, and differ among countries and reports, a simplified distinction is made for this design project. A schematic overview of this distinction is shown in figure 3.1. The definitions of the waste types and streams are explained in the next paragraphs.

Four main types of waste can be distinguished: industrial waste, municipal waste, hazardous waste, and wastewater.

- Industrial waste is all solid waste generated by large industries, like waste generated during the industrial production of products, but also construction and demolition waste. Mineral waste accounts for the biggest quantity of this type.
- Municipal waste is what you would probably think of when speaking about waste. This type is the solid waste mainly discarded by consumers, such as product packaging, food leftovers, and clothes.
- Hazardous waste is in quantity very small compared to the other waste types but is categorized separately thanks to its high risk of a tremendous negative impact on the environment and public health.
- Wastewater is the last type, which is probably the easiest to define. This type includes all liquid waste that is not defined as hazardous waste, such as sewage water and surface runoff.

The focus of this project is on municipal waste (sometimes called municipal solid waste, MSW), which encompasses most waste daily discarded by consumers. Although the name might imply that it is all waste that municipalities collect, this is not the case. This name originates from the fact that traditionally, the collection and management of these types of waste streams have been a municipal responsibility, but today this might be different, and municipalities might collect and manage waste streams that do not fall under this definition (Eurostat, n.d.; Hoornweg et al., 2015).

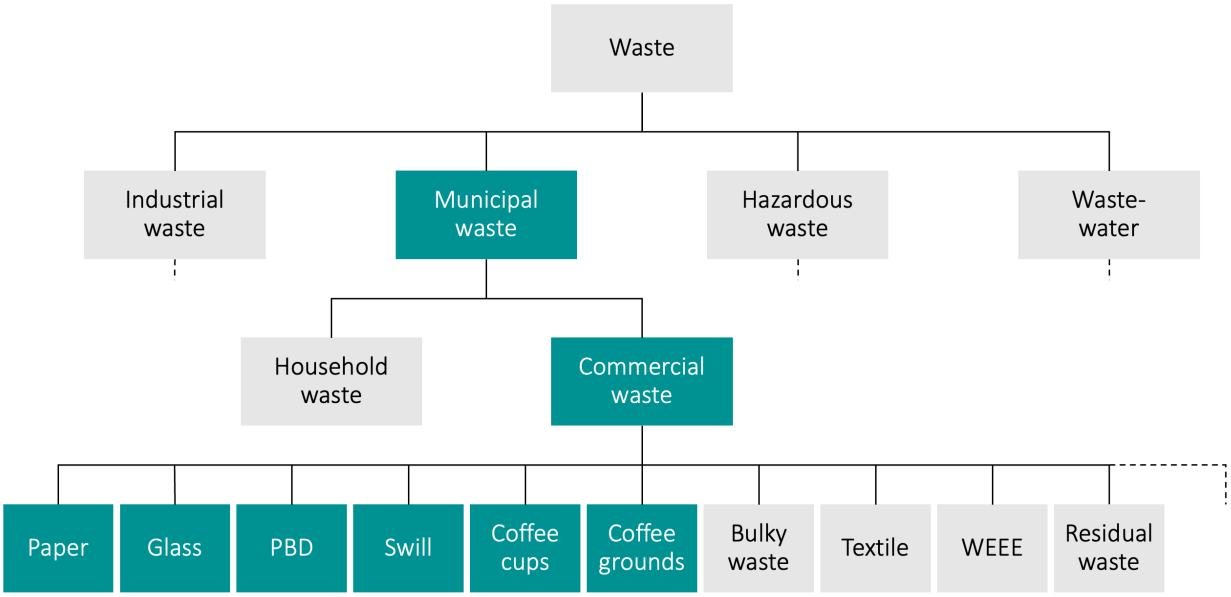


Figure 3.1 Schematic overview of the defined waste types, subtypes, and streams. The relevant waste types and waste streams are highlighted in turquoise..

All these waste types can be further detailed in subtypes and specific waste streams. Since other types are out of scope for this project, the focus is on municipal waste in figure 1.1. This type is subdivided into two main types of waste: household and commercial waste. Household waste is waste directly generated by consumer households, which consumers collect and pay for themselves. The other type is called commercial waste, on which PreZero focuses its Return logistics concept. This type encompasses all solid waste streams generated by commercial parties (offices, shops, restaurants, institutes, etc.) that do not fall under the definitions of industrial or hazardous waste. Note that this means that the waste type is not simply based on the type of waste generator and that one business can easily generate multiple types of different waste types (Kaza et al., 2018).

All waste types consist of waste streams. As Bourguignon defined in the briefing for the European Parliament: "Waste streams are flows of specific waste, from its source through to recovery, recycling or disposal" (2015). These streams are the specific material or product flows you probably know from consumer source separation, such as glass, plastics, metals, paper and cardboard, and small electronic devices. Since treatment and separation solutions for these streams can differ, the definitions of waste streams can vary by region.

The waste streams relevant for this project are defined using PreZero's definitions and can be found in Table 3.1. Note how these commercial waste streams might differ from some well-known household waste stream definitions. Other waste streams like textile, small electrical and electronic devices (called WEEE in the EU), cartridges, and batteries might be interesting for the project as well but are not yet included in the scope (Eurostat, n.d.). Furthermore, the current types and definitions of waste streams might develop, as new technologies for waste separation and recycling emerge, and new applications of specific materials are found.

Table 1.1 Definitions of the waste streams that are relevant for this graduation project (PreZero, n.d.).

Waste stream	*Definition*
Paper	All paper and cardboard waste suitable for recycling (e.g. plain paper and cardboard boxes, but no drink containers or pizza boxes). Confiden-tial papers that need to be destroyed are collected seperately.
Glass	All glass containers like bottles and jars, empty but not cleaned, metal lids allowed, sometimes collected separated on color.
PBD	Dutch abbreviation for plastic packaging, metal containers and drinking cartons ("Plastic verpakkingen, Blik en Drinkpakken", also called PMD: "Plastic verpakkingen, Metaal en Drankenkartons")
Swill	Organic kitchen waste, also defined as 'GFE', a Dutch abbreviation for vegetables, fruit, and food scraps ("Groente, fruit en etensresten") – which differs from the household waste stream 'GFT' in which garden waste is allowed too.
Coffee cups	Empty paper coffee cups without plastic coating, collected for recycling to new paper products.
Coffee grounds	Pure (wet) coffee-grounds from grounded coffee beans, without any other materials such as filters or packaging.

3.2 Waste management

Waste management has historically been an urban service operated on a local level, as it is essential for the health of communities. It encompasses the entire system of providing waste collection solutions to citizens and businesses (like wheely bins), the collection of the waste (in containers and by cleaning the streets), the transportation to a waste plant (possibly via one or multiple transfer locations), the actual waste treatment, and the final disposal. The collection of municipal waste differs per country and region. In Europe, it often is a combination of door-to-door curbside collection and collection at central drop-off points like waste-separation containers in neighborhoods or at grocery stores. For waste treatment, different solutions are possible, like landfill, incineration, composting, and recycling. As mentioned before, almost seventy percent of global waste is still being dumped in a landfill, though the trend is moving to more recycling and composting. Furthermore, the percentage of waste that is incinerated to generate energy is increasing (Kaza et al., 2018).

3.2.1 Source-separation of waste

If waste streams are collected separately at the source, the ease, and quality of recycling the waste stream into a raw material stream that could be used for new purposes increases. Furthermore, composting and incineration are more efficient with source-separated waste streams (Murray, 1999). This is a key component of integrated waste management, which is considered to be essential for the successful treatment of municipal waste (Hu et al., 1998, McDougall et al., 2001).

In the Netherlands, source separation of waste streams has become a common practice for many consumers. Waste streams like paper, glass, plastic, and organic waste are source separated in many municipalities. If separated correctly, the source-separated waste streams minimize labor and energy needed in the waste treatment phase (Murray, 1999). The risk, however, is contamination by bad source separation, which eventually leads to higher costs in the waste treatment phase. Waste disposers, therefore, need to be trained and instructed on how to separate their waste to reach the maximum potential of this system (Zhuang et al., 2008).

3.2.2 Dutch waste management

As the name implies, municipal waste management in the Netherlands is primarily a municipal responsibility. It used to be executed by municipalities themselves, but since the 1980's the belief in market forces pushed reforms, and many new forms of organizations started to be created. Torsteinsen and Genugten (2016) define five types of local waste organizations that are listed below.

1. Unit or directory of the local government.
2. Semi-autonomous organizations without legal independence but with considerable managerial autonomy ("Gemeente bedrijven").
3. Legally independent organizations with managerial autonomy ("Gemeenschappelijke Regeling").
4. Organizations established by or on behalf of the local government ("overheidsvennootschappen").
5. Tendering and contracting out to public or private organizations.

Nowadays, waste management in the Netherlands is predominantly executed by semi-private organizations (types 3 and 4) and Torsteinsen and Genugten expect the market

to stay rather stable in this form. PreZero was established by the local government (type 4) but is now privatized (type 5) and contracted by municipalities throughout the country.

All companies that operate in the Dutch waste market need to be registered on the 'VIHB-list' from the Dutch transport organization NIWO ('Nationale en Internationale Wegvervoer Organisatie'). This list is an abbreviation of the different types of roles an organization can perform within the market: transporter ('Vervoerder'), collector ('Inzamelaar'), trader ('Handelaar'), mediator ('Bemiddelaar'). An organization can perform one or multiple of these roles. PreZero is labeled as 'VIHB', being registered to fulfill all these roles (NIWO, 2022).

Unlike consumers, who pay a specific waste charge to their municipality for the collection and treatment of their household waste, businesses in the Netherlands can choose between different commercial parties to deal with their waste. Businesses are obliged to conclude a contract with a commercial waste management provider that will collect and treat their commercial waste streams. There are many providers on the market that provide different waste containers, collection intervals, prices, and additional services (City of Amsterdam, n.d.).

3.3 Towards a circular economy

As mentioned in the introduction, the Dutch government aims to transform the entire country to a circular model by 2050. To enable this transition, all sorts of legislations and incentives have been developed over the years. Since the waste market is a highly regulated market, changes in legislation can be of great impact for businesses. Therefore, a closer look at the main governmental programs is needed.

3.3.1 From waste to resources

As mentioned in the introduction, the government-wide program for circularity is called 'Nederland Circulair in 2050', which was presented in 2016. This program is the successor of the From Waste to Resources (VANG: Van Afval Naar Grondstof) program which was executed between 2014 and 2016 (Ganzevles et al, 2018). Figure 3.2 illustrates the transition aimed for.

The three main objectives of the program are:

1. Increase the material-efficiency of existing production processes to reduce the need for raw resources.
2. When raw resources are needed, increase the use of sustainably produced, renewable and commonly available resources to reduce the dependency on fossil resources,.
3. Develop new circular products and production methods.

These objectives are aimed to result in a fifty percent decrease of primary resource use (such as minerals, metals, and fossil fuels) by 2030. By 2050, the government wants to have a circular economy in which waste does not exist, by only using renewable resources and reusing existing products and materials for new purposes.

The circularity program consists of several policy frameworks. The most important one for the waste management sector is the National Waste Management Plan 'LAP' (Landelijk Afvalbeheerplan), which describes the policy and objectives for waste management and prevention. The first version of this framework came into effect in December 2017, and per March 2021 the framework was updated to its third and current version 'LAP3' (Ministerie van Infrastructuur en Waterstaat, 2021).

This latest version of the LAP describes detailed plans for eighty-five sectors and defines 'minimum-standards' for waste streams within each sector, which detail how the waste stream should be treated. The biggest change is the new responsibility for organizations to source-separate their commercial waste streams on their own premise. This increases the recyclability and is of great influence for this graduation project (Schröder, 2021).

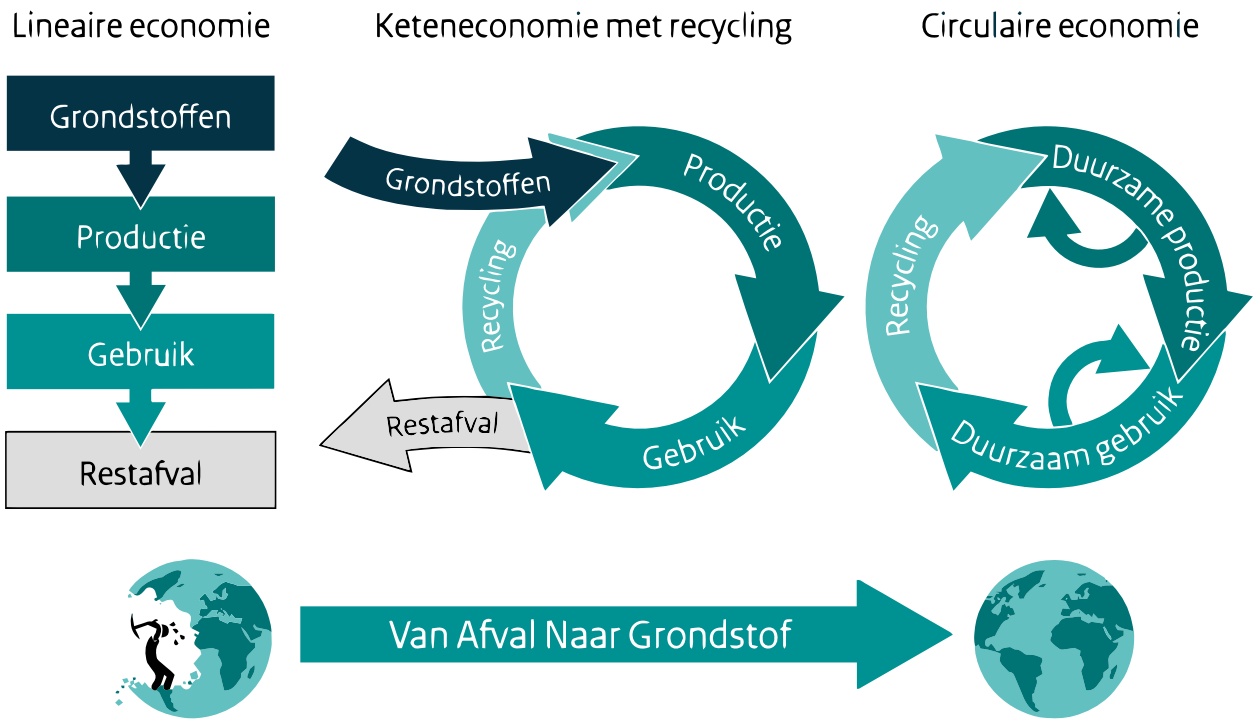


Figure 3.2 The governments system vision for the transition towards a circular economy (adapted from Ministerie van Infrastructuur en Waterstaat, 2014).

3.3.2 Sustainable inner-city logistics

Next to the Dutch efforts to close material loops, the aim to transition to a circular model is also translated in efforts to reduce overall carbon emissions. For the inner-city context logistics, Dutch logistics organizations and local governments collaborated to create the Green Deal ZES ('Zero Emission Stadslogistiek') in 2014, to define targets and an approach to reach more sustainable inner-city logistics in the Netherlands by 2025. The clear overarching goal is that by 2025, 30 to 40 of the biggest municipalities will have emission-free zones. This will push the market to transition to modes of transport that are emission free, thus reducing overall carbon emissions.

One of the solutions to reduce the emissions in city centers is by using hubs that are strategically located on the outskirts of cities. As one of the solutions promoted in the Green Deal ZES, this idea might sound new, though the first pilots with such city hubs ("stadsdistributiecentra") originate from the 1990's (Witte, Alonso-González & Rongen, 2021). Though there seems to be a new attention for the potential of this market, since an increase in commercial hubs is noticeable: the Netherlands currently houses over 300 hub initiatives throughout the country, of which fifty percent were realized between 2019 and 2022 (data provided by Buck Consultants International during a PostNL Stadslogistiek webinar on March 25th, 2022).

The business model of these hubs is to offer paid transshipment and last-mile delivery services to suppliers of goods with customers in city centers. Depending on the partnership, this additional cost is covered by the supplier, by the customer (as delivery costs) or as a combination of both.

Although unloading and loading goods during transshipment can take time and has an additional price, city hubs offer the following advantages:

- For suppliers, the warehousing facilities offer sufficient unloading space, driver facilities, and enable larger deliveries for multiple customers to be delivered at once, decreasing the logistics time and costs. Furthermore, the use of lightweight electric vehicles (LEVV: "lichte elektrische vrachtvoertuigen") for the last-mile delivery can be of value to suppliers to increase the sustainability of their logistics and to be unburdened of dealing with environmental regulations that vary per municipality.
- For customers, the value of city hubs is that their parcels are combined into one delivery of multiple suppliers, as well as the beforementioned sustainability gain.
- For municipalities, city hubs could be a method to reduce the inner-city traffic and corresponding emissions. These initiatives could be supported by offering exceptions on entry restrictions (like time windows and environmental zones) and offering special loading and unloading facilities.
- The central government can support hub-initiatives by participating in the market as 'launching customers', as is the case with the city hub in The Hague where PreZero is piloting its return logistics system (Witte, Alonso-González & Rongen, 2021).

3.3.3 PostNL Stadslogistiek

One of the organizations operating city hubs is PostNL, the largest (previously state-owned) postal service in the Netherlands. It has a governmental universal service obligation to deliver mail to every address within the country five days a week. Their city hubs are operated by the PostNL subsidiary 'Stadslogistiek', which aims to reach emission-free delivery of goods in 25 cities in the Netherlands by 2025. Stadslogistiek operates hubs by combining existing (PostNL or thirdparty) warehouses with the PostNL logistics expertise, and electric delivery vehicles that deliver supplies to the city center (see Figure 3.3). Different from PostNL's commercial parcel service at which drivers are hired in a self-employment structure and paid per delivery, the drivers of Stadslogistiek earn a fixed hourly wage.

The first Stadslogistiek city hub was opened in Delft in 2016. Having a monumental city center with small streets and canals, the city was deemed very suitable for the system (Velthoven, 2015). Unfortunately, the Delft hub turned out to be ahead of its time, and Stadslogistiek Delft eventually had to terminate its operations due to a lack of market interest. Although zero emission zones and sustainable delivery were on the political agenda already, the urgency for supporting legislation was missing, according to a Stadslogistiek manager. Furthermore, customers were not willing to pay the additional service fee and change their existing operations (personal communication, August 2022).

With new regulations supporting city hubs, stricter circularity targets, and the deadline for the ZE-zones approaching, the market of today has improved strongly, enabling PostNL to open new Stadslogistiek hubs in Amersfoort, Nijmegen, The Hague, Tilburg, Utrecht, and Zuid-Limburg, and to plan for expansion into other cities in the coming years (Transport Online, n.d.).

Figure 3.3 Photo of a PostNL Stadslogistiek lightweight electric vehicle being loaded by a driver (PostNL 2022).

3.3.4 PreZero Smart Collection

To improve the sustainability of its waste collection operations, PreZero created a Smart Collection department in 2020. This team is stationed in PreZero's headquarters in Arnhem and is responsible for innovations in the collection of waste in the Netherlands. Since the beginning of 2022, the team consists of four employees.

Currently, the team's main activity is to operate the Green Collective initiative, which was publicly launched in May 2021. For this initiative, PreZero collaborates with their biggest competitor Renewi to form a joint venture. The idea of the joint venture is to increase the efficiency of their garbage trucks. Normally, both organizations collect waste from their business customers with their trucks, often crossing paths with their competitors on their route. With the Green Collective initiative, the waste from both organizations' business customers is collected at once, using "neutral" trucks driven by drivers from either one of the organizations (see Figure 3.4). This reduces the number of trucks driving the same streets, resulting in lower emissions, less traffic, and lower collection costs due to denser routes. The initiative is currently operational in six municipalities, but the goal is to go live in 30 municipalities in 2023 (PreZero, 2021).

Next to the Green Collective initiative, the Smart Collection department of PreZero Netherlands is currently also piloting a new initiative called 'return logistics', for which they collaborate with logistical partners to collect specific, source-separated waste streams at businesses in the city center.

Figure 3.4 Photo of a Green Collective garbage truck (Green collective, 2022).

3.4 The Hague pilot

To explore the possibilities of a return logistics system for waste collection, a pilot is currently operated in The Hague. The groundwork for this pilot started in 2019, when the Dutch central government (Rijksoverheid), together with the municipality of The Hague, launched a tender for an emission-free solution for deliveries to their offices in the city of The Hague. The reason for this tender is that the municipality is planning to launch a zero-emission zone in 2025 (see Figure 3.5) and it wants to push the industry to come up with solutions by being the first customer themselves. (Gemeente Den Haag, 2021).

PreZero applied to this tender together with a logistical partner and a warehouse owner, to create a new city hub with electric vehicles to operate last-mile delivery to the city center and first-mile collection of specific waste streams to the hub. The addition of return logistics for waste collection made their application for the tender unique and got them to officially win the tender in August, 2019 (Atlas Nieuws database, 2020).

When PreZero won the tender, no specific solutions for the Return Logistics were yet designed. With the hub planned to open in January 2020, PreZero rapidly orchestrated a minimum viable product to be able to pilot the system, using industry-standard garbage bags and boxes.

The new 'Haagse Hub' was opened in January 2020. It is operated by Stadslogistiek in a warehouse of Djinny Logistiek in Leidschenveen, which is located next to the two main highways in the region (A4 and A12). The hub is a nine-kilometer drive away from the center of the planned zero-emission zone to which goods are delivered and waste is collected by electric vehicles. Next to multiple commercial organizations, the main customer of the pilot is FMH, a shared service organization from the Dutch Ministry of the Interior and Kingdom Relations with 500 employees, responsible for the facility services of the 17 government departments in The Hague (Ministerie van Binnenlandse zaken en Koninkrijksrelaties, 2022). Only the FMH locations (governmental offices) are currently taking part in the return logistics of waste, with the other customers just receiving deliveries from the hub. In total, 70 locations in the city center of The Hague make use of the services of the hub.

Figure 3.5 Map of the zero-emission zone and the location of The Hague Stadshub.

MEANS & GOALS

As the effectual logic defines, first, the current means and goals need to be mapped. By defining who I am, what I know, and whom I know, the foundation for the rest of the project is built. The means that are explored are the current competitive environment, the client's brand, the current pilot in The Hague, and all the existing stakeholder commitments surrounding that pilot. The current goals are defined by analyzing the proposed system and container improvements and exploring the potential value propositions.

4.1 Who am I?

4.1.1 Competitor analysis

The idea of return logistics is not new, it can be traced back to the traditional dairyman delivering fresh milk and collecting the used bottles. This idea has inspired many other organizations to build a system solution for the existing market. To understand PreZero's position and learn from competitors in this and other markets, a competitor analysis was executed..

The competitive landscape of the return logistics system is hard to define since it covers the waste collection, but also logistics, parcel deliveries, and packaging solutions. To get a better grip on the kind of competitors currently already on the market, and organizations in adjacent markets that could be useful for inspiration for the own system, three levels of competitors are defined and displayed in figure 4.1. Not all possible competitors are illustrated with their logo, but certain organizations are chosen to reflect different types of competition.

Figure 4.1 Overview of the competitive landscape of the return logistics system

The inner circle in the figure contains the most direct competitors of the return logistics system. Renewi and Milieu Services Nederland are examples of large waste management organizations with similar means and capabilities compared to PreZero to get a return logistics system up and running. Although these organizations are not yet developing such a system, they could easily copy PreZero. Seenons is the most direct competitor on the market of smart return logistics for specific waste streams. This organization is an IT organization that has built a plat-form to connect waste disposers, logistics providers, and sustainable organizations that use specific waste streams for their production process. The fact that Seenons does not operate its own hubs, vehicles, or waste recycling plants, makes them different from the Return logistics system, but also makes them much more flexible to adjust its operations and expand to other cities.

In their operations, Seenons is depending on local organizations like those that can be found in the second ring of the figure. Organizations like De Clique, GroenCollect, and Inzamelhelden are local initiatives that prove that there is a market for smart waste stream collection, by working with other small local organizations that dispose of and buy specific waste streams. The ad-vantage they have over PreZero is that local organizations tend to be more easily chosen and supported by other local organizations.

In the outer circle of the figure, several types of organizations can be found that fulfill specific roles that are of interest to the return logistics pilot. First, online supermarkets like Picnic and Albert Heijn Thuisbezorgd deliver their goods to customers using certain containers. For Picnic, these containers are only used for transport and plastic bags inside the containers are given to the client. Their containers are not foldable, but with a clever electric vehicle design and advanced data analysis for planning routes, they optimized their costs and use of space. With supermarkets like AH Thuisbezorgd clients have the option to receive the container as well, which is foldable, reducing the amount of plastic bags needed, but adding the extra cost of deposit and effort to later return the containers. Pieter Pot is another type of online supermarket, but they took it one step further and completely got rid of packaging by delivering all their products in glass preserving jars that are collected after use to be cleaned and reused. This involves an extensive logistical challenge of filling, delivering, collecting, cleaning, and managing all those containers. The last type of organization in the outer ring is Citybarge, an example of innovative new inner-city logistics that uses the existing waterways in a new way, by letting autonomous boats ship goods and waste. This organization is still in its startup phase, but it shows potential innovations happening in the context of inner-city logistics.

4.1.2 Containers & vehicles

As the above analysis of the competitive landscape shows, organizations are working with different solutions to transport certain goods like deliveries or waste. To learn from their experience, an analysis of the containers they use is performed. On the next page, a collage of images of the containers used by competitors is shown (see figure 4.2).

As the figure shows, many types of containers and vehicles are already in use. Apparently, all these containers function well enough to be operational for the competitors and even cheap solutions like buckets fulfill. This is a valuable insight for PreZero to learn that the focus might not be needed on the container itself, but more on the system around the container.

Figure 4.2 Overview of vehicles and containers used by competitors.

4.1.3 The PreZero brand

PreZero Nederland is part of PreZero international, which is part of the Schwarz Group. All different countries of PreZero operate under the same vision statement "New thinking for a cleaner tomorrow" (see figure 4.3). The ambition of PreZero is to reach zero waste and 100% reusable material (PreZero International, n.d.).

With the acquisition of SUEZ Netherlands by PreZero, the well-known brand name SUEZ disappeared from the Dutch market. Although most of its containers and trucks have been rebranded, PreZero realized that its brand name was not yet as well-known as the previous SUEZ brand was. Therefore, a brand campaign was launched on June 20th, 2022, by PreZero Nederland, to build brand awareness in the new Dutch market (AfvalOnline, 2022).

The main slogan for this campaign is 'What if it succeeds', focusing on their ambition to close material loops and reach zero waste (see Figure 4.4). With marketing stories evolving around examples of new material creation out of waste streams, the branding campaign is aimed at Dutch businesses that might want to do something about their waste management (PreZero Nederland, 2022).

Figure 4.3 The Dutch version of the PreZero vision statement 'New thinking for a cleaner tomorrow' (PreZero, n.d.).

Figure 4.4 The brand campaign of PreZero (PreZero Nederland, 2022).

4.2 What do I know?

4.2.1 Pilot review

To gain a more detailed understanding of the current return logistics pilot, I performed a site visit and followed a Stadslogistiek driver for a morning. In this section, the insights about the current state and system of the pilot are shared.

The hub

At the warehouse of Djinny Logistiek, one corner of the space is reserved for Stadslogistiek storage. Suppliers can either deliver parcels to the hub per order or use the warehouse to stock regularly ordered items for quicker delivery to the customer.

A Stadslogistiek manager receives the orders from both PostNL deliveries as PreZero collection requests and manually creates routes that fit within one vehicle. The deliveries on the hub are received, stored, and picked onto roll containers for the next day by the same manager as well. Every morning, the drivers get their route as a list of addresses with the types of goods they need to deliver and collect, so they only need to load the right roll containers into their trucks and follow the planned route (see Figure 4.5).

Figure 4.5 Driver preparing the deliveries.

The vehicles

Although visuals from Stadslogistiek and PreZero often also show smaller electric vehicles like electric cargo bikes and minivans, the only vehicles used by Stadslogistiek The Hague are the smaller electric box trucks with lift gates, of which they currently operate two. The loading capacity of these trucks enables Stadslogistiek to handle different types of smaller and bigger deliveries, placed on roll containers or pallets (see Figure 4.6).

The orders are loaded into the trucks in reverse order, so the first delivery will be in front for easy access. The vehicles do not have pre-installed navigation with the route: the driver used his own phone for navigation, using the list to search for the addresses he did not know that well. Depending on the sizes of deliveries and the amount of waste collected, a driver will drive one or several routes from the hub to customers.

Figure 4.6 Driver laoding the truck.

Deliveries

Stadslogistiek delivers supplies from connected suppliers. Currently, the main deliveries are office supplies (like printer paper, toilet necessities, and consumables like coffee), laundry service of work clothes (collecting dirty laundry and delivering cleaned laundry), and empty bags and boxes for waste separation (see Figure 4.7). Step by step more suppliers are getting involved in the system.

Depending on the delivery address, the deliveries are delivered at the door or brought all the way into the building to the desired location. Since many deliveries are frequent deliveries, the Stadslogistiek driver is well-known with each location, the employees, and the types of deliveries per address.

Some mistakes did occur during my day, which could be traced back to mistakes in order picking at the hub (items on the wrong roll container or the driver loading the truck in the wrong order) or planning (the other truck having to visit the same address, resulting in an unnecessary truck pick-up). Furthermore, some addresses did not have the goods to-be-collected ready for pick-up (mainly empty roll containers that should be returned).

Waste collection

FMH is the facility service provider for the governmental offices in The Hague. These locations are all big enough to have a separate service entrance with room to stack the Bioboxxes and store the waste bags in standard waste containers (see Figure 4.8). These containers are designed for traditional automated emptying by waste trucks, but in the pilot, the containers are manually emptied by the Stadslogistiek driver, who puts the bags in the truck.

Figure 4.7 Driver manually collecting laundry.

Figure 4.8 Collecting waste from the waste containers.

While emptying the containers, the driver needs to count the number of bags per waste stream for administration and manually label each bag with a permanent marker with the one- or two-digit customer number that is found on the route list of the day. This registration is planned to be digitized, but is currently still manual, which results in miscounting and missing data.

The labeled bags and Bioboxxes are put in the truck, either on the empty roll containers that were used for delivery, or loosely stacked in the truck. This results in a risk of contamination of the goods that still need to be delivered. To minimize this risk, the waste is put in the back of the truck, and the roll containers that still need to be delivered are moved forward upon each delivery to create more space in the bag for more waste.

The bags with PBD and coffee cups can contain liquids from leftover coffee or drinks. To minimize spilling waste in the truck, the bags should be tightly sealed with a knot by the customers. Since this did not always occur, the drivers agreed with the client that only the sealed bags are collected, and open bags are left behind. Nevertheless, bags with punctures still leak.

With the offices opening again after several months of lock-down due to the Covid-19 pandemic, the waste streams were rapidly increasing. The waste collection interval had not yet been changed, which resulted in full containers with loose bags on top at many of the waste collection locations (see Figure 4.9) and the truck being filled with waste before the end of the planned route was reached (see Figure 4.10).

Figure 4.9 Waste piling up on top of the containers.

Figure 4.10 Waste piling up in the back of the truck.

Waste at the hub

When the truck is full or the route is completed, the truck is manually emptied by placing all bags and BioBoxxes in an empty 40ft sea container that is placed on the terrain next to the hub (see Figure 4.11). Here, a subcontractor of PreZero collects the bags a few times per week, weighing each bag before transporting the waste to one of the recycling facilities in the country. Since waste is tightly regulated in the Netherlands, special licenses were needed to be allowed to shortly store waste at the hub.

The BioBoxx

For the collection of coffee grounds a special biodegradable cardboard container is used, called the BioBoxx. This Bioboxx is produced by the Dutch company of the same name and delivered as a flatpack which is folded into a box by the customer. It is designed to be used without an in-liner (garbage bag) so it can be completely fermented into biogas by the company in Groningen.

While this box is designed to be fermented, the coffee grounds collected by PreZero are aimed to be upcycled into a raw material used for the production of new products like coffee cups and notebooks. Furthermore, the pilot proved that wet coffee grounds make the BioBoxx wet, losing its structural properties and starting to leak (see Figure 4.12). Therefore, the BioBoxxes are now used with a garbage bag as an in-liner and separated from the coffee grounds, and thrown in the cardboard waste bin next to the sea container by the subcontractor (see Figure 4.11).

Since clients now use the box with a garbage bag, the FMH locations are not even using the BioBoxx for the collection of the coffee grounds next to the coffee machine. Instead, they are using traditional bins with garbage bags, and the BioBoxx is only folded into a box for the garbage bags to be put in to be able to stack the boxes for collection by Stadslogistiek. The driver said that often these boxes are not even folded properly into a box. This means that this expensive box is bought for no good reason.

Figure 4.11 The sea container at the hub.

Figure 4.12 BioBoxxes stacked in a roll container.

4.2.2 Waste journey map

In the introduction, a first system overview was illustrated in figure 1.1 to show the flow of goods and waste in the total return logistics system. With the new insights from the site visit, a more detailed system overview can be created, zooming into the waste collection part of the system. The format of a journey map is chosen, using the perspective of the waste. In this way, all the steps that the waste goes through, and all stakeholders that are involved in these steps, become clearer.

Traditional system

For comparison, first, a waste journey map of the traditional waste collection is made (see figure 4.13). In traditional Dutch commercial waste collection, waste is collected in wheely bins. These vary in size, from 120L to 2500L (with the most common wheely bin for many waste streams being 240L). The colors of the numbers in the figure refer to the stakeholder responsible for that step: blue is for the customer, and green is for PreZero.

The traditional waste journey consists of 4 steps:

1. The user throws one or multiple waste streams into their own waste bin.
2. The full garbage bags are taken out of the bin and collected in the bigger wheely bin (often place outside the building or at a service entrance).
3. The wheely bins are placed at the curbside for door-to-door collection by the waste collector, which uses garbage trucks with automated grippers to empty the wheely bins into the truck.
4. The garbage truck transports the waste to the waste treatment facility, where the waste is sorted and treated.

Pilot system

The waste journey map of the current return logistics system in The Hague is a bit more complex. Figure 4.14 shows the return logistics waste journey from the moment that the waste enters the system (being thrown away by the customer), up to the moment the waste enters the PreZero recycling facilities. Next to the waste journey, the two additional steps of the delivery of the bags and boxes for waste collection are included. Note that this figure might imply a linear waste flow, while in fact, the final step at the recycling facility aims to recover as much value from the waste as possible, but that step is out of scope for this project. The colors of the numbers in the figure refer to the stakeholder responsible for that step: blue is for the customer, orange is for Stadslogistiek, and green is for PreZero.

The waste journey in the current pilot in The Hague consists of 12 steps:

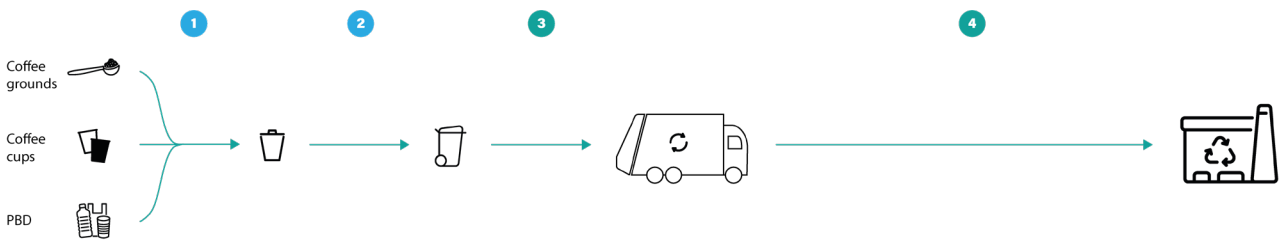


Figure 4.13 Waste journey map of the traditional waste collection system.

1. The user throws away the waste streams ‘PBD’, coffee cups, and coffee grounds into specific containers.
2. The garbage bags with PBD and coffee cups are taken out of the bins and collected in bigger wheely bins in which prepaid ‘PBD’ and ‘Coffee cups’ garbage bags are placed. If these bigger bags are full, they need to be sealed with a knot. The beforementioned ‘BioBoxx’ is folded into a box, after which the garbage bag with coffee grounds is sealed with a knot and put into it. This step is fulfilled by the FMH cleaning employees, that also place the full wheely bins and BioBoxxes at the collection site.
3. The Stadslogistiek driver arrives at the collection site on the specified day of the week and takes out the full garbage bags and BioBoxxes. All bags and boxes are counted and labeled with the location code using a permanent marker. The driver notes these numbers on a form.
4. All bags and boxes are manually loaded into the electric truck. Often, the driver must first rearrange the remaining deliveries in the back of the truck to make room for the waste bags and boxes and still be able to unload the deliveries at the next addresses.
5. If all deliveries are delivered and all waste is collected, the waste is transported back to the hub.
6. At the hub, the Stadslogistiek driver empties the van by placing the waste bags and boxes in a bigger 40ft sea container (M40) for later collection by a subcontractor of PreZero.
7. At the hub, the subcontractor separates the garbage bags with coffee grounds of their BioBoxxes, which are flattened and thrown into a ‘paper and cardboard’ container. When this container is full, it is transported to the waste recycling facility as well.
8. The subcontractor counts and weighs all the labeled bags and boxes and lists the masses with the corresponding customers.
9. The waste streams are loaded into a box truck and transported to one of the PreZero recycling facilities.
10. At the PreZero recycling facility, all the bags of each waste stream are emptied into a homogeneous waste stream for treatment and recycling. The coffee cups are recycled into a clean paper stream that can be reused for paper and cardboard products. The coffee grounds are upcycled into products and soap. The PBD stream is sorted by massive sorting installations that try to gain as much value from the plastics as still possible.
11. New BioBoxxes and garbage bags are delivered and stored at the hub.
12. Upon request, new BioBoxxes and garbage bags are delivered to the customer.

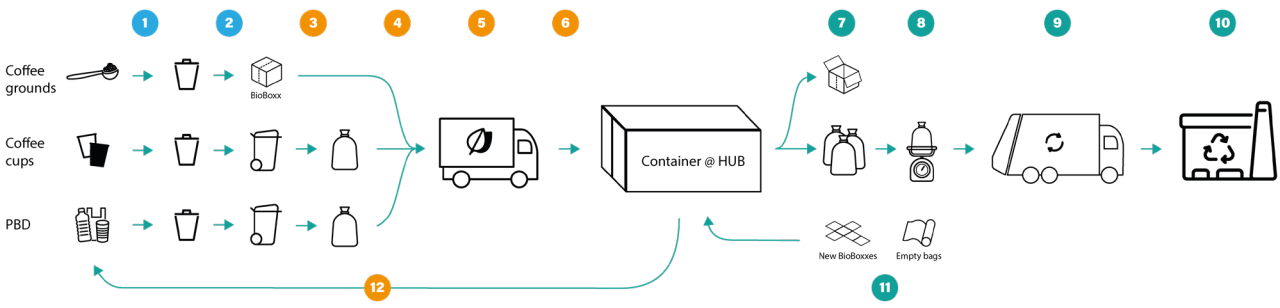


Figure 4.14 Waste journey map of the pilot waste collection system.

4.2.3 Learnings

The pilot review and waste journey mapping gave many valuable insights into the current process and problems. The main takeaways are described below.

Manual planning and registration

The first and foremost insight of the day with the driver was the very basic level that the pilot is at currently. All actions are still performed manually: from receiving orders per email that are put in the system by hand, the manual planning, and printed routes that the driver gets, and the manual counting and labeling of the collected bags and boxes. Furthermore, the system has no track and trace, so customers do not know the time window in which Stadslogistiek will arrive for delivery and/or collection.

Number of manual actions

Comparing the traditional waste stream journey with the journey of the pilot, we can conclude that the new system introduces many extra actions. Waste separation might take a little extra effort, but the number of manual actions performed by the customer, the FMH employees, the driver, and the subcontractor needs to be lowered to increase the efficiency of the system.

Leakage

The current waste bags and boxes are not leakproof, resulting in un-hygienic transport and possible contamination of deliveries placed next to the waste.

The roll container

My first impression of the system when it was explained to me, was with smaller cargo bikes collecting waste streams in small volumes. The pilot showed me that the volumes of deliveries are so big that the roll container is the minimum size of transport used for delivering and collecting goods and that it plays a crucial role in the flow of the system and the ease of use for the driver.

Trucks

The electric box trucks used for the pilot were bigger than the cargo bikes and small electric vans were often used in promotional images for the return logistics system. This means that many deliveries can be collected at once, and different collection solutions are suitable. The decision for the types of vehicles used is essential for the solutions to be designed.

Costs and material use

Since all current containers are single-use, pre-paid bags and boxes, the costs and material use of the waste separation are higher than probably necessary.

4.3 Whom do I know?

The pilot review showed the many different stakeholders that are involved with the return logistics system. All these stakeholders add value to the system and collaborate with PreZero to be able to collaboratively gain value. In this section, the 'Whom do I know?' question is answered.

4.3.1 Stakeholder commitments

The current stakeholder commitments were explored to understand the means of the return logistics pilot. By having meetings with employees of different stakeholders to discuss their experience with the pilot, the goals, means, and risks of each stakeholder were mapped.

	PreZero	*PostNL*	*Stadslogistiek*	*Djinny Logistiek*
Goals	▪ Capture the entire waste value chain and close material loops. ▪ Transition to emission-free first-mile transport. ▪ Gain maximum value out of waste. ▪ Lower the collection costs. ▪ Increase sustainability of brand image. ▪ Gain waste market share.	▪ Lower transport costs. ▪ Transition to emission-free last-mile transport. ▪ Increase sustainability of brand image. ▪ Gain delivery market share.	▪ Enable zero emission zones in Dutch cities. ▪ Gain customers. ▪ Be profitable.	▪ Gain market share. ▪ Enable zero emission zone in The Hague. ▪ Increase sustainability of brand image.
Means	▪ Existing customers and partnerships. ▪ Waste storage solutions and garbage trucks. ▪ Experiences employees. ▪ Decades of international waste management experience. ▪ Decades of experience with governments and legislation. ▪ Schwarz Group backing and knowledge sharing.	▪ Existing customers and partnerships. ▪ Electric delivery vehicles. ▪ Warehousing and sorting facilities throughout the country. ▪ Experienced employees. ▪ Decades of nation-wide logistics experience. ▪ Planning and logistics software automation. ▪ App with extensive functionalities.	▪ Experience with the launch and operation of hubs in Dutch cities. ▪ Delivery and collection via city hubs. ▪ Existing partnerships. ▪ Experience from the return logistics pilot.	▪ Warehouse location. ▪ Warehousing software. ▪ Existing customers. ▪ Logistics experience.
Risks	▪ Dependency on partners. ▪ Helping possible competitors with in-house knowledge. ▪ Losing market share and revenue to competitors. ▪ Changing regulations.	▪ Dependency on partners. ▪ Helping possible competitors with in-house knowledge. ▪ Losing market share and revenue to competitors. ▪ Changing regulations.	▪ Dependency on partners. ▪ Not being able to become profitable. ▪ Changing regulations.	▪ Changing partnerships. ▪ Becoming obsolete.

Not all stakeholders could be directly reached, so the information is based on conclusions of the meetings held with employees of PreZero, PostNL, Stadslogistiek, Djinny Logistiek, and FMH, and additional online sources about the project and involved stakeholders.

The results are shown in Table 4.1.

Table 4.1 Overview of stakeholders goals, means, and risks with the return logistics system.

FMH	*Suppliers*	*The Hague Municipality*	*Sustainable producers*
▪ Provide best quality service to the client. ▪ Reduce CO2 emission from operations to net-zero. ▪ Reduce residual waste to 35%. ▪ Reduce costs. ▪ Increase sustainability of reputation.	▪ Be able to deliver goods to clients in city centers. ▪ Increase sustainability of brand image.	▪ Reach the Dutch Climate Agreement targets. ▪ Increase air quality in the city. ▪ Reduce emissions in the city. ▪ Reduce traffic in the city. ▪ Reduce own CO2 emission to net-zero. ▪ Gain sustainable & healthy reputation of municipality.	▪ Get clean waste streams as material input for production. ▪ Scale production. ▪ Grow market share. ▪ Be profitable.
▪ Bargaining power on behalf of their client. ▪ Experienced facility employees. ▪ Existing clients and partnerships.	▪ Partnerships with logistics partners. ▪ Bargaining power.	▪ Laws and regulations. ▪ Subsidies. ▪ Bargaining power as big customer themselves.	▪ Production facility. ▪ Experience in sustainable production with waste streams. ▪ Sustainable brand image. ▪ Market trend towards sustainability.
▪ Problems with innovations in the current system. ▪ More responsibilities for employees without price increase.	▪ Problems with outsources delivery. ▪ Changing regulations.	▪ Not getting reelected. ▪ National regulations contrasting local policy.	▪ Inconsistencies in waste stream quality and volume. ▪ Changing regulations.

4.3.2 Value flow modeling

To get a feeling of the complex relationships between the stakeholders, a value flow model is made from the current return logistics pilot. In Figure 4.15, the key stakeholders of the system are included, and their interrelationships are shown in the values of information, waste streams, goods, money, and intangible value..

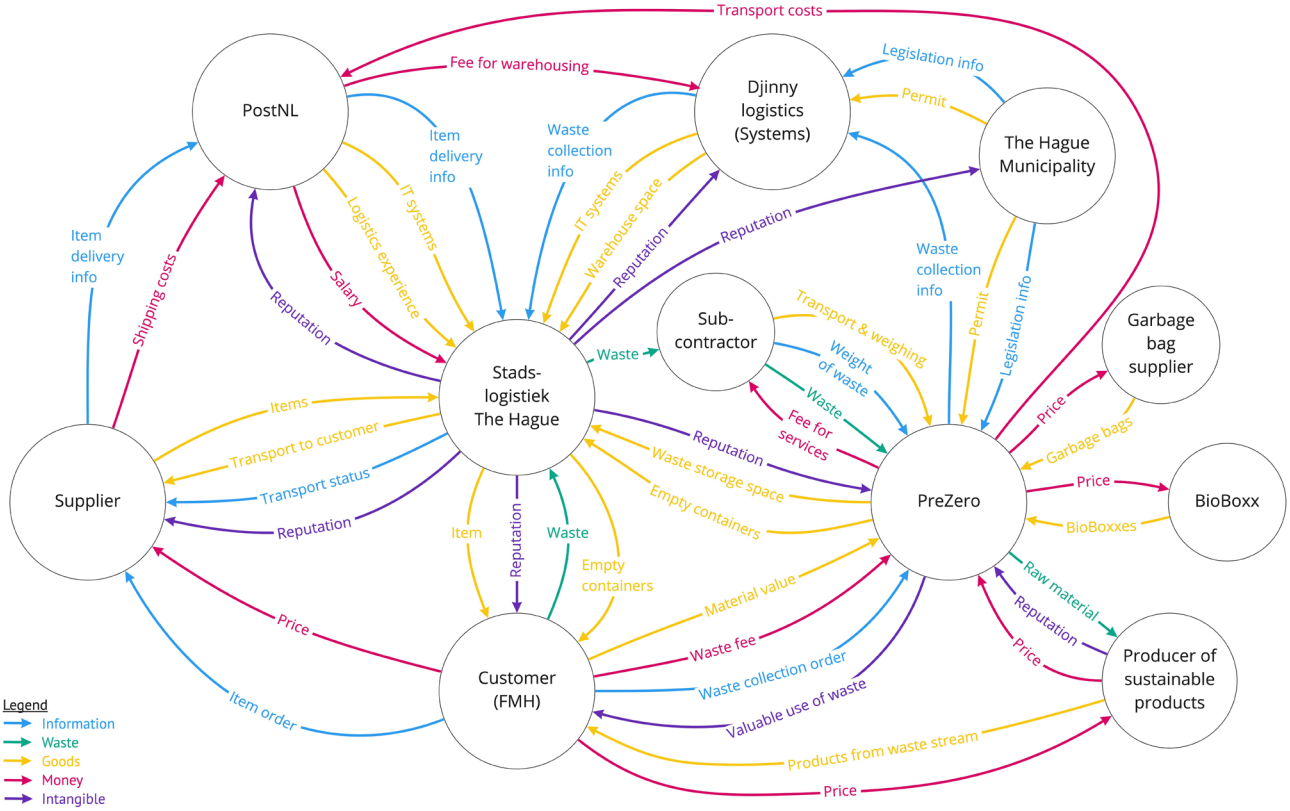


Figure 4.15 The value flow model of the return logistics system.

4.4 What can I do?

With a current pilot up and running, the stakeholders have learned about their current means but also realized which short-term goals need to be achieved. The Smart Collection team of PreZero has a certain vision on what the current goals are to improve the system and make it ready for launch with different customers and in other cities. To understand their reasoning, and the needs and wishes behind them, the current goals for the pilot are discussed in this section.

4.4.1 System vision

The Smart Collection team of PreZero has a vision for how they think the ideal return logistics system would work. This vision is captured in figure 4.16. The colors of the numbers in the figure refer to the stakeholder responsible for that step: blue is for the customer, orange is for Stadslogistiek, and green is for PreZero. The green box represents some sort of waste container that is used to transport the waste all the way from the customers up to the PreZero recycling facility.

This vision is translated into two main themes that are also on the 'dashboard' of the PreZero management: the return logistics system and the so-called 'waste packaging'. The team has found a preliminary solution for the packaging, which will be discussed in the next section, but the foundation of this very graduation project is the fact that they are interested to see what the ideal container would look like, and how that would work in the system.

The vision waste journey consists of 12 steps:

1. The user throws away the waste streams 'PBD', coffee cups, and coffee grounds into specific containers.
2. The containers are closed and, as a whole, collected at the collection site of the building, without the need for any further actions.
3. The Stadslogistiek driver arrives at the collection site on the specified day of the week and loads the full containers into the truck using a roll container. To register the number and type of containers, some sort of registration method is needed for this step.
4. If all deliveries are delivered and all waste is collected, the driver returns to the hub.
5. At the hub, the driver empties the truck by unloading the roll containers with waste containers into a bigger 40ft sea container (M40) for later collection by PreZero.
6. This 40ft sea container is collected and transported to a PreZero recycling facility.
7. At the PreZero recycling facility, the sea container is unloaded, after which each container is weighed and optionally checked on waste quality.
8. All containers are emptied.
9. The three homogeneous waste streams are collected for treatment and recycling.
10. The emptied containers are cleaned and dried for reuse.
11. The cleaned containers are collected and transported back to the hub.
12. Upon request, clean containers are delivered to the customer.

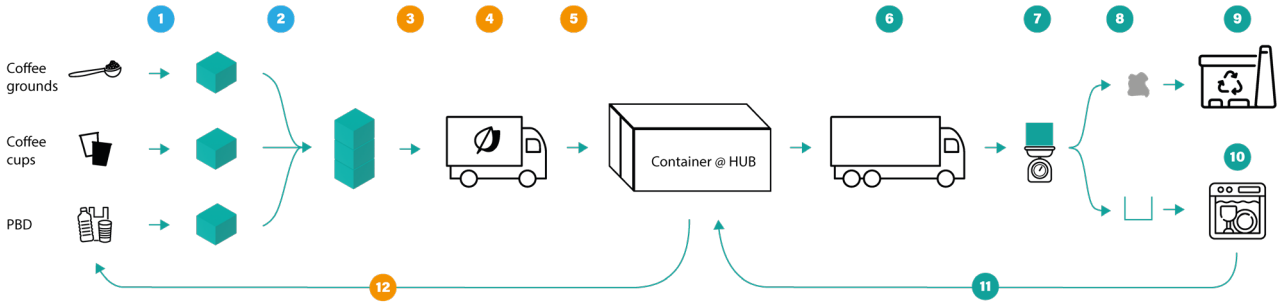


Figure 4.16 Waste journey map of the return logistics system vision of PreZero

Comparing the steps described above to the current pilot, the actions taken by customers and Stadslogistiek are decreased and simplified, while extra actions are added near the end of the system at PreZero. The main goals reached by this vision, are to maximize the ease of waste separation for the customer, minimize the manual actions that need to be performed by the customer and Stadslogistiek workers and optimize the space used in trucks. Furthermore, the goal of this vision is to enable a scalable and profitable system design.

Before this vision can become reality, PreZero needs to find solutions to fulfill the additional actions of weighing and cleaning the collected containers. The team's vision is that these actions will take place in a specific waste recycling facility, which they call the PreZero MSC (Dutch abbreviation for 'Monostromen Sorteer Centrum', which can be translated to a waste stream sorting center). Next to this envisioned mean, two other means are needed to enable this vision: a new waste container and better system automation. These will be discussed more in detail in the next sections.

Figure 4.17 The proposed new waste container (Kruizinga BV, 2022)

4.4.2 New waste container

In the current pilot, industry-standard garbage bags and the BioBoxx are used for waste collection. As evaluated, these solutions are expensive and unsustainable. The team has found a plastic box that could replace the current waste bags and boxes and function as the first step toward their system vision. This box is another industry standard solution: a stackable plastic storage box often used to deliver medicine to pharmacies (see figure 4.17). The team does not think this container is the ideal solution yet but sees it as a provisional solution to bring their vision one step closer.

The motivations to choose this new waste container are:

- It is stackable (when full).
- It is nestable (when empty).
- It is leakproof.
- It fits the standard roll container dimensions when stacked and nested.
- It has better handles than the BioBoxx.
- It is more sustainable: these containers are manufactured from recycled polypropene (PP) and used more than once.
- It is more cost-efficient since it can be used more than once.
- There are different sizes available (for different waste streams) that still can be stacked efficiently.
- It is expected to be more reliable in use.

Limitations of this new container:

- It is not airtight (smell risk).
- It is not sealed when closed (spill risk).
- Might not be suitable for automatic rotation for emptying.
- Might be poorly cleanable due to the many sharp corners and ribs in the design.
- Still expensive.
- Handles might not be suitable for carrying heavy loads.

4.4.3 System automation

The system implications of this new container are quite extensive. By using a reusable container that will go through the entire system flow, the following extra steps are introduced:

- Empty containers need to be delivered to the customer.
- A deposit and inventory management system are needed to keep track of empty containers placed at customers.
- The containers need to be emptied, cleaned, and stored after use.

Next to these new challenges, the existing system already needs several improvements, of which the most important one is IT automation for registration, planning, and track & trace. The current pilot is being operated with the different software solutions from PostNL, Djinny Logistiek, and PreZero. The links between these systems are not yet automated and need improvement (see figure 4.18 for an overview of the information flows between the systems).

The vision for the ideal system architecture is that each waste container is labeled with a QR code or NFC chip to be easily scanned during certain steps in the process. In this way, higher automation and less manual registration could reduce the time and work needed in handling the waste stream. This could increase the system efficiency (lower the time needed for collection per customer), enable accurate inventory management, and give insights on the waste stream weight and quality, to give customers feedback on their waste management.

This system sounds very nice and tangible, but the truth is that it is yet far away. PreZero is currently collaborating with PostNL, Stadslogistiek, and Djinny Logistiek to build the software solutions needed to automate the current pilot. The stakeholder relationships as discussed before, make this a complex collaboration that evolves slowly, since every organization had its own existing solutions that they want to be embedded, without sharing too much knowledge with partners that could become competitors. Furthermore, the IT capabilities of PreZero are lacking, so partnerships or new employees are needed to get the means to develop their system vision.

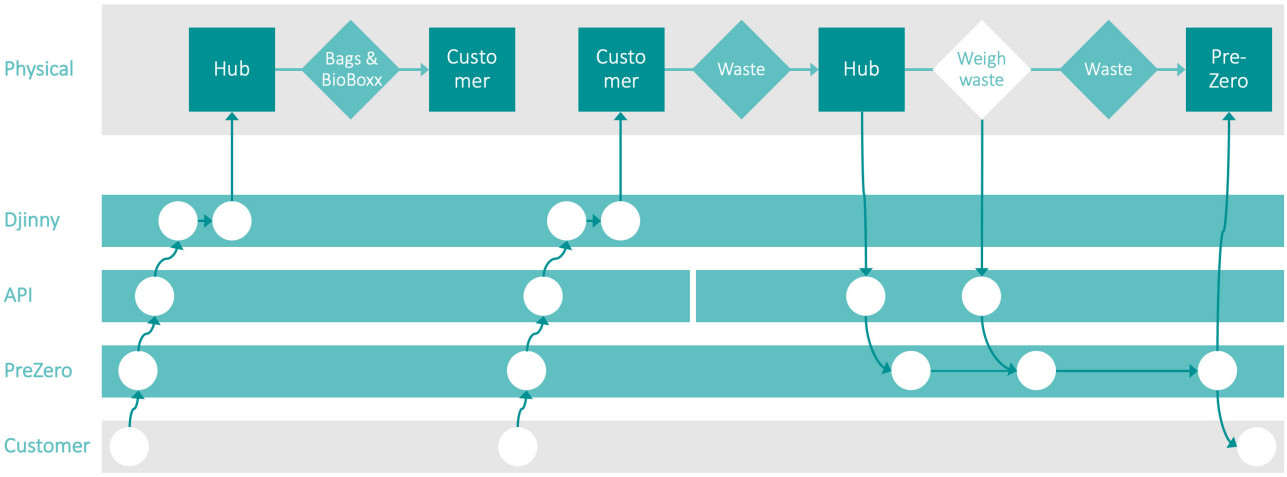


Figure 4.18 A simplified overview of the IT architecture and information flows in the current pilot.

4.4.4 Potential value propositions

The new system vision described in the previous sections could potentially unlock a new set of value propositions. In various sessions with the client and the involved stakeholders, the potential for the return logistics system was discussed. The resulting potential new value propositions can be divided into three main directions, which are detailed in the next sections.

Waste data generator

The first type of value proposition emerges from the use of a waste container that contains a specific waste stream from the source (the user disposing of its waste) all the way through the system up to the final recycling facility of PreZero. Currently, the many individual waste streams collected at customers are merged into one truck upon collection. This means that no individual trace can be drawn back from the recycling facility toward a specific customer. In the case of contamination of a waste batch, it is unknown which customer created this pollution. This is a shame since contamination of for instance PBD and paper batches can mean that the entire batch (often the volume of a truckload) is marked unsuitable for recycling, meaning that all the waste of that batch gets incinerated.

Current quality control of collected waste is limited to sporadic quality control by the garbage truck drivers that look at the top layer of the waste in wheely bins to decide if it is suitable for collection. Often, this only occurs when a wheely bin is evaluated to be peculiarly heavy for the waste stream, and even if the quality turns out to not be correct for collection, the waste collectors might still collect the waste for lack of care or effort to report the contamination. The managers of PreZero try to decrease this collection of polluting waste streams, but no systemic approach for quality control is yet operational.

By transporting the waste streams within their own containers all the way to the PreZero MSC, the ability to build a system for quality control arises. This system is yet to be designed but could for instance be operated by employees performing random quality checks, or automated by evaluation of parameters like mass, volume, and visual quality (e.g.: using image recognition to evaluate the quality of the waste stream).

If a system of quality control of the waste containers is set up, it would enable the following opportunities:

- *Decrease of lost batches of recyclables:*
  Due to lower contamination rates of batches of recyclables, the purity of waste streams created by PreZero can be increased.

- *PAYT:*
  Being able to accurately weigh the mass of the collected containers, new business models like pay-as-you-throw billing (PAYT) are enabled.

- *Data-driven quality improvement:*
  By collecting container-level data on the waste disposed of by a customer, very detailed data can be gathered and linked back to the customer. For instance, a quality score could be used to incentivize customers to increase the purity of their waste streams by earning discounts or credits.

- *Strategic waste management:*
  The detailed data on waste separation creates new value as is, which could enable PreZero to become a sustainability partner to its customers, strategically helping them reduce the costs of waste management and increase the sustainability of operations.

Raw material supplier

It is PreZero's ambition to close material loops, and the main objective of the return logistics system, is to collect pure, homogenous waste streams that can be transformed into new raw material flows for the production of new products. Although marketing materials might hint that creating raw materials and closing loops is already the core operation of PreZero, the reality is that the waste market and associated legislation are still very much about managing waste. Raw material production from waste streams is increasing and could eventually become the core business of PreZero. This would mean a major shift in focus, from a service-oriented organization taking care of the waste of customers, to a sales-oriented organization selling raw materials to manufacturers.

Different than smaller local initiatives discussed in the competitor analysis, PreZero could create the volumes needed to transform major industry partners to use waste material streams over new material streams. Using their economies of scale, PreZero could create new value propositions by collaborating with major industry partners to transform waste streams into new raw material flows needed in their production facilities.

Waste insights educator

As the introduction showed, the world is becoming more aware of its waste problem and more countries are aiming for a circular economy. The waste industry has been known to be secretive about its processes and as the documentary series by Teun van de Keuken showed, the marketing campaign about 'Waste is material' could also be used against the industry itself if not operated to its true extent.

One of the problems in the waste industry is the lack of data and transparency on specific waste streams. The return logistics system vision could enable a very detailed insight into the waste stream, connecting specific waste streams to their actual source. In line with PreZero's brand ambition to collaborate with partners to close material loops, the data from this system could be used to share key insights and learnings about source separation quality and consumer behavior. This could make PreZero a strategic partner for policymakers, businesses, and individual customers in their efforts to build a circular economy.

To inform customers about their waste management and consumer behavior, material stories like the existing 'Dit is niks nieuws' campaign could connect the product to the source waste streams used to produce it (PreZero Nederland, n.d.). Other value propositions that educate and influence this trend of sustainable consumer behavior could be developed to maximize the value of the detailed insights into waste streams.

4.5 Conclusion

This section explored the existing means and goals of the PreZero return logistics project. To summarize the findings from this and the previous sections, an overview is made based upon Figure 2.2 of section 2.1.1, in which the differences between causal and effectual logic were explained. Using this format, the main insights are summarized in Figure 4.19.

In this figure, the given means are defined based upon the insights from the context analysis and the insights from this section. The goals in the figure are the main goals that the Smart Collection team is currently working on. As the previous chapter showed, the current means and goals enable some very interesting valuable propositions already, these are shown on the right of the figure.

This figure is just a temporal capture of the existing status of the project. As discussed in Section 2.1, the goals and means evolve based upon new stakeholder commitments, changes in the environment, new means, and new goals, which are called the expanding cycle of resources and converging cycle constraints on goals. This means that Figure 4.19 should not be addressed by causal logic, using the potential value propositions as rigid goals to aim for. Actually, it should be used to iterate towards possible futures that will keep on changing.

Additional value propositions have been left open in the figure since other futures might be possible as well. To explore what other means and goals could be already distinguished, and to what potential value propositions those could possibly lead, the next section interacts with stakeholders to explore potential new means and goals.

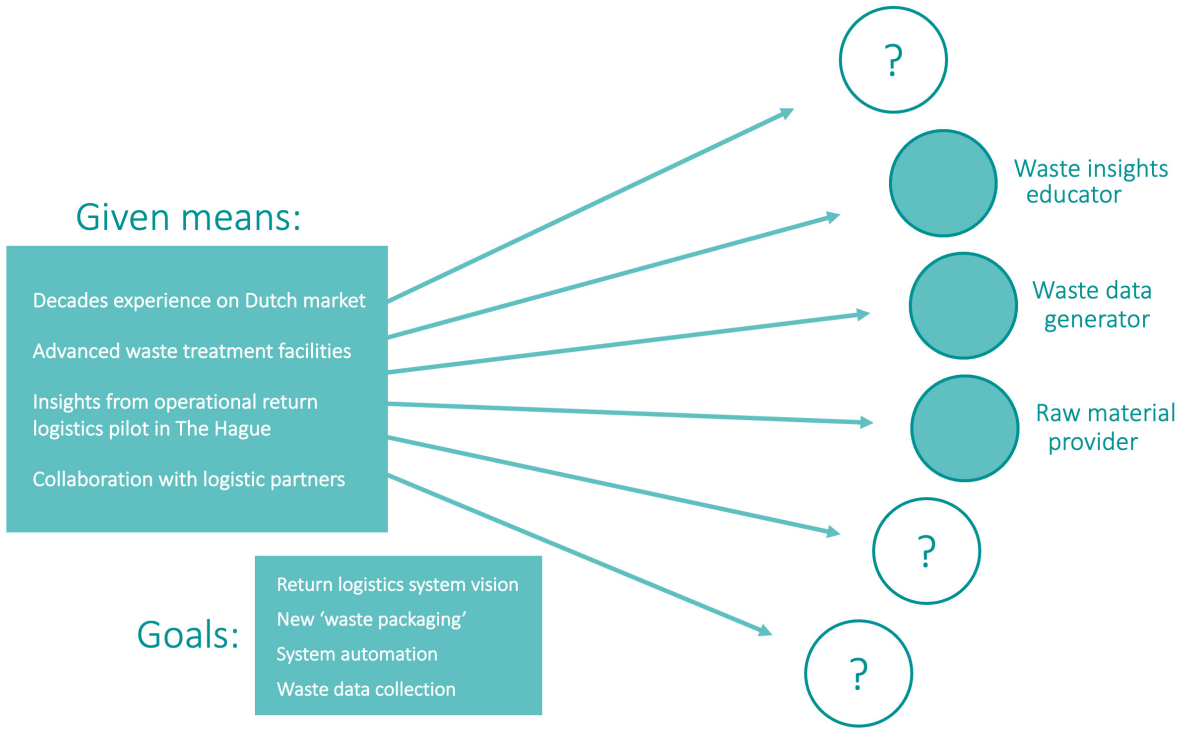


Figure 4.19 Current means and goals, and potential value propositions of the PreZero return logistics project.

5

EXPLORATION

With the current means and goals mapped, the possible new means and goals are explored by interacting with potential stakeholders. This is done in three areas. First, new potential customers are addressed to learn about their needs and wishes. Secondly, an existing return logistics system of a direct partner of the client is analyzed to learn from their expertise. And lastly, a potential main competitor is interviewed to gain insights into their perspective of the market. The insights are summarized in a list of additional means and goals.

5.1 Potential customers

The pilot in The Hague is focused on serving a very big office customer. Although valuable, this pilot will only give insights into office type of customers, while the goal of the return logistics system is to be able to serve all different types of inner-city businesses. To explore the other perspectives that these businesses might have, a series of semi-structured, exploratory, open interviews was conducted with potential customers in the inner-city of The Hague. In this section, the method, results, and conclusions from these interviews are discussed.

5.1.1 Method

The goal of these interviews was to learn about the context of potential customers of the return logistics system. The city of The Hague was chosen as the location since the system is piloted in this city and these potential customers are most likely to be the first up next with access to the system. By interviewing customers in the same city as the pilot, the insights from the pilot review could be combined with the interview insights. Another city might result in other insights due to another type of municipal legislation, inner-city infrastructure, and types of clients.

The approach of these interviews was to go to The Hague and, without an appointment, visit different types of businesses to see if one of the employees or managers had time to answer some questions about their waste management. This qualitative, accessible method was chosen to gain rich data about personal experiences in a short amount of time. Using a semi-structured interview guide helps to make sure all topics are covered in each interview, but since the appointments were unplanned, the duration of the interviews heavily depended on the willingness and business of the employee.

The interview guide for these interviews consisted of a short introduction and five interview topics with open questions and sub-questions and can be found in Appendix B of this report.

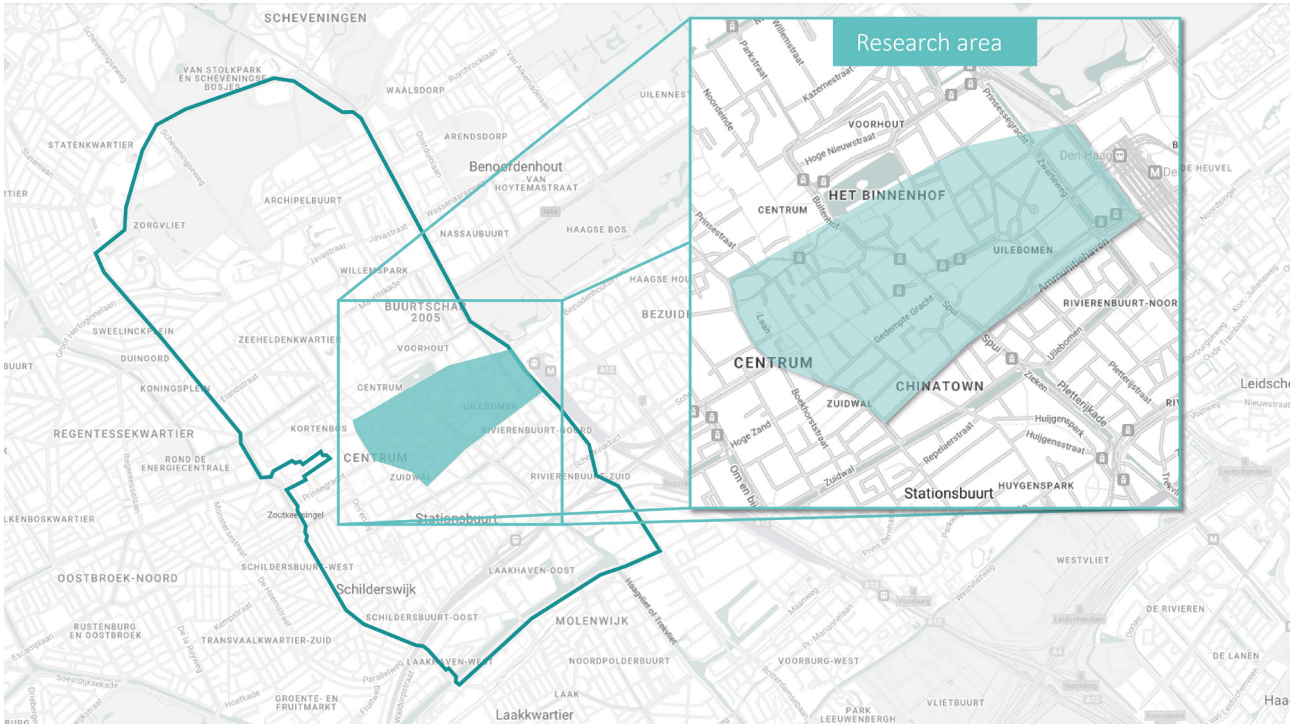


Figure 5.1 Map of the research area within the planned zero-emission zone of The Hague.

The topics were: 1) waste management and separation, 2) waste storage, 3) waste collection, 4) system evaluation, and 5) deliveries. The aim was to cover all topics. Not all questions needed to be answered by the participating employee. If answers to questions were already given spontaneously, questions could be skipped, or the order of topics could be changed to keep the conversation going. The interviews were conducted in Dutch and recorded with a smartphone to be later transcribed.

5.1.2 Participant sampling

Fitting the scope and resources of this 20-week student graduation project, participants are sampled by a convenience sampling strategy by entering businesses in the city center of The Hague (see figure 5.1 for the target area) that are open on the interview day, to see who wants to participate in the research.

The aim is to gain rich insights into the contexts of potential customers. Therefore, the participant sampling will focus to find participants in different types of businesses with varying types and sizes

Table 5.1 Overview of the interview participants.

Industry	*Business type*	*Location size*	*Location*	*Role participant*	*Duation (minutes)*
Hospitality	Café-restaurant	Large	Main road	Employee	2
	Pub	Small	Alley	Owner	7
	Café-restaurant	Large	Main square	Manager + 2 employees	6
	Restaurant	Small	Street next to main square	Owner	5
E-commerce	Phone shop	Medium	Shopping district	2 employees	8
Retail	Health store	Medium	Shopping district	Employee	4
	Shoe store	Medium	Shopping district	Owner	3
	Giftshop	Medium	Shopping district	Employee	2
	Food store	Small	Shopping district	Employee	6
	Cosmetics	Medium	Shopping district	Manager	13
	Shoe store	Large	Shopping district	Manager	6
Personal care	Hairdesser	Medium	Main road	Employee	3

of locations and numbers of employees. Using this timebound approach and limited sample group, data saturation will not be reached.

On the morning of April 1st, 2022, twelve interviews were completed following the method described before. Although many employees were too busy for an interview, eventually a wide variety of participants was found to be willing to participate in the interviews. An overview of the participants is given in Table 5.1.

5.1.3 Data processing

The interviews were recorded and transcribed. The transcripts were coded to highlight interesting insights. This resulted in a first-order selection of 34 participant quotes. These quotes captured the opinion of participants on the five interview topics.

The selected quotes were combined and filtered to get to a selection of 20 quotes that were deemed interesting for the aim and purpose of this research. This selection is heavily dependent on the researcher's subjective decision-making for what is deemed interesting. To lower the influence of my own bias on the selection of these quotes and conclude these 20 quotes into tangible insights, an interactive session with the Smart Collection team of PreZero was held.

In this session, the 20 quotes were printed on paper and the two participants from the Smart Collection team of PreZero were asked to select a top three interesting insights and a bottom three of not interesting or relevant insights. The results of this session can be found in t C. More important than the actual ranking of the quotes, was the discussion that followed, in which the team discussed their reasoning to get to their selection. This led to interesting insights into the scope of the research project.

5.1.4 Insights

The interviews uncovered some key parameters of influence for businesses in their decisions about waste management. Next to these, the key decision drivers were found to be costs and time (ease of use). When informed about the system for return logistics of waste, the main doubts were about the hygienic risks of transporting waste next to fresh goods and having to ask customers to source separate waste. See Figure 5.2 for an overview of the key insights.

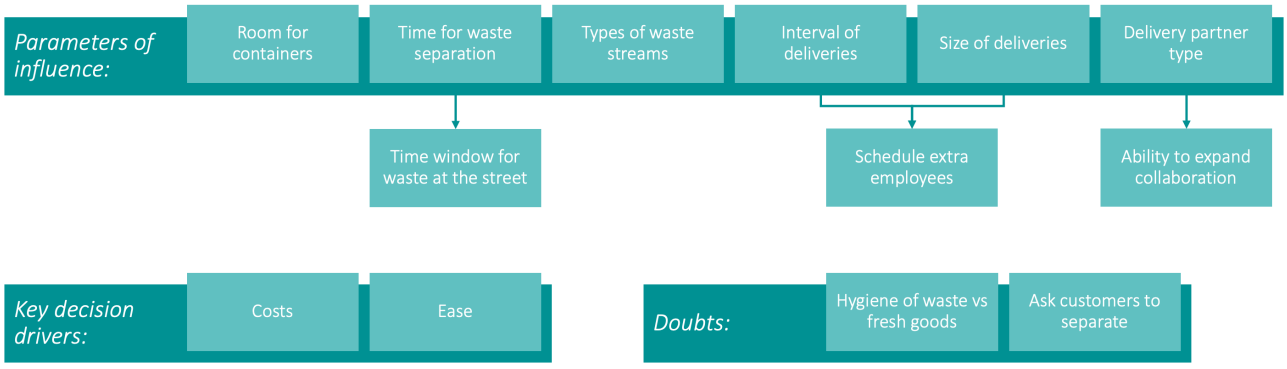


Figure 5.2 Overview of the key insights from the interviews with potential customers.

5.2 Return logistics case study

The acquisition of SUEZ by PreZero gave the Dutch organization a whole new set of means. Being part of the international Schwarz Group, it suddenly got direct access to the group's other brands: the supermarkets Lidl and Kaufland. Although this notion was shared inside the Smart Collection team, no direct use of this new set of means had yet been made.

In one of the meetings about the return logistics system with managers of PreZero, the connection was made to the way Lidl distribution centers collect and manage their waste. It turns out that supermarkets often have their own version of a return logistics system up and running already. Since this was yet an untapped field of knowledge, a site visit was scheduled to a Lidl distribution center in Etten-Leur. In this section, the case study of the return logistics at this distribution center is discussed.

5.2.1 The return-logistics system

All 441 Lidl supermarkets in the Netherlands are supplied from only six distribution centers. These centers are strategically located throughout the country to efficiently serve their own set of supermarkets. The distribution center of Etten-Leur is responsible for the distribution of food and non-food goods to eighty supermarkets located in parts of the provinces Noord-Brabant, Zeeland, and Zuid-Holland.

Next to the supply of goods, the distribution centers also serve as collection sites for all waste streams and packaging (like pallets and trolleys) that are returned from the supermarkets. By making clever use of the empty truck space from trucks returning to the distribution center to collect these streams, none of the Lidl shops need to have a waste management partner to collect waste from the stores. Solving the collection of these streams in-house saves the company costs and limits the traffic and unloading movements around the supermarkets.

A total of eleven different waste streams are source separated at the supermarkets and returned to the distribution center. These include two types of swill, glass, foils (colored and transparent), PET bottles, cardboard, wood, and residual waste. A strict manual is distributed to all supermarkets to instruct the personnel on the waste separation guidelines, which include the guideline to collect each waste stream on a different pallet to keep them separated. Next to these well-defined waste streams, often other waste types are returned from the supermarkets as well, mainly consisting of non-food products like clothes, electronic devices, and batteries which are returned by customers.

Next to the waste streams, fourteen different types of packaging are collected and returned to the distribution center. These include ten different types of EURO-pallets, trolleys, a specific cart for the cooled transport of raw meat, and the two types of beer crates that are sold at the supermarket. These packaging returns have very specific guidelines for collection and transport as well, which are included in the waste stream separation guidelines poster.

Trucks drive to supermarkets an average of two to three times a day. In the morning, fresh food is delivered to all supermarkets, plus additional goods that are needed. Depending on the size of the supermarkets, new deliveries arrive in the afternoon and in the evening. Waste streams and packaging are collected by the same trucks that deliver the goods. If the driver still has deliveries

for other supermarkets in the truck, preferably no waste streams are collected. If it is necessary, only 'dry' waste streams (like cardboard, wood, and flower buckets) are allowed to be collected. A partition wall is then used to divide the waste streams from the deliveries. However, this is often not needed, since full truck loads are not uncommon to be delivered at one supermarket alone, allowing the empty truck to collect all waste streams and packaging types at once.

Each pallet with a specific waste stream on it needs to be labeled with the supermarket number and registered by the truck driver on its shipping document. This labeling is done by hand using a permanent marker. An overview of the return logistics system of Lidl can be found in Figure 5.3.

5.2.2 Waste at the distribution center

The distribution center almost functions as a complete waste treatment facility. With the eleven different waste streams arriving at the site, workers inspect, sort, and collect the waste streams into big containers that are collected by PreZero when full. Next to the sustainable aspect of good waste separation, the main incentive for the strong policies at Lidl is the financial value that clean batches of one specific waste stream offer compared to mixed batches of waste.

A strong policy of quality control is maintained to be sure that all the waste streams collected by PreZero are as pure as possible. By randomly inspecting the quality of fifteen waste batches per day, the quality of the collected waste streams is inspected and reported. Poorly separated batches of waste are returned to the

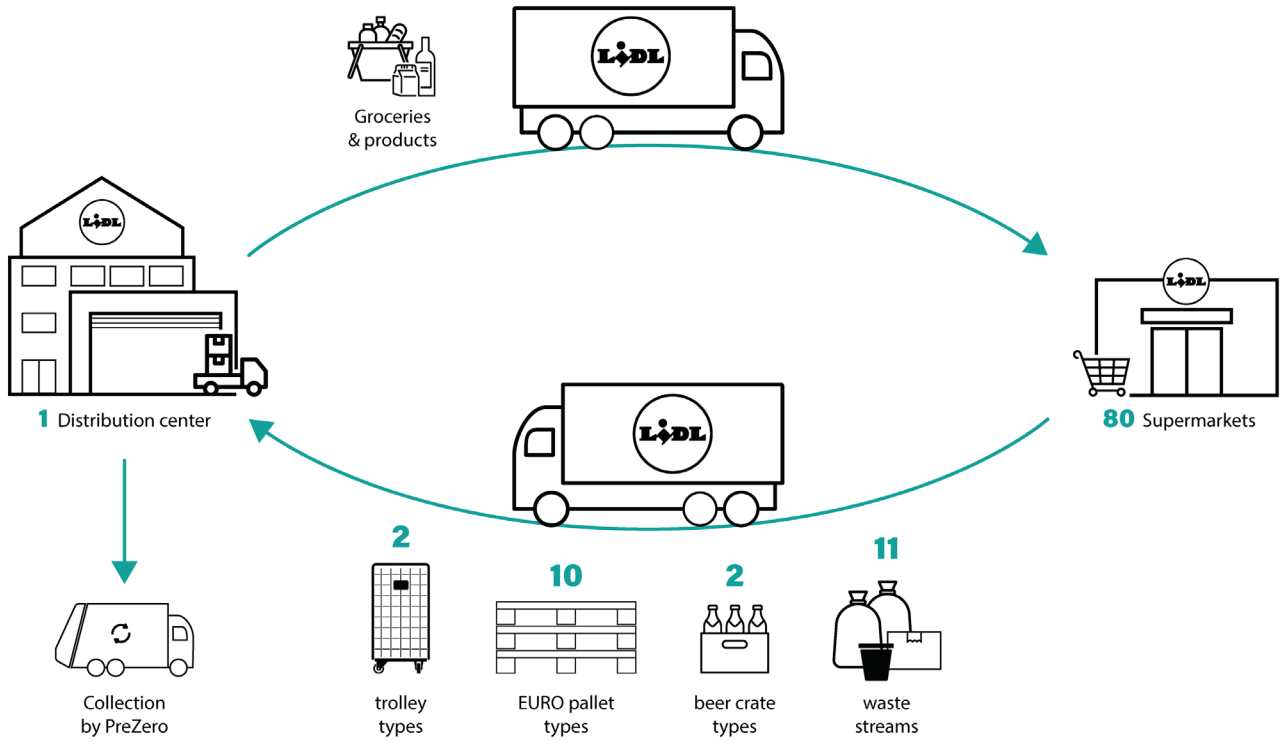


Figure 5.3 Overview of the Lidl return logistics system.

source supermarket, to let them learn from their mistakes and incentivize them to do better. The results of all inspections are collected in an extensive dashboard and transformed into an overall grade. These are periodically shared with all supermarket managers, so they can see how they are doing and how their scores compare to those of other supermarkets. This system results in high awareness of the importance of waste separation.

5.2.3 Learnings

Overall, both the PreZero supervisor and I were impressed by the effort put into waste management at Lidl. The site gave great insights into an existing return logistics system. The main insights for the return logistics project are described below.

Source separation as the economic choice

This case study is an example of an organization that sees the economic value of source-separating their waste to gain more value from their waste streams. Although the source separation costs quite some effort, employees, facilities, and training, the Lidl distribution center has found a way to make it work and build an operational system. This could be an example for other companies.

No automation needed

One of the key obstacles that the Smart Collection team thinks it faced, is the needed digitization of the labeling and reporting of the collected waste streams since this is currently still performed by hand. However, the return logistics system of Lidl shows that this can very well still be operated by hand and permanent marker, even at the scale of a distribution center collecting waste streams and packaging from eighty supermarkets. This was a good wake-up call for the PreZero team, which made them realize that the futuristic visions of automated scanning, weighing, quality control, and data collection of the waste streams are not necessarily needed to get a return logistics system operational.

Punishment works

One of the solutions used by the Lidl case to incentivize better waste separation behavior is sending poorly separated waste batches back to the supermarkets at which they were collected. The fact that forms of incentives are used to enforce the guidelines for correct source separation is interesting for further research since these might be needed to make a return logistics system work well. However, this specific solution will be harder to implement with individual customers that have voluntarily chosen to pay for the return logistics system.

5.3 Competitor interview

Next to potential customers and partners to collaborate with, learning more about the perspectives of existing competitors on the market could generate valuable insights into possible means and goals to define. To do this, a competitor of PreZero was interviewed to gain insights into different perspectives on the current and future market of source-separated waste collection and the position of different types of organizations in this market. In this section, the competitor selection, the method, and the insights from the interview with a competitor are described.

5.3.1 Competitor selection

As described in Section 4.1 several direct and indirect competitors can be identified. Ranging from small local initiatives to large international corporations, the waste management market offers a wide array of methods and visions of sustainable waste collection. All of them could be interesting to explore but the scope and planning of this graduation project allowed for only one company to be selected for an interview.

Discussing the competitive landscape, the client highlighted one specific company to be the most direct competitor to the return logistics vision for waste collection. This IT focused startup facilitates the collection of specific waste streams by connecting disposers with organizations that could use these waste streams as material input for their production processes. Arranging the transport for collection and delivery with third parties, the main asset of the organization is the app in which customers get insights into their waste streams and environmental impact.

Having started in 2019, this company is a relatively new entrant to the waste collection market that has a different vision about the way the waste market should be operated, compared to many of the existing market leaders. Being a startup with several years of experience growing their business on the waste market, makes this company an interesting participant for the interview about the current and future waste collection market and market players, which could uncover refreshing insights. Furthermore, I turned out to have direct links with people working at this company, enabling me to reach out for an interview. The co-founder (and Chief Commercial Officer) of the company was willing to participate in an interview.

5.3.2 Method

Aiming to collect rich data about the competitor's perspective on the current and future market, the qualitative research method of a semi-structured interview was chosen. A semi structured interview guide was made to be sure all relevant topics were covered, while leaving enough room for an open conversation. The four topics that were discussed were: 'About the company', 'Experiences with the market', 'The future market', and 'PreZero' (see Appendix D for the complete interview guide).

To make sure no confidential information about the return logistics project status and ambitions was accidentally shared, the interview guide was prepared in collaboration with the client's project supervisor. Furthermore, the participant was informed about the client of the graduation project and the publication in the repository of the Delft University of Technology at the end of the graduation project. Luckily, the company still agreed to participate.

5.3.3 Insights

The interview was held on July 4th, 2022 and took place in the competitor's office. The interview lasted approximately forty-five minutes and was audio-recorded. Using this recording and the personal notes, a summary of the most interesting insights was made, and presented to PreZero on July 6th, 2022. Based upon the discussion with the client during that meeting, the insights were finetuned, resulting in the list below.

Market cooperation is needed

It's the participant's view that circularity can only be reached by full cooperation within the market. Individual efforts of different organizations won't be enough to reach the sustainability targets, so stakeholders need to cooperate to enable the system transition to speed up. This notion is directly in line with the logic of effectuation, in which stakeholders form commitments to build upon each other's means and minimize risks. This can create new means to reach future goals.

It makes sense that this effectual logic is the logic of the participant, since the company is a startup that literally builds upon the means of others (like waste management organizations, logistical partners, manufacturers that buy waste streams for their production facilities, etc.) to create its value proposition. The fact that this works, and that they have been able to grow over the past years, shows the value of the effectual approach.

It's the view of the participant that each organization should be empowered in its own expertise and share knowledge and insights to bring the entire industry to a higher level. The CCO stated that secrecy slows down the transition, while sharing information with competition will challenge everyone to keep improving their own business to stay the best in what they do.

The biggest challenge for the industry is non-collaborating businesses. PreZero and the competitor had been in contact to discuss the possibility of collaboration, but this has not yet resulted in a partnership or commitment. The participant therefore pointed to PreZero as an example of a market leader that could potentially have a big impact on the industry if it would be willing to collaborate more openly with other stakeholders. Although labeled as competitor in this report, the CCO did not see its organization as a competitor, bus as a facilitator of the system transition from which all involved stakeholders could benefit, eventually. This is an example of the different way of looking at a market and at stakeholder commitments than in traditional causal logic as discussed in Section 2.1.

The existing waste market will die

Evaluating the existing waste management market, the participant was very clear and strong in its wording: "The expertise of current market leaders is to handle large quantities of waste streams in the most efficient way, but that market will eventually die." The crux in the existing market, according to the participant, is that the current solutions have created a need for large quantities of waste, which results in negative incentive to reduce the waste generated by customers and transition towards a circular system.

The expensive waste treatment and incineration plants are only cost and energy-efficient if operated on the ideal capacity, needing a constant stream of waste to be treated or incinerated. The Netherlands currently has a larger waste treatment capacity than the volumes that are generated within the country, leading to waste being imported from other countries to keep the plants up and running. But this system

can't last forever since the world will run out of resources eventually. New solutions are needed that will treat current waste streams as new materials streams to be reused, according to the participant.

The participant even stated that current market leaders oppose (EU-) legislators in their efforts to pass stricter waste treatment laws, slowing down the transition from this existing model to a more sustainable and circular model.

Customers demand full transparency

Waste management organizations claim to be sustainable organizations, recycling waste streams to be put to new uses, but documentaries like the one from Teun van de Keuken showed that this is mainly greenwashing, and the main volumes of our waste are still downgraded or incinerated.

The company of the competitor shows that we could have the tools to bring full transparency to the market and bring insights to customers about what happens with their waste streams. The participant denounced the fact that existing market leaders are not doing this well enough yet and feels empowered by the customers that switch to its company because they have lost faith in the market leaders and demand full transparency. Several of the senior employees of the competitor used to work at one of the existing market leaders, but switched because they realized that what they were doing did not make the impact they wanted to see, according to the participant.

The opportunity PreZero missed

In line with the previous insight, the overall conclusion of the interview is that the existing market leaders have clearly left a market potential untapped in the past years. A completely new startup was able to enter the market and convince customers and employees to join its vision, and in the meantime no market-ready alternative has yet been produced by the existing market leaders.

The market entry of this competitor might have encouraged the creation of the Smart Collection team by PreZero in 2020, but the fact that they only still have a pilot up and running shows the lack of innovation capabilities within the organization. This insight was echoed by the client's project manager himself, which sometimes even uses the existence of the competitor to grow urgency within PreZero to get the support needed for the Smart Collection team to realize its system vision.

With its existence on the market, competitors like these uncover potential waste streams that did not exist before and show new value propositions that can be explored. If PreZero could incorporate a more innovative mindset within the company, or collaborate with innovative partners, they themselves could push innovation, uncover untapped potentials, and grow competitive advantage.

5.4 Conclusion

Interviewing potential customers, learning from a current return logistics system, and interviewing a competitor brought valuable insights to the project. These can be used to define potential new means and goals. In this section, these new goals are described in the form of potential new value propositions, with the new means being discussed afterward.

5.4.1 Potential value propositions

Some of the insights generated in this chapter add up to the previously defined possible value propositions, but others ask for new value propositions. Using these insights, three additional value propositions can be defined which PreZero could iterate towards in the future.

Space saver

The interviews with potential customers discovered an interesting pain that is not yet served by the waste management market: the problem of space needed for waste storage and separation. Inner-city buildings have high (rental) prices per square meter, which means that businesses often try to maximize the space used for commercial activities and minimize service areas. Currently, large wheely bin waste containers are the norm, and only some cities offer the option to dispose of individual garbage bags at central collection points. This means many customers still need at least several square meters of service area to store their waste containers before collection.

Collecting waste in smaller volumes than the traditional wheely bins creates a value proposition that might be a solution to this problem. By offering the service of high-frequency collection of low-volumes of waste, a new business opportunity could emerge. Next to the fact that this enables businesses to reduce the space needed for waste management, it could also enable source separation at locations that yet have too limited space for different waste containers. This could be a currently untapped potential of customers that would be interested in waste separation but are restricted by their available space.

Source separation convincer

Another untapped potential among business customers is small businesses that are separating their waste, but secretly use the household waste collection to get rid of their commercial waste streams. Some interviewees explained how the municipality they live in uses a standard fee per household for the collection of source-separated waste streams. This means that taking certain waste streams home from work to be disposed of with the other household waste streams is cheaper than paying for a separate commercial container at the company.

This target audience is hard to reach, since the current solution is free of charge, and any product offered to them will probably at least cost something. The challenge would be to make the commercial waste management solution so convenient to use, that the effort to continue to take waste home would not weigh up against the price that the convenient commercial solution costs.

Smart logistics enabler

In the current pilot in The Hague, PreZero collaborates with PostNL's subsidiary Stadslogistiek to enable zero-emission inner-city logistics. The vision is that deliveries from all sorts of suppliers will eventually be delivered to their customers in the city center via the Stadslogistiek hub, to create the most efficient routes with electric vehicles. But this still is work in progress

for PostNL and other logistical organizations are creating competing hub solutions as well. The future of this market is still highly uncertain, being shaped by innovations and initiatives from many different types of organizations and policymakers. PostNL might turn out to not have been the most suitable partner in hindsight, but as the uncertainty of isotropy states (see section 2.1.1), one can never know which current parameters to focus on.

Several potential customers questioned the suitability of PostNL to serve them via a hub, since they rarely got any deliveries from other parties than their one main supplier. Customers from the hospitality sector explained that they mainly get deliveries from one big food and drinks supplier (like Sligro, Hanos, Bidfood, and Heineken) with whom they often have a contract. The case study of Lidl's distribution center showed that these kinds of organizations might already have an extensive internal logistical operation with central hubs, in which some form of return logistics could be incorporated directly. Although it is Stadslogistieks responsibility to convince these kinds of suppliers to also start using the hub to reach their customers in the city, another approach for PreZero might be to collaborate with these suppliers directly and use their trucks for the collection of specific waste streams to be brought to their logistical hubs.

This approach resonates with the insights from the interview with the competitor, which showed the value of cooperation within a market. Cooperating with many different partners might lower the risks of investment for PreZero, while growing the waste collection capabilities. This means that it might be strategic to explore possible collaborations with different logistical parties besides PostNL, although this should not hinder the current stakeholder commitments in the pilot.

5.4.2 Means and goals

The insights from the previous three chapters influence the means, goals and value propositions as presented in Figure 5.19 at the end of the previous section. To update this figure, the new means and goals are described below.

Means

The main takeaways on the topic of current and future means are the following:

- Among PreZero's current customers, potential customers for the return logistics system are found. These should be addressed to become part of the 'crazy quilt' for further development of the system.
- Within the Schwarz group, an advanced, fully functional return logistics system is already operational. PreZero should utilize the knowledge within the group to boost their innovations.

Goals

Looking at the goals of Figure 3.19, the main takeaways from the previous chapter are:

- The Lidl case study showed that no advanced system automation is needed to operate a high-volume return logistics system. In combination with the fact that this existing return logistics system is operated by a company within the Schwarz Group, this means that PreZero should already have all the means needed to build the return logistics system and start operating. This should be a wake-up call to the client to focus on the design of an MVP version of the system and 'just' start doing it.

- The interview with the competitor and customers showed the potential that collaborating with more different (logistical) stakeholders could have on the market size and speed of development of a return logistics system. A goal should be to explore these kinds of new partnerships to try to minimize the risks and keep adjusting the value propositions.

Combining the new insights with the additional potential value propositions, the resulting overview is updated and shown in Figure 5.4.

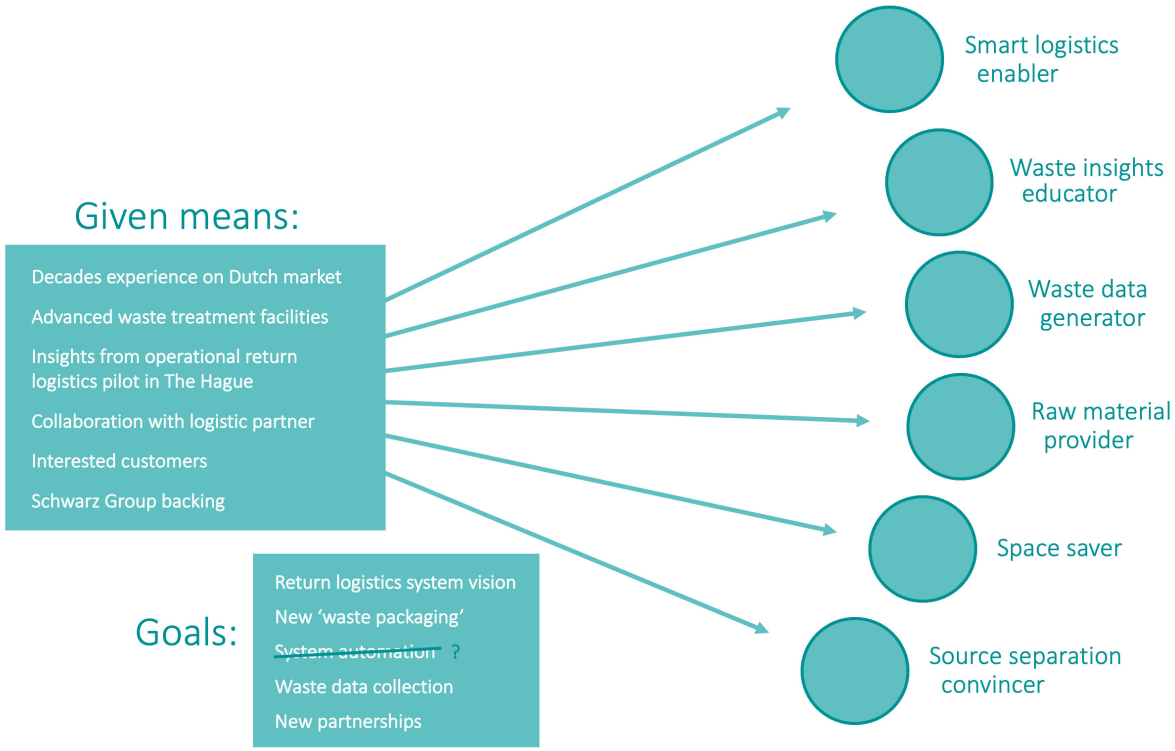


Figure 5.4 New means, goals, and potential value propositions of the PreZero return logistics project.

SCOPE

The previous chapters have evaluated the current means and goals of the return logistics system and have explored possible new goals to aim for in future iterations. Six possible new value propositions have been discovered, and all these directions could be interesting to look further into. However, the time and resources of this graduation project are limited, so decisions must be made to define a clear scope for the further development of new means and goals for the project. In this chapter, this scope is co-created and defined.

6.1 Setting the scope

6.1.1 Interactive scope session

Following the method of co-design, the definition of the scope was co-created with the client in an interactive session. As mentioned in the introduction of this chapter, the previous chapters explored multiple possible directions this project could take. To evaluate the client's perspective on these directions, eight contrasting scales were defined. During the session, the client was asked to place a circle somewhere between these scales to highlight the direction for the scope of this graduation project. Furthermore, the answers were discussed, to gain an understanding of the reasoning behind the made decisions. This latter step was very important since the client found it quite hard to choose in some cases. In Figure 6.1, the outcomes of this session are shown.

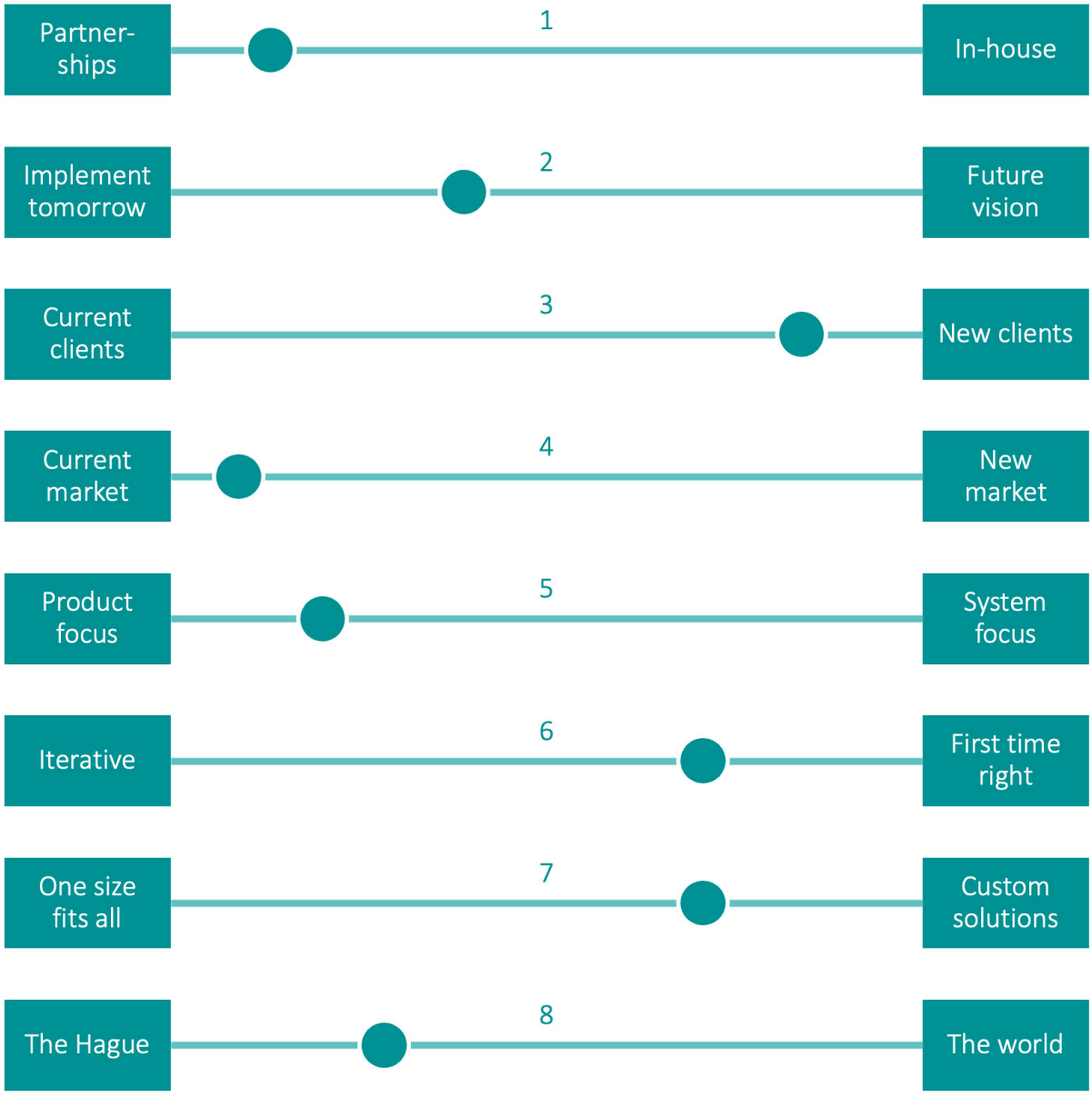


Figure 6.1 Outcomes of the interactive scope definition session

6.1.2 Target audience

One of the main insights of the scope session was that the customer to aim for was not the office customer type that is addressed in the current pilot of the return logistics system. The client evaluated the results from the interviews with potential customers to be valuable and agreed with the found value propositions for these types of customers. It expects more value to be found in serving the needs of smaller inner-city businesses in different industries, like the hospitality industry (restaurants, cafes, and hotels) and retail.

Innovation and decision-making in the current pilot are evaluated to go rather slow. A site visit to one of the office locations of FMH was planned to be held in the first month of the graduation project but was only realized three months into the project. The large type of organization, with many managerial levels involved, makes the processes evolve slowly. For this graduation project, faster iteration is desirable, therefore, smaller businesses are more interesting to research and design for.

The theory of effectuation emphasizes that stakeholder commitments should form naturally between self-selecting stakeholders. This means that no hard target audience will be defined since that could potentially exclude interesting stakeholders that might want to collaborate. However, some focus is needed to be able to know where to look for interested stakeholders. Therefore, the following target audience is defined, for now, to scope a search area to look for potential stakeholder commitments: small- and medium-sized enterprises (SMEs) with locations in Dutch city centers.

6.1.3 A change in perspective

As the waste industry is trying to become more circular, the phrase 'waste is material' is echoed by all stakeholders in the industry. An interesting insight during the research so far is how this so-called material is not treated like other materials would normally be treated: being thrown around in anonymous black plastic garbage bags and merged into massive waste streams in which the individual materials are hard to distinguish.

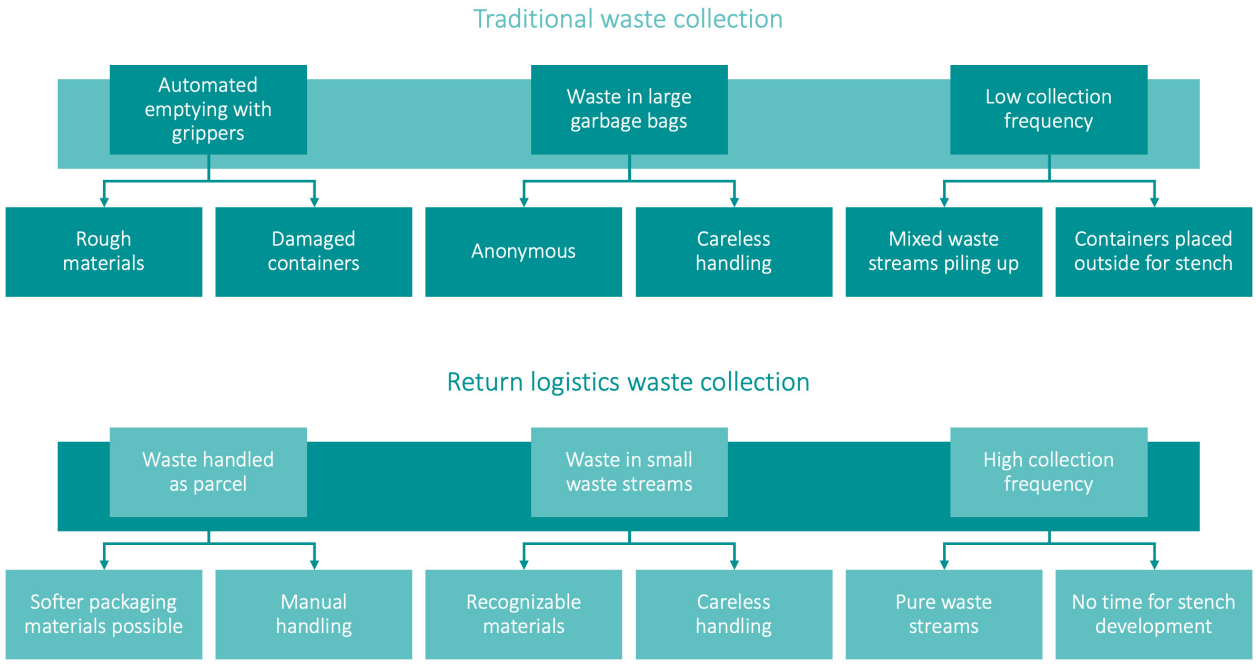


Figure 6.2 Traditional waste collection versus the new return logistics system vision.

The proposed system vision of the client that uses some sort of container that solely consists of one specific waste stream, has the potential to make us treat waste more like a valuable raw material. To explore the differences between the existing waste collection and the proposed waste collection in smaller containers, some properties, and their potential consequences are compared in figure 6.2.

The client was very interested in the design of a product-service system in which some sort of container is used throughout the entire return logistics system. Since this system has great potential value propositions, this direction is chosen for the further development of concepts and ideation.

The chosen scope means that the focus for the designing phase will be on the following potential value propositions:

- Waste data generator
- Waste insights educator
- Space saver
- Source separation convincer

6.1.4 Range extension

Evaluating the system and container design proposed by the client, I realized that one key element of the entire system was not yet included. This was the way a certain container would be used in the context of the customer.

This means that the actual design challenge for PreZero lies not within the known territory of the entire system flow, finding solutions for how to logistically manage this new way of waste collection from the customer to the MSC and making it profitable. The real challenge that needed to be resolved before being able to test any version of a system with their proposed container, is to design a solution that not only fits the proposed return logistics system design but also fits the many different customer contexts in which this solution will be used. Since the container proposed by PreZero will replace the existing garbage bags, used worldwide and for which many appropriate solutions are designed, a new configuration of waste collection is needed within the context of the customer.

PreZero's expertise with the system starts at the back door where the waste is collected for transport and continues to its recycling facilities. What is needed for this new system proposal, is to step beyond the front door of the customers and design a waste container solution that is usable for many different types of customers. This range extension is visualized in Figure 6.3.

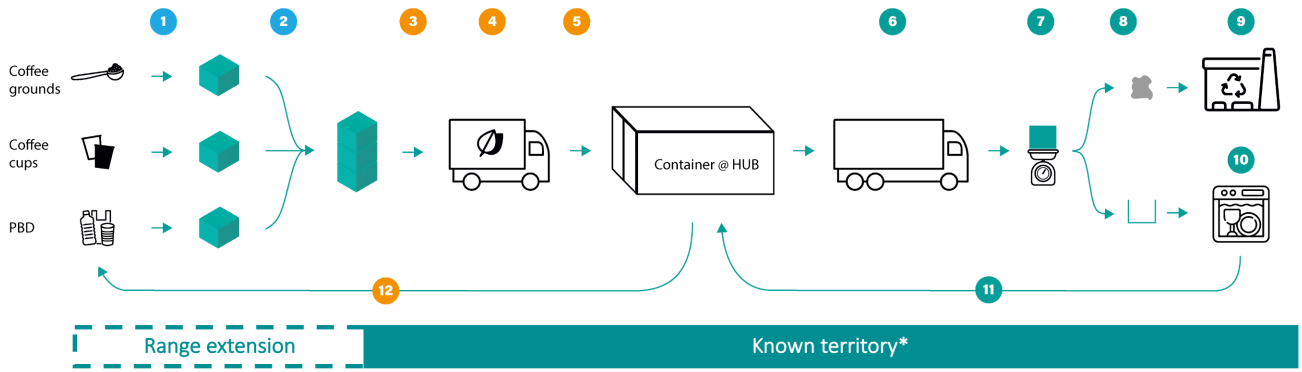


Figure 6.3 Range extension of PreZero's capabilities

6.2 Design Challenge

The target audience, change in perspective, and range extension allows for the definition of a clear design challenge that will form the focus of the coming design phase of this graduation project. This design challenge sets the scope for the design of solutions for the next iteration of the return logistics system and can be framed to be the following:

Design and validate a waste collection solution for specific, source-separated waste streams, fitting both the smart return logistics system as envisioned by the client and the various contexts of SME customers in the inner-city environment.

7 DESIGN

This chapter details the process to design solutions for the set vdesign challenge. First, the system vision is further explored, to understand the requirements that the waste collection solution should meet. Next, the process of ideation, concept development, and rapid prototyping is shown, after which an initial MVP (Minimum Viable Product) was designed. With this design, potential customers were addressed to see which customers would be interested to facilitate a pilot to test the MVP. The chapter ends with the conclusions from this concept validation.

7.1 Service blueprint design

Before diving into the ideation of waste collection concepts, a more detailed map of the envisioned return logistics system is needed to extract the requirements that the waste collection solution should meet to be able to successfully implement it in existing the context. Based upon the case study of the existing pilot, the evaluation of the proposed improvements, and multiple meetings with the PreZero team and IT department, a service blueprint was designed for an envisioned return logistics product-service system for smart waste collection. See Figure 7.1 for the service blueprint and Appendix E for a full page version.

The blueprint consists of 15 steps, which are described in this section. Note that this blueprint is just a suggested system design that is open for iterations. It was developed with all insights from the previous sections in mind and considering the means and goals available. The blueprint design will evolve based on learnings from new pilots and feedback from involved stakeholders. The value, for now, is to have one clear description of the entire flow within the system, which had not been detailed like this before, to be able to communicate about it to the involved stakeholders and start designing specific solutions for the system.

Collection order

The blueprint starts at the point that a new waste collection order is placed by a customer. This could be either manual, as shown in the blueprint, or automatically: being based upon a chosen periodical collection moment. Either way, the action results in the fact that the system creates an order request with the data needed to fulfill this request: the customer details, the type and number of waste containers to be collected, and a preferred time window for collection.

Route planning

With the information from the collection order, a Stadslogistiek employee can plan the route to be fulfilled by a driver. This results in a certain time window at which the Stadslogistiek driver will arrive at the customers to collect and deliver waste containers. The result of this step is that the customer receives a notification with the date and time window.

Order picking

On the planned day, the Stadslogistiek employee picks the orders by filling roll containers with the designated number of clean waste containers. Each order is labeled, to enable the Stadslogistiek driver to easily load the right order into its truck. Meanwhile, the customer will prepare the collection of full waste containers by bringing them to the location where the Stadslogistiek driver will collect them. This location differs per customer context and is agreed upon during the first moment of collection.

Delivery at customer

Once arrived at the customer's address, the driver unloads the empty containers from its truck and scans them before delivery. This action registers the delivery in the system, connecting the scanned containers to the specific customer.

Collection at customer

At the same time of delivery, the driver will also collect the full waste containers. This step might even take place before the delivery of the new containers. The number of collected containers might differ from the initial order, therefore, the driver scans each full container to register these into the system.

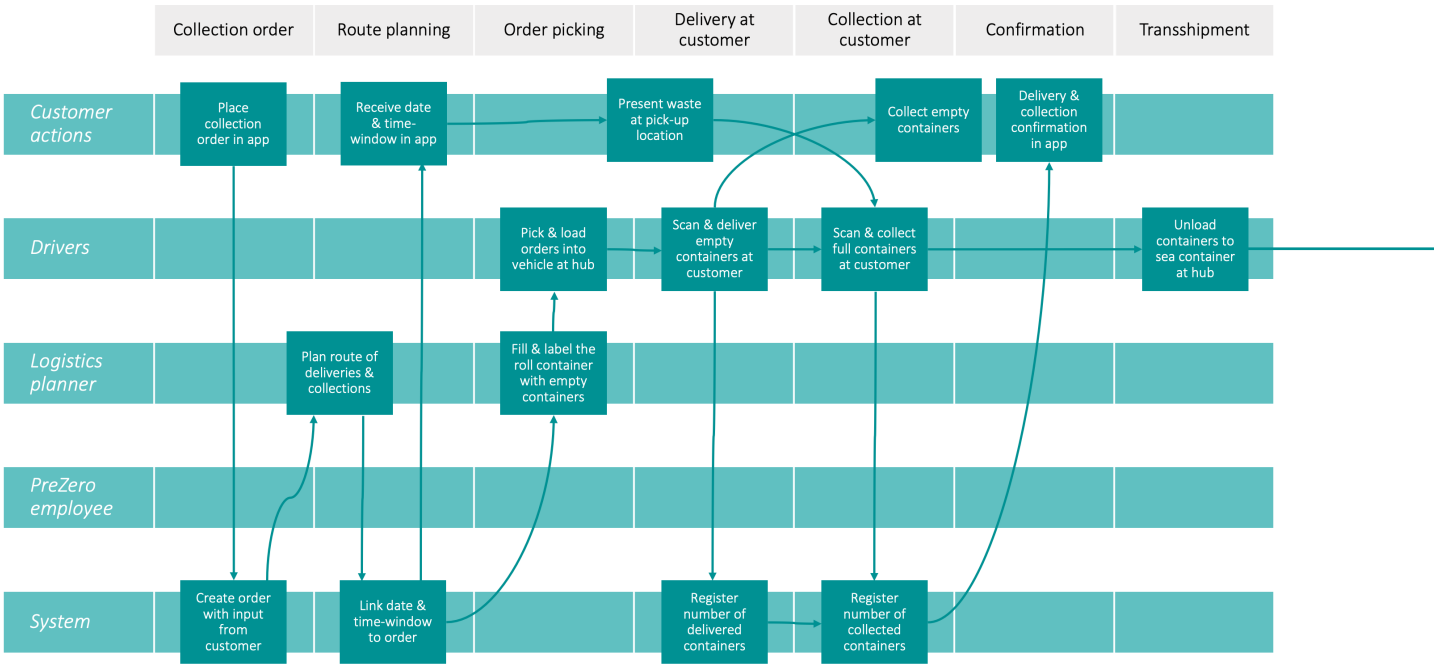


Figure 7.1 The service blueprint of the envisioned return logistics product-service system for smart waste collection

Since an equal number of clean, empty containers is delivered to the customer to replace the collected containers, the driver might have too many or too few clean containers in the truck. Although an optimizations strategy for this could be generated based on enough collected data once the system is operational, the first trials of the system could use a temporary fix for this problem: if the number of containers collected exceeds the number from the order, an automatic additional container delivery could be generated in the system. The large stock of clean containers at the hub and the daily presence of Stadslogistiek drivers in the city center should enable the additional containers to be delivered either the same day or the next day.

Confirmation

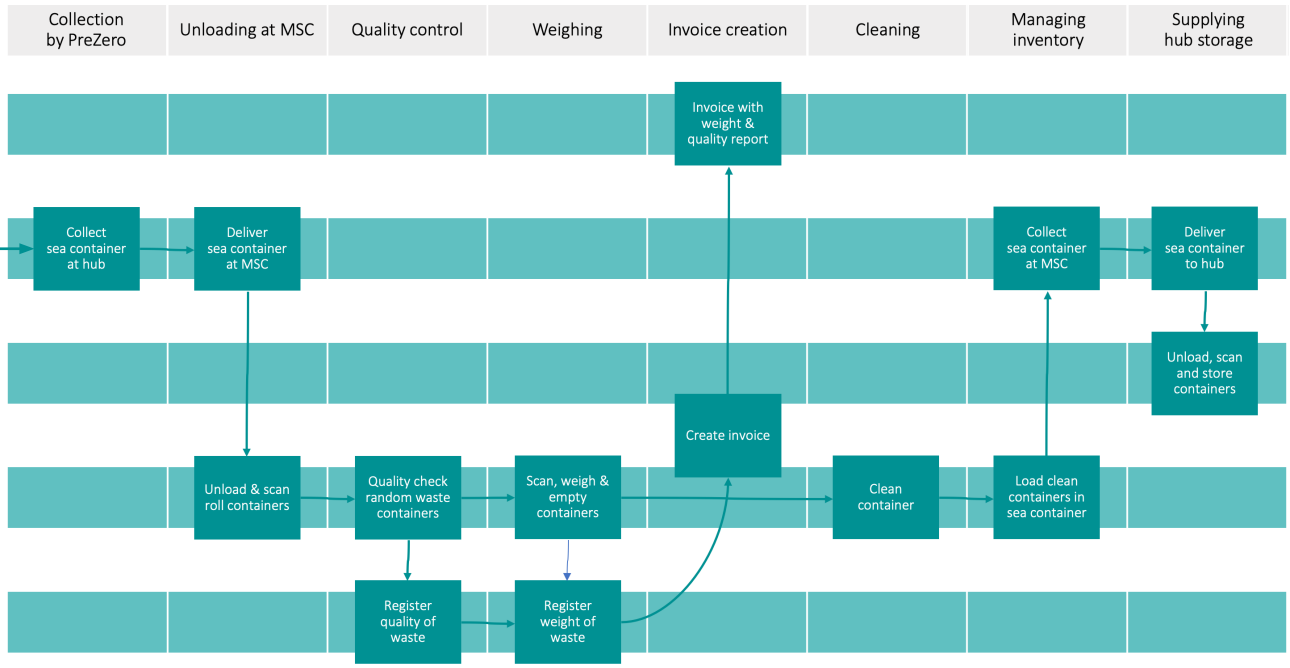
In the confirmation step, the number of registered collected and delivered containers are confirmed to the customer. This step is crucial since the collection and delivery could happen without the presence of the customer. The confirmation enables the customer to later verify if the number of containers is right and if additional actions are needed. This step enables the customer to feel in control over the containers present at its location.

Transshipment

Once collected, the containers filled with waste are transported back to the hub, where the Stadslogistiek driver unloads them into a sea container.

Collection by PreZero

When the sea container is full enough, it is collected by a PreZero driver. To maximize the return logistics of the system, this driver delivers a truck filled with clean containers to refill the stock of the hub (see the last step of the service blueprint for more details about this action).



Unload at MSC

The sea container is unloaded at the PreZero MSC (waste sorting and recycling site), where the containers are scanned to register their arrival and keep track of the inventory.

Waste quality control

A potential value proposition of collecting waste in individual containers that are delivered to the hub is that the quality of waste streams could be checked and connected to specific customers. This quality control could be realized in several ways, but the most feasible short-term goal is to let a PreZero employee at the MSC performs random quality checks (like those performed at the Lidl distribution center) which are registered in the system.

Waste weighing

Next to the quality control, the waste containers also enable more precise waste weighing, which is performed and registered in the system during this step. This step could be automated but will most likely be first (semi-)manually performed by a PreZero employee at the MSC location.

Invoice creation

With the waste mass and quality registered in the system, an invoice can be made. This could be an automated process, but more likely is that this action is periodically performed manually by either a Stadslogistiek or PreZero employee, using the registered data in the system. Who will do this depends on the chosen communication and billing channels used to interact with the customer.

The value for the customer is that its invoice consists of more precise data about the weight and quality of its waste. This feedback loop could be much further extended to become a value proposition on its own, as described in Section 4.4.4.

Container cleaning

After the container has been emptied, it gets cleaned and dried to be reused in another loop of the waste collection again. To increase customer satisfaction, periodic inspection of the cleanliness of these containers is needed to ensure that quality is delivered. These steps will also most likely be performed by PreZero employees at the MSC.

Inventory

The clean containers are stacked and loaded into a sea container, which is again collected by a PreZero driver when full, to be transported to the hub.

Hub storage

At the hub, the sea container with clean containers is unloaded (after which the sea container with full containers is loaded onto the truck, see step 'Collection by PreZero'). The Stadslogistiek employee unloads the clean containers from the sea container and stores them in the hub. During this step, the number of containers needs to be registered again, for inventory management.

7.2 Concept development

Using the detailed system flow as proposed in the system blueprint, ideation for waste collection solutions that fit both the system as the various customer contexts could start.

7.2.1 Container ideation

To start, some kind of waste container is needed to collect waste at the customer and get collected as a whole by the driver. The competitor analysis (Section 4.1) and the container vision of the client (Section 4.4.2) showed that many kinds of containers could be used as solutions to transport waste through all the steps of the system. Yet, the pilot evaluation (Section 4.2.1) showed that not just any solution will work. To detail what a container should look like, a set of requirements is defined:

- It is stackable (when full)
- It is nestable (when empty)
- It is leakproof
- It fits the standard roll container dimensions when stacked and nested
- It can contain different types of waste: PBD, coffee grounds and -cups, glass, and swill
- There are different stackable sizes available (for different waste streams)
- It has suitable handles for lifting
- It is made from sustainable materials
- It lasts multiple use cycles
- It is cleanable without manual labor
- It is cost-efficient.

Brainstorming and exploring possible containers to carry the waste, I started to realize that the container itself does not matter that much in this phase of the project. If the selected or designed container fits as many of the requirements as possible, it will do for this stage in the pilot. The real challenge to making customers switch from traditional garbage bags to this new system is to make any of these types of containers work

in the customer context since no solution is yet designed for that. Thus, the actual focus should mainly be on some sort of bin to place the containers in.

Since PreZero has already invested in several of their proposed new containers (see Figure 4.17), I choose to use those containers as starting point to start designing solutions that fit the customer context. Of this container, several standard dimensions are available which fit a roll container and cleverly stack (see Figure 7.2).

The beforementioned possible limitations of this container (not airtight, not sealed when closed, not suitable for automatic rotation, poorly cleanable, expensive, handles are not suitable for carrying heavy loads) are to be evaluated in the concept validation.

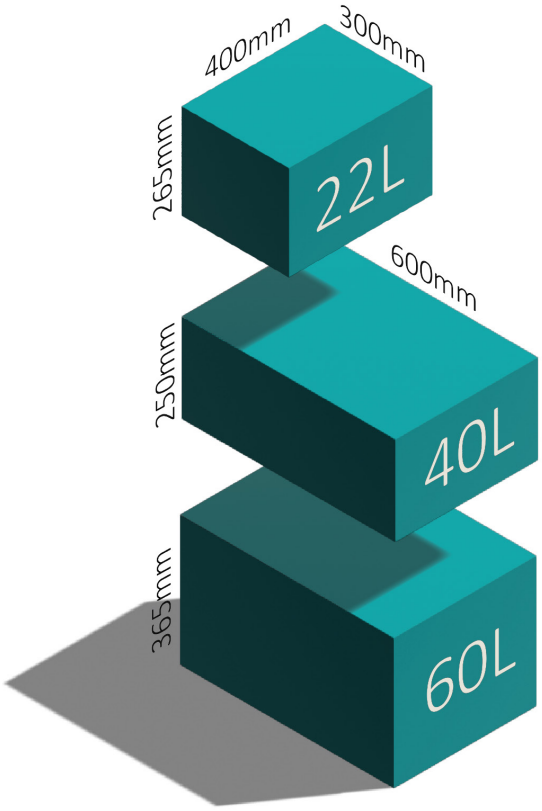


Figure 7.2 Dimensions of the three container types suggested by PreZero for use in the system.

7.2.2 Bin requirements

The challenge in designing a waste storage solution that uses the new containers instead of traditional garbage bags is that garbage bags extend vertically in length and are often quite long, while the new containers are only 21 to 34 centimeters high. This means a solution should be found to stack containers cleverly while still being able to throw away waste at a convenient height for the user. The customer research showed that waste separation is often a problem of space and time. The dimensions of new designs should fit within the dimensions of current waste bins as well as possible and their usage should not cost a considerable amount of extra time for the users. Based on these insights, the requirements and wishes for the waste bin were defined.

The requirements for a waste bin are:

- It is suitable for the selected waste containers
- It enables source separation of multiple waste streams
- Its dimensions are comparable to existing waste bins
- It is intuitive to use
- It complies with hygiene regulations of the customer contexts
- It is made from sustainable materials
- It is durable
- It is cleanable
- Its cost price is comparable to existing waste bins.

Wishes for the waste bin solution are:

- Its dimensions are smaller than existing waste bins
- It reduces time needed for waste separation
- It is cheaper than existing waste bins.

7.2.3 Bin concepts

The decision for an off the shelf solution for the container enabled the design phase to focus on the bin solution in the customer context, for which no insights or ideas had yet been gathered by the team. Considering the time available for this graduation project and the wish to develop a prototype or MVP to be tested with customers, a rapid concept development approach was chosen to develop a concept.

With online research into current waste separation bin designs and space-saving solutions, and a brainstorm about solutions that could fit the beforementioned requirements, a series of first ideas were drafted. In co-design with the client, these ideas were translated into three concepts, after which one was selected to be further detailed.

The concept is a modular bin-rack in which the waste containers can be used, so to detail the concept, three modules were made for the varying context in which the bin might be used.

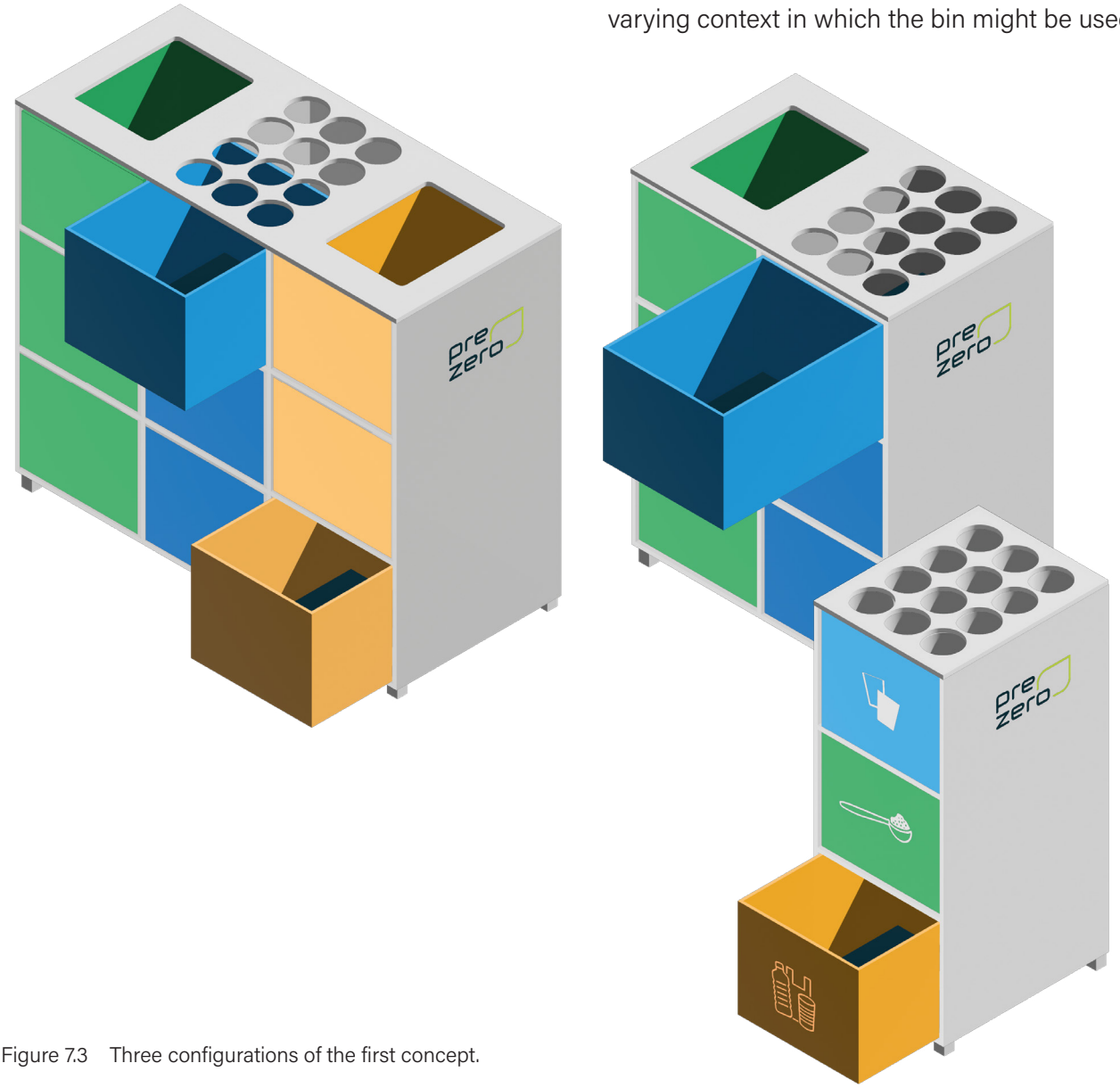


Figure 7.3 Three configurations of the first concept.

The first versions of these concepts were presented to several departments of the client, and the existing logistical stakeholders. Their considerations were implemented in the three concepts, resulting in the configurations visualized in figure 7.3. See Appendix F for more details about how each configuration works.

7.2.4 Product-service system design

Using the proposed concepts and the envisioned system, I made a graphic overview of the entire product-service system to use in communications to the involved stakeholders of the project.

Figure 7.4 gives an overview of the system cycle that the waste container will go through during every use cycle.

Using the same starting point as the service blueprint, we start at the top, where the user separates its waste in the designated container. The three colors of containers are used to illustrate different waste streams. In reality, all containers will probably have the same color, to simplify inventory management. Each waste stream can be labeled with a specific color, however, to support the customer in its source separation actions.

Figure 7.4 The container cycle of the product-service system design

7.2.5 Value flow model

Following the theory of effectuation, new goals can be reached by forming new stakeholder commitments. To see what these commitments would look like, and how the value of the system is created and shared by all stakeholders, a new value flow map is made. In this map, the key stakeholders and their interrelationships with the envisioned system are shown on the values of information, waste streams, goods, money, and intangible value (see Figure 7.5, or go to Appendix G for a full-size version and additional versions in which each value flow type is highlighted separately).

The Value Flow Modeling exercise gives a good overview of how value is shared by the stakeholders in the system. An important insight is that there are more values in a system than just monetary value. For some stakeholders, intangible value flows might even be the main reason to take part in the system. In the case of return logistics, the main intangible value flow will be the reputation gained from operating in a more sustainable way. On the other hand, values don't have to be free, so it is important to keep the value flows between stakeholders in balance to keep the system in balance.

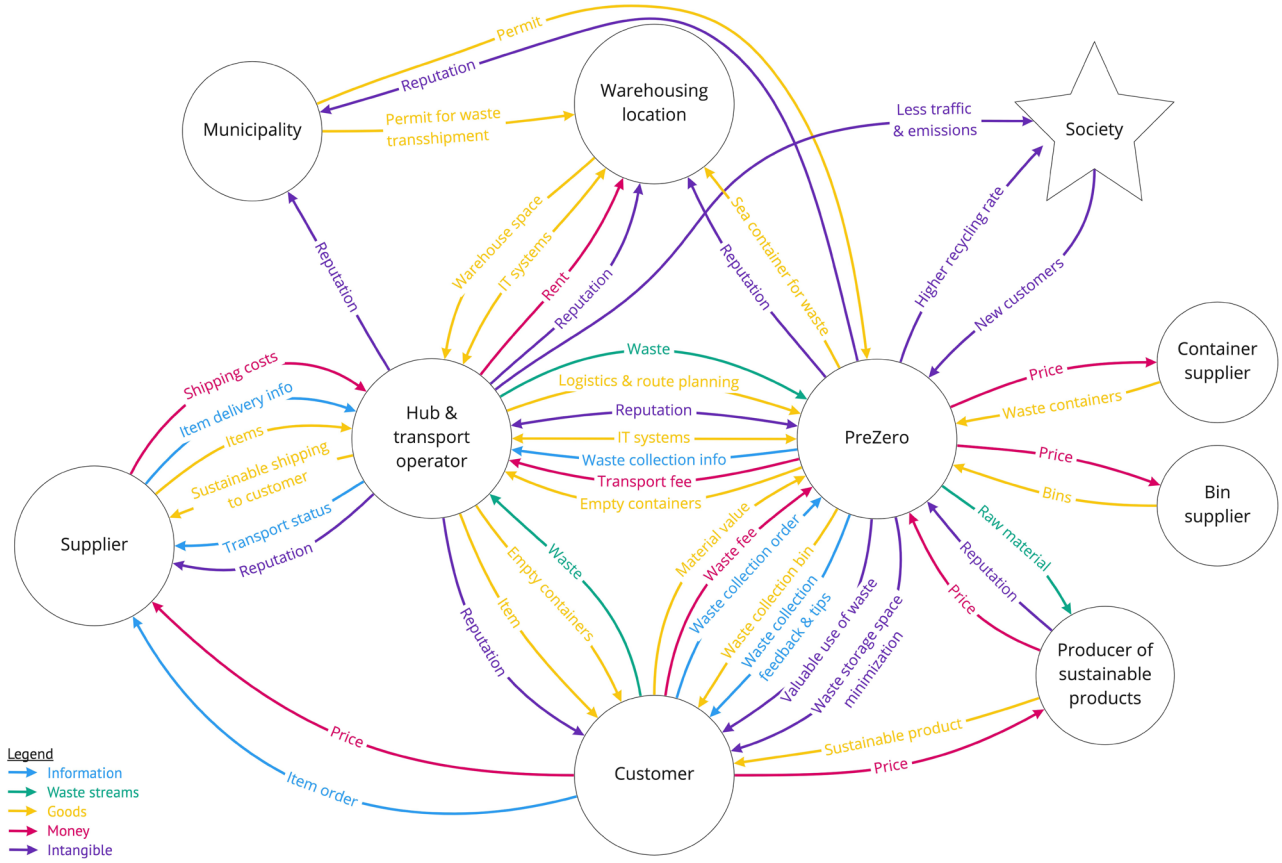


Figure 7.5 The value flow map of all stakeholders in the return logistics vision

7.3 Rapid prototyping

Both analyses of current and new means concluded that PreZero (in collaboration with the committed stakeholders) already has the means necessary to start building an improved return logistics system. Furthermore, potential customers were expected to be present in the current customer base of PreZero. The effectual logic empowers stakeholders to use their current means to iteratively form new stakeholder commitments, reach set goals and expand into new means and a new goal. Following this reasoning, the concepts were prototyped to become MVPs (Minimum Viable Products) that could be tested in customer settings.

To keep the affordable loss low and still be able to rapidly prototype and easily change and discard concepts, the prototypes had to be developed from a cheap material using a rapid manufacturing process. PreZero had previously collaborated with KarTent, a Dutch company that started with the production of cardboard festival tents and nowadays makes all sorts of products. Together with KarTent, PreZero developed the cardboard version of the ECOO-bin (see figure 7.6).

Building upon this existing partnership, KarTent was involved in the co-creation of the concepts and helped to transform these into functional MVPs. For the material, the same 10mm honeycomb cardboard as used with the ECOO-bin was chosen, which is manufactured from recycled cardboard. Although this cardboard could have turned out to not be suitable for all customer contexts, the material properties of the previous ECOO-Bin from cardboard were evaluated well enough by the PreZero team to use this material for prototyping. By using laser-cutting to cut the material into specific panels, prototypes are developed within days.

Figure 7.6 The cardboard ECOO-Bin made by KarTent

Smart Collection ECOO-Bin 2

Construction manual for carboard prototype 1

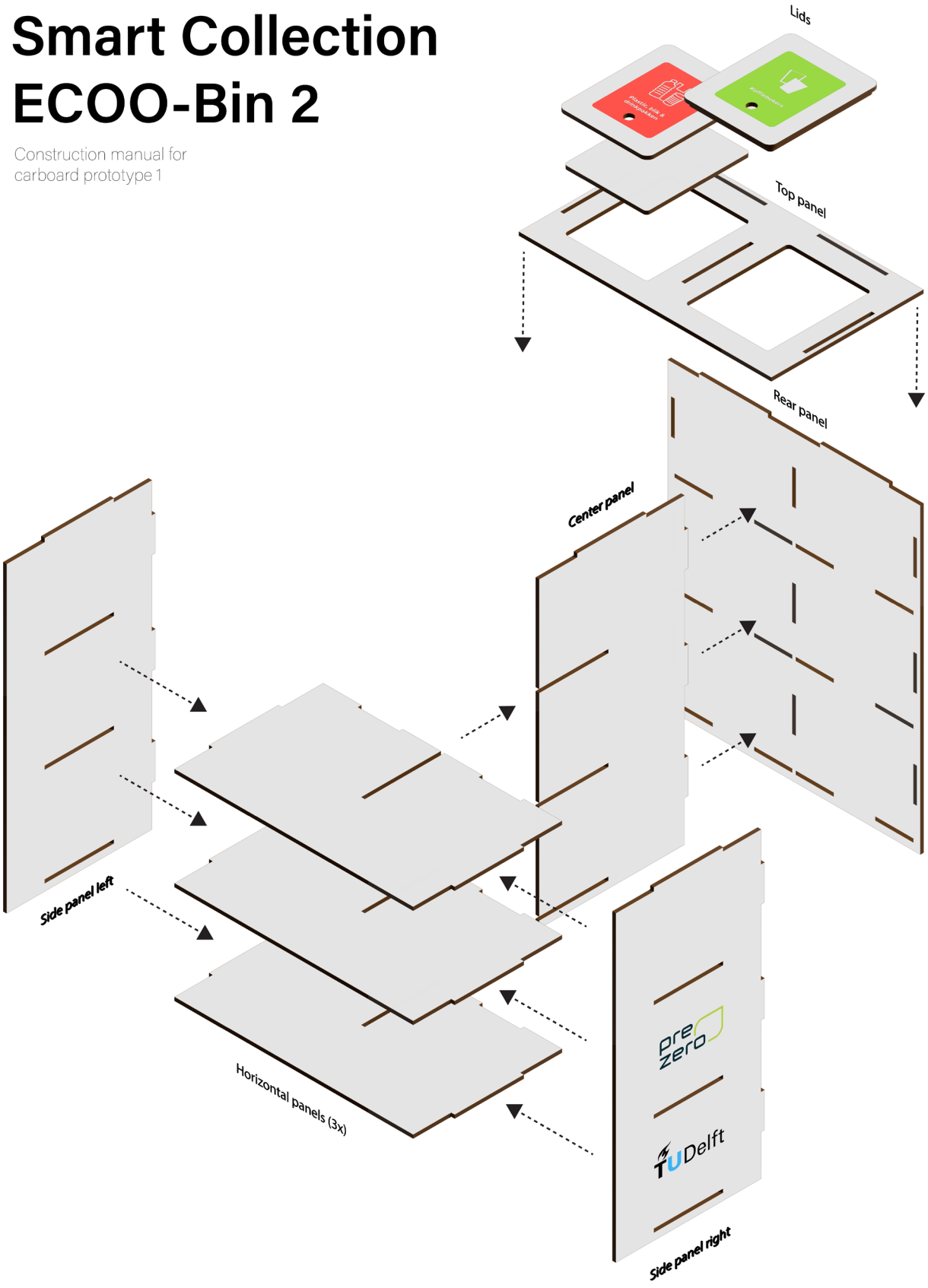


Figure 7.7 Exploded view for the construction of prototype 1.

7.3.1 MVP design

The context of the customer influences the type of bin configuration needed. For the first prototype, no specific customer was yet found. The configuration of concept two was chosen (two waste streams with each three waste containers) to gain experience with the material properties of this honeycomb cardboard. In collaboration with a KarTent designer, the design was fine-tuned (see Figure 7.7). When the flatpack with all panels arrived, the prototype was put together without the need for any glue or other construction tools.

The first prototype was used to evaluate the feasibility of the prototype to be used in the customer context during a concept validation pilot. Although small improvements could be made, the prototype was deemed feasible for customer testing (see Figure 7.8, 7.9 and 7.10 for photos from the first prototype).

Figure 7.8 How the prototype parts as flatpack.

Figure 7.9 The first prototype fully assembled.

Figure 7.10 Detail of the lid of the first prototype.

7.4 Concept validation

The cardboard bin MVP design and the chosen container enabled PreZero to organize a pilot to test and validate the envisioned system design and learn about their current means and potential stakeholder commitments. Using the current means available in The Hague, customers in the city center of The Hague were addressed to see who would be willing to participate. A custom prototype was developed to fit the customer context. This prototype was placed and used for a given time of ten days, with containers being collected by Stadslogistiek and brought to the hub. This section discusses the method, objectives, results, and conclusions.

7.4.1 Method & objectives

As described in the approach section of this report, the method of phenomenological research was applied to the pilot, since the main objective was to learn about stakeholder experiences with the designed product-service system. These stakeholders are not limited to the customer at which the prototype is tested and include the experiences of Stadslogistiek workers and the PreZero team. The main objective can be divided into four parts, which are detailed below.

System operation

The pilot would mean that PreZero, together with their partners at Djinny Logistiek, Stadslogistiek, and PostNL would be challenged to make their envisioned system design come true. Although many steps could remain the same as in the existing pilot with FMH, the additional steps of delivering, emptying, and cleaning containers are needed to be realized. Furthermore, the potential value propositions build upon a new set of data points that are collected within the new system. This could be modeled as well as possible to evaluate the value. The Smart Collection team has been discussing and envisioning this new system for a long time already but has not tested it yet. The effectual approach to just do it is meant to bring valuable insights to all involved stakeholders.

Container selection

Secondly, the chosen container is expected to be suitable for some requirements (like size, material, stackability), and lacking in some others (like sealing and cleaning). The pilot is set up to be able to evaluate these properties and see if other requirements might be relevant as well.

Bin prototype design

Thirdly, the bin prototype will be evaluated in this pilot, by being used in the actual customer context. The participating customer will be asked to periodically reflect on their experiences with the prototype and the containers, to evaluate its design.

Stakeholder commitment

The final objective of the pilot is to interact with actual stakeholders (customers) and explore potential stakeholder commitments. Testing the pilot with an actual customer, enables the evaluation of the proposed value propositions and explores the value of the current prototype and system design.

7.4.2 Data collection

For the collection of data, different methods can be applied. Limited by time and resources available, interviews, participant observations, and action research were used to gain as rich insights as possible in a short time.

To learn about the participant's experiences and opinions about all components of the product-service system, a series of semi-structured, open interviews was executed during the operation of the pilot. Different stakeholders were interviewed at different moments in the pilot.

Starting with the customer, live interviews were held during the setup of the prototype, during the first waste-collection moment, and at the closure of the pilot during the collection of the prototypes. Furthermore, continuous prototype evaluation was encouraged by using online text messages (WhatsApp) to ask the customer to reflect on their experiences in between the live moments.

Participant observation was applied to the Stadslogistiek driver, which was followed during its first waste collection of the pilot. After this first collection moment, the driver was interviewed about his experiences. Furthermore, the second collection moment was evaluated per online text messages. The Stadslogistiek employee responsible for the operations of the hub was interviewed after the completion of the pilot.

The pilot was set up to mimic the ideal system as well as possible with the means available. Since no system for emptying and cleaning the containers was yet set up, these steps were performed by myself, together with the client project supervisor. This created the opportunity for some action research to experience and evaluate the designed solutions for ourselves. After completion of the pilot, the PreZero team was asked to evaluate the personal insights that operating the pilot had brought.

7.4.3 Participant selection

In line with the effectual logic to use existing means and build new partnerships, a convenience sampling method was applied to find an interested stakeholder among the current customers of PreZero. Since the existing pilot with The Hague is located in The Hague, participants in the same region were addressed to easily add them to the existing routes of Stadslogistiek.

First, all active PreZero customers in the Hague city center (postal code 2511) were selected. These were filtered on the types of waste streams generated since the prototype is designed for the collection of small waste streams like coffee cups, coffee grounds, swill, or glass. All existing FMH locations were excluded since these are part of the other pilot, and customers linked to PreZero via third parties (like rolbakkie.nl) were excluded too since a direct customer connection was needed. The remaining fifteen customers were called to find one that was interested in collaborating. Although several customers were interested, only one customer directly agreed to make an appointment and was ready to start a pilot within weeks. This customer was a cooking school and -workshop location.

7.4.4 Setting

The customer context is an open kitchen space with 5 cooking islands and three large dining tables, see Figure 7.11.

Figure 7.11 The customer context of the pilot.

The existing waste collection at the customer consisted of four waste streams: glass, paper, PBD, and residual waste. Each of these streams was collected in separate containers in the alley outside the building. Although PBD is collected separately, it is not collected by a commercial partner. Instead, it is taken home by the manager to be collected as household PBD, for which he pays a fixed price that is not volume related. Currently, swill is not collected separately. Inside, standard open bins were used for the collection of residual waste. Each cooking island has one bin for residual waste. Empty wine bottles formed the main source of glass waste, which was collected by the host of the cooking class during and at the end of each evening and directly disposed into the waste container outside. The paper is collected and disposed of in the same manner.

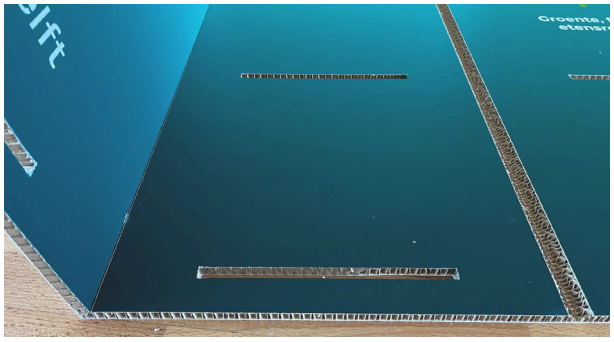


Figure 7.13 The production mistake with prints on the inside.

7.4.5 Prototype development

The customer was visited to explore the customer context and explain the pilot with the actual container and several figures of the system flow and prototype. The customer was interested to collect both swill and glass using the return logistics system and containers. Since glass is manually collected by the host of the cooking workshop, no special bin design was needed for that. This resulted in the wish to design a bin prototype to collect the swill from the cooking islands. In co-creation with the customer, a configuration of two small (22L) containers were designed, of which the customer will receive two, to be placed between the cooking islands next to the current residual waste bins.

Building upon the insights from the production of the first prototype, some additional improvements were included in the design, such as folding corners and an additional top panel with an incorporated lid, which hinges open using a fold in the cardboard (See Figure 7.12). Unfortunately, a mistake in the production process resulted in the insides of side panels being printed, instead of the outsides (see Figure 7.13).

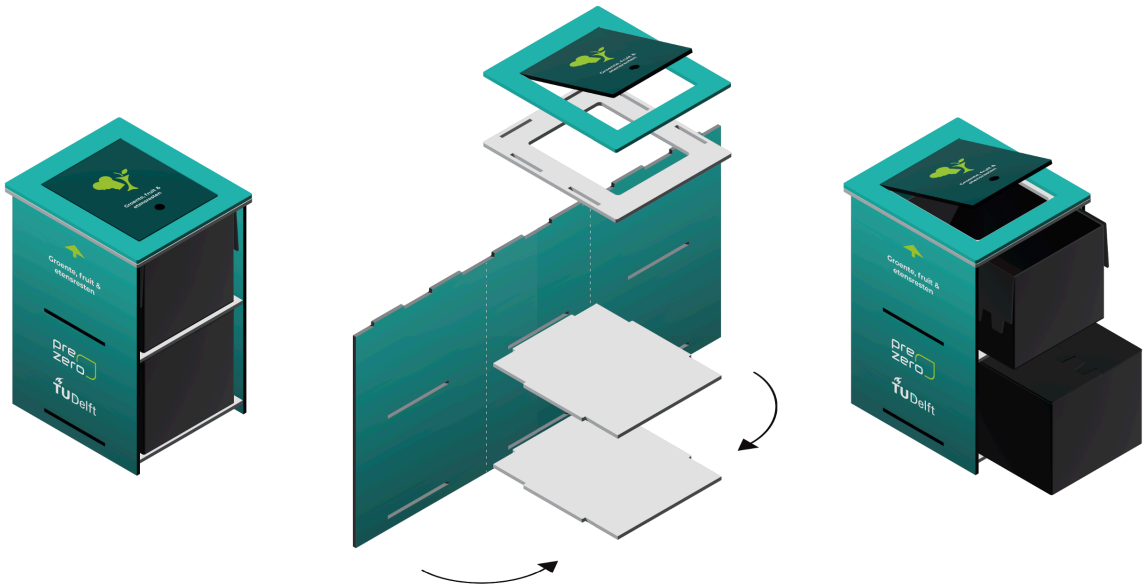


Figure 7.12 Design of prototype 2.

7.4.6 The pilot

To mimic the existing system as well as possible, the customer was given the choice between manually placing collection orders or deciding upon a periodic collection day. The customer chose the second option and preferred the waste to be collected once per week, since not every weekday someone is present. Although this presence was not needed, since the containers could be placed in the alley, the customer liked to be present to be able to give feedback to the Stadslogistiek driver or ask questions if needed.

On June 21st, the two prototypes were delivered to the customer. The top panel with the lid was not yet glued into place to give the customer the choice in what direction the container should be placed. The customer preferred to have the open side at the back. Although this meant that the bin needed to be moved from the wall each time the containers are removed, the customer preferred the look of the bin this way. With the in place, the containers were immediately taken into use by the cooking school (see Figure 7.14).

For a period of ten days, the customer used the prototype to collect its swill. During cooking workshops, salad bowls are used to collect swill on each cooking island. These bowls are emptied into the containers. Although it was discussed that the customer should use the additional containers for the collection of waste too, unfortunately, this did not happen.

The first collection of containers was documented by participant observation. The second collection moment was done by Stadslogistiek without me joining, to see if they could successfully fulfill this step by themselves.

After the first collection, an additional empty roll container was delivered to the customer. This roll container could be placed in the alley outside and used to stack the full containers after use. This entire roll container was then collected by Stadslogistiek on the final Thursday, June 30th (see Figure 7.15).

Figure 7.14 Prototype in use at the customer.

Figure 7.15 Stadslogistiek driver collecting the containers.

Initially, the plan was to let the containers be emptied and cleaned by employees of a re-employment organization that has an industrial washer. Unfortunately, the negotiations about this collaboration were not concluded on time for this pilot. Therefore, the emptying and cleaning had to be done by me and the PreZero team (see Figure 7.16).

After the first collection moment, I emptied the containers at the hub. After the second collection moment, I visited the hub to empty the additional containers as well. Then, all used containers were transported to the PreZero waste treatment site in Alphen aan den Rijn, where an employee cleaned them using a high-pressure cleaner (see Figure 7.17). Although functional, this meant that no learnings about envisioned automated emptying and cleaning of the containers were gained.

7.4.7 Insights

The pilot resulted in interesting insights for the system, container, prototype, and stakeholder commitments, which are discussed below.

System operation

Setting up the pilot uncovered an organizational structure within PreZero that limits its innovative capabilities. When first coined, the idea for a customer pilot with the prototype was applauded and deemed easily possible. However, the many organizational levels made it hard to quickly iterate and make decisions. Furthermore, the search for suitable customers in the city center of The Hague uncovered a lack of active account management for SME customers. All Dutch SME customers are the responsibility of the Customer care division of PreZero, which is organized as a helpdesk that does not have personal connections to specific customers. Furthermore, the customer contact information turned out to be outdated or incomplete, which made it hard to benefit from PreZero's existing customer base.

Figure 7.16 Manually emptying the containers.

Figure 7.17 High-pressure cleaning the containers.

When a customer was finally found, the lack of active account management meant that less was known about this customer. A lack of correct data meant that no clear information about the quantity and types of waste previously collected at the customer was available. Reducing the container size to 22L instead of the traditional 120+L means that more accurate data about the waste collection is needed to be sure no shortage of container space occurs at customers.

Both Stadslogistiek and Djinny Logistiek cooperated very smoothly in the setup of the pilot. Even though the collection of swill, a waste stream reasonably considered more disgusting than the existing streams, had not been executed at the hub before, no resistance was encountered.

Container selection

The container performance was in line with the expectations, see Table 7.1 for the scores per requirement.

The container is very well suitable for the logistical operation from the customer to the hub, using a standard roll container available at the hub. Both the Stadslogistiek drivers and hub workers evaluated this as a suitable solution.

The biggest downside of the chosen container is that it is not airtight when the lids are closed. With containers filled with fish leftovers being placed in the sun, this resulted in heavy smell development around the containers. All stakeholders evaluated this as problematic and would see a solution to this problem. Next to possibilities to change the design of the container,

Table 7.1 Harris profile evaluation of the container.

Requirement	*Evaluation*	*Substantiation*
Stackable on roll container	+ +	*Layers of four containers (2x2) can neatly be stacked on a roll container.*
Nestable on roll container	+	*Nested containers are too wide to be neatly stacked in layers of four, but still more empty than full containers fit on one roll container.*
Reliable in use	+ +	*The containers have been used in different industries for decades and are evaluated reliable.*
Leak proof	+	*The plastic container is leak proof, but not sealed, meaning that spilling might occur when tilted.*
Airtight	-	*The containers are not airtight, but this might be solved with a higher collection frequency.*
Handles for carrying	+	*No specific handles are present, but the ridges around the container enable easy carrying.*
Sustainable	+	*Recycled PP is used to manufacture the containers, yet more sustainable materials exist.*
Price	+	*The actual cost of the containers will depend on the durability among many use cycles.*
Different sizes	+	*Different compatible sizes exist, but a smaller volume might be needed for specific waste streams.*
Automatic emptying	-	*Although not tested yet, the pilot showed possible limitations for automatic emptying.*
Automatic cleaning	-	*Although not tested yet, the pilot showed possible limitations for automatic cleaning.*

the collection interval plays an important role in the smell development as well. If the containers would have been collected every day, the swill would have had less time to start smelling, thus possibly solving this problem.

When emptying the containers, some waste would stick to the bottom of the containers and not let go. A piece of cardboard was used to scrape these pieces out, but a better solution is needed for this.

Another insight gained from the pilot is that multiple containers were only half full when collected. Following HACCP regulations, the customer took out the used containers at the end of every day (no waste is allowed to be left overnight in a kitchen). If containers turn out to always be half full, a smaller container would be preferable to increase the space-efficiency of the containers and bin.

Bin prototype design

The bin prototype was evaluated well by both the customer and its own clients, see Table 7.2 for the scores per requirement and wish.

Table 7.2 Harris profile evaluation of the bin prototype.

Requirement	*Evaluation*	*Substantiation*
Suitable for selected waste containers	+ +	*The prototype is designed for the 22L containers.*
Enable source separation of multiple waste streams	+	*The prototype was designed for only 1 waste stream but could be changed to multiple.*
Dimensions comparable to existing bins	+	*It was comparable in size to the existing bins but could be more compact with smaller containers.*
Intuitive to use	+	*It was evaluated to be intuitive to use, although the lid and opening could be improved.*
Complies with hygiene regulations	+	*The customer evaluated it HACCP compliant, but no official check was performed.*
Made from sustainable materials	+ +	*The prototype is made from recycled cardboard and can be 100% recycled.*
Durable	-	*Carboard is not durable enough for the kitchen context but might be suitable for other contexts.*
Cleanable	-	*The cleanability was better than expected but using moist to clean will eventually remove the top layer.*
Price comparable to existing waste bins	+ +	*Although only two units were produced the price was comparable to existing bins.*
Wishes		
Smaller than existing bins	+	*If a smaller container could be used, the bin can easily get smaller than existing solutions.*
Reduces time needed for waste separation	+ +	*Since no in-liners are needed, the time needed to switch containers is shorter than changing a bag.*
Cheaper than existing bins	+ +	*If produced in larger quantities, the price could get much lower than existing solutions.*

The customer was happy that the bin enabled them to finally source separate swill. Furthermore, the design of the bin was liked, even though the design artwork was printed on the inside. The clients of the customer (students at the cooking school and participants of cooking workshops) could easily use the bin and understood the waste separation system. The bin prototype is produced in a sustainable way, being made with recycled cardboard, delivered in a flatpack, constructed using dry connections for easy de-mounting after use and being 100% recyclable.

To improve the existing design, the stakeholders suggested the following improvements:

- A step-on bin would be more suitable for a kitchen context, where the customer wants to open the lid without using their hands, to minimize the risk of contaminating food. In the current design, the lid stayed open during use, which was evaluated poorly for hygienic reasons.
- The top of the containers was evaluated to easily get dirty. A bigger opening or some sort of detachable funnel were suggested by the customer as improvements.
- The cardboard was evaluated better than expected, yet a more waterproof material was preferred to be more sustainable for longer use in a kitchen environment.
- At one point during the pilot somebody disposed waste into the bin while the container was being replaced, thus polluting the inside of the bin. The customer wished for some solution to lock the lid when the container is not present.

Additional own insights on the bin design are the following:

- The current prototype was designed following the PreZero brand style. However, the unique cardboard property of easy printability could be used to make the bin blend more into the context of the customer.
- The current bin dimensions are primarily based on the container dimensions. However, DINED could be used to design the lid to be at a more user-friendly height.

Stakeholder commitment

The main takeaway from the pilot is that there are potential customers for the return logistics system in the current customer base of PreZero, and that the system is evaluated positive by these users after having piloted it for ten days.

Another insight the pilot setup gave, was that finding a container emptying and cleaning partner turned out to be harder than expected. The initial meetings with the potential stakeholder were evaluated very positive, and quick progress was expected to enable testing in the pilot. However, this progress turned out to be slower, when the partner realized that the waste stream that had to be emptied and cleaned from the containers was swill. Fearing its location would become a waste management site and expecting difficulties to enthuse its employees to fulfil the needed work, the progress with the partner stagnated. This shows the dislike many workers and people might probably still have to working with waste.

Having emptied the swill containers filled with rotten fish that had waited in the sun for a week, I do most definitely understand this dislike. Although PreZero might have employees in-house that are fine with these actions, automating the most disgusting steps might make the entire system far more suitable for collaboration with new stakeholders and scaling operations to other locations.

7.5 Conclusion

The client has been working on the envisioned return logistics system for over a year already, but progress has not been as fast as preferred, while all key means needed to develop and operate a return logistics system should be available. The work from this chapter was a design intervention to show the client what can be reached in a short period of time when the effectual logic is applied to the project. The effectual approach showed how available means can help to develop solutions for the beforementioned design challenge and how a rapid process of prototyping MVP's and involving stakeholders could generate rich insights. The key insights of this design phase are discussed below.

Design for the end-user

The focus of the client has mainly been on the feasibility of the system itself, not involving the key stakeholder in this process so far, which is the actual end-user. As the service blueprint design showed, however, the user experience of this end-user is central to the complete system design and cannot be isolated. This design sprint showed the value of testing and learning from end-users, to be sure that next to feasibility, the desirability of the system is also considered.

One of these end-users is the (potential) customer from PreZero, that considers the system as a possible solution for the management of their business waste. This is the end-user to convince, yet the more important end-users for the design of the bin and container, are probably going to be the employees and customers of this business customer. Since these will be less involved in waste management, their user experience with the bin and container itself will be essential for the desirability of the product-service system design.

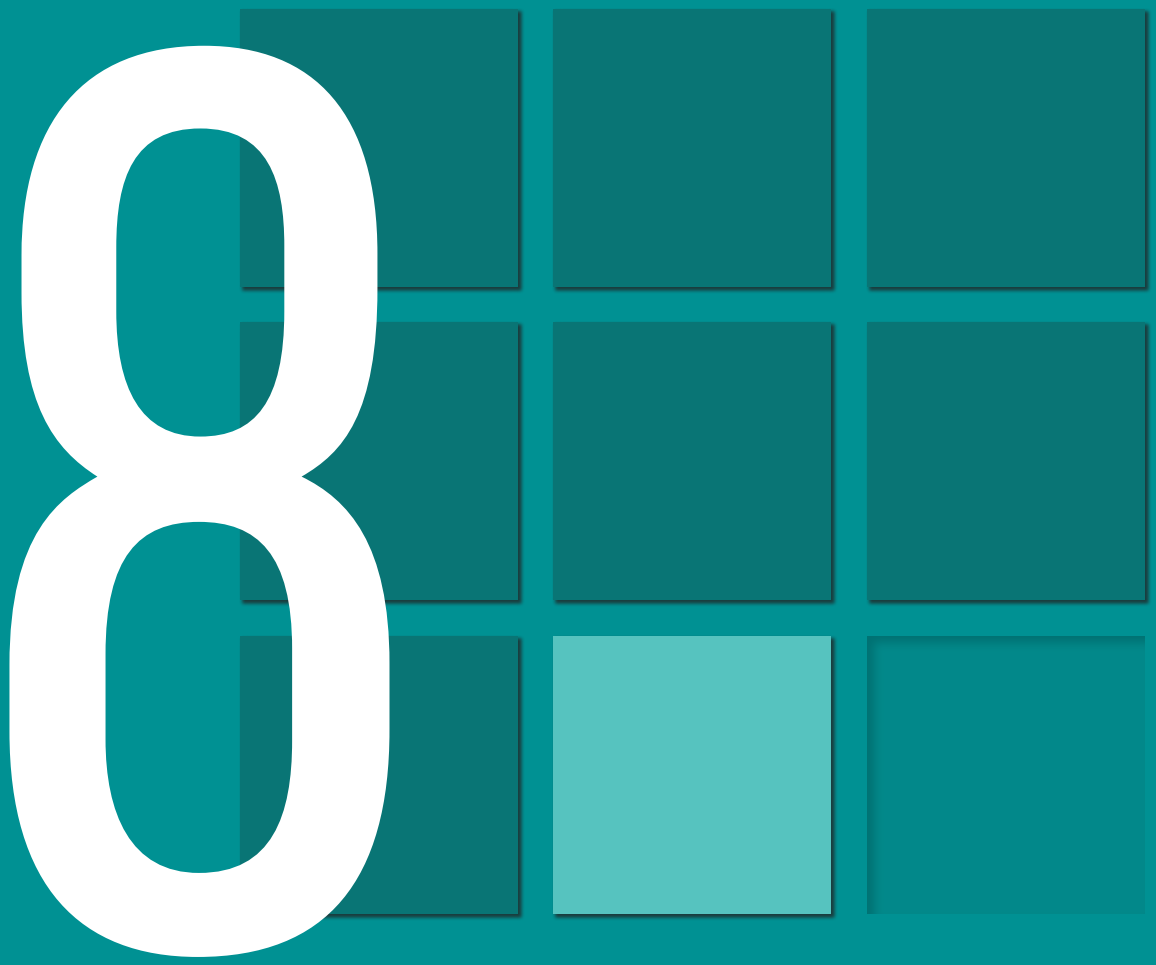
Involve stakeholders

This design sprint showed the willingness of existing stakeholders to commit to designing a potential new solution. The stakeholder commitments from the existing pilot in The Hague showed mainly valuable for quickly setting up a pilot for a new prototype. Finding a customer was evaluated more difficult, due to a lack of active SME account management, but once found the customer was very involved in the process. Trying to find a partner to clean the containers uncovered a possible obstacle of willingness to work with waste streams. Although this is normal within PreZero, others might still have different opinions about this work. If no suitable stakeholder can be found, automation could be a solution to cut out the need for human labor in these specific emptying and cleaning steps.

Iterate

As the previous section about the insights from the pilot showed (7.4.7), the designed solutions for waste collection are not perfect yet. However, working with these imperfect solutions did already generate valuable new insights about the process, the container, the bin, and the stakeholder commitments. Partnerships with production partners like KarTent should enable continuous rapid prototyping of new prototypes, which allows building custom prototypes for pilots in other contexts too.

With these main insights about the prototype design gathered, the next chapter will zoom out more to explore what possible futures could be reached by continuing this effectual way of working.



8

IMPLEMENTATION

So far, this graduation project has been an example of how the effectual project approach can be used to generate value and potential new products. As the previous chapters have shown, this approach has already resulted in valuable insights for the client. The challenge that remains, is to enable the client to implement these insights, and embed the effectual approach into its own organization as a new set of means to reach the envisioned possible futures. In this chapter, this is addressed by co-creating the next steps with the client and further detailing the possible futures that could be aimed for.

8.1 Co-creation session

During the entire graduation project, I closely collaborated with the Smart Collection team. They saw the method of effectuation in action and were enthusiastic about the results it generated. And although they also shared these results with their superiors, these managers had not yet learned about the effectual logic behind the process that created those results.

To be able to share my results and explain the effectual mindset that would help the further development of the new business model of return logistics for waste collection, a co-creation session was planned with the 'Stuurgroep Retourlogistiek', a periodical meeting with all relevant managers for the return logistics project. This co-creation session had the following objectives:

- Align ambition & expectations,
- Show the value of effectuation,
- Share key insights of the project so far.
- Define the next goals and needed means.

8.1.1 Method

The session of one hour consisted of three parts. First, the participants were asked to ideate about the goal ('What is our goal?'), means ('How are we getting there?') and obstacles ('What are our obstacles?') of the return logistics system. Their input was mapped in a Miro board. Then, the essentials of effectuation were explained and the key insights from the graduation project were shared, for which prototype 1 was brought to the office. Afterwards, an open discussion was held to discuss the presented results and define the goals that should be next, and the means that should be applied to reach those goals ('What are our means?', 'What could be our goals?', and 'With whom should we interact?'). The discussion was recorded for later notetaking and analysis of the insights.

The session was held on June 30th, 2022. Unfortunately, next to the two project supervisors of the Smart Collection team that joined the session, only two of the five other invited participants could join the session. Luckily, one of them was the Head of Transport in the Netherlands, the director of the department which Smart Collection belongs to.

8.1.2 Results

During the first part of the session, it became clear that the present managers were very well aligned on the goals, means and obstacles that the return logistics system faces (see Appendix H for the Miro boards). Afterwards, the participant replied very enthusiastic and involved in the presentation of the results of the graduation process and asked detailed questions about the effectual logic and how to apply it well. This resulted in an interesting discussion in which the obstacles were discussed, and the goals were defined that need to be reached to enable further iteration of the return logistics project. The outcomes of the session are summarized in figure 8.1.

As figure 8.1 shows, the participants saw a potential for the prototype and system to be used for other types of customers as well. The effectual logic allows for the system to develop in whatever direction possible with the current means and goals, so exploring the potential for other customers of PreZero could be very interesting for future research.

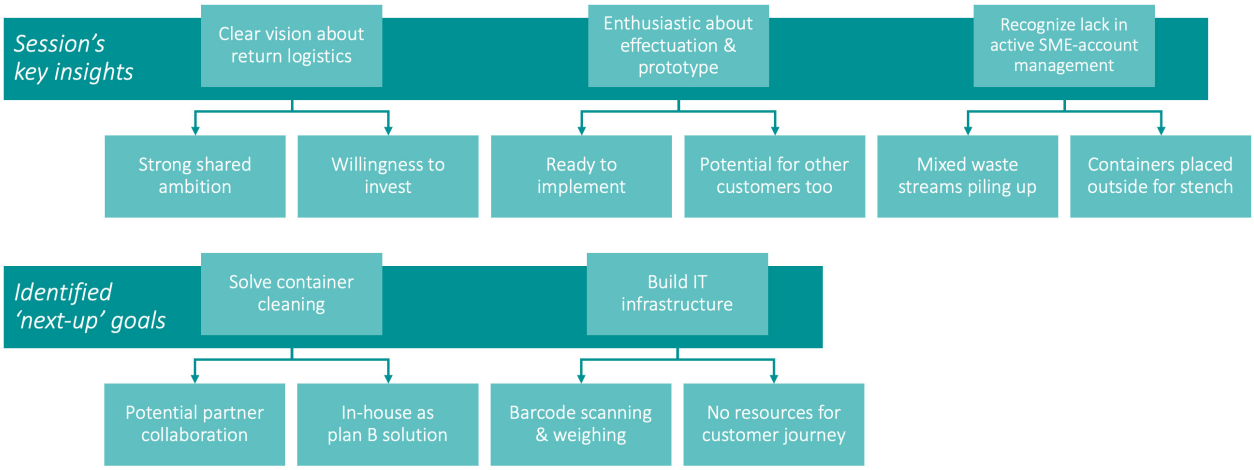


Figure 8.1 Overview of the key insights from the co-creation session with the client.

As discussed in Section 7.4.7, setting up the pilot with the customer uncovered the lack in active account management of SME customers by PreZero. This was echoed in the co-creation session, and further explained. The vision of PreZero that personal contact with all SME customers is not viable, that's why these customers are now helped by a general customer care department. The problem, however, is that a lot of knowledge about these customers has been lost since the end of active account management, since there has not been set up a system of active data collection and management about these customers, resulting in no clear view of this target segment. If the return logistics vision will indeed aim at this target segment, the participants agreed that more knowledge about these customers should be gathered again.

The main goal the participants defined, is to solve the container cleaning with some sort of semi-automated solution. This should enable new pilots to be executed and should give valuable insights into what is needed to truly operate a return logistics system on larger scale.

The second goal defined by the participants, was to build the IT infrastructure to be able to scan barcodes of waste containers and weigh them. Although the insights from Section 5.2 showed that no advanced IT infrastructure is needed to build a functional return logistics system, the team has already been working on this part of the project and strongly believes that it is needed to smoothly operate the envisioned system.

Another part of IT infrastructure that the participants noted as a future goal, is some sort of portal or app for a smooth customer journey for the envisioned system. This could be a way to solve the beforementioned lack of personal account management. Unfortunately, the participants recognized that currently, the resources to build such a system are not present within the organization.

8.2 Future visions

The co-creation session showed the value of a tangible prototype for envisioning possible futures, sparking the creativity of the participants to think about possible implementations for this product. The Smart Collection Team had noted the same behavior before when they bought the first new waste container of 22L, after which many employees at the office came by to look at it and discuss the possibilities and possible improvements. If a simple tool like that could help a certain idea come to life within the organization, this method could be applied to the insights from this graduation project as well.

Discussing the tools that the client needed for implementation of the effectual logic and the insights from this graduation project, the client showed interest in a more vivid description and visualization of the potential value propositions that have been defined throughout the report. Like the prototypes, these could be used to bring the future vision to life within the organization, and get employees involved in the iterative processes towards these potential futures.

Interacting with different stakeholders to explore current and future means and goals resulted in the definition of the following six potential value propositions that could be possible futures for PreZero to aim for: 'Waste data generator', 'Raw material supplier', 'Waste insights educator', 'Space saver', 'Source separation convincer', and 'Smart logistics enabler'. These have been covered in sections 4.4.4 and 5.4.1 but could be further detailed to form rich future visions.

Since some of the value propositions overlap or might form a stronger business model together, the value propositions were combined to form four possible future visions that are shown in Figure 8.2. In the next sections, each of these future visions is further detailed to show how the value propositions could be used to build a new business model for PreZero, and what steps are needed to reach these possible futures. All these business models are based on the return logistics system as envisioned in section 7.1.

The goal of these future visions is to bring possible new roles of PreZero to life within the organization, thus empowering the Smart Collection team in their internal processes to get the support needed to build towards these new business models. The risk, however, is that these visions could cause a tunnel vision of causal logic, in which means are developed to reach a set goal. Following effectual reasoning, the future visions should remain open for change and should only be used to make decisions about the goals and partnerships of the near future, which will themselves influence the future business model.

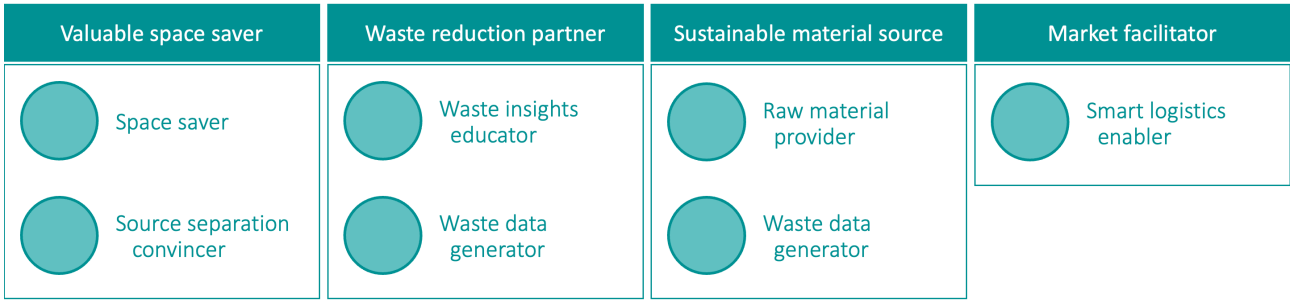


Figure 8.2 Overview of the four future visions and the correspnoding value propositions.

8.2.1 Valuable space saver

In the first future vision, the business model of PreZero is to be a space saver for customers by minimizing the space needed to source separate waste streams. This role is based on the potential value propositions 'Space saver' and 'Source separation convincer' described in section 5.4.1, which were the result of interviews with potential customers in the inner-city environment. An overview of the business model is shown in the business model canvas in Figure 8.3.

Value proposition

By collecting waste streams in small quantities on a smaller interval than traditional (e.g., daily instead of weekly), customers are unburdened of the space and time needed for source separated waste management. The space needed for the collection of different waste streams can be minimized using smaller containers (like those used in the MVP pilot) in a compact waste bin from PreZero. The time needed to source separate is reduced by collecting the containers as a whole and replacing them with empty containers, instead of manually taking out the garbage bags and placing new ones as in-liners of existing waste bins. This value proposition could enable and persuade customers that are not yet separating their waste streams to start doing so.

Customers

The business model is targeted at SME customers in an inner-city environment, where the price per square meter of business space is high. Optionally, other types of customers (like bigger enterprises) that have business locations in places with high prices per square meter (e.g., shops in train stations or shopping malls) could be targeted as well. The primary target audience are existing and potential customers that are not yet source separating their waste. Furthermore, customers that have been source separating their waste could be addressed, to see how the solution could benefit them as well.

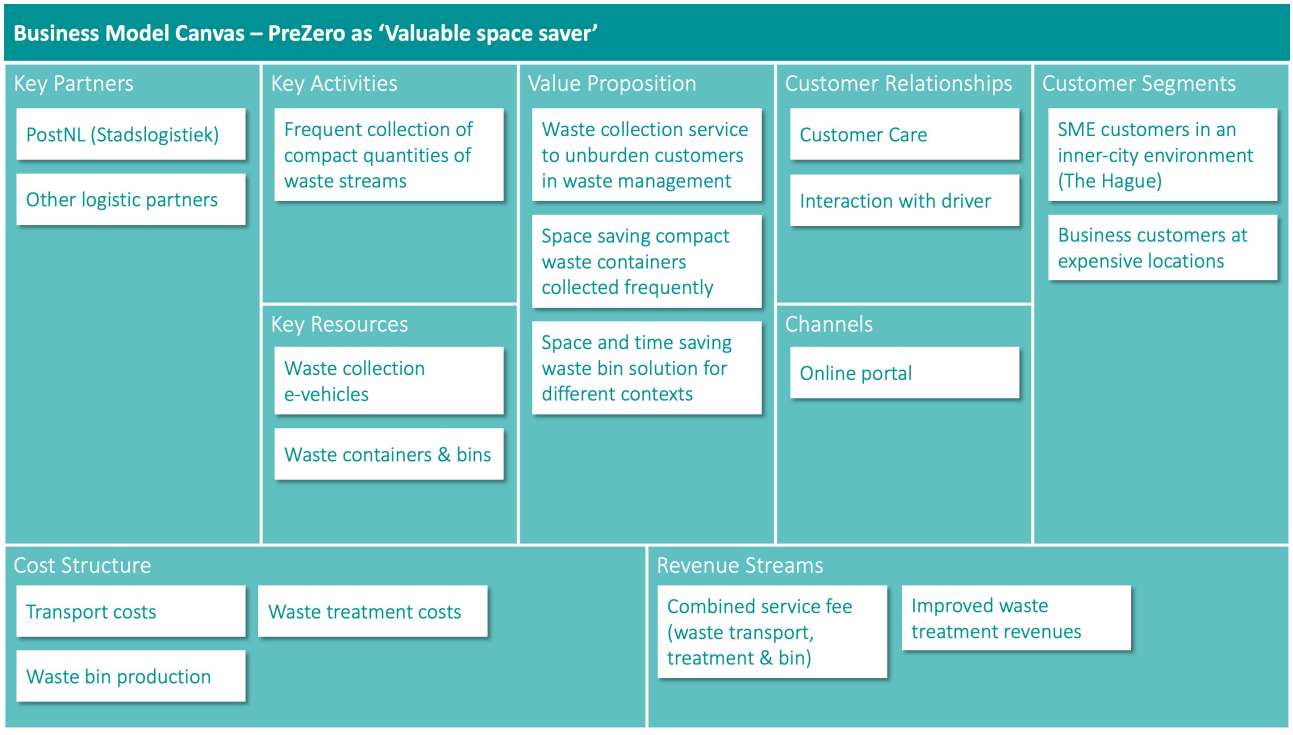


Figure 8.3 Business Model Canvas for the 'Valuable Space Saver' value proposition.

Partners

The key partners in this business model are logistical partners that could collect the small quantities of waste on a high frequency. Essential for the viability of this business model, is the efficiency or routing, to combine as many collection addresses as possible and minimize empty truck space. To increase the efficiency and reduce the costs, the return logistics system of PostNL seems very suitable for the operation, though other solutions could be explored as well.

Business model

The service of enabling customers to source separate while also unburdening them from the time and space needed to do so, creates a new value proposition that can be exploited. Currently, the price for waste management is roughly made up from two parts: waste transport and waste treatment. The higher frequency of waste collection could be marketed as a new service for which PreZero could charge a specific fee to cover the additional transport costs.

The waste bin that is placed at the customer to use the compact waste containers has a price as well. Several pricing strategies could be identified to place this bin at the customer:

- Customers could buy the bins, which allows for high customizability to the customer context in both the configuration of the bin and the artwork on the sides of the bin. The initial investment will be higher in this scenario, but this could result in an incentive to keep using the service, which could create reliable customers. This means that the first purchase is most crucial, so a capable sales department is needed to bring this strategy to a success. Furthermore, designers are needed to develop the custom bins.
- Another strategy is to lease the bins to the customer. This reduces the initial investments for the customer, making it easier to choose the service. To be able to lease bins to many types of customers, a more general set of bin designs would be needed to make this a viable strategy. A solution might be to have a modular system that can be adapted to different contexts. This would also allow customers to adapt the bin more easily to changing contexts (e.g., scaling up organization, or changing the waste streams to be collected), creating a flexible waste management solution.
- A third strategy is to include the bins in the price of the system, addressing the system as a waste-management-as-a-service kind of solution. This strategy needs the same kind of bin solutions as described in the previous strategy, but the price of the bins would be hidden in the monthly fee for the waste management service.

Steps to be taken

This first business model seems the most reachable value proposition for the near future. PreZero is already collaborating with PostNL in The Hague, and the designed MVP in combination with the 22L containers could enable a quick setup of a first system in The Hague. Additional data collection about the weight and quality of the waste is not strictly necessary for this business model. The frequent collection of small volume containers valuable already, and a fixed price per collection moment could be used to set the price and the existing PreZero portal is suitable for customer interaction. To improve the system, smaller containers should be included too, more bin configurations should be designed to fit all customer contexts, and a more advanced customer portal should be developed.

Challenges

In building this possible future, several challenges could occur.

- First, the challenge is to make the operation of this service viable. This will most likely not be the case in the very beginning when only a few customers will use this service, thus resulting in a less efficient collection route. This could be minimized by collaborating with Stadslogistiek and starting with customers within the existing pilot area in The Hague. Since Stadslogistiek is already present in that area every working day, the costs of collection can be reduced, if PostNL is willing to collaborate on this service and agrees upon viable rates. With more customers choosing this service, the service area could be extended to additional areas and eventually to different cities.
- Next to the viability, it is a challenge to convince customers of the desirability of the service. This is the task of the sales department, which should successfully bring the values across to get customers willing to pay for this unburdening service.
- The overall goal of this envisioned system was to increase source separation while reducing emissions and inner-city traffic. It will be a challenge to find the sweet spot between enabling source separation with this service, while reducing inner-city traffic by cleverly combining parcels and waste collection. It might mainly be a challenge if door-to-door collection of small quantities of waste is feasible, or that another collection method might be preferable, like curbside collection. If that's the case, a whole new set of regulatory challenges arises.

Visual

To truly bring the envisioned future business model to life, a poster is made to convey the main value that PreZero could offer to its future customers (see Figure 8.4). The poster shows how smaller containers could be combined into a compact waste collection solution for multiple waste streams. The poster is in Dutch to best reach the targeted audience of employees of PreZero Netherlands and potential customers. The visual style of the poster is based on the client's 'Wat als het lukt' brand-campaign discussed in section 4.1.3. The poster will be printed and handed over to the Smart Collection team to be put at the wall in the headquarters, to kickstart conversations about the possible transition PreZero could make. Furthermore, the visualization can help to convey the direction to support the development towards this potential value proposition.

Figure 8.4 Poster for the 'Valuable Space Saver' value proposition.

8.2.2 Waste reduction partner

In the second future vision, the business model of PreZero is to be a waste reduction partner for customers by generating detailed insights into their waste streams and incentivize waste reduction. This role is based on the potential value propositions 'Waste data generator' and 'Waste insights educator' described in section 4.4.4, which were the result of the client's vision for a return logistics waste collection solution. An overview of the business model is shown in the business model canvas in Figure 8.5.

Value proposition

Collecting waste in traceable units enables for data collection about the waste streams all the way from the individual source to the final waste treatment. This allows for detailed insights that can be used to advice and incentivize customers to reduce their waste production, optimize the source separation and reuse of waste streams, and reduce their environmental impact. Currently, the batch collection only allows for estimated averages of waste insights and does not allow for full transparency on waste stream detail. For this value proposition, at least the quantity and weight of collected containers is needed to be measured, but additional variables could be added. Bringing these insights makes PreZero a strategic partner in the transition towards a circular economy, enabling organizations to reach their set sustainability goals and improving the public image of the company and the market to be more transparent and trustworthy.

Customers

The business model is targeted at two types of customers. The main target segment consists of organizations that are aiming to become circular and are looking for insights and help how to make the transition. This could be SME customers in the inner-city environment like with the previous business model, but more likely are larger organizations with clear visions about sustainability and budgets available to invest in the transition towards sustainability.

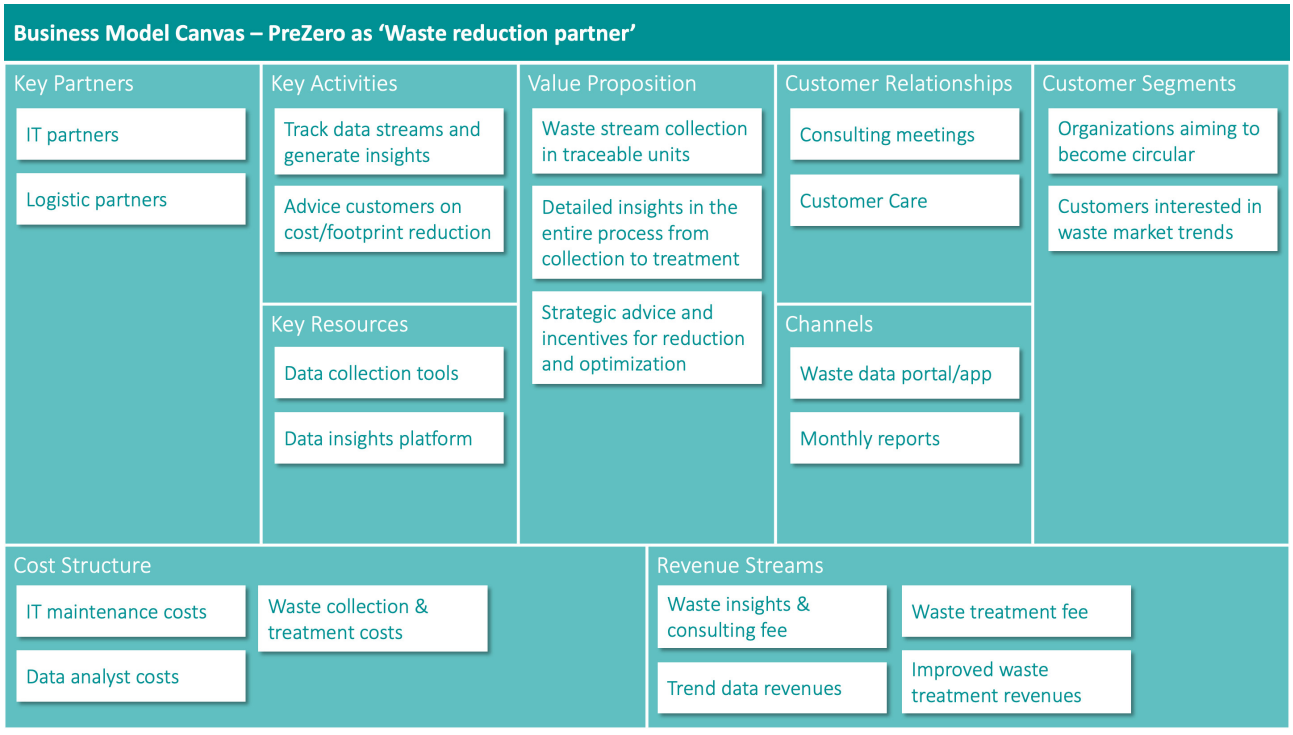


Figure 8.5 Business Model Canvas for the 'Waste reduction partner' value proposition.

The secondary target segment are all customers interested in waste treatment data and trends. Since the industry is known to be secretive about the processes and waste treatment figures, transparent waste treatment data and insights are scarce and could be interesting to sell to policy makers and organizations like consulting firms that influence the transition of the market.

Partners

The key partner in this business model is the IT partner(s) that enable the data collection and data visualization of the individual waste streams. Currently, PreZero is collaborating with PostNL to build the IT infrastructure needed to link the quantity and weight of the collected containers to the specific customer. Additional systems are needed to transform this data into an interactive and insightful data portal on which customers can evaluate their waste streams and that can be used by PreZero employees to advise improvements and reductions.

Business model

The additional data points of each waste stream allow for multiple different business models to be realized.

- The main business model for this value proposition is to let customers pay a periodical or one-time fee for additional insights into, and advice about, their collected waste streams and how to reduce and optimize these. Since financial gains can be created with more efficient waste management, the value can be two-fold. First, costs for the customer can be reduced by handling its material flows more effectively and reducing expensive waste streams. Secondly, PreZero can gain better waste treatment revenues if the waste streams become higher in quality and residual waste streams are separated into more valuable source-separated waste streams. Additionally, sustainability targets can be met using the insights from the waste stream data. These values can be translated to consulting fees for the insights that PreZero will bring to the organization.
- The waste stream data gathered at all different customers could be used to map the market trends and generate insights on for instance effective policies, best-practices, and interesting trends. If anonymized, these insights and data can be published or sold to policymakers and other organizations to empower the system transition.
- Next to these direct business models, the revenue of the existing waste treatment facilities could increase. The collection of smaller containers that are not directly mixed with others upon collection, enables the opportunity to perform (random) quality checks of the waste. This could reduce the number of lost batches and therefore increase the waste stream purity, thus increasing revenues. Furthermore, more insights into the waste volumes, sources, and quality enables better strategic planning by PreZero management.
- Finally, new billing systems could be implemented to nudge customers to reduce their waste or increase the waste stream quality. E.g., pay-as-you-throw (PAYT) billing could be enabled, letting customers only pay for the waste that is collected. Another possibility is to penalty customers that had contaminated waste streams, or reward those that are generating the purest waste streams.

Steps to be taken

As previously stated, PreZero is already developing a method to measure and connect the weight of containers to the specific customer using a barcode scanner and IOT scale. If that works, a portal to upload this data to is needed for billing and generating insights for customers. Ideally, the portal becomes an extensive tool to which more and more features could be added over the years, and on which clever data analysis tools could be used to develop the most valuable insights. Since PreZero is lacking the capabilities to do this themselves, partners should be addressed to build such a portal. Quality control could be enabled in the most basic form by random quality checks performed by PreZero employees at the MSC. Later, more advanced solutions like an automated assembly line and image recognition for visual inspection of the waste stream could be developed to automate the process. Luckily, PreZero is already used to the role of consultant for organizations in the transition to circular operations, so once the additional data is gathered, it should be easy to be incorporated in the existing methods of advising organizations about their processes.

Challenges

In building this possible future, several challenges could occur. To start, all challenges described in the previous business model broadly apply to this model as well, since it operated on the same basic system principles. The biggest additional challenge lies in the IT capabilities that are needed to build the portal where all data can be gathered. As stated before, the IT capabilities of PreZero are lacking, so the most likely approach to solve this is to outsource the IT systems to an external partner with more experience in this field. Next to this challenge, implementing new billing systems can be very challenging, since this is at the core of the revenue streams of the organization.

Visual

Just like the first future vision, this future vision is also visualized in a poster conveying the main value that PreZero could offer to its future customers, using the beforementioned style of the brand campaign (see Figure 8.6). The poster visualizes the waste streams that could be hidden in residual waste streams and challenges the reader to uncover the potential value hidden in these streams.

Figure 8.6 Poster for the 'Waste reduction partner' value proposition.

8.2.3 Sustainable material source

In the third future vision, the business model of PreZero is to be a sustainable material source for manufacturers by transforming the collected waste streams into raw material streams that can be used in all kinds of new applications. This role is based on the potential value propositions 'Waste data generator' and 'Raw material supplier' described in section 4.4.4. An overview of the business model is shown in the business model canvas in Figure 8.7.

Value proposition

PreZero is already operating this value proposition to some extent, recycling specific waste streams into raw materials that are used in the production of specific products (e.g., notebooks made from coffee grounds and cat cages made from recycled plastic). Applying the principles from waste collection in smaller containers that are quality checked, like described before, would enable purer waste streams and more detailed insights in the entire material flow from source to final product. If tracked carefully, the products that are produced using the raw materials made from waste streams could get a material passport in which the source of the materials could be explained. This could be a powerful tool for companies to produce sustainable products.

Partners and customers

Since this business model has a B2B (business to business) focus, the partners and customer segments partially overlap. The most important partners and customers are manufacturers of sustainable products that use upcycled waste streams as raw material input in their production processes. They are partners when the R&D for a new raw material flow is executed in collaboration with PreZero, or could just be customers that buy a ready-to-go raw material type from PreZero. Similarly, customers that generate large quantities of specific waste streams, could be a partner for delivering the waste streams as reliable material input for PreZero to produce materials with, but simultaneously act as customer to which the service of waste management is sold.

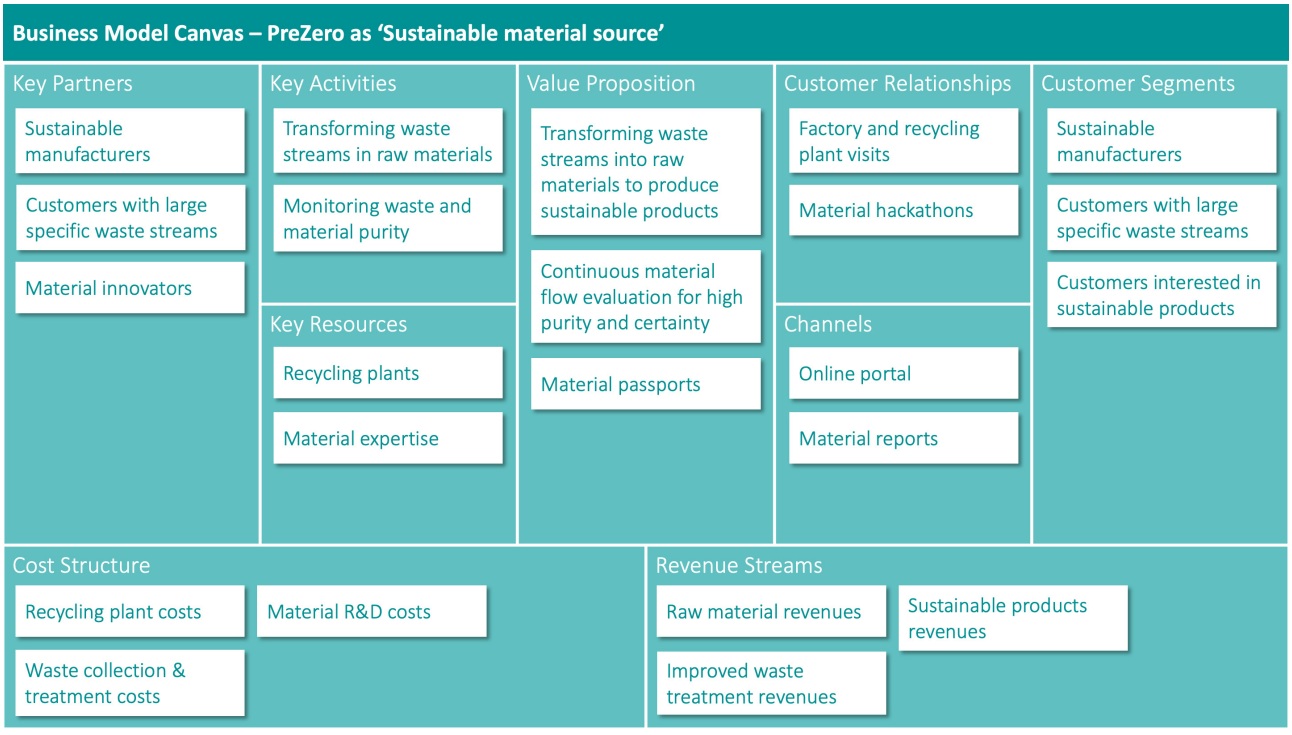


Figure 8.7 Business Model Canvas for the 'Sustainable material source' value proposition.

A different type of partner would be material innovators that come up with new techniques to use waste as a material for production. These could be internal or external experts. An additional customer segment could be customers interested in buying the products that are produced using the PreZero material streams. Although these would be produced by third parties, it is likely that PreZero could sell the products themselves as well, as branding tool.

Business model

This B2B business model mainly builds on the costs and revenues of the waste/material streams.

- For PreZero, the main costs lie in the treatment of the waste streams to transform them into raw material streams. This involves the collection, quality control, sorting, treatment, and final quality control of the waste stream. Furthermore, R&D costs are needed to explore and develop new methods and tools to extract value out of new waste streams and transform them into potential material streams.
- The revenues are mainly the revenues from selling the material streams, as well as sustainable products. As described in the previous business model, the increased control over the waste stream from source to end enables for lower costs during the process due to less lost batches and higher material purity.

Steps to be taken

The main steps that need to be taken to bring this potential future to reality, is increasing the quality control of collected waste streams, like described before. Furthermore, new partnerships should be formed to collaborate with manufacturers to use their expertise and inventiveness to generate new applications of waste streams. This could be extended by hosting material hackathons, in which clients, students or other interested parties could creatively work together to ideate new material and product possibilities. Next to this, partnerships should be formed with customers that generate large volumes of waste, to explore how their waste streams could be used to generate new materials. This could also be executed with smaller customers, but their waste streams might vary more between customers, forming a risk for the purity of the stream.

Challenges

If PreZero becomes the sustainable material source that connects specific waste streams from customers to raw material buyers to produce sustainable products, this would be directly in line with some existing competitors on the market (specifically, the interviewed competitor of section 5.3). This means that the USP (unique selling point) of PreZero should be different or better than theirs, to gain and sustain a market advantage. This could be found in the (inter)national reach of the organization, as well as the existing large customer base and large waste quantities that could allow to lower the price thanks to economies of scale. Furthermore, partnerships like those with PostNL could consolidate the position.

Visual

The visualization of this future vision challenges the reader to use second-hand materials to produce new appliances, by showing an imaginable shop for raw materials made from source separated waste streams (see Figure 8.8 on the next page).

Figure 8.8 Poster for the 'Sustainable material source' value proposition.

8.2.4 Market facilitator

In the fourth and final future vision, the business model of PreZero is to be a market facilitator for source separated waste collection by offering waste collection solutions to partners, which they can implement in their existing logistic operations. This can increase the efficiency and sustainability of these systems since leftover truck space is used for waste collection. This role is based on the potential value propositions 'Smart logistics enabler' described in section 5.4. An overview of the business model is shown in the business model canvas in Figure 8.9.

Value proposition

Multiple times during this graduation project, different contexts were mentioned to be potentially interesting for the envisioned system design as well. Unfortunately, the scope of this graduation project did not allow to explore those contexts and partnerships as well. By widening the scope to all sorts of partnerships, PreZero could become the market facilitator to transform traditional waste collection to a new waste collection system which uses the logistic capabilities of many kinds of partners.

The core focus of PreZero is to get as much value as possible out of waste streams. The actual collection of the waste is less important, as is proven by the Green Collective joint venture. By designing solutions to collect waste in existing transport vehicles (like those envisioned during this project), the collection responsibility can be outsourced to third parties. The value for these partners is that the efficiency and sustainability of their existing operations can increase by cleverly using empty truck space. This is the core of effectual logic: building stakeholder commitments to use each other's means and reach new goals.

Customers and partners

The customers of this future vision are hard to define, since they strongly depend on the partnerships that will be formed. The focus for key partners should be on organizations with existing

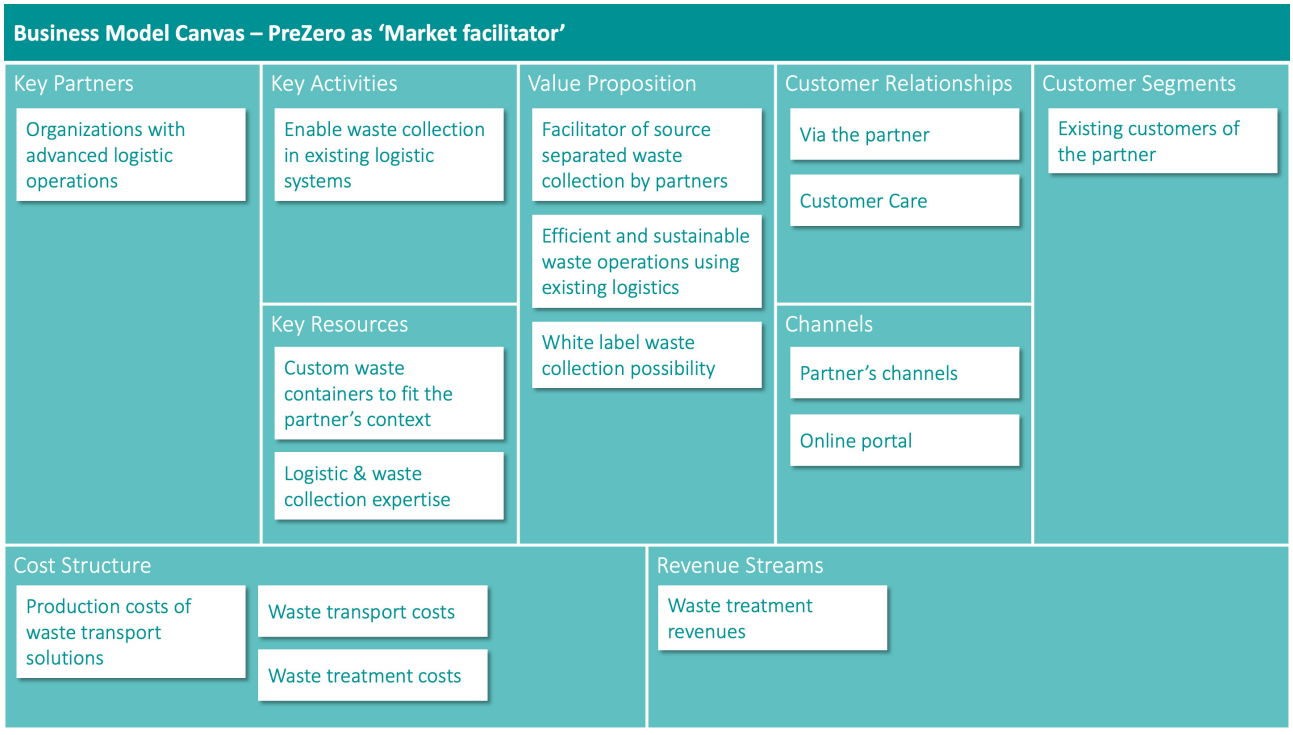


Figure 8.9 Business Model Canvas for the 'Market facilitator' value proposition.

advanced logistic operations, since the impact of waste collection via these operations has the biggest potential. The customers segments that will eventually use the new collaboration to get their waste collected completely depend on the target segments being served by the partner. A possible example is the beforementioned collection of waste by hospitality goods supplier Sligro (see section 5.4), in which case the partner would be Sligro and the customers would be hospitality businesses that order at Sligro.

Business model

This business model is based on the 'economies of scope' principle, in which one tool is used for two multiple value propositions (like one production facility being used to produce two different products, thus lowering the production cost per product). In this case, the tool is the existing truck space that is already used for the core business of the logistic partner, and the second value proposition is giving this space additional purpose by using it to collect and transport waste streams when possible. Using this principle, PreZero could design solutions to enable logistic partners to collect and transport waste in their existing logistic system. This increases the efficiency of transport and decreases the costs per product. This profit can be used to cover the costs of additional services and time needed to collect waste.

The costs include the development of waste collection solutions that enable the partners to collect and transport waste from their partners to their logistical hub. Whom the actual waste disposer has a contract with can differ, depending on the kind of partnership. The disposer could have a contract with both the partner and PreZero for the different services, or one contract which encompasses all services. White label solutions could be possible too, in which PreZero would deliver all tools needed for the partner to start collecting waste as part of its own business. However, essential is that the revenues from the waste management should remain for PreZero since that is its core business.

Steps to be taken & challenges

The main challenge for this possible future, is that PreZero is already in a partnership with PostNL for the collection of waste at business customers. Before taking any actions towards other logistic partners, PreZero should very carefully explore the room for collaboration with other logistic partners within the existing partnership and discuss the effects that this might have with PostNL to not damage this existing partnership. If room for new partnerships is created, PreZero should actively reach out to potential stakeholders to explore the possibilities for waste collection in their existing operations.

Once new partnerships are formed, a similar process as performed in this graduation project should be executed, to explore possibilities and rapidly develop an MVP to test in the actual context. Following the effectual logic, the investments and risks should be kept at a minimal level, while the value proposition can keep on growing.

Visual

The final poster of the series shows an empty truck ready to load. It challenges the reader to stop transporting air and increase the efficiency of existing logistics operations by collecting waste when returning from customers (see Figure 8.10).

Figure 8.10 Poster for the 'Market facilitator' value proposition.

8.3 Implement effectual logic

The possible future visions sketched in the previous sections show promising new business models that PreZero could potentially operate in the future. Each business model was detailed with steps to be taken and potential challenges, but one main overarching challenge deserves special attention: the one applying effectual logic on the path towards one of these envisioned futures. Like Duening, Shepherd, and Czaplewski (2012) stated in their paper about effectuation, implementing effectual logic into enterprises is possible, but it can be challenging. Many existing control mechanisms within organizations are based upon causal logic, so a constant attention on the logic in the way of working is needed.

The most important pitfall to look out for is to develop a tunnel vision towards a certain goal. Effectual reasoning is not about trying to collect a certain set of needed means to reach a predefined goal, but about leveraging the existing means and partnerships and constantly asking the questions "Who am I?", "What do I know?", "Whom do I know?" and "What can I do?".

Next to this general advice, the following possible methods could be applied to start the iterative process to undefined futures:

- Integrate effectuation in processes like in the NPD Stage Gate process of section 2.1.
- Interact with the existing customer base to validate potential value propositions.
- Involve employees in the development of new business models using co-creation.
- Use the waste management expertise to build a first version of the MSC, but don't try to build the ideal version at once: minimize investments and leave room for iterations.
- Use the partnership and experience with KarTent for rapid prototyping.
- Use the expertise about return logistics systems within Schwarz Group and explore possibilities for collaboration within the group.
- Use the traffic on the existing web shop to A/B test pricing strategies and test interesting in the product (see Figure 8.11 below for an example).
- Just start doing it and learn along the way!

Figure 8.11 Example of how product interest test among customers could look like in the PreZero web shop.

9 EVALUATION

Concluding this graduation project, the results and insights are summarized and the answers on the research questions are discussed. Furthermore, the limitations of this graduation project are discussed and possibilities for future research are listed. The report is concluded with a personal reflection.

9.1 Conclusion

In this master thesis, the theory of effectuation was applied to design and develop a new return logistics system for the collection of source-separated waste streams for client PreZero. In this final chapter, the results of the project are concluded and discussed. The main research question is answered by answering the four sub-questions and concluding with a set of final recommendations. In the discussion, the theoretical framework and methods are evaluated, and the project's limitations are discussed in combination with future research possibilities. The project is concluded with my personal reflection on the entire project.

9.1.1 Research questions

Who are the current and potential stakeholders of the return logistics system and what are their needs and wishes?

Analysis of the existing return logistics pilot in The Hague resulted in the identification of eight key stakeholders. Four of these are directly involved in the operation of the return logistics system, being the customer disposing of waste, the logistic partner collecting the waste, the warehousing partner for temporary storage, and the client itself for the waste treatment. The other four are more indirectly involved but mapping the interrelations of all stakeholders in a value flow model showed the value that these organizations bring to the system as well. Next to these current stakeholders' commitments, potential stakeholders were explored by interviewing potential customers, studying an existing return logistics case within the client's network, and interviewing the main competitor. The main shared value between all mapped stakeholders was the value that a sustainable transport solution for parcels and waste offers, both financial, strategic, and in reputation.

How should the client position itself in the complex stakeholder context of inner-city waste collection?

The context of inner-city waste collection is bound to change in the coming years, due to new environmental zones in Dutch city centers, stricter regulations on source separation and waste treatment, and new market entrants like the interviewed competitor. To define a possible strategic positioning in this evolving market of inner-city waste collection, the theory of effectuation was used as the framework for this thesis. This logic uses the current means, goals, and partners of the client to define potential near-future goals and stakeholder commitments. With these, new value propositions can be defined as potential strategic positions to aim for in the future.

To start this process, customer journey maps were made from the perspective of the waste to evaluate all steps the waste goes through in the traditional system, the pilot system, and the envisioned system. This showed a difference in the number of actions to be performed to collect waste and a shift in the responsibility of who performs what tasks. Combined with the beforementioned stakeholder interactions, these insights lead to a set of six main means and five current goals. The most important insight was that the client should already have access to all means needed for the implementation of the envisioned return logistics system. Following the 'effectuation in action' model, the means and goals were used to define six potential value propositions: 'waste data generator,' 'raw material supplier,' 'waste insights educator,' 'space saver,' 'source separation convincer,' and 'smart logistics enabler.'

All these value propositions can be used to define a strategy to reach a specific position in the market for the client. To limit risk, the client should explore new stakeholder commitments to build means and set new short-term goals to aim for. While continuously staying aware of possible changes in the environment, the client can iteratively repeat that process to develop toward one of the potential value propositions. The next sub-question is focused on the design process that shows what such an iterative step could look like.

How can a product-service system for return logistics of source-separated commercial waste streams be designed and validated?

The effectual approach of non-predictive control uses the things within direct control to co-create the future. To show how such logic is applied in a project, the design phase aimed to rapidly design and develop the next iteration for the return logistic system of waste collection. First, the scope was co-defined with the client, discussing the range and preferred focus of the project. This resulted in the insight that the main design challenge was the range extension that the envisioned system would mean for the client, extending its operations from curbside-collection into the actual customer context.

Detailing the system flow with a service blueprint design resulted in a flow of fifteen steps to be taken by the main four stakeholders and supporting system tasks. This laid the groundwork for the further ideation and concept development about waste collection solutions to fit both the customer context and system flow. For the waste collection container, an off-the-shelf solution was chosen that fit most of the requirements. This enabled the design phase to focus on designing a custom solution for the actual customer context. Ideation and concept development in co-design with the client resulted in a modular 'bin rack' concept of which three possible configurations were made to fit varying contexts.

Rapid prototyping with an existing partner of the client allowed the concept to be transformed into a cardboard MVP (minimum viable product) that could be tested in the actual customer context. In collaboration with the logistic partners in The Hague, a ten-day pilot was setup to test the MVP at an existing customer of the client, for which two custom prototypes were developed to fit the customer context. Next to valuable design improvements for the system, the bin, and the container, the main takeaway of this pilot was the fact that this minimum viable product was already evaluated very positive by all involved stakeholders, thus proving the value of the effectual approach.

This entire design phase functioned as a design intervention to show the client the value of this design approach that address all aspects of the envisioned product-service system, from end-user experience to detailed system steps, and to learn by doing in collaboration with the end-user and potential stakeholders.

How can the client apply the insights from this project to realize and implement the proposed product-service system?

The insights from the MVP pilot gives the client a new set of means and the potential value propositions show possible directions to innovate towards. To support the client in their strategic decisions about which value proposition to aim for, these possible futures were further detailed into four rich future visions

with supporting business models and visuals. All four future visions build upon the existing means available for the development of a return logistics system for the collection of waste in an inner-city environment. The visions are supported with a list of recommended starting points and posters that could be hung in the client's office, to keep reminding the team and their colleagues about possible future that their work could co-create.

In 'Valuable space saver' the client's role is to minimize the space needed for source separation of waste by collecting small volumes of waste on a high collection frequency. 'Waste reduction partner' places the client in the role of detailed waste insight generator to support customers in their waste reduction efforts. In the third role, the focus of the client shifts to industry partners and customers, to become a 'Sustainable material source' for manufacturers that can use material streams from treated waste streams. In the final future vision 'Market facilitator', the client collaborates with all sorts of logistic partners to enable them to use their existing logistics for the collection of waste streams.

Evaluating the master thesis, the team said to be inspired by the effectual logic and is looking for ways to implement the approach and insights from this master thesis in their daily work. Furthermore, the development of the designed concept is continued with the committed stakeholders to iteratively develop the envisioned product-service design.

How can a scalable product-service system for smart return logistics of source separated commercial waste streams in an inner-city environment be designed and implemented by the client?

The four sub-questions collaboratively answer the main research question in a broad sense, showing all the aspects that enable the client to iterate to a possible design and implementation of the product-service system for smart return logistics of source separated commercial waste streams in an inner-city environment. Yet, the question remains what my strategic advice for the client would be. At which of the four future visions should the client aim and what steps should be taken tomorrow to start implementing the insights from this master thesis? These answers are detailed in my final recommendations.

9.1.2 Final recommendations

Choose one

You must choose. During this entire master thesis, I heard many of the potential value propositions be used interchangeably as the main goal of the return logistics project. Although the future visions show that the return logistics system could be the foundation for all of those, the evaluation of the innovation capabilities of the client shows that all efforts are already needed to be able to reach one of those visions. Aiming for multiple futures at once interferes with a strategic use of these available resources, thus resulting in no clear results.

Aim for sustained competitive advantage

Although the 'Valuable space saver' seems the best reachable future vision, this value proposition is also the weakest one due to a high risk for competition. Increasing the waste collection frequency and lowering the container size might build a strong initial business case to gain new customers. But, it won't secure sustained competitive advantage since other competitors could quite easily copy the designed solutions to build the same value proposition.

Based upon the insights gained during this entire master thesis, I think the biggest potential for a sustained competitive advantage lies in the 'sustainable material source' future vision, even though this might be the furthest away from the current business model and available means. The business model of the client might still be relevant for quite some years into the future, yet all trends show that the market will eventually change and that the aim is to build a circular economy in which waste does not exist anymore. Since the main revenue stream from the client is waste treatment, this trend forms a high risk for its core business. Incineration will eventually get completely obsolete, but the built expertise in waste treatment and separation do not have to be lost. If the client can cleverly transition the core business to a material treatment business model, the same expertise could be applied in generating pure material streams from recyclables that allow manufacturers to create new products. The key mean for this, however, is to be able to guarantee a certain level of purity to the manufacturers to work with. That's why insights in the waste streams are needed.

Focus on insights

To get to the beforementioned future vision of the client as 'sustainable material source', they should start focusing on generating insights about waste streams as soon as possible. The return logistics system could help, since it collects waste in smaller quantities, but even if that project might fail, detailed information about the source, quality, contents, and purity of waste streams will still be relevant in the transition to a circular economy. Although waste streams might shrink, the transition to developing production materials will still result in enough quantity to support the revenues. Furthermore, the data itself can become an asset to build revenue from as well. Since this information is near to absent in the current market, taking the lead in developing technologies to capture this datapoints could result in a sustained competitive advantage in the future.

Do not stick with it

Although the recommendations above are very direct, the main takeaway from this entire graduation project should be that the effectual approach is an iterative approach that influences the future by co-creating it. So do not stubbornly stick to this advice from August 2022 but iterate towards the possible futures that are shaped by your own actions.

9.2 Discussion

9.2.1 Theoretical framework

The selected theoretical framework of this graduation project is that of effectual logic, which embodies an iterative process of building upon means, defining goals, and interacting with potential stakeholders to form commitments, to develop a new product, firm, or market. Although the approach turned out to fit my personal preferences and the client's project very well, the logic is contradicting the causal logic used in scientific writing and is often applied to structure a master thesis. Thus, writing a structured report was more challenging than using causal logic would have made it. Furthermore, the logic made it hard to give true strategic advice on what future ambitions to aim for since the iterative essence of effectuation states that the future cannot be predicted but is co-created and evolves based on one's direct actions.

If another method would have been chosen at the beginning of this project, this could very well have resulted in different insights and other conclusions. As Sarasvathy explains about effectuation, the decisions each entrepreneur makes are subjective and might sometimes seem counterintuitive with the available information, yet some of these entrepreneurs have turned out to be very successful. This is called the uncertainty of isotropy and makes it practically impossible to use effectuation as a replicable method since the very essence is subjective. To counter this argument, it could be argued that subjectivity is embedded in all creative methods, so I would still happily recommend the effectual approach to use as a framework for a master thesis.

9.2.2 Methods

In this graduation, a variety of research methods is applied. These are evaluated in this section.

Co-creation

Co-creation was used to include the client and stakeholders in the entire design process of design. The main method for this co-creation was by organizing sessions on key moments in the project to get insights or feedback for the further course of the project. I had envisioned making co-creation a more essential element in the graduation project, with larger sessions of multiple hours as key moments of input, but unfortunately, this turned out to be much harder than anticipated. First, the stakeholders and clients did not have the time available for longer sessions to collaboratively brainstorm and design certain solutions. Secondly, the continuous iterative character of effectuation made it harder to pinpoint specific decision moments for which co-creation is very suitable. Thirdly, I did not always have enough time to prepare a larger co-creation session. The result is that the co-creation applied in this graduation project has been a more continuous form of involving stakeholders and the client in my process.

Interviews

Multiple semi-structured interviews were held during the project, with potential customers and the main competitor of PreZero. I think this method is the most valuable method since it allows for rich data gathering from various perspectives. The interviews with potential customers were harder than the ones with the competitor, since I randomly addressed the customers during their work, and they did not always have the time or interest to give extensive answers to my questions. In future research, I would reserve more time for conducting these kinds of interviews.

Case studies

Two case studies are included in this project, about the pilot in The Hague and about the Lidl return logistics system. Although I addressed both these system analyses as a singular case study, I think they only merely fit the definition of a case study. Due to a lack of time, no extensive preparatory desk research could be conducted in advance of the case studies, resulting in them being more some kind of site visit than a true case study. The insights these research activities generated were very valuable, however, and form an essential foundation of the entire graduation project.

Phenomenological research

To validate the designed prototype, phenomenological research was performed with the customer and the employees involved in the pilot. Multiple data collection methods were used to gather rich data about the experiences of the involved stakeholders. I had never officially performed this type of research before, although capturing peoples' experiences is a common practice in design processes. It was interesting to truly focus on the experiences and not get distracted too much by the technical details of the pilot operation. This helped me to truly listen to the stakeholders' experiences and minimize my personal bias and opinion. Harder, however, was how to capture the results into the report.

Value flow modeling

Another new method for me was the method of value flow modeling. Dealing with a complex stakeholder environment, this method really helped to unclutter the tangled interrelations between all stakeholders and gain a better understanding of where the key value transitions were taking place.

The definition of some value flows did feel quite subjective or personal to me since it is hard to strictly define what counts as a value flow and what doesn't.

Service blueprint design

Service blueprint design and journey maps are found throughout the entire report, showing the value of these tools for service designers. Changing the perspective from the customer journey to a waste journey resulted in interesting insights about the steps that the waste goes through in the system and enabled a clear set of requirements for the waste bin and container.

9.2.3 Limitations and future research

The graduation project gave valuable insights and answered the research question. Yet, several limitations can be identified, which could be used to define potential future research possibilities.

Generalizability

The first and foremost limitation of this graduation project is that it is a design project commissioned by a specific client. During the execution of this graduation project, the client itself continued to work on the project as well, thus influencing the scope and direction that it would like to see the project develop. For future research into the topic of return logistics for waste collection, an independent research project could be interesting to be executed. This would give more freedom to involve competitors in the research phase and could generate more independent and general conclusions about the market potential and direction.

Scalability

The design process aimed to design a scalable solution for a return logistics system of waste collection. Both the initial pilot evaluation and the MVP pilot were executed in The Hague since existing stakeholder commitments were focused on that area. This limits the insights into how such a system might operate in a different city in the Netherlands, or even in different areas like smaller villages or in other countries. The feasibility of operating a return logistics system could strongly depend on the population density and available infrastructure. Additional research into the differences and similarities between different locations is needed to be able to build a scalable solution. Furthermore, a challenge mentioned in the report is to find the balance between reducing inner-city traffic versus offering service by collecting waste in smaller volumes. An system modeling approach could be taken to model the variables of influence and design the optimal system.

User behavior

In the design and development of solutions for the collection of waste streams, the assumption was made that customers would be willing to source separate their waste and would be capable of doing so. Although the research showed that many customers seemed interested, the actual activity of source separation could differ from the customer expectation. This could reduce the number of customers willing to source-separate waste and influence the purity of the source-separated waste streams.

A detailed design study on the consumer behavior of source separation could be executed to evaluate the feasibility of source separation and uncover potential parameters of influence in the design of waste collection solutions. Research could focus on the effect that a smaller waste collection volume might have on the experience and quality of source separation, on the differences between customer groups in their source separation activities, or on the influence of the context on the source separation behavior. Furthermore, the design properties of the bin and container could be varied to measure the influence on source separation behavior and user experience.

Integrated product-service design

The scope of this 20-week master thesis did not allow for a more detailed design of the proposed solutions for the bin and container. As the MVP evaluation showed, many design improvements are possible to increase the likeability that the envisioned product-service system could be successfully implemented. A more integrated product-service design approach could help to further detail the designs. Topics of interest for the container would be the durability, ergonomics, and automatic cleaning. For the modular bin rack, different configurations could be designed and the user experience and context-dependent durability could be evaluated. And for the entire system, the automation of steps and customer app development could be researched to increase the efficiency and scalability of the system.

9.3 Personal reflection

Here we are, the final section of a graduation project that has grown to become a 126-page book of a report about the past twenty weeks. I cannot express enough what a relief it is to write these final paragraphs knowing that I am to graduate next week.

Since the Bachelor thesis, I have looked up to graduation. I consider myself a real team player and don't like to work on a project completely individually. Furthermore, I doubted my planning skills since I generally like to procrastinate on work until the final deadline. Those characteristics could form quite the challenges for graduation, thus I set out to be very transparent about these risks from the start onward and gather a nice group of supervisors and people around me to support me in my process of graduation.

Interestingly, the graduation project went much smoother than I could have ever anticipated. Although my procrastination was still present at some times, the hard deadline to graduate on August 31st – the final day of this study year – and the strict planning with well-defined deadlines along the way really helped to keep the project moving. Furthermore, the support from my supervisory team of the faculty and the client created a strong feeling of responsibility to keep delivering and did not make it feel like I was doing this project all by myself.

I am glad I set out to graduate with a design project for real world client, since this allowed for the interaction of many stakeholders, making the research phases much more fun than traditional desk research during the Master. It was a pleasure to involve and manage all stakeholders and gain rich insights from those interactions. Furthermore, working with a real client enabled me to prototype an actual version of my concept, and test it with a real customer.

Working with different methods during my bachelor and master, I always struggled to find a method that actually felt like the way I am used to work. This resulted in often reverse engineering the process on paper to please the course coordinators. Knowing that reverse engineering an entire graduation project is impossible, I discussed this struggle with my supervisory team and I am really glad to do so. The effectual approach that Sander suggested turned out te be the perfect theoretical framework for my way of working, enabling me to be empowered to quickly iterate without feeling quilty of not following a certain structure. Reporting this process turned out to be a bit more of a struggle, but in the end I would not have liked it differently!

Looking back at my initial personal ambitions for graduation, I can conclude that it was a great success. I have managed to successfully manage the project and graduate on the planned date, I have managed to get out of the paper world and develop an actual prototype (although made from paper) to test, and finally I survived to do all of this by myself – being supported by a set of wonderful people.

A final thank you to everyone involved in this project, we made it!

Joppe de Waart
August 2022

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APPENDIX

A. Project Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name	De Waart 5609
initials	J.J. given name Joppe
student number	
street & no.	
zipcode & city	
country	
phone	
email	

Your master programme (only select the options that apply to you):

IDE master(s): ( ) IPD ( ) DfI ( ) SPD

2nd non-IDE master:

individual programme: - - (give date of approval)

honours programme: ( ) Honours Programme Master

specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair	Ellis van den Hende	dept. / section:	MCR
** mentor	Sander Mulder	dept. / section:	MOD
2nd mentor	Wilco Ledderhof		
	organisation: PreZero Nederland		
	city: Arnhem	country:	Nederland

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

Procedural Checks - IDE Master Graduation

TU Delft

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Ellis van den Hende date 18 - 03 - 2022 signature Digitally signed by Ellis van den Hende Date: 2022.03.18 13:58:00 +01'00'

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: 28 EC

Of which, taking the conditional requirements into account, can be part of the exam programme 28 EC

List of electives obtained before the third semester without approval of the BoE

☐ YES all 1st year master courses passed

☐ NO missing 1st year master courses are:

name C. van der Bunt date 22 - 03 - 2022 signature C. van der Bunt Digitally signed by C. van der Bunt Date: 2022.03.22 09:39:27 +01'00'

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ☐ APPROVED ☐ NOT APPROVED

Procedure: ☐ APPROVED ☐ NOT APPROVED

comments

name Monique von Morgen date 29 - 03 - 2022 signature

Personal Project Brief - IDE Master Graduation

TU Delft

Smart waste stream collection in an inner-city environment — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 15 - 03 - 2022 — 31 - 08 - 2022 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Aiming for more sustainable inner-city logistics, Dutch logistics organizations and local governments collaborated to create the Green Deal ZES ('Zero Emission Stadslogistiek') in 2014, stating targets and an approach to reach more sustainable inner-city logistics in the Netherlands by 2025. Accelerated by the Paris Agreement, these targets lead to the logistic targets of the 2019 Dutch National Climate Agreement with one clear overarching goal: 30 to 40 of the biggest municipalities will have emission-free zones by 2025. One of the organizations contributing to this goal is PreZero, an international utility organization specialized in waste management (disposal, recycling and recovery). PreZero is owned by the Schwarz Group, a multinational that also includes Lidl and Kaufland. Operating on 430 locations in 11 countries, PreZero is active in the Netherlands since its acquisition of SUEZ Netherlands in 2021.

Next to their 'Green Collective' initiative (a joint venture of PreZero Netherlands and Renewi to collaboratively collect waste in neutral trucks to minimize inner-city traffic and emissions) the Smart Collection department of PreZero is piloting a new initiative called 'Return Logistics'. This initiative focuses on the smart collection of small, specific, source-separated waste streams (e.g., coffee grounds, paper cups, and plastics) for better recycling, in the context of an inner-city environment.

In this context, PostNL has already started an initiative called 'Stadslogistiek'. Instead of different suppliers directly delivering to each individual client, supplies and packages for businesses in the city center are collected at a 'StadsHUB' (warehouse) located just outside the city center. There, the deliveries are cleverly combined and delivered by Stadslogistiek with their electric vehicles (PostNL trucks, vans, and cargo bikes), resulting in fuller trucks with more efficient routes and thus lesser traffic and pollution in the city center.

With 'Return Logistics', PreZero uses this infrastructure for an extra opportunity: the Stadslogistiek vehicles still return to the StadsHUB empty, while PreZero uses their own trucks to collect waste at businesses in the city center. By letting the Stadslogistiek vehicles collect specific waste streams in small containers that fit in their vehicles, fewer trucks in the city center are needed and small waste stream collection might become a feasible business model.

The containers are collected in a bigger M40 container at the StadsHUB to be later transported to the PreZero recycling facility for weighing, quality control, recycling, and cleaning of the containers that go back to the clients again. This process creates a new possible value proposition for PreZero, controlling separated waste streams from the source to their collection site, enabling them to weigh & quality control waste streams per disposer and increase the recyclability, which is not yet possible in the current infrastructure.

PreZero is currently piloting the Return Logistics concept at the StadsHub in The Hague to learn about the system and container requirements. Stakeholders included are: PreZero (waste management), PostNL / Stadslogistiek (electric delivery vehicles, planning & logistics software), the PostNL deliverers (client interaction, need to learn to handle waste containers), the StadsHUB owners (new legislation needed for waste storage and need a viable business model) and employees (need to learn to handle waste streams), clients/'disposers' (businesses in the city center, like offices, retail stores, restaurants, cafes, and hotels), current subcontractors that will become obsolete with Return Logistics (waste weighing and collectors of small waste streams). The waste streams currently being collected in the pilot are 'PBD' (Dutch abbreviation for plastic packaging, metal containers, and drinking cartons), coffee cups, and coffee grounds. The aim is to collect glass and organic waste and expand to three other municipalities by summer 2022.

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introduction (continued): space for images

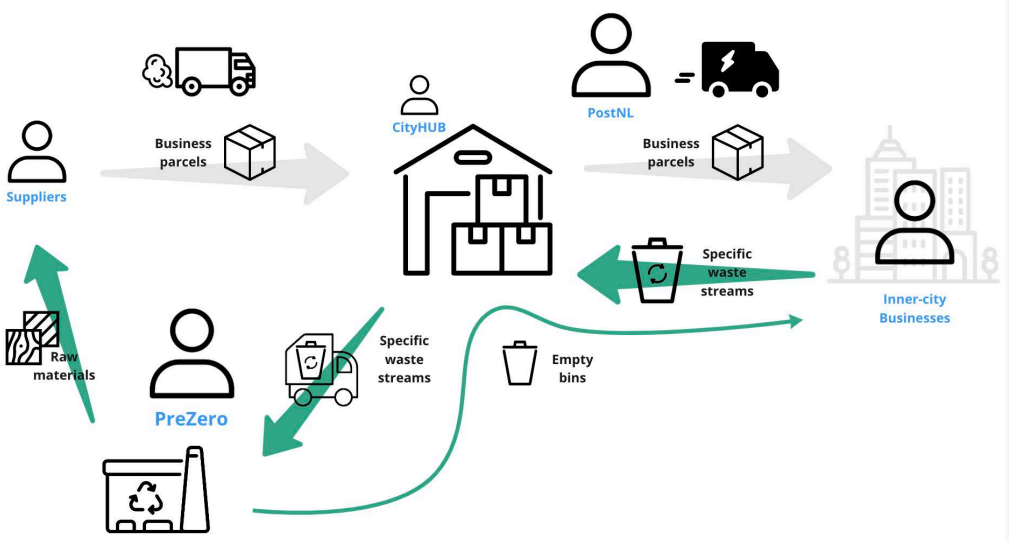


image / figure 1: Overview of the preliminary Return Logistics concept (green) with the Stadslogistiek system (grey)

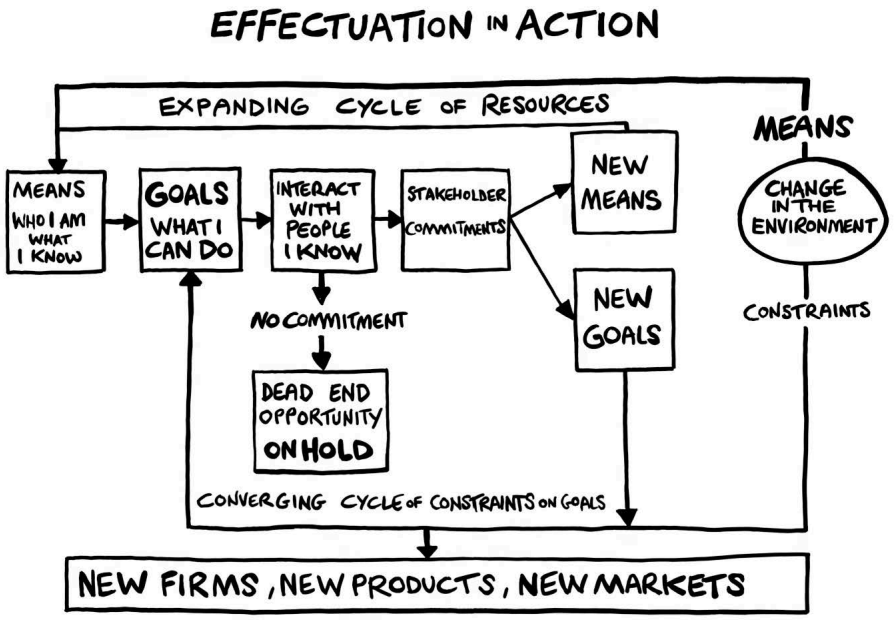


image / figure 2: Sarasvathy's 'Effectuation in Action' model (2009) as the framework for this graduation project.

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

With the preliminary vision for the ideal return logistics system in mind (see Figure 1), the key challenge for this project is to design the detailed product-service system in such a way that it is feasible for PreZero to operate, viable for all stakeholders to sustain, desirable for clients (waste disposers) to use, and scalable to other cities. The strategic element of the problem is to make the design work in the current and future complex internal & external context of PreZero. The idea of return logistics is not new, so the question is why PreZero will be the right stakeholder to bring this concept to realization. How can the organization become ready for such a disruptive change in logistics?

It helps a great deal that PreZero is already piloting in The Hague, gaining insights about current challenges. On a product level, they are now using off-the-shelf industry-standard garbage bags and bio-boxes, but these are evaluated as poor solutions. Therefore, PreZero is looking for a custom container to fit the needs and wishes of all stakeholders. These need to be explored and mapped. The complete product-service system should be scalable to other cities, to be able to generate enough revenue streams to account for the extra expenses that the system requires. A strategic blueprint is needed to enable PreZero to navigate its complex context, now and in the future, and bring this design to successful implementation.

The client has indicated the possibility of developing prototypes to test in the actual context (The Hague pilot, test with actual stakeholders). With the current pilot already running, the approach of this project will be an iterative one based upon the principles of intrapreneurship (see Figure 2 for Sarasvathy's model of 'Effectuation in Action' and see the planning section for details): going out in the field to learn from the existing system and prototype and gather information from the different stakeholders, developing prototypes and MVPs (minimum viable products), iterating towards a holistic product-service system design for source-separated waste collection that is future-proof and scalable to other cities.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Design a scalable product-service system for smart return logistics of small specific waste streams in an inner-city environment, to increase the quality of source-separated waste. Build a strategic blueprint for future implementation of the design in different cities, considering the capabilities of PreZero and its position in the changing stakeholder context.

I aim to deliver the following deliverables:

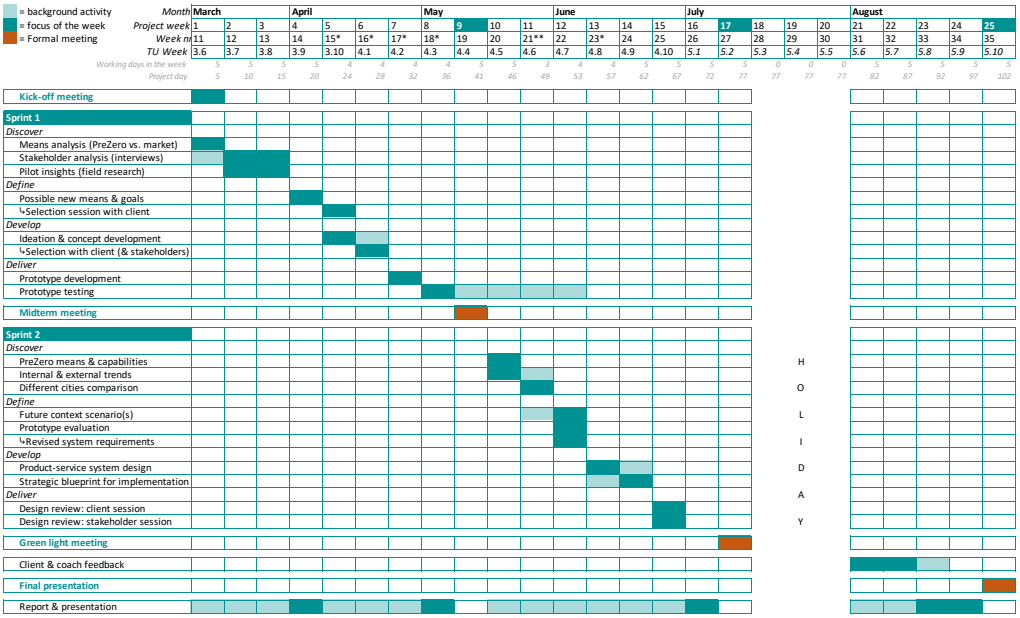
A product-service system design for smart return logistics in the inner-city environment.
- On the product level, I will develop improved waste retrieval concepts based on the needs and wishes of all stakeholders. The aim is to develop at least one prototype to be tested in the actual context. With the insights from that test, the final system design is created, considering the changing context of the inner-city environment.

A strategic blueprint for future implementation in different cities.
- For the future implementation of the product-service system design, the internal and external capabilities of PreZero, and its position in the changing context are analyzed. Possible future scenarios are drawn to develop a blueprint to support the organization in its transition towards this new form of waste collection.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 15 - 3 - 2022 31 - 8 - 2022 end date



I like a hands-on approach, quickly iterating on new insights from tests in the field. Therefore, I will work following the entrepreneurial model of effectuation (see figure 2) to structure the way I work. This means I will iterate from small to big: starting small with the current pilot of PreZero, iteratively expanding it into a complete system design by following the loop in figure 2.

To structure my planning, I decided to split the project into two sprints of 8 weeks that both roughly follow the Design Council's evolved framework for innovation (also known as the Double Diamond, 2015). In the first sprint, I will focus on the rapid development of a new prototype for the pilot in The Hague, building on the insights from the pilot and my own research into the context. This, to be able to test & learn from a new prototype within the scope of the project. While the prototype testing will continue in the background, I'll start on the second sprint, in which I will zoom out more, to place all the gained knowledge into the wider context to design the complete product-service system design with a strategic blueprint for future implementation of the design in new cities.

During both sprints, I will collaborate closely with the client by involving them in critical decisions for the direction of the project. Furthermore, many insights from the actual stakeholders will be gathered during the process, by interviewing them, going to the test site, and joining workers for a day to learn more about their processes and needs. If new Covid restrictions might hinder these activities, desk research and virtual interviews will be the alternative.

The green-light meeting is planned a bit earlier than day 80 of the project, because of the summer holidays of the committee and client. I will work full-time on the project, but I have included the many public holidays in the months of April, May, and June in the planning (see the 'working days in the week' row).

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

The reason I chose a design project over a research project is that I'd really like to experience the value of strategic design for a project with a real client and a tangible result. Most projects during the bachelor's and master's ended with conceptual ideas that often didn't result in the actual realization by the client. With this project that is already doing its first pilot, I hope to have found the right place for me to actually make an impact and see real results within, but also after, my graduation project.

The reason I like the direction and topic of this graduation project is that I want to work on projects that make an actual impact to create a more sustainable future world. Reducing waste and improving the recyclability of the leftover waste streams are important issues yet to be solved. It is a completely new world for me that I'm looking greatly forward to exploring.

My biggest learning objective for this project is to succeed in the project management of such a big, individual project. Planning has been a topic for me during my entire educational career. I work well under pressure, but that strength often gets used as an excuse for procrastination. With many courses that might not be the biggest problem, but in a 20-week graduation project, it needs attention. Luckily, previous experiences in internships and extracurricular activities have helped me to learn how I can manage this challenge. I will therefore build a tight schedule and communicate enough strict (midterm) deadlines with others (in this case my committee and the client) to push myself to improve.

Next to that, I'd like to deepen my prototyping knowledge. SPD'ers tend to stay really conceptual with roadmaps and posters, but I'd like to get a little more IPD into my project to actually deliver a working prototype that we can test with the real stakeholders.

I used to not be really looking forward to the graduation project because I'm more of a team player, but with this project and committee I now actually can't wait to get started and get this project going!

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

B. Interview guide potential customers

Below, the interview guide for the exploratory interviews with possible customers in the city center of The Hague is listed.

Introduction:

Hi, my name is Joppe de Waart, and I have a few short questions about waste management for my graduation research of the TU Delft, would you like to participate in my research? The results will be completely anonymized. I will record the conversation for notetaking and delete the recordings before the end of my graduation.

Topic 1: Waste management and separation

- How do you manage the waste in your business?
- What types of waste do you collect and separate?
- How would you evaluate your waste management and separation?

Topic 2: Waste storage

- Where do you store your waste?
- What types of containers do you use?
- How would you evaluate this storage?

Topic 3: Waste collection

- How often is the waste collected? By whom?
- How do you take out the waste? How is the waste collected?
- How would you evaluate the waste collection?

Topic 4: System evaluation

- How would you evaluate the current waste management system?
- What works well? What does not?
- What are possible improvements to the system?
- What are your requirements and wishes for waste management?

Topic 5: Deliveries

- What types of parcels and deliveries do you receive?
- How often do you receive deliveries? By and from whom?
- What would you think of a system in which the parcel deliverer also collects your waste?

C. Results quotes ranking session

Consumer quote	*Wilco*	*Wouter*
Als het afval en de leveringen gecombineerd zouden kunnen worden zou het perfect zijn, dan rijden er ook minder auto's hier, de straat is ook niet heel breed hier.	+	
Dat zou ik die bezorgers jongens niet aan willen doen. Dan zouden ze dus iedere dag een doosje komen halen, of twee. Dat is voor die gasten natu-urlijk ook een hoop werk voor niks.	- -	
De gemeente zou flexibeler moeten zijn met wanner we de bakken aan straat mogen zetten en moeten toestaan dat er los karton naast geplaatst mag worden, dat moeten we nu vaak nog snel van achter halen als ze er zijn namelijk.	+	
Het afval staat nu best vaak vooraan in de winkel terwijl er al klanten zijn, omdat ze alleen aan de voorkant kunnen komen en ze niet altijd op tijd zijn, dus dan moeten we het weer binnen zetten.	++	+
Het afval van onze 6 zaken wordt op 1 verzamelpunt verzameld en 1x per dag opgehaald.	+	
Ik ga niet tegen klanten zeggen: je moet afval scheiden. Dat ga ik niet doen. Dat is wat anders voor het milieu, maar ja... Klanten gaan dat niet doen.	+	-
Ik rooster speciaal extra mensen in op de leveringsdagen, want het zijn pallets, het zijn niet een paar dozen, en alles is geautomatiseerd via SAP op basis van wat we verkopen.	+	
In principe ben ik wel een voorstander van afvalscheiding, maar dan komen ze met zo'n grote bak en dan denk ik, ja waar laat ik die?	++	+
Je hebt er geen tijd voor. Je kan wel heel veel verschillende bakjes gaan neerzetten, maar die moet je dan allemaal gaan legen, daar heb je ook weer personeel voor nodig, en het neemt heel veel ruimte in.	++	+
Karton wordt gescheiden, en glas, maar alleen als het lukt zoals nu. Maar als ik met een vol bord aankom waar toevallig nog een viltje en plastic op ligt, dan ga ik het niet scheiden.	++	
Koffiedik is op zich niet zo'n probleem, daar hebben we al een losse bak voor die we maar 2x per avond legen.	-	
Nee daar kan hij geen afval in kwijt, want de chauffeur rijdt ook nog naar andere winkels en als m'n donuts naast het afval staan, dat wil je natu-urlijk niet, dat is geen mogelijkheid.	+	+
Sommige van onze producten worden al geleverd in deze stapelbare plas-tic bakken, dus daardoor hebben we überhaupt al minder afval.	-	
We hebben genoeg ruimte in de kelder om ons papier op te slaan. Wij hebben maar een paar pieken in het seizoen, zodra de nieuwe collectie binnenkomt, dan is het veel, maar dat is niet het hele jaar door.	-	
Wij hebben alleen papier en plastic, van de verpakkingen, en dat gaat weer mee terug naar ons distributiecentrum om verwerkt te worden.	-	
Wij werken liever met lokale bedrijven i.p.v. zo'n hele grote. Modus is een Haags bedrijf. We kennen de chauffeurs nu goed.	- -	
Wij zijn niet de enige waarbij de leveranciers moeten leveren, die gaan heel de straat langs. Dus als de bus dan ook in elke winkel afval ophaalt, weet ik niet of de bus dan te vol wordt en het lastig wordt met uitladen.	- -	+
Ze komen pallets leveren, die wij meteen leeghalen om alles naar achter te brengen. Die pallet nemen zij wel meteen weer mee terug, dus daar zouden we misschien wel nog vuil-nis op kunnen meegeven, maar ik weet niet of dat handig is voor hun.	+	
Ze nemen het voor ons gewoon gratis extra mee. Ik zou er prima voor willen betalen, maar we werken natuurlijk wel voor een miljoenenbedrijf, dus dat zou dan de hele keten omhoog door moeten voor goedkeuring.	- -	
Zelf vind ik het hygiënischer om de volle zakken in een bak te bewaren, i.p.v. los in de kelder, maar wij hebben daar hier in de winkel geen mo-gelijkheid voor.	+	++

D. Interview guide competitor

Below, the interview guide for the interview with the main competitor of PreZero is detailed.

Introduction:

General introduction into my graduation project:

- Client: PreZero
- Context: Return logistics for waste collection in an inner-city environment
- Case: Pilot in collaboration with PostNL for The Hague government offices
- Project: Stakeholder mapping, service blueprint design and prototyping
- Goal: Product-service system design for the next iteration (no further details)

Do you agree to participate in this interview for my graduation project of IDE at the TU Delft? Your name can be anonymized. The results of my graduation project will be published in the TU Delft Repository.

Is it okay if I record the conversation for notetaking? I will delete the recording before the end of my graduation.

Topic 1: About the company

- How would you define the market that your company is active at?
- What is the purpose of your company?
- What is the USP of your company?
- How do you compare to competitors?
- How would you describe your business model?
- How do you compare to competitors?

Topic 2: Experiences with the market

- How have your experiences entering this market been so far?
- What have been the main obstacles?
- What have been the main achievements?
- What was different than expected/ anticipated?

Topic 3: Future market

- How will the market of the future look like?
- How does the ideal market of the future look like?
- What do you expect from the market of the future?
- How will we get there?
- What are the main challenges?
- What are the main drivers?

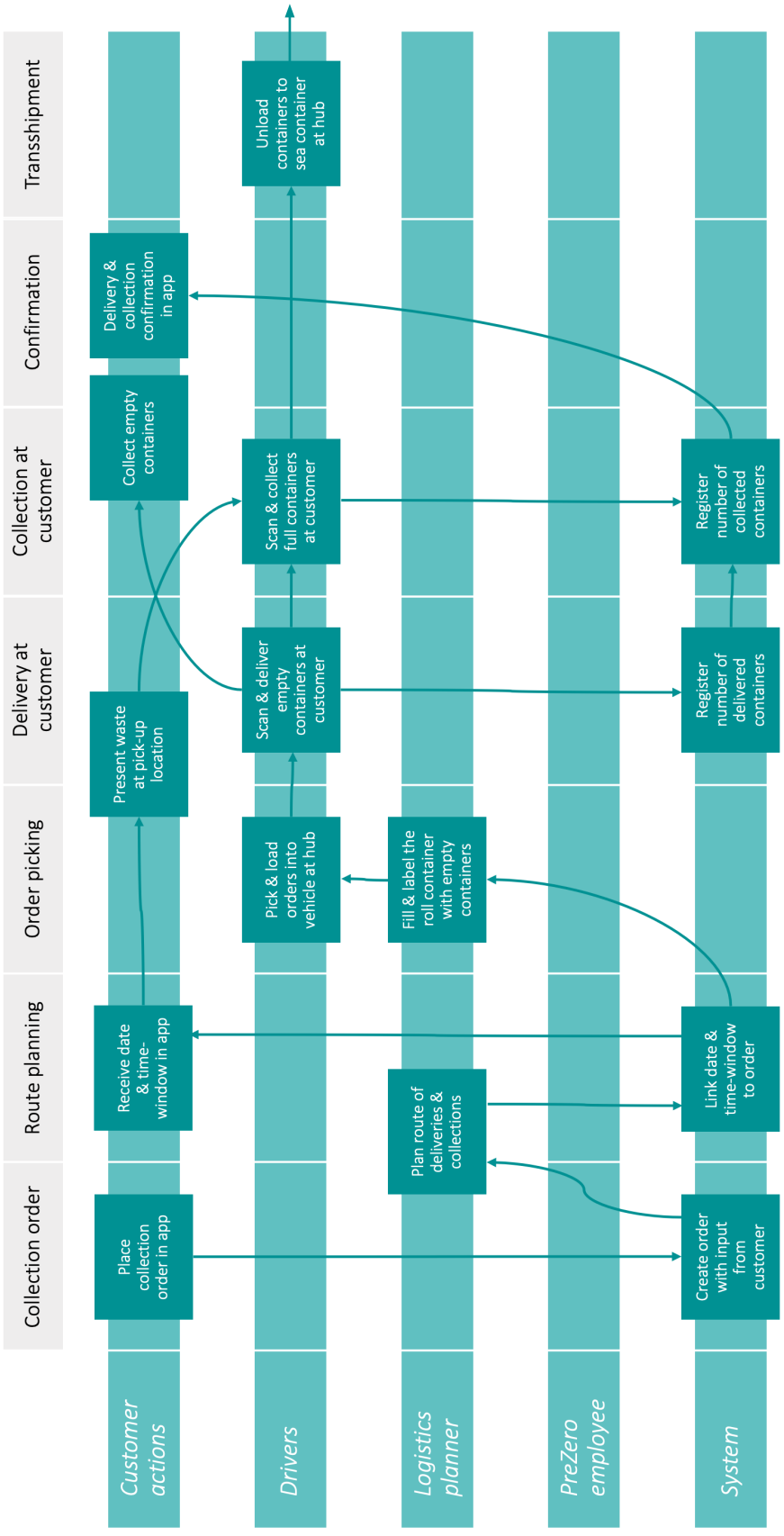
Topic 4: System evaluation

- How would you evaluate the current waste management system?
- What works well? What does not?
- What are possible improvements to the system?
- What are your requirements and wishes for waste management?

Topic 5: PreZero

- What do you think of PreZero?
- What do you think of the return logistics system of PreZero?

E. Service blueprint design




Collection by PreZero
Unloading at MSC
Quality control
Weighing
Invoice creation
Cleaning
Managing inventory
Supplying hub storage
Invoice with weight & quality report
Collect sea container at hub
Deliver sea container at MSC
Collect sea container at MSC
Deliver sea container to hub
Unload, scan and store containers
Create invoice
Unload & scan roll containers
Quality check random waste containers
Scan, weigh & empty containers
Clean container
Load clean containers in sea container
Register quality of waste
Register weight of waste

F. Concept: Three modules

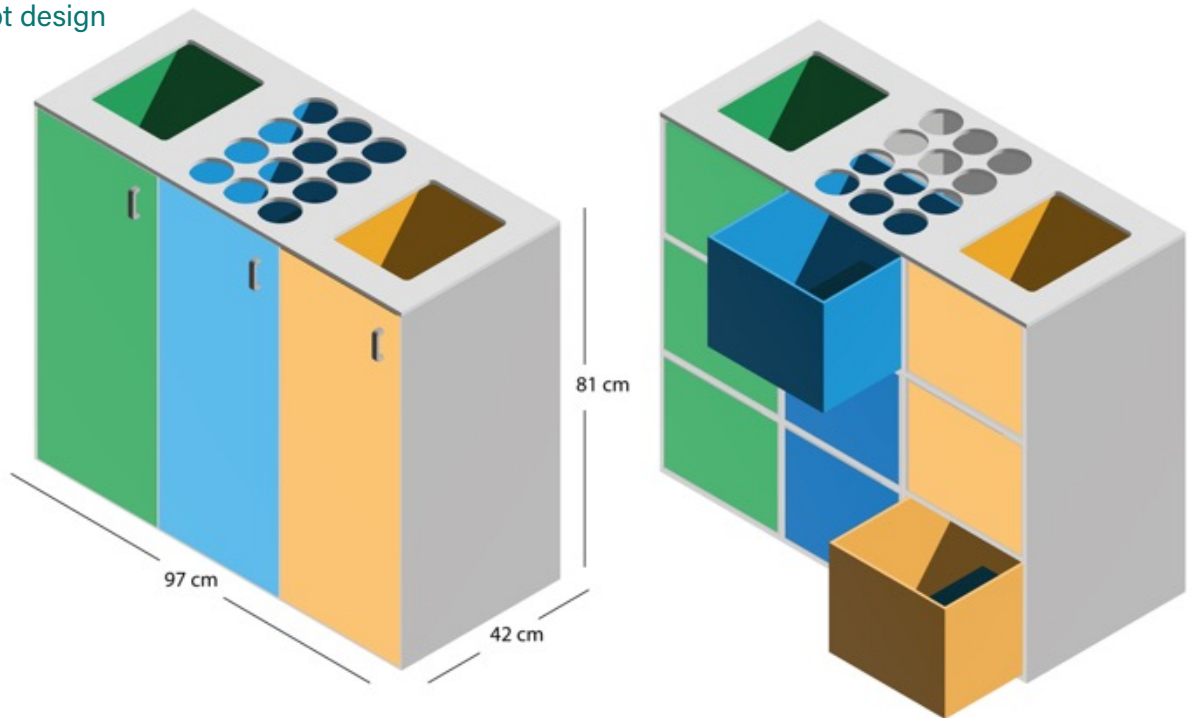
Concept 1: Office ECOO-Bin

Context

Offices with enough space to place wide ECOO-bins on the hallways and office floor to stimulate employees to separate their waste. Different models for different waste streams could be developed.

Current solutions

Concept design



Use

From the outside, the concept design barely differs from the existing PreZero ECOO-Bin. The top waste containers of each type are used. When a container is full, the door can be opened to swap the full container with an empty one. By color coding the containers, the separate waste streams are easily recognizable. By labeling the front of the container with 'empty' and the back with 'full', the side in which the container is placed in the rack can quickly give information to the cleaners to see what containers need to be removed from the rack and brought to the service entrance of the building to be collected by PreZero.

Concept 2: Restaurant step-on bin

Context

Restaurant kitchens with space for only one waste bin, that do want to separate waste different streams. For hygienic regulations, the waste bins need to have a lid that can be opened without using the hands.

Current solutions

Concept design

Use

Similar as the ECOO-Bin, but with two waste streams and an step-on pedal to open the lid.

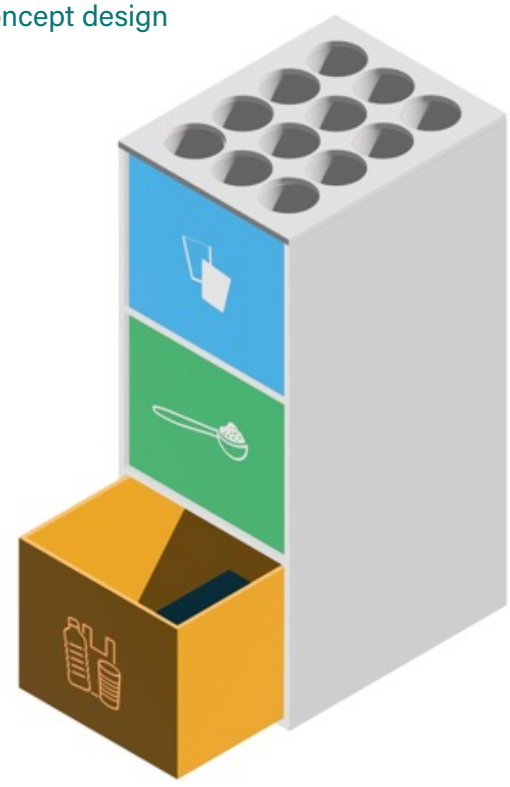
Concept 3: Compact drawer bin

Context

For retail locations with minimal space for waste separation, compact solutions are needed to enable customers to start separating waste. Since the interval of collection will be high, the bin can remain very compact, with containers that can get emptied daily if needed.

Current solutions

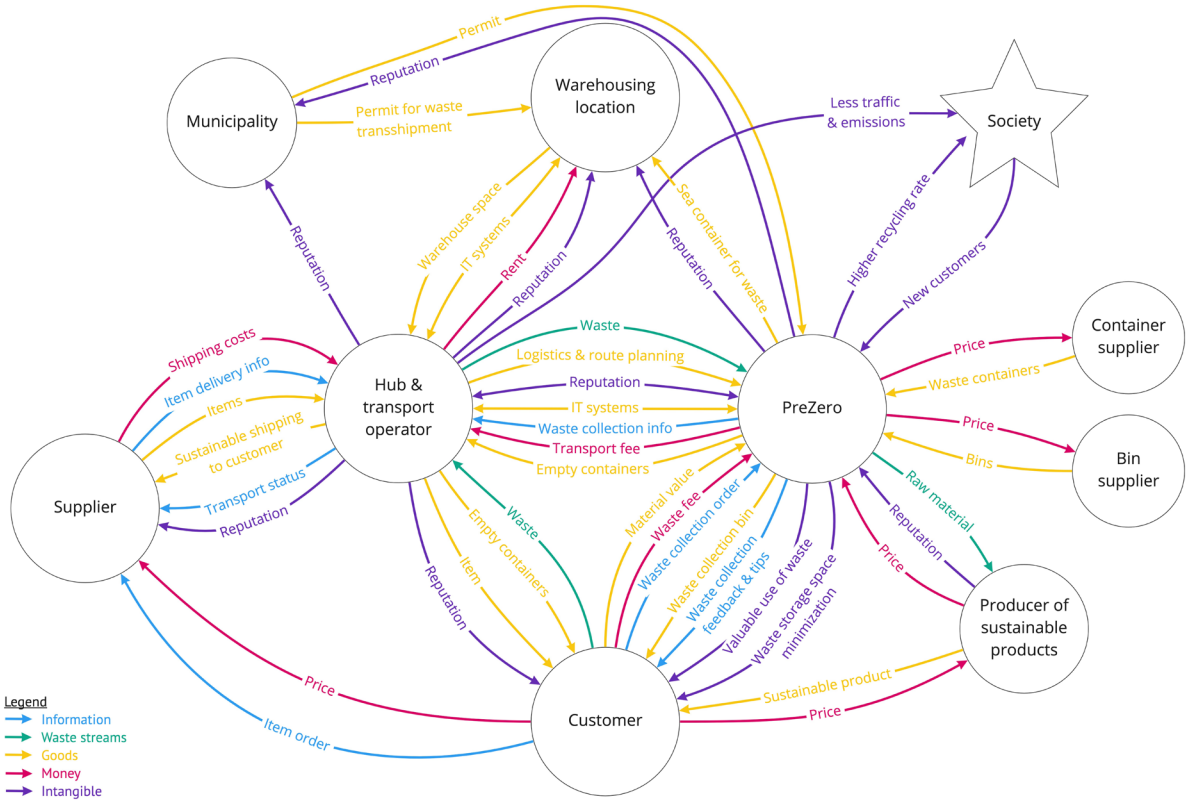
Concept design

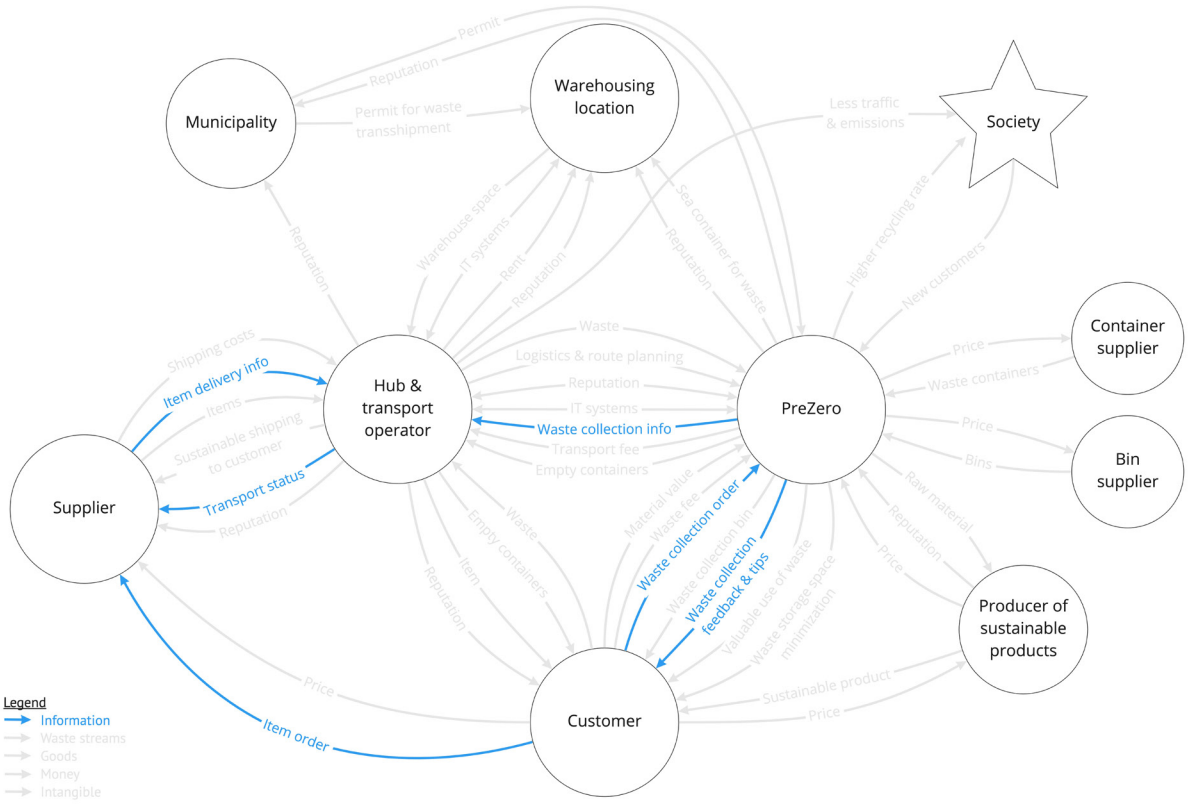


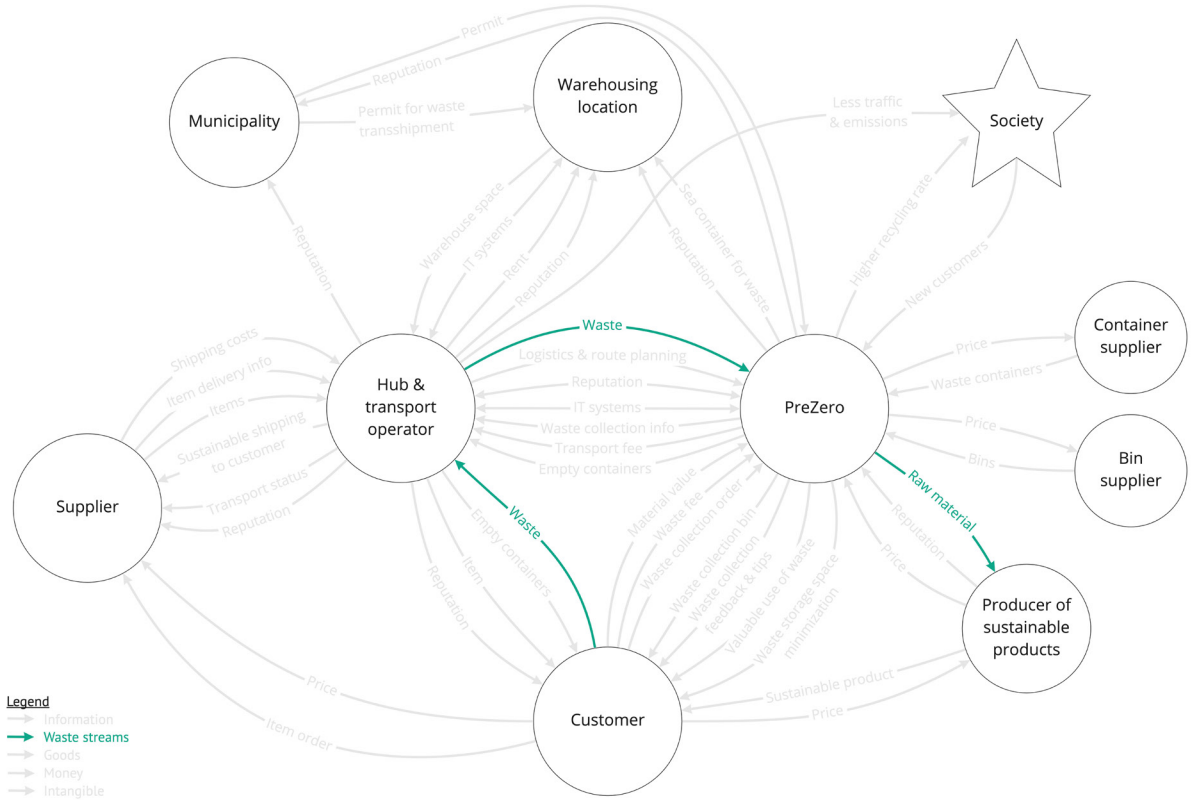
Use

This bin is the most compact form that the return logistic containers can offer. It is used differently than the previous concepts because in this case, the bottom two containers are actively used for different waste streams than the top container. This is a less ideal usage height, so if the customer has room for another type of solution, it should be designed or chosen. Yet, the compact size enables even customers with only room for a normal traditional bin, to replace that one with this concept and start separating waste.

G. Value flow maps of the envisioned system






Municipality
Warehousing location
Society
Hub & transport operator
PreZero
Container supplier
Bin supplier
Supplier
Producer of sustainable products
Customer
Permit
Reputation
Permit for waste transshipment
Less traffic & emissions
Warehouse space
IT systems
Rent
Sea container for waste
Higher recycling rate
New customers
Waste
Logistics & route planning
Shipping costs
Item delivery info
Items
Sustainable shipping to customer
Transport status
Waste collection info
Transport fee
Empty containers
Price
Waste containers
Bins
Raw material
Material value
Waste fee
Waste collection order
Waste collection bin
Waste collection feedback & tips
Valuable use of waste
Waste storage space minimization
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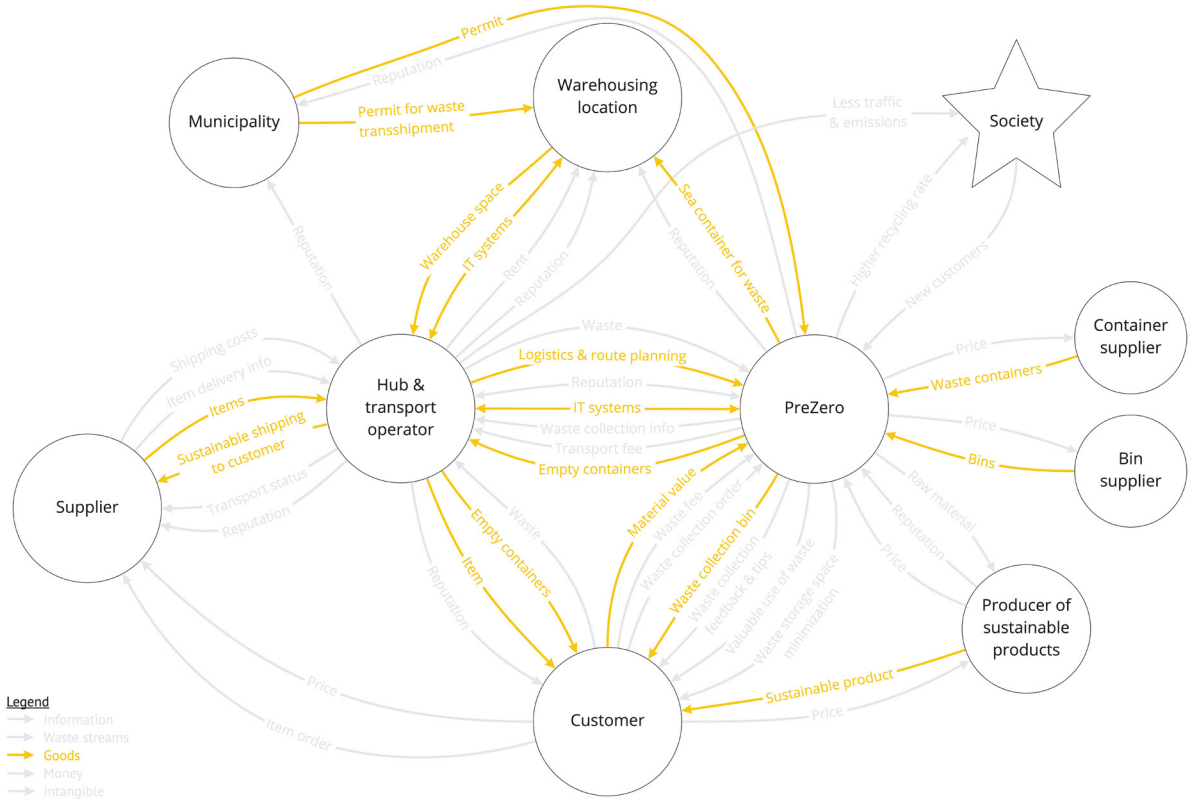
Sustainable product
Item order
Legend
Information
Waste streams
Goods
Money
Intangible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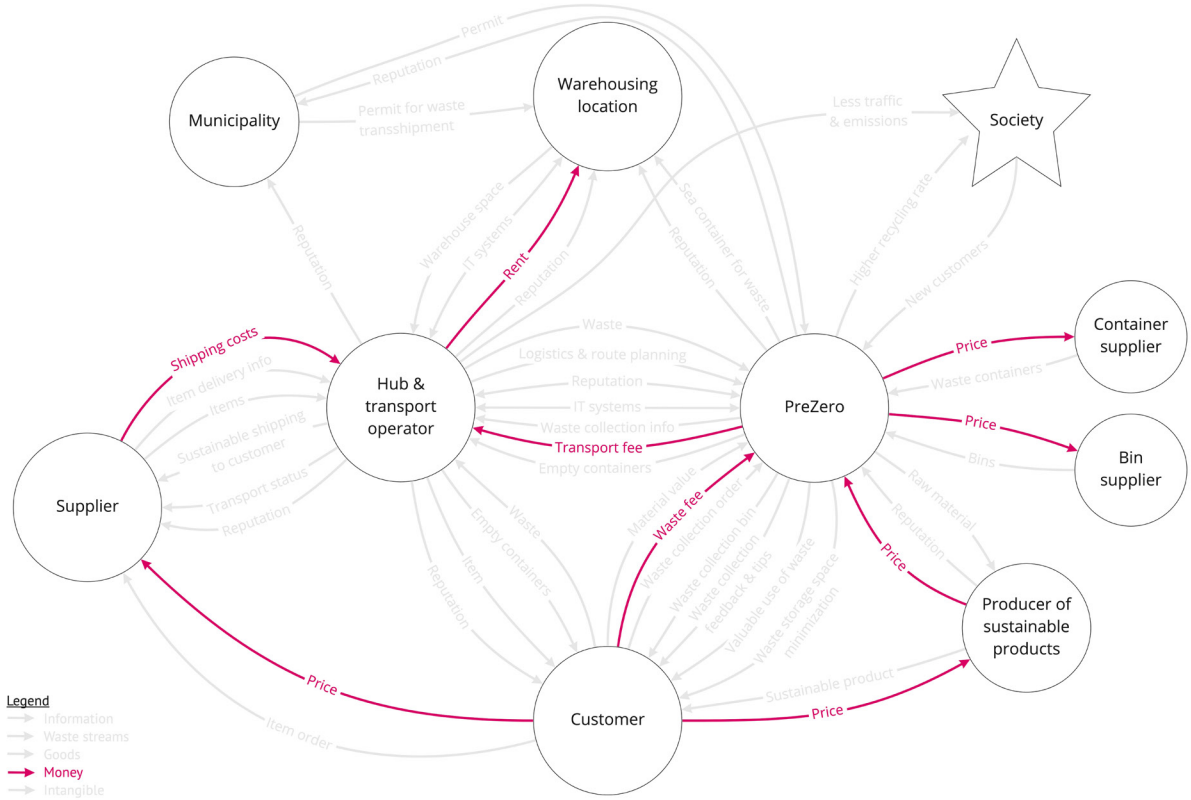
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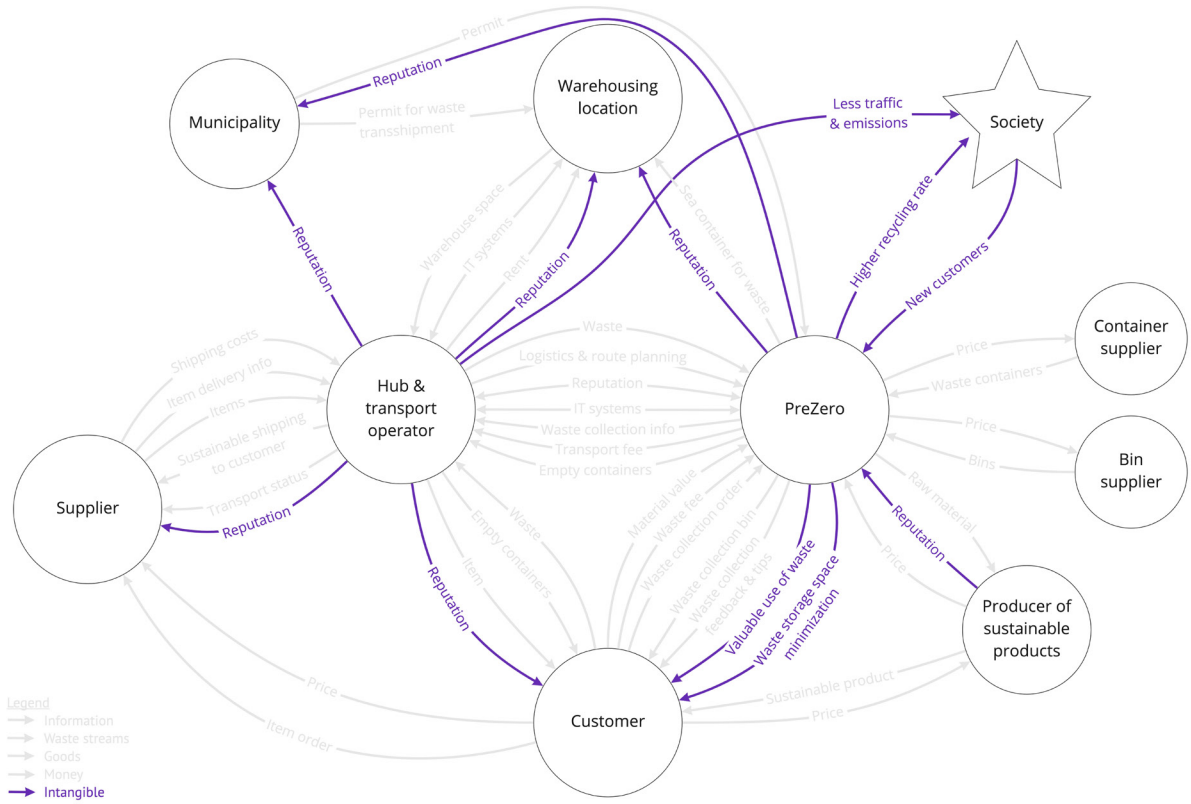
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H. Stuurgroep co-creation session miro boards

1

2

3