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Master's Degree Project in Logistics and Transport Management

The Recycling Barge

A research investigating recycling behaviours in Älvstaden

Authors:

Minda Langmoen & Louise Thörn

Graduate School

Master of Science in Logistics and Transport Management

Supervisor: Johan Woxenius

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By Minda Langmoen and Louise Thörn

School of Business, Economics and Law, University of Gothenburg
Vasagatan 1, P.O. Box 610, SE 405 30 Gothenburg, Sweden
Institute of Industrial and Financial Management & Logistics

Contact: minda.langmoen@hotmail.com; lousie.thorn@telia.com;
peter.arnes@kretsloppochvatten.göteborg.se; martin.svanberg@sspa.se

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Gothenburg, 31st of May 2019

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Minda Langmoen **Louise Thörn**

Abstract

Title: The Recycling Barge. A research investigating recycling behaviours in Älvstaden.
Thesis Degree: Master's degree in Logistics and Transport Management
Authors: Minda Langmoen and Louise Thörn
Supervisor: Johan Woxenius

Purpose: The purpose of this thesis is to identify the current recycling behaviour in regard to bulky waste for citizens in Älvstaden. Also, what the citizens demand in order to use a recycling barge. Finally, to examine how a logistics system connected to the recycling barge should be designed in order to create the most preferable solution.

Research Questions: In the context of Älvstaden: **(**1.) How do residents recycle bulky waste today? (2.) What do residents demand in order to recycle bulky waste on the recycling barge? (3.) How should the logistics system, connected to the recycling barge, be designed in order for residents to use it?

Methods: This research is an experimental case study with a qualitative approach. Both primary and secondary data has been used for data collection. The main source for the empirical framework is based on a survey performed with 206 respondents and two interviews. The empirical and theoretical results have been compared in the analysis.

Main findings:
The research has identified that people do not reflect much upon their recycling habits. There exists a lack of knowledge in regard to the handling of bulky waste. Although, most of the respondents went by car to a recycling center located outside of the city center to dispose bulky waste. The current recycling solution for bulky items are perceived as inconvenient and residents demand a convenient system. The willingness to use the recycling barge was generally high. Some factors were crucial for residents in order to use the barge. For example, distance to the barge, opening hours and the opportunity to hand in products for second hand. A service that ease the movement of items to the barge can also increase the willingness to use it. In addition, an efficient logistics system must be designed in order to provide the visitors with a good overall experience. Waste management triggers the first mile in a reverse flow. In this case, it is important to engage residents to use the barge and thereby initiate the reverse flow. The recycling barge is an opportunity to reach for a more sustainable Gothenburg and increased living standard for citizens.

Key words: *Recycling Behaviour, Barge, Sustainability, Bulky Waste, Reverse Logistics, Waste Management*

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List of abbreviation

SWW	City of Gothenburg, Sustainable Waste and Water

Definitions

Barge	A flat-bottomed cargo ship for heavy goods. The barge in this case need to be towed by a boat
Bulky Waste	Cannot be disposed like regular waste. For example, furniture, appliances, chinaware, metal
Household Waste	Can be disposed in the regular waste collection. For example, newspapers, packages, plastic, glass bottles
Recycling Center	Handles almost all kinds of waste. Often located in the sub urban areas
Recycling Station	Handles household waste. Often located close to households
Älvstaden	Area around Göta River in Gothenburg. Includes by definition, Backaplan (incl Kvillebäcken), Lindholmen, Frihamnen, Ringön, Gullbergsvass, Centralen and Södra Älvstranden. In this thesis, Eriksberg is also included due to its location

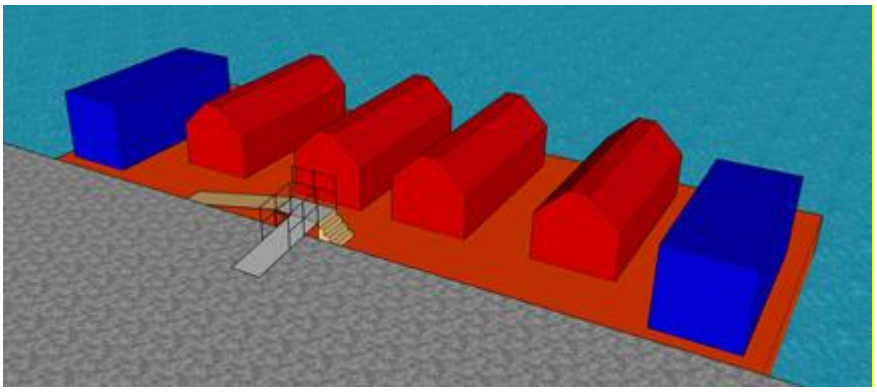
1. Introduction

This chapter gives the reader a background to the topic and introduces the concept of the recycling barge. This is followed by a problematization discussing current and future challenges. Afterwards, the purpose and three chosen research questions are presented. In addition, the two partner companies for this research are described. Finally, limitations and the outline of this thesis are stated.

1.1 Background

Consumption is constantly increasing and cities around the world need to tackle the challenge with the increased amount of waste that follows (Worldwatch Institute, 2019). Today, it is more important than ever to implement waste management and develop new solutions to take care of the increasing amount of waste. Recycling systems are particularly an important part to focus on when developing cities and trying to combine urban logistics with waste management. An efficient waste management system can lead the way to more sustainable urban logistics and efficient urban logistics can ease the waste management system (Cherrett et al. 2015). This is a challenge many cities are facing globally and each must take their responsibility for a sustainable future. Many cities have started initiatives related to this.

Gothenburg constantly works on making the city more sustainable. There are currently several initiatives in order to increase the living standard for citizens (Closer, 2019). One project, called DenCity, has been introduced in Gothenburg. Actors from both the private and public sector are involved. A main focus is to find sustainable solutions in order to develop transport and mobility solutions for the dense city. This will enable a decrease in the number of cars in urban areas which would have a positive effect on the environment. The current utilization of resources is analyzed in order to recognize areas of improvement. By developing technology and innovative solutions, the actors try to find long term efficient solutions for Gothenburg (ibid). DenCity is divided into different departments, each with different focus. This thesis is involved in the part that focuses on waste management in Gothenburg. The main actors involved in this part of the project are SSPA and the City of Gothenburg Sustainable Waste and Water, SWW. The purpose is to examine whether there is a need for a mobile recycling center for bulky waste. By introducing a recycling center on a barge, the citizens will have an opportunity to recycle and/or reuse the bulky waste without using a car. The main idea is to create a more efficient, convenient, and sustainable handling of bulky waste for people living around the Göta River. The plan is to dock at different quays located on both sides of Göta River. The barge will unload the waste in Skräppekärr, north of Gothenburg. Skräppekärr is located in connection to Göta River and the barge can dock close to where the waste is handled. Thereby, the waterways will be utilized to a higher extent compared to roads in this project. An illustration of how the recycling barge intend to be designed can be seen in picture 1. The idea is to place containers for different kinds of bulky and hazardous waste on the barge.



Picture 1: The Recycling Barge, illustrated by Viktor Daun[1], Gothia Marine (2019)

In addition to this, due to the increased population, there is a need for developing the city and provide new households and transportation solutions for citizens (City of Gothenburg, 2019a). The area around Göta River, Älvstaden, is facing big changes. For example, 25 000 new apartments will be built by 2035. Consequently, there is a need to find new suitable and sustainable solutions in terms of infrastructure (City of Gothenburg, 2015). This is an opportunity for the city to utilize its waterways to a higher extent. Since Gothenburg is a port city with waterways going through the city, there is a potential to increase the use of waterborne transportation. Today, Göta Älv is mainly used for public transportation (Älvstranden Utveckling AB & Göteborgs Stadsbyggnadskontor, 2015). In line with making the densely populated cities more sustainable, the importance of using traffic modes with less negative environmental impact increases. Hence, by utilizing Göta Älv as a transportation solution, an opportunity to reduce the road traffic emerge (Garberg, 2016). Also, this could also be beneficial since waterborne transportation is considered more sustainable compared to other traffic modes (McKinnon et al. 2015).

In recent years, attention has been put on reverse logistic for waste management (Cherrett et al. 2015). The urbanization has resulted in growth in demand of products and services for inhabitants in densely populated areas. Thereby, the need for an efficient waste handling has also increased. Information regarding recycling and waste has increased with an aim to encourage inhabitants to improve their recycling behaviour (Tabernero et al. 2015). In order to engage more people to recycle, it is important to raise awareness and introduce them to new convenient and sustainable solutions. Today, there are five recycling centers scattered around Gothenburg located in Alelyckan, Bulycke, Högsbo, Sävenäs and Tagene (City of Gothenburg, 2019b). In order to reach these locations, a car is more or less required due to the distance from the inner city. This is one of the reasons why new ideas are being developed. Recycling centers handles almost all kinds of waste, including items that are not possible to dispose as household waste or at recycling stations. This kind of waste is classified as bulky waste or hazardous waste. Examples are chinaware, furniture, and electrical items (ibid). Today the supply of bulky waste recycling systems is limited in the densely populated areas, and it is only few landlords

[1] Viktor Daun, Gothia Marine, e-mail conversation May 21st 2019

providing handling of bulky waste. Hence, this opens up opportunities for improvement. Therefore, the recycling barge will focus on handling bulky and hazardous waste.

1.2 Problematization

Gothenburg is currently experiencing a transformation. The city is expanding and needs to manage the increased urbanization. During the last ten years, Gothenburg has experienced a rapid growth in population and it is expected to increase further (City of Gothenburg, 2019a). Älvstaden is particularly affected due to the vast availability of land that allows for new construction. There are plans to build roads, a bridge and buildings besides the 25 000 new apartments (Älvstaden Göteborgs Stad, 2019). This leads to less space for traffic and parking lots, which can be problematic in terms of congestion and pollution. Therefore, different actors, city of Gothenburg, companies and inhabitants, must collaborate in order to find efficient solutions to share space and at the same time develop a more sustainable urban logistics (Taniguchi & Thompson, 2015).

It is important to deal with the situation and find not only temporary solutions as the population continues to increase. According to Closer (2019), there is a need for new transportation systems and services for citizens in order to reduce the number of cars in Gothenburg. In addition, the city of Gothenburg has decided to reduce the number of parking lots when building new apartments. Peter Årnes[2] describe that it is estimated there will be about 50% less parking lots built in the future, compared to today.

This makes it much harder for inhabitants to own a car. If people should choose not to buy or use a car, there is also a need for developing convenient systems and cheap substitutes for car transportation. There is an ongoing trend in several sectors to provide services such as home delivery. More services need to be provided in the same way in order for people to choose not to have a car.

The expected and planned constructions in Gothenburg mainly regard apartment buildings, therefore urban logistics needs to be adjusted to this kind of living situation. The limited living and storage space in apartments will most likely generate less waste than houses would and the urban logistics needs to be adjusted accordingly. Moreover, the type of waste generated may differ between apartment buildings and houses considering the different ways of living. For example, apartment building usually do not have gardens. Hence, they will not require as much, if any, recycling of this kind of waste. When developing a new waste management system, it is essential to take this into consideration and meet the demand of the inhabitants.

Convenience is also crucial in order for people to recycle (Bernstad 2014). The everyday waste recycling of household materials is currently easy to get rid of due to the garbage rooms and recycling stations located close to the apartment buildings. However, the landlords often do not

[2] Peter Årnes, Strategist SWW, e-mail conversation March 4th 2019

provide the possibility to recycle bulky waste items. Residents must go to the recycling centers located outside of the city to recycle such items, which requires a car. It is therefore interesting to investigate if there is a need for a new solution and how to design a new potential waste management system.

There is an ongoing discussion about different types of traffic modes and the negative environmental impact each cause (McKinnon et al. 2015). Most transportation of goods and people are on roads. This causes problems in terms of congestion, pollution, vibration and noise for people in the cities. Waterways can reduce these problems since they have several benefits. Gothenburg is a port city with access to Göta River. It is, however, not used to its full extent (Arvidsson et al. 2017). Hence, it is interesting to investigate if inhabitants in Älvstaden will use a recycling barge and how a logistics system can be designed in order to meet their demands.

1.3 Purpose

The purpose of this thesis is to identify the current recycling behaviour in regard to bulky waste. The target group is the residents in Älvstaden. A survey will be performed to get deeper insight and understanding in the residents' opinions, demands and their willingness to use the recycling barge. Further, the findings will also be used to examine how the logistics system connected to the recycling barge should be designed in order to create the most preferable solution.

1.4 Research Questions

In the context of Älvstaden:
Research question 1. How do residents recycle bulky waste today?

Research question 2. What do residents demand in order to recycle bulky waste on the recycling barge?

Research question 3. How should the logistics system, connected to the recycling barge, be designed in order for residents to use it?

1.5 Company descriptions

This thesis is a collaboration with two partner companies, SSPA and The City of Gothenburg Sustainable Water and Waste. Each company is described below.

SSPA
SSPA is a company working with creating sustainable maritime solutions for, among others, ship owners, ports and maritime authorities (SSPA,2019). The company is operating globally and have two offices in Sweden, in Gothenburg and Stockholm. A big part of the resources is used for research and development in order to provide the latest solutions to customers (ibid).

The city of Gothenburg Sustainable Waste and Water (SWW)
SWW is responsible for the collection of various types of waste from residents in Gothenburg as well as the supply of water (City of Gothenburg, 2019). They operate within the municipality of Gothenburg and are constantly working on developing efficient and environmentally friendly solutions. One area of interest is how to develop sustainable recycling centers that meet the need of the inhabitants (ibid).

1.6 Limitations

Due to a limited time frame and the scope of the project, have certain limitations consciously been made. The DenCity project operates in Gothenburg, thereby the thesis is focusing exclusively on inhabitants recycling behaviour in Gothenburg. In this research, only the characteristics of Gothenburg city and Älvstaden have been considered and not other cities. The survey has only been performed in chosen areas in Gothenburg, closely connected to the selected quays in Göta River in Gothenburg. Additionally, this thesis is only investigating the need for a recycling barge as well as finding out whether there is a demand for a service that could increase the willingness to use the barge. Hence, the technical aspect in regard to the recycling barge are not examined in this research. For example, the layout, lightning, staff needed and, policies and regulations regarding handling of waste are not considered in this thesis.

1.7 Outline

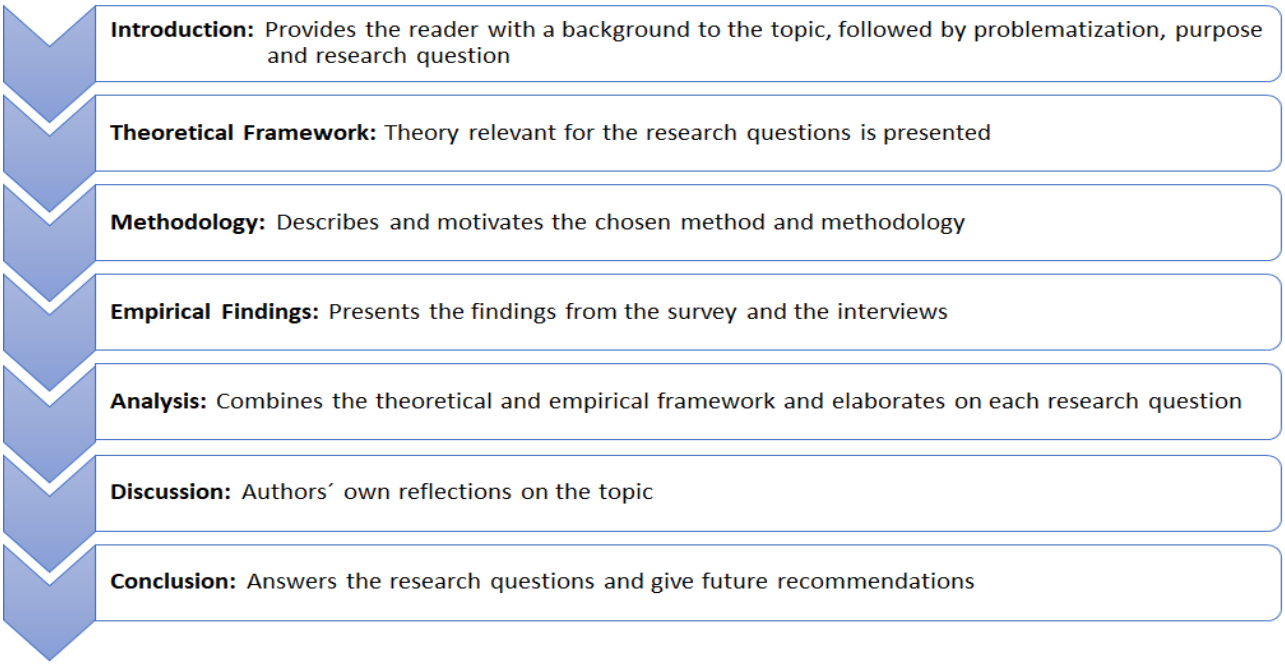


Figure 1: Outline of the thesis

2. Theoretical framework

This chapter will present some of the existing literature connected to urban logistics and recycling behaviour. In addition, since Gothenburg is a port city, the benefits of utilizing waterways will be presented. The theories will be discussed from a general point of view as well as local, Gothenburg, perspective. In the end of this chapter, a summary of the theoretical framework is provided.

2.1 Urbanization

According to United Nation Department of Economic and Social Affairs (2018), 55 % of the world's population was living in urban areas in 2018. This trend is only expected to increase and by 2050, approximately 68 % will reside in urban areas around the world. In Sweden, about 85 % of the inhabitants live in cities and again, this number is expected to increase (SCB, 2015). According to the City of Gothenburg's webpage (2019c), the number of inhabitants grew fast in Gothenburg during 2018 to a number of 571 868 inhabitants. This is approximately 140 000 more compared to 1990, when Gothenburg had 432 035 inhabitants (City of Gothenburg, 2019d).

The urban growth will lead to many challenges (Taniguchi & Thompson, 2015). For example, more people will share the same area which can result in an increase in congestion and limited space for parking. New solutions and innovations are needed in order to make urban development as efficient and sustainable as possible. Policies and regulations are required to manage the changes in urban areas. It is important that all citizens can benefit from new solutions in order for the city to be sustainable (ibid).

2.2 Urban logistics

In line with the growth in urbanization, the importance of an efficient urban logistics increases (Browne et al. 2018). Urban logistics plays a crucial role for the development of a sustainable city and has several objectives related to mobility and sustainability. Many cities want to decrease congestion, air pollution and noise. Also, they want to develop and provide efficient transport solutions. The motives are to make the city safe and to increase the living standard for inhabitants (ibid). Due to rapid changes and challenges, it has become essential to develop an efficient urban logistics system both individuals and businesses can benefit from (Rose et al. 2017). According to Lindawati et al. (2014), it is important for stakeholders to collaborate in order to succeed and optimize the potential of cities. Shippers, freight operators, administrators and residents are the four main stakeholders and each of them have different perspectives on how to develop a city. Also, the stakeholders often have different time horizons for various actions (ibid).

When planning urban logistics, several aspects need to be taken into consideration. According to Taniguchi and Thompson (2015), three elements are especially important; technological innovations, changing mind-set for companies and the communication between the public and private sector. An updated technological system can optimize planning and thereby save time and costs. This can also lead to a decrease in the negative environmental impact. In addition, a changing mind-set amongst different actors in society is crucial in order to reach for more sustainable solutions. It is important to recognize the environmental benefits and be flexible for changes in order to improve. For example, when it comes to traffic modes, actors must realize the benefits of using alternative modes for a greener freight system. Communication and collaboration between stakeholders, are two key aspects when planning for urban logistics. Resources and spaces are shared, thus it is essential to make common decisions and have a continuous dialogue. It is not enough if only one stakeholder tries to change to the better. Hence, in order to reach long term results and solutions for a sustainable city, stakeholders must communicate and collaborate (ibid). In addition, Lindholm and Browne (2015), also stress the importance of partnership between the public and private sector. They describe long-term partnerships as crucial when solving problems related to urban logistics. By bringing representatives from different sectors together, various perspectives can be understood. Further, the mutual understanding can initiate new solutions in order to improve urban logistics (ibid).

According to Taniguchi and Thompson (2015), the public sector is often involved in the planning of urban logistics solutions as they are responsible for the public interests. For example, are freight and mobility two important concerns. The public sector is often involved in financing the building of roads, urban consolidation centers and other solutions with common interest to solve problems related to urban logistics. The role of the public sector differs, depending on country and city (ibid). In Gothenburg and in the DenCity project, the public sector has a large role. They have an interest in solving problems related to congestion and air pollution in the city of Gothenburg. Nevertheless, Lindholm and Browne (2015), inform that the establishment of partnerships cannot alone solve all problems related to urban logistics. It should rather be considered as a significant contribution as well as a good opportunity to address problems and solutions from different perspectives.

2.3 Waste Hierarchy

Waste hierarchy is an often-mentioned concept related to waste and resource management (Van Ewijk & Stegemann, 2016). The concept presents an order of preferences in regard to different actions for waste handling (Williams, 2015). The primary purpose of the waste hierarchy is to conserve the resources in society or else minimize the waste creation and thereby reduce the impact on the environment. The concept ranges from the top priority of action, prevention of waste, to the least favourable action, disposal of waste (ibid). The different levels are presented in figure 2 below.

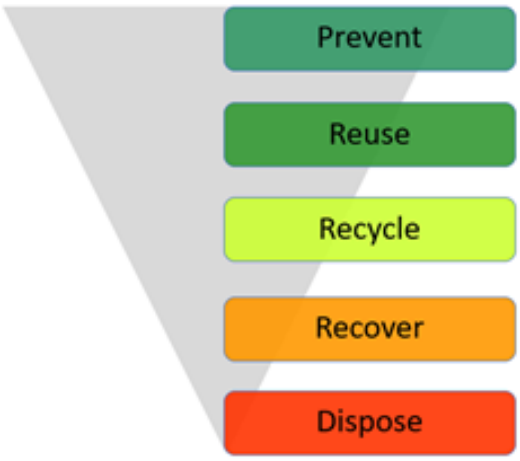


Figure 2: The Waste Hierarchy

Each level is connected to the state of the product and to what extent there is a potential to recover energy from it (Blackburn et al. 2004). The key objective is to avoid complete disposal and rather promote actions for energy efficiency. Hence, the waste hierarchy can be used as a tool for sustainable waste management (ibid).

In the waste hierarchy, prevention is the most desired action since the product is considered as non-waste (European Commission, 2019). According to Fortuna and Diyamandoglu (2017), there exist several means of control in order to reach this top level. By improving the design of products or developing substitutes, prevention could be achieved. For example, when buying a product, the packaging is included. Hence it is important to not only consider the product itself, but also the additional features that might be unnecessary. Moreover, products should be designed in a way enabling repairs and reuse of the item (ibid). From a customer perspective, it is essential to reflect on the consumer behaviour, if they really need to invest in new items (Department of Communications Climate Action & Environment, 2019). The following steps are different levels of the condition of the material and are classified depending on the state of the material (ibid).

Product reuse means that a product finds a second use without the need for being re-processed (Fortuna & Diyamandoglu, 2017). This step in the hierarchy plays an important role when striving for minimizing waste (ibid). Today, there are many charities and second hand shops that has grown in popularity and it has become a trend to leave items for reuse (Naturskyddsföreningen, 2018). At the recycling level, materials and resources can still be saved (Department of Communications Climate Action & Environment, 2019). Thus, the products must be processed. In the recovery stage, the remaining parts of a product can be used for energy extraction. Disposal is the final and least desired step, since nothing can be used nor saved. This results in landfill and must be carefully managed (ibid).

Williams (2015) stresses the importance of engaging all parts in society in order to implement and develop a sustainable waste management strategy. Different actors mentioned are

government, companies, charity and individuals. In a common effort, they must strive for the top shifts in the waste hierarchy and all parts are dependent of the commitment of one another For example, a sustainable strategy towards a sustainable waste management must be formulated, in order to set a framework and policies for the society. However, it must also be accepted and enforced in practice. This requires information, training, new infrastructure, adapted markets, redesigned products and a positive attitude towards the changed behaviour. Further, Williams (2015) states that a responsibly waste management can have a positive impact on the environment and public health. Hence, the concept should rather be discussed in terms of lifestyle actions rather than the waste people cause (ibid).

2.4 Reverse logistics for waste management

The supply chain reaching from manufacturer to end customer has been an area of focus for many researchers (Cherrett et al. 2015). This is also the traditional view on a supply chain (Lumsden, 2012). However, Cherrett et al. (2015) describe that logistics activities connected to the reverse flow have gained importance during the later years. According to Lumsden (2012) packages stand for a big share of the total weight and volumes in supply chain. Used packages are one important part initiating reverse flows (ibid). The reverse flow of goods also includes for example the logistics activities associated with the handling of damaged or waste products (Cherrett et al. 2015). By understanding and improving the reverse logistics for waste management, costs can be reduced in line with an increased efficiency. A distinction is done between the term “waste management” and “reverse logistics”. Waste management only refers to the handling of products that have no reuse potential. Reverse logistics on the other hand, focuses on the flow of products from consumption back to the origin, products might still have a purpose of recapturing value (ibid).

According to Kara et al. (2006) producers have to focus beyond the traditional forward logistics distribution chain, adapt a more holistic approach and thereby include the reverse flow as well. By doing this, they are responsible for the entire environmental footprint they are causing. According to Ramezani et al. (2013), it is crucial to integrate forward and reverse logistics in order to optimize all parts in the supply chain. Dias and Braga Junior (2016) also discuss the extended scope of responsibility retailers need to adapt. Today, products have a relatively short life cycle which cause damages on the environment. Hence, retailers should consider problems in regard to waste being generated from their production (ibid).

According to Cherrett et al. (2015), there is a lack in recycling performance since there is poor availability of recycling markets. Certain waste materials are difficult to handle and there is a need for developing more convenient recycling systems (ibid). Additionally, there has become an increasing pressure on companies to take responsibility of their actions (Kara et al. 2006). They must take responsibility beyond the production and distribution process and also focus on the recovery of their products in the end of the life cycle. Recovery encompasses recycling, reuse and remanufacturing. These are the end of life options and depending on the materials and characteristic of the product, they are handled due to their best option. The reverse flow is

considered more complex than the forward logistics flow, because the quality of the products as well as the quantity are uncertain. Thereby, the handling process are naturally affected (ibid).

2.5 First mile

Whilst last mile logistics has been in the spotlight during the latest years, first mile logistics has not received as much attention (Halldórsson et al. 2018). First mile logistics refers to the first movement of a good or item in a logistics process. It can for example be from the retailer to the carrier or from an end user to a recycling center. According to Macioszek (2018), the first mile can be referred to as the first part of the way to or from a customer. Also, the first mile is one part in a logistics process that is seen as the most cost sensitive. In reverse logistics, the first mile starts when a customer wants to get rid of a product or item and decides to go somewhere with it. This process can be energy intensive due to the many factors involved. For example, the large quantities of waste that must be carried away and the use of heavy vehicles that often is required to carry the waste away (ibid). Kohtamäki and Rajala (2016) states that depending on the perspective of the logistics flow, households can have different roles. Either they are end consumers in a forward flow or suppliers in a reverse flow. In the later, households initiate a first mile in the logistics process (ibid). Halldórsson et al. (2018) explain that households have a large responsibility to handle their waste, since they trigger the start of a new flow. Hence, they have an opportunity to impact the efficiency for the upcoming steps (ibid).

2.6 Recycling centers in Gothenburg

According to Eklund et al. (2010), a recycling center is a place where you can dispose almost all kinds of waste. At many centers it is also possible to leave items for reuse. There are several different materials that recycling centers can handle, for example, different types of wood, metal, pieces of furniture, concrete and non-combustible items. Sundin et al. (2011) states that recycling centers are an important part of the total recycling system in Sweden and it is therefore important to continuously work to improve and develop the centers. According to Peter Årnes[3], the recycling centers in Gothenburg can handle various types of materials and waste. Bulky - and hazardous waste are the two most common categories of waste that are handled. Wood, combustible waste and non-combustible waste are the three materials of bulky waste that most people get rid of at a recycling center. Many visitors also leave hazardous waste such as paint, oil, batteries and electronics (ibid).

The recycling centers are mainly for individuals but some small companies are also welcome (Eklund et al. 2010). In Gothenburg there is five recycling centers located outside of the city center, in Alelyckan, Bulycke, Högsbo, Sävenäs and Tagene (City of Gothenburg, 2019b). In order to visit the centers, individuals need to have a recycling card which allows six free visits per person every year. The recycling card can be ordered from the City of Gothenburg's website and every adult registered in Gothenburg can order a card (ibid).

[3] Peter Årnes, Strategist SWW, e-mail conversation January 22nd 2019

It is important to understand the difference between recycling stations and recycling centers. According to City of Gothenburg's webpage (2019b), a recycling station is a place where individuals can throw away waste such as: newspapers, packages, plastic and glass bottles. Whereas, at recycling centers individuals can dispose bulky and hazardous waste (ibid). In addition, recycling stations are mainly located in adjacent to households, in walking distance, whilst recycling centers often are located in suburban areas and not in direct connection to households (Eklund et al. 2010).

2.7 Existing handling of bulky waste in Gothenburg

Despite the existing recycling centers, there are other small-scale solutions for disposing bulky waste in Gothenburg. According to the City of Gothenburg (2019e) residents living in apartments should have an opportunity to dispose bulky waste in either a garbage room for bulky waste or in a temporary container provided by the landlord. In addition, the city of Gothenburg provides the residents with services that ease the recycling of bulky and hazardous waste (City of Gothenburg, 2019f). A truck collecting hazardous waste, such as electronics, is circulating in the city on scheduled times. The residents can for free hand in hazardous waste they want to get rid of. Moreover, the city of Gothenburg offers a service collecting appliances, such as fridge, dishwasher or stove, for a fee (ibid).

In addition, charity organizations like Stadsmissionen and Erikshjälpen, also provide services where they can pick up items from residents living in Gothenburg (Stadsmissionen, 2019; Erikshjälpen, 2019). Citizens have the opportunity to leave different kinds of items such as pieces of furniture, clothes and domestic articles to the pick-up (ibid).

2.8 Recycling behaviour

According to Bernstad (2014), convenience is essential in order to make people recycle more. Further, Bernstad states the importance of developing recycling systems close to where people generate waste, their households. Miliute-Plepiene et al. (2016) also discuss the importance of convenient recycling systems in close connection to households in order to engage residents to recycle more. People having access to a recycling system close to their households, tend to recycle more compared to others. However, these studies have been done in regard to household waste and not bulky waste. According to Halldórsson et al. (2018) bulky and hazardous waste have a tendency to be stored longer and is thereby not recycled as often. Further, people prefer to use a car when disposing bulky or hazardous waste at a recycling station (ibid).

Selander Lyckeborg[4] thinks that the interest and acceptance for recycling household waste, such as plastic and food, is relatively high. Several landlords provide residents with convenient solutions to get rid of this kind of waste. The information regarding recycling of household waste is also communicated to a high extent and residents usually know what to do with this

[4] Jonas Selander Lyckeborg, Project Manager Obelix, Interview March 22nd 2019

kind of waste. However, this is not the case for bulky waste. Selander Lyckeborg describes that the lack of information regarding handling of bulky waste and the solutions for this kind of waste are not as convenient. According to Selander Lyckeborg and Dalek[5], recycling centers are often located outside of the city center and visitors are more or less required to go there by car. This argument is also stated by Eklund et al. (2010).

Eklund et al. (2010), argue that the typical visitor to a recycling center is a man driving alone, about 5 km from his house. The visitors often combine the trip with other activities, such as grocery shopping or dropping of kids. Eklund et al. (2010), further state that most of the visitors to a recycling center, live in houses and not in apartments. Further, visitors want to travel a shorter distance in order to recycle and suggest that recycling centers can be placed near shopping malls or similar. In terms of environmental concerns, it can be perceived as contradictory to drive long distances with a car to recycle a small amount of waste (ibid).

2.9 Shift in traffic mode

According to Giuliano (2018), the environmental impact of different traffic modes can be divided into three regions, local, regional and global. The impact from traffic modes on a local level refers to the effect on inhabitants and their living standard. Operations on a local level mainly affect the environment in the short term. Hence, it is not as difficult to handle as the two other levels. On a regional level, traffic modes have a negative impact that can have an affect on water and ground for a longer period of time. From a global point of view, pollution and different kinds of emissions affect the ecosystem. This will have an impact over a long-time horizon, therefore, it is more complex to manage. However, all modes of transportation can affect both, locally, regionally and globally (ibid).

The choice of traffic modes and the impact each cause on the environment are increasingly discussed. According to Woodburn and Whiteing (2015), there is an ongoing discussion in many sectors about changing traffic mode from road to other alternatives with less environmental impact. This is because of the challenges with climate change. Today, most of the goods are transported on roads. However, due to the negative environmental impact road traffic causes, there is a need for change. Woodburn and Whiteing (2015) describe that waterborne traffic together with rail traffic are generally the two modes that affect the environment the least in regard to emissions. Another benefit with waterborne freight is the ability to carry larger quantities in comparison with for example trucks. Although, waterborne freight is generally less flexible and there is often need for road transportation to reach the final destination. One solution is to use intermodal transportation, where two or more modes are combined. For example, water can be used in cities and later be switched to road or vice versa (ibid).

[5] David Dalek, Business Developer Renova, Interview March 13th 2019

2.9.1 Urban waterways

Urban waterways refer to waterways in cities or urban areas. Today, roads in cities are used to a larger extent than they have capacity for (Arvidsson et al. 2017). Freight of goods are mainly performed on roads and is often concurring with the "ordinary" passenger traffic. Challenges regarding congestion, pollution and limited parking space are increasing all the time and with the growing urbanization this is only expected to grow further (ibid). According to Arvidsson et al. (2017), waterways in cities are not used to its full extent and they can be developed and used more than they are today. The usage of waterways might be one of the solutions for a more efficient transportation system (ibid).

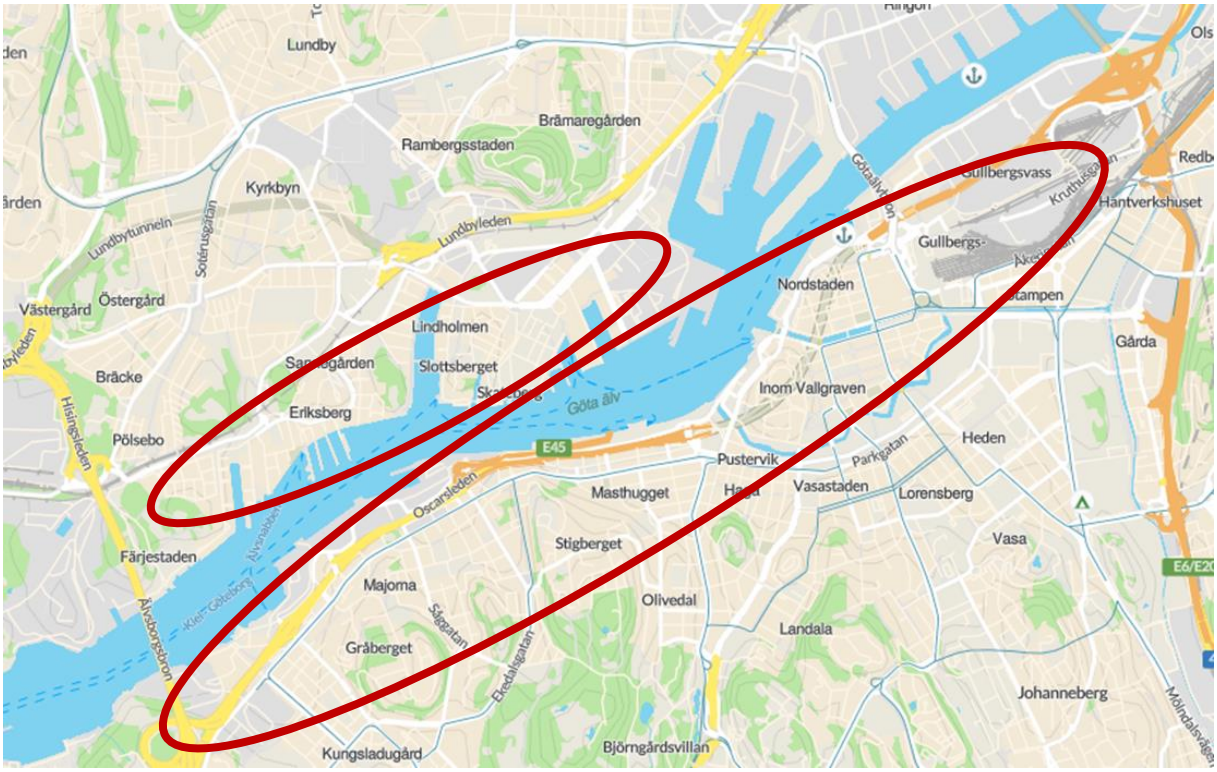
A barge is one traffic mode often used on urban waterways and is especially known for transporting bulky goods such as coal, sand and chemical products (Konings, 2009). Further, several benefits are highlighted with this traffic mode. Firstly, a barge can handle large quantities with low operating costs. This traffic mode can carry multiple containers and is relatively easy to load and unload. Secondly, a barge enables a high level of reliability since they can utilize waterways to a higher extent and thereby avoid congestion. Finally, this traffic mode is known for its high level of safety. Further, Konings (2009) states some disadvantages with barge transport. The infrastructure of waterways is not as flexible as the infrastructure for road and rail transport, which limits the catchment area. In addition, a barge is a traffic mode with a relatively low speed (ibid).

2.10 Demographics in Älvstaden

Gothenburg is a port city, located in the end of Göta River which continues north to one of the largest lakes in Europe, Värnen (Browne & Woxenius, 2018). The Port of Gothenburg is relatively large in comparison to the size of the city and number of inhabitants. The location of Gothenburg and Älvstaden enables the use of waterborne transportation. In areas with access to waterways, urban freight does not necessarily need to be performed on road or rail, but instead utilize the water (ibid).

The area around Göta River in Gothenburg is called Älvstaden. This part of the city is divided into seven sub-areas shown in picture 2, Backaplan (incl Kvillebäcken), Lindholmen, Frihamnen, Ringön, Gullbergsvass, Centralen and Södra Älvstranden (City of Gothenburg, 2015). These areas are mainly consisting of apartments and workplaces. As can be seen in picture 2, the areas are located in close connection to the water. In 2015 Älvstaden had approximately 5 500 inhabitants and this number is expected to increase to 50 000 inhabitants in 2035. There are possibilities to develop Älvstaden in terms of new infrastructure, apartments and workplaces. It is stated that 5 000 000 square meters are available for constructions and development (ibid). There are currently several constructions in the area and more are planned to be implemented. For example, 25 000 new apartments are planned to be built (Älvstaden Göteborgs Stad, 2019).

By definition, Eriksberg is not included in Älvstaden. Although, in this thesis Eriksberg will be included since it is located in connection to Göta River and the other parts of Älvstaden. Also, there are a large number of citizens living in this area.



Picture 2 - Älvstaden, map from hitta.se and the authors´ own illustration.

2.11 Summarizing the theoretical framework

In the theoretical framework of this research, various key areas connected to the recycling barge have been explored. First, it is evident that the city of Gothenburg is facing challenges within urbanization and urban logistics. The growth in population requires flexibility considering new innovations and solutions in order to maintain a good living standard for the citizens. In addition, it appears that this requires a collaboration between several stakeholders in society.

The theory also states the importance of reverse logistics for waste management. It is essential to not only focus on the traditional forward flow but also on the reverse flow. This flow contains a higher degree of uncertainty due to quantity and quality. The initial stage in a logistics flow is called the first mile. In a reverse flow for waste management, the first mile is sensitive since the end consumers are the ones initiating the flow. In the theoretical framework, the concept of the waste hierarchy is examined. This can be considered as a tool for a sustainable waste management since the aim is to minimize the environmental impact waste is causing.

Recycling centers are an important part of the total recycling system in Sweden, Gothenburg is no exception. Bulky waste cannot be disposed with the household waste, hence these items must be disposed in specifically intended places. Currently, recycling centers are located

outside of city centers and there is more or less a need for a car in order to get there. However, other solutions exist in a smaller scale, for example garbage rooms for bulky waste and pick up services. Further, previous research shows that convenience is a crucial factor in order for people to recycle. The handling of bulky waste is not communicated to the same extent as household waste.

Waterborne transportation is known for having less negative impact on the environment. Although, waterways are not used to its´ full extent, this can encourage a switch from road to water. One flexible traffic mode on waterways, is a barge which has various benefits. For example, it can carry large quantities of material and is able to utilize the waterways efficiently. Gothenburg is a port city and Göta River goes through the city, thus, Gothenburg has the right conditions for utilizing a more sustainable mode of transportation.

3. Methodology

In the following chapter the chosen methods and methodology are described and motivated. The section is divided into research approach, research design, data collection and research quality. The purpose is to elaborate how the working process of this thesis has looked like and what factors to take into consideration throughout the process.

3.1 Research Approach

In order to gain a deeper understanding of what citizens in Gothenburg demand, a qualitative research approach has been chosen. Qualitative research focus on the interpretation of data and are usually more adaptive (Collis & Hussey, 2014). Furthermore, Justesen and Mik-Meyer (2011) explain that qualitative research aims to create a deeper understanding of a context or phenomena. In this thesis, the focus is on citizens and their opinions, it is therefore suitable with an approach allowing interpretation. The authors of this thesis aim to gain an understanding in recycling behaviour of citizens as well as their demands. Additionally, the recycling barge project has just started and there is limited research done regarding mobile recycling solutions. There is a need of performing a more exhaustive investigation in the topic in order to gain a deeper knowledge. Hence, a survey has been performed to fill the research gap. Also, two interviews with experts representing similar projects to the barge project, have been done. The information gained from the survey as well as the interviews have been interpreted and formed the basis of the thesis. Again, a qualitative approach is suitable to apply in this case due to the interpretation of information.

Qualitative methods are often used when doing observations, analyzing texts and performing interviews (Bryman & Bell, 2015). A fundamental approach in this method is to see the reality from the perspective of the respondents (ibid). To gather the relevant information for this thesis, a literature review has been performed of both scientific articles, reports and relevant books. The process when gathering and interpreting the literature has been perspicuous, since information from each source has been briefly summarized in an Excel file. This enabled a convenient working process, because it was easy to get a quick overview of the processed theory. Moreover, monthly meetings with experts from the DenCity project have been attended. The participants in the meetings represented different sectors relevant for the project and possessed specific knowledge. During the meetings, the project was discussed and all participants contributed with their point of view. The meetings opened up for discussion and useful inputs were given from the different perspectives. This enabled a deeper understanding of the topic and inspired the holistic structure of this thesis. For example, it helped create the design of the survey. Also, the participants in the meetings continuously gave feedback throughout the working process of this thesis as well as on the end result. Again, this motivates the choice of the qualitative approach since information from different sources has continuously been interpreted.

According to Bryman and Bell (2015) a disadvantage when using qualitative methods could be the level of subjectivity which makes the results difficult to generalize. Compared to quantitative methods, a qualitative approach does not depend on statistics and numbers. However, since the topic of this thesis is relatively unexplored, it is essential to get a deeper understanding in the field and interpret opinions from inhabitants. However, the research has elements of quantitative approach, since some of the data from the survey were summarized in graphs and tables. Nevertheless, they were mainly used in order to visualize the answers and not to be use as a strictly quantitative research.

This thesis has an abductive approach, which means that there are elements of both deductive and inductive research approaches (Patel & Davidsson, 2011). The authors have gained a deeper understanding in the field from reading previous research and attending meetings before collecting any data. This can be seen as a deductive element. Since the project is new, there are many uncertainties and there will be new elements that contribute to the result of this thesis. Hence, it is crucial to adapt to the presumptions, which is a part of an inductive approach. The mix of the two angles creates the abductive approach.

3.2 Research Design

It is important to consider a research design in order to understand the collection and interpretation of data. The design will determine the process of decisions in the research (Lammgård, 2007). There are different kinds of research designs, in this thesis is case study chosen. A case study is conducted when researchers want to explore a single case that can be generalized (ibid). Since the recycling barge is considered a case and the researchers collect in depth information regarding the project, a case study is suitable. According to Collis and Hussey (2014) it is common to use several methods in order to obtain in-depth knowledge for the case study. In this research, the methods used are survey, interviews and collection of theory. This variety of methods confirm the choice of a case study.

Moreover, Collis and Hussey (2014) mention four types of case studies, descriptive, illustrative, explanatory and experimental. The descriptive and explanatory case studies are not suitable in this context since they refer to existing theory or practices. The recycling barge does not exist yet neither are there much information in theory. The illustrative case study aims to illustrate new procedures connected to a specific company. The concept and idea of this project has existed in other cities. Hence it is not completely new and therefore this type of case study is irrelevant. An experimental case study on the other hand, is the most relevant because this method tries to describe the implications and opportunities in regard to new projects (ibid). By examining opinions from residents around Älvstaden regarding the new recycling barge, key areas of possible implications and opportunities have been recognized. As well, interviews with experts from similar projects have been performed in order to identify potential difficulties with the implementation of the barge. In addition to this, Yin (2018) describes that a case study is usually connected to research questions that aim to examine "*how"* and "*why".* This is also relevant for this thesis due to the articulated research questions.

One difficulty with case studies, described by Collis and Hussey (2014), is to find suitable limitations for the study. Since the recycling barge is a new project there are many variables that must be examined in order to find the right scope of the study. Collis and Hussey (2014) also describe case studies as time consuming and this thesis has a certain time frame which has led to challenges in regard to scope and limitations.

3.3 Data Collection

Both primary- and secondary sources have been used to collect data for this thesis. According to Collis and Hussey (2014), primary data is described as data collected from its´ origin, such as interviews and surveys. In this thesis, both a survey and interviews have been conducted as a part of the data collection. Moreover, several meetings with experts representing different areas, have been attended. Secondary data on the other hand is information gathered from existing sources, such as literature and publications (Collis and Hussey, 2014). In this thesis, scientific articles, reports and literature have been studied in order to gain fundamental knowledge of the topic. Both the primary and secondary data have contributed to get useful knowledge and inputs in regard to the topic. They have also helped to formulate relevant questions both in the survey and to the interviews.

3.3.1 Survey

Survey is defined as a methodology of collecting data from a sample with the purpose to obtain results that can represent a population (Collis & Hussey, 2014). A survey is suitable in this thesis since the project is an unexplored area in Gothenburg and there is a need of collecting opinions regarding the topic. There are different types of survey designs, according to Forza (2002), the three most common types are, exploratory, confirmatory and descriptive survey research. Exploratory survey research is often used when identifying insights during an early phase of a project. Usually there is a lack of previous research and predetermined models. The confirmatory survey research tests if previous theories are valid in regard to the area of research. When conducting a descriptive survey, the researcher aims to explore if there exist any relationships between variables (ibid). The two later approaches, confirmatory and descriptive are not applicable for the purpose of this thesis. The recycling barge is a new project, at an early stage and there are no well-defined models nor any theories new insights can be compared with. Hence, the exploratory research is best suited for this thesis and will be considered during the whole research process.

The questions in the survey had a semi-structured character due to the open questions. Bryman and Bell (2015) mention this as a possibility for respondents to speak freely. Opportunities for unusual answers can thereby be derived. Furthermore, the interviewer had the possibility to adjust the questions depending on answers. Although, there are some disadvantages that must be considered. Open questions are more time consuming due to increased administration and answers must be coded (ibid).

However, before creating the questions for the survey, a checklist (appendix 1) regarding the ethical ways of performing a survey was designed. The answers from the survey represented one of the main inputs for the thesis, hence a proper design was essential. The points in the checklist are a compilation from an article and the literature. The checklist was used as a guideline in order to secure a well worked survey containing all essential aspects. Further, when designing the questions in the survey (appendix 2), inspiration from existing literature, inputs from experts and learnings from similar projects were gathered. Moreover, there was a continuous interaction with experts from different sectors that gave feedback on the questions before performing the survey. Hence, the survey was a living document and the questions were adjusted after feedback until it was regarded as finished. The language used in the survey was adjusted to the spoken language, in order to make sure everyone understood the questions.

The structure of the survey was divided into two parts and each part had different focus and purpose. The first aimed to find out the current recycling behaviour and the second part examined the willingness to use the barge. The motive behind the first part was to understand if there exist a need for improvement in regard to current recycling habits. The second part in the survey was introduced with a description of the concept with the recycling barge at Göta River and gave scenarios about its´ operations. The questions in this part aimed to examine the willingness to use the barge as a recycling option for bulky waste. Further, this part aimed to get a deeper understanding about what demands citizens have to use the barge. This was relevant to examine in order to recognize the attitudes towards the recycling barge as well as identifying crucial factors that could contribute to the actual usage.

Performance of survey

The survey was performed by telephone interviews. Bryman and Bell (2015) highlight benefits and limitations with this type of interview. One benefit is the time saving, considering the interviewers' ability to make all phone calls from the same location. It is therefore seen as a cost-efficient alternative. However, the interviewer cannot observe the body language which can impact the overall impression and evaluation of the interview (ibid). The authors of this thesis have considered the limitations connected to phone interviews, but argue that this will not be a problem in this research. The questions survey is of a relatively insensitive character not connected to a complex or emotive subject.

A company located in Gothenburg called IMA Marknadsutveckling AB performed the telephone interviews. IMA has several years' experience of performing surveys by telephone and have done multiple studies for SWW. Hence, the company is well acquainted with the area concerning recycling. In order to secure a mutual understanding of the purpose of the survey and meaning behind every question, a close dialogue was held with the contact person from IMA. Through continuous email conversations and multiple phone calls, the survey was discussed and adjusted together with this contact person. Due to IMA´s high level of experience, they are considered as professionals within the field. Hence, their input to the survey and to each question was highly valued and taken into consideration. Before actually performing the telephone interviews, the employees at IMA were introduced to the topic and were given specific instructions about the survey. If something would appear unclear during

the telephone interviews, IMA had the possibility to contact the authors of this thesis. After the interviews were completed, the results were discussed with the contact person from IMA. This was done in order to make sure both parts had interpreted the results in the same way.

As stated before, the telephone interviews had a semi-structured character. Therefore, the interviewers from IMA adjusted the question depending on the answer from the respondents. As can be seen in appendix 2, there were standardized questions asked to everyone. However, depending on answers, different follow up questions were asked. For example, if the respondent was negative to a described scenario, the interviewer would ask why and if some additional service or similar was needed in order to change their attitude. On the other hand, if the respondent was positive to the described scenario, this follow up question was not asked. These kinds of questions were predetermined.

As mentioned before, a disadvantage with open questions is the extensive administration. However, since IMA is an experienced and skilled company in regard to performing surveys, one could argue that they know how to handle potential limitations. The company has routines and resources for managing question of this character efficiently, as well as handling the associated administration properly. Moreover, according to IMA a common disadvantage with phone interviews is that many people chose not to answer calls from unknown numbers. This is the case with IMA, they call from an unknown number. When performing this survey IMA called 850 different phone numbers, 288 answered the call but 82 choose not to participate. This resulted in a response rate of approximately 24 %.

Sample

When performing a survey, it is important to choose a sample representing the population (Collis & Hussey, 2014). The purpose of this thesis is to understand the recycling behaviour of residents around Göta River as well as identify the attitudes towards the recycling barge. People living around Göta River are therefore the relevant population and the sample was selected based on this living area. By definition, Eriksberg is not included in Älvstaden, however, due to its´ location it has been considered to be a part of Älvstaden in this thesis.

Three different areas were focused on when choosing the sample. The areas were Eriksberg, Rosenlund and Klippan. The reason why these areas were picked, was because the recycling barge is planned to dock in these specific locations. A crucial factor was that people live close to the quays and that the barge has permission to dock there. Moreover, the infrastructure around the quays had to be suitable for the recycling barge´s operations. All three locations were discussed during meetings with experts. Further, the authors of this thesis searched for zip codes in close connection to the selected quays. These areas were scattered out on printed maps (appendix 3). An analysis of the zip codes and walking distance to the quays was performed in order to select the most appropriate zip codes. After discussing with the partner companies, SSPA and SWW, zip codes in close connection to specific quays were selected. In addition, the number of residents at each zip code was taken from Hitta.se (2019b). Each zip code was searched on at the homepage and summed up to a population of approximately 45 000 inhabitants.

Areas with a long walking distance to the quay or areas not containing households were excluded. For example, some areas comprise of industrial facilities for companies. Hence, they were not relevant respondents for this survey. By selecting zip codes based on walking distance to the quays, everyone living in these areas have an equal chance of being selected. This approach is called random sampling (Collis and Hussey, 2014). The main advantage with random sampling is the avoidance of bias sampling. On the other hand, there is no guarantee that the results are universal (ibid). It is important to keep in mind, that the answers in the survey could have been different if other quays or respondents were selected. Some might have been more or less willing to use the barge if the quays were closer to or further away from their household.

According to Collis and Hussey (2014) a larger sample is better since it will reflect the population to a higher extent. Although, a larger sample size is costly and takes more time (ibid). Approximately 45 000 people live at the chosen zip codes (Hitta.se, 2019b) and are thereby the population included in this thesis. Due to time the constraints of this thesis, it was decided to perform between 200 and 210 telephone interviews. It resulted in 206 respondents and these were divided into the three locations, 70 interviews were performed in Eriksberg, 70 in Rosenlund and 66 in Klippan. This made it possible to identify opinions from three different areas around Älvstaden and compare answers. The sample size was discussed with IMA and they described that 206 respondents were a valid sample of the population in the area.

3.3.2 Interviews

According to Bryman and Bell (2015), the combination of both survey and interviews can generate more information, general and in-depth. Since the topic of this thesis is an unexplored area, interviews with two experts have been performed. Interviews are a popular method used in qualitative research due to flexibility (Collis & Hussey, 2014). A general rule is to design questions according to the targeted respondents (ibid). Bryman and Bell (2015) state three different kinds of interviews; structured-, unstructured-, and semi-structured interviews. In this thesis a semi-structured method was considered as the most appropriate approach due to the context. An advantage with this approach, compared to the structured and unstructured is that it allows for a greater flexibility in regard to making adjustments of the questions and ask follow-up questions depending on the answers (Bryman & Bell, 2015). A semi-structured interview was a well-motivated approach, since it encourages the respondent to speak more freely. The respondents are experts and might have additional inputs the authors did not know about. Hence, this approach enables a way to gain valuable information and insights.

The interview guide (appendix 4) was also semi-structured in order to gain as much insights as possible about similar projects. In this approach, the interviewee does not need to follow the interview guide strictly, and can adjust the order depending on the answers (Bryman & Bell, 2015). The interview guide was designed with the purpose to get more information regarding similar projects and acknowledgements from them. The questions were formulated after studying related information from each project. The main purpose of the questions was to learn from mistakes and recognize the essential drivers for success. The two interview guides were

designed in the similar way, although some questions differ depending on the specific area the expert represented. Further, the questions were formulated as neutral as possible in order to avoid the respondents to be led in a certain direction.

Performance of interviews

Both interviews were conducted by telephone. According to table 1 the interviews took approximately 30 min each. Both interviews were recorded in order to enable the authors to transcribe and listen through the conversations again when needed. Bryman and Bell (2015) recommend this method when performing interviews since it allows for a more reliable transcription. However, according to Collis and Hussey (2014), ethical concerns are important to consider. For example, the two respondents were asked whether they approved the recording of the interview. Also, the purpose of the recording was described. Later, both interviews were semi-transcribed which covered the main information from the conversations. This eased the writing process later in the report.

Selection of respondents

According to Bryman and Bell (2015), it is important to find relevant respondents for the specific purpose in order to get the most accurate information. The two selected respondents have both been involved in similar projects, which motivates the choice. David Dalek, business developer at Renova in Gothenburg, was involved in a project regarding mobile recycling stations scattered in the municipalities around Gothenburg. He was one of the key persons in both the planning stage and in the realization phase of the project. Hence, his knowledge was considered valuable for this thesis.

The other respondent was Jonas Selander Lykeborg and he was one of the main persons in charge for a project called Obelix in Stockholm. This project was similar to the studied project in this thesis. Obelix was a recycling boat for bulky and hazardous waste in the city of Stockholm, which operated during 2006. However, the Obelix project was soon to be closed down, due to different reasons. Selander Lyckeborg´s knowledge was therefore considered valuable for this thesis.

Date for interview	Respondent	Time
13 March	Business Developer, David Dalek	30 Min
22 March	Project Manager, Jonas Selander Lyckeborg	30 Min

Table 1: List of interviews

3.4 Research quality

In order to legitimize the performed research, it is essential to consider the research quality. There are certain aspects that have to be evaluated when reviewing the research. According to Bryman and Bell (2015), the quality of a qualitative research is measured according to two aspects; authenticity and trustworthiness.

According to Lincoln and Denzin (2017) authenticity means that opinions from the participants should be mirrored in a truthful way. One way to mirror the opinions in a truthful way is to have a representative sample for the survey. As described above, 206 respondents were randomly selected and the population consists of approximately 45 000 inhabitants. A larger sample would of course increase the authenticity of the research. However, a sample of 206 respondents can represent the population. Moreover, the research should help people and find measures in order to improve their situation (Lincoln and Denzin, 2017). In this thesis, authenticity is fulfilled since the purpose is to recognize if residents around Göta River find the current solution for recycling of bulky waste to be a problem. If they do, the ambition is to introduce a barge that can ease the recycling behaviour.

The trustworthiness can be divided into four subcategories; credibility, conformability, dependability and transferability, which are often used when evaluating a research (Bryman & Bell, 2015). These aspects have permeated the thesis in order to secure a high research quality. Firstly, qualitative studies are based in the social reality, which makes it challenging to objectively depict it. Although, this is essential in order for others to consider the research as *credible*. In this thesis, the credibility criteria have been addressed by attending several meetings, supervisions and seminars. Hence a comprehensive view has been gained. In addition, the empirical framework consists of several sources. The authors of this thesis argue that the credibility increases when using a wide scope of sources. Thereby, the research includes a variety of perspectives, which allows a higher objectivity

Secondly, Bryman and Bell (2015) state that in order to secure *dependability*, the researcher should present the decisions made throughout the study. Also, it should be easy for the reader to track the origin of sources. This should preferably be controlled by independent examiners to make sure the given information is true (ibid). This criterion has been fulfilled by continuously having a structured working process and document all sources used. Again, supervisions and seminars can be considered valuable when securing dependability. Additionally, this way of working has diminished the risk of missing important aspects during the time of writing the thesis.

Due to the third criterion, *conformability*, the personal opinions of the researcher should not consciously influence the study (Bryman & Bell, 2015). Even if this might be difficult, it is important the researcher keeps the criterion in mind (ibid). The authors of this thesis have strived to fulfill this by not putting any personal opinions into the research. Again, conversations with several partners have helped the authors to increase the conformability by opening up for different perspectives. According to Bryman and Bell (2015), the fourth

criterion, *transferability*, might be difficult to address in a qualitative research. Due to the nature of a qualitative research, the results might not be easy to be simply transferred from one context to another (ibid). This thesis focuses on Gothenburg, therefore, it is not certain that this research is transferable to other cities and cases. Furthermore, Guba and Lincoln (1989) describe that the level of transferability is decided by other researchers. Therefore, the authors of this thesis cannot determine whether this research is fully transferable or not.

4. Empirical Findings

The following chapter will examine findings from the survey. The structure of this chapter will follow the design of the survey, firstly the current state of the recycling behaviour of the inhabitants is described, secondly the attitude and willingness towards the recycling barge will be discovered. Some results are also visualized in figures. Finally, the findings from the two interviews are presented. All numbers in the empirical framework are gathered from the attached Excel document.

Overall, the answers from the three areas; Rosenlund, Klippan and Eriksberg, are quite similar. In some questions, minor variations occurred and these are highlighted where relevant. The pie charts below (figure 3) visualize the age of the respondents. Of the respondents were 55 % female and 45 % male.

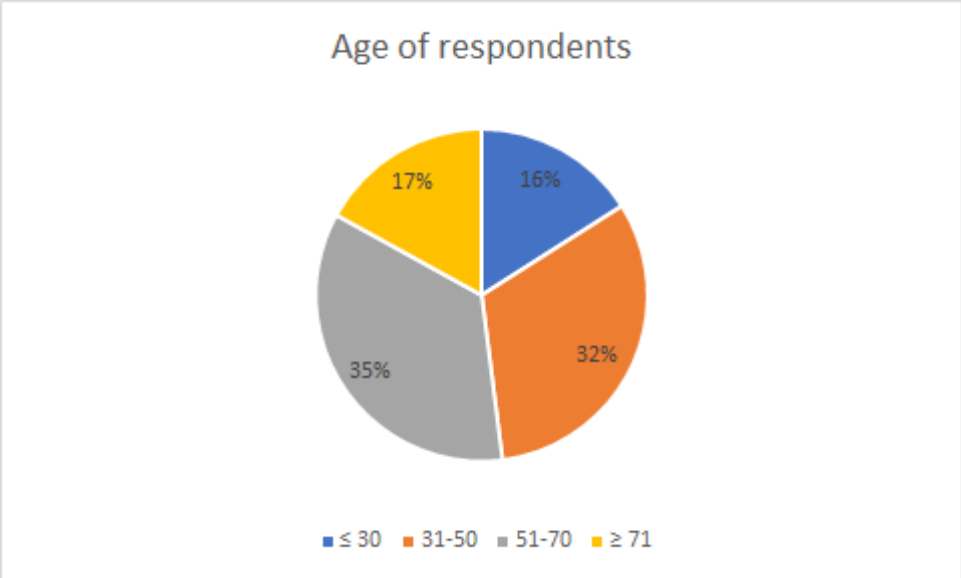


Figure 3: Age of respondents

4.1 Behaviour of residents

This section will present findings from the survey regarding household characteristics and current recycling behaviour.

Recycling behaviour during the five latest years

The initial questions in the survey aimed to find out the recycling behaviour of residents during the five latest years. One question examined whether the respondents have been in need of disposing bulky waste. The other focused on the level of knowledge in regard to handling of bulky waste. Respondents were also asked if they had used any kind of service when disposing bulky waste.

It turned out that 92% of the respondents, at least once during the five latest years, has needed to dispose bulky waste. The majority, 67%, replied that they went to a recycling center to get rid of items. Furthermore, 13% and 12% respectively, recycled their bulky waste in a garbage room for bulky waste or in a temporary container provided by the landlord. Other answers indicated that ordinary garbage rooms intended for household waste were used to get rid of bulky waste. Further, a small share of the respondents still stores items at home or have left it for second hand. One distinction that can be made between the three areas, is that people living in Rosenlund and Klippan used garbage rooms for bulky waste to a larger extent than residents in Eriksberg. The residents in Eriksberg stand for the highest percentage concerning trips to recycling centers.

Moreover, 30% of the respondents implied that they at least once during the five latest years did not know how or where to dispose a certain item classified as bulky waste. Of these, 46% described that they as a consequence put such items in their storage room. Furthermore, some respondent used the ordinary garbage room since they did not know where else to put it. Only a minor share, sold or donated the item to second hand alternatively to charity. Below follow some quotes describing what they did with the items when they did not know where to dispose it. The quotes show that there exists a lack in knowledge and that respondents prefer convenient solutions. The answers are independent of gender and age.

"Store the bulky waste in the closet" (respondent 19, female, 38 years)

"I do not have a car anymore, what should one do then? I had to give the bulky waste to my son who drove to another municipality" (respondent 140, female, 75 years)

In addition to this, 17% of all 206 respondents in the survey had used a service in order to get rid of bulky waste. Respondents referred to both companies and charity organizations picking up different items. For example, companies replacing an old dishwasher with a new. When asked why they used such services, several different reasons were mentioned. A few are stated below:

"It is inconvenient to go to a recycling center" (Respondent 190, female, 39 years)

"I do not have a car, I cannot manage it myself" (Respondent 8, female, 85 years)

"A service is convenient, it costed 1000 SEK, with installation included" (Respondent 189, male, 72 years)

These opinions were shared with other respondents replying in a similar way. The result of the survey cannot determine whether there exists a connection between car ownership and usage of a service. This because the answers were similar for respondent both owning and not owning a car.

Characteristics of households

In order to get a deeper understanding of recycling behaviour, a question regarding how many people living in the households was asked. The answers are summed up in a pie chart (figure 5) divided in three. The numbers show that 27% of the respondents live alone, 25% are living with kids and the rest are households containing two or more adults.

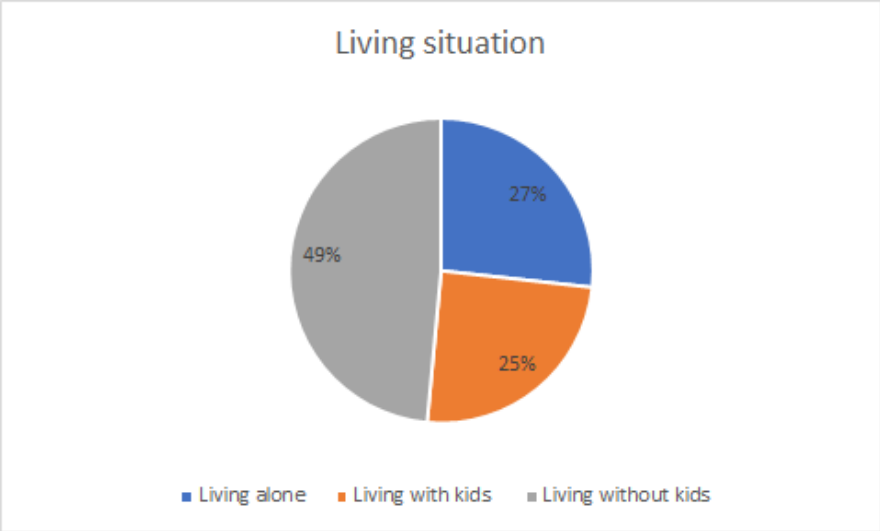


Figure 4: Living situation

Another question regarding the characteristics of households concerned the access to storage rooms. The replies indicated that 65% of the respondents have access to a storage room in their building where they can store bulky waste before getting rid of it.

A question regarding the usage of cars was asked. The answers showed that 64% of the total sample had a car (Figure 5). Out of the respondents that did not have a car, 57% had rented a car with the purpose to dispose bulky waste. A distinguished difference between the three locations, is that residents living in Eriksberg have access to cars to a larger extent compared to the other two areas. See figure 6.

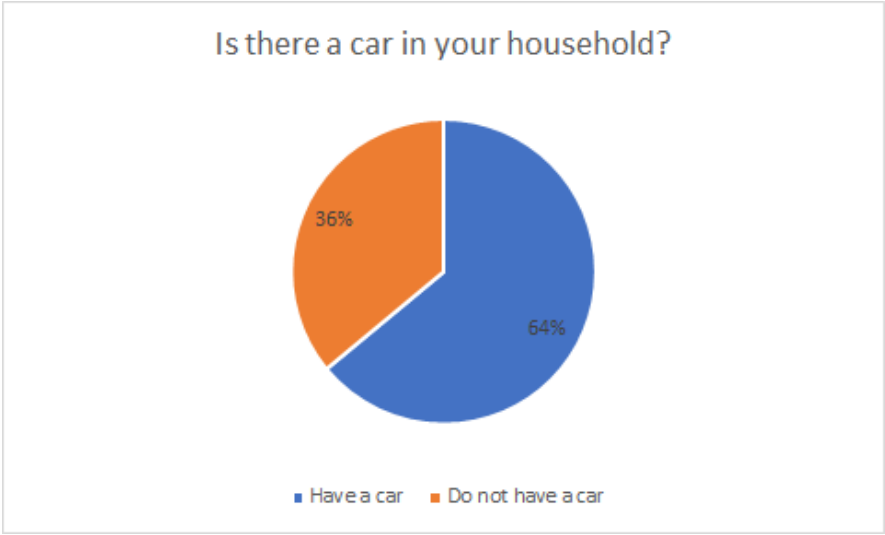


Figure 5: Is there a car in your household?

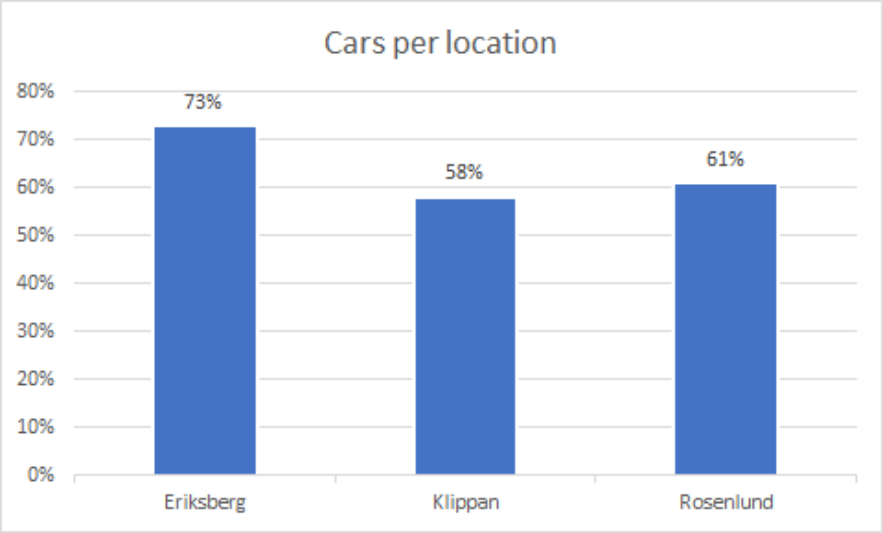


Figure 6: Cars per location

Level of satisfaction

One of the questions examined the level of satisfaction in regard to the current recycling situation for bulky waste. The respondents were asked to rank their level of satisfaction from a scale ranging from 1-5. Number 1 corresponds with *very dissatisfied* and number 5 refers to *very satisfied.* A score from 1-3 indicates that the respondent is dissatisfied, while 4-5 show satisfaction. In general, 56% of the respondents are satisfied whilst the rest are dissatisfied or has no opinion. The main reason behind the dissatisfaction is explained with the long distance to recycling centers and the necessity of using a car. The following opinions are examples mentioned by respondents dissatisfied with the current recycling situation for bulky waste. The quoted answers have similarities, independent of gender and age.

"Far and inconvenient" (respondent 32, female 58 years)

"It could be easier" (respondent 87, female, 37 years)

"The recycling center is too far away, and I do not have a car" (respondent 24, female, 65 years*)*

"There is no possibility for me to get rid of big items nearby, I always need to ask a relative" (respondent 164, female, 74 years)

"If you do not have a car, it is obviously ranked as 1, because it is almost impossible to take the bus all way there in a good way" (respondent 81, male, 44 years)

"It feels like there is not much information about how to handle the waste and it is not convenient" (Respondent 49, female, 23 years)

"I have not recycled bulky waste before or had a need, so I have not thought about it yet" (Respondent 5, male, 24 years)

Figure 7 visualizes the level of satisfaction of the total sample of respondents as well as the distribution over the three locations.

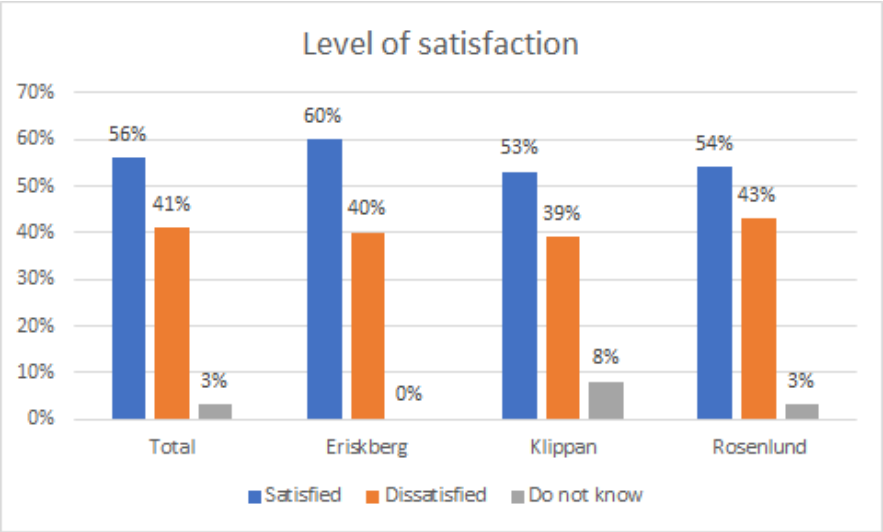


Figure 7: Level of Satisfaction

Another aspect worth mentioning in this context is that respondents with a car were satisfied to a larger extent than respondents without a car. Of the respondents with a car in their household, 63% scored a number of 4 or 5 whilst 43% of the respondents that do not have a car shared the positive attitude.

4.2 Willingness/attitudes to use the recycling barge

This section will present the opinions about the recycling barge and what factors influencing the willingness to use it.

Attitudes towards the barge

In the survey, two scenarios were depicted regarding the willingness to use the recycling barge. The first scenario aimed to find out whether residents would bring smaller items, classified as bulky- or hazardous waste, to the barge. The second scenario on the other hand focused on the willingness of leaving larger items on the barge. Numbers showed that 77% of the respondents had a positive attitude to bring smaller items, whilst 48% were willing to bring larger bulky items to the barge. Respondents having a negative attitude to bring smaller items, mainly motivated their statement by saying that they have a garbage room for bulky waste or are provided with a container. Moreover, another frequent answer was that they preferred going to a traditional recycling center instead. Below are some of the statements from respondents connected to why they would not bring smaller bulky waste to the barge.

"Too far for me to walk" (respondent 69, female, 80 years)

"I do not want to adjust to the scheduled opening hours" (respondent 66, male, 43 years)

"I would rather store items and drive with everything to a recycling center. It is more convenient to go by car" (respondent 128, female, 34 years)

The main reasons behind the lacking willingness to bring larger bulky items, were that it would be too heavy as well as unmanageable. Still, a lot of residents would rather go to a traditional recycling center instead of carrying items to the barge. Comments mentioned in regard to not bringing large bulky items to the recycling barge are stated below:

"It is difficult to bring larger items without a car" (Respondent 81, male, 44 years)

"I need help to carry it and if the car is needed one would rather go to the recycling center" (respondent 102, female, 52 years)

"There is no way for me to transport the items to the boat" (respondent 49, female, 23 years)

One noticed difference between the locations, is that residents in Rosenlund were less likely to use the recycling barge in both scenarios. Out of respondents in Rosenlund, 30% would not bring smaller bulky items compared to 21% in Klippan and 17% respectively in Eriksberg. Additionally, a negative attitude to bring larger bulky items was 63% in Rosenlund, relative to 45% in Klippan and 47% in Eriksberg.

Moreover, 73% of the respondents having a car are willing to use the recycling barge for smaller items and 85% of the respondents that do not have a car shared the same opinion. When it comes to larger bulky items, it turned out that residents with a car were interested to use the recycling barge to a larger extent compared to those without a car, 51% and 43% respectively.

Factors influencing the willingness to use the barge

A question regarding the possibility to leave items for second hand or charity was asked in the survey with the aim to recognize if this was desirable. Moreover, this question sought to give an understanding of what kind of items people want to bring. The majority of the respondents, 79%, wanted the possibility to leave items for second hand or charity on the recycling barge. In Eriksberg, 94%, had a positive attitude towards the suggestion whilst, 66% in Rosenlund had the same opinion. Klippan was in between with 76 % finding this a good idea. Clothes and fabric were the most frequently mentioned category of items to hand in for second hand or charity. The second most mentioned item was smaller household items. Other categories stated were, furniture, toys, electronics and books.

Another question in the survey aimed to find out whether any kind of service could ease the movement of items to the recycling barge and thereby influence the willingness to use it. It was

an open answer question and several suggestions were mentioned. It turned out that 32% wanted a pick-up service where waste is collected directly from home. Cargo bikes and trolleys as well as the possibility to rent a car or trailer were also mentioned as suggestions. Many of them were also willing to pay a fee for using a service. However, 42% of the respondents did not come up with any ideas.

In the question regarding preferred opening hours, the respondent could answer freely which day or days they wished the barge to be accessible. This is important to understand from an operational point of view. The majority wanted the barge to be opened during weekends. The least favorable day was Fridays and around a fifth did not consider the opening hours relevant. Respondents preferring weekends, got an additional question regarding how crucial these opening days were in order for them to use the barge. For 56% of the respondents, it was definitive.

The way to communicate information about the barge is also important to understand from an operational point of view. Hence, a question regarding what channels being most appropriate was asked. The most favorable suggestion was to get the information by post, 40 % of the respondent preferred this option. The second most favorable alternative was public advertisement, followed by social media and announcement in newspapers.

4.3 Interviews - Earlier projects

There are two projects similar to the one examined in this thesis, one of them operated in Gothenburg and one in Stockholm. In the section below, interviews with two experts from these projects are presented as well as information from appurtenant reports.

4.3.1 Mobile recycling centers in the municipalities around Gothenburg

During the interview with David Dalek[6], the drivers behind the implementation of a project testing mobile recycling center were described. Recycling centers are often located outside cities and it requires a car to get there. In addition, there is a demand for recycling centers to be located closer to the households where the waste is generated. Therefore, municipalities in general have started to investigate the possibilities to implement solutions for recycling centers located closer to the households. The municipalities around Gothenburg were no exception and they started to look into the idea of using mobile recycling centers for bulky- and hazardous waste that could be temporary located closer to citizens. During 2016, Renova decided to realize the idea and perform a pilot study in the municipalities located around Gothenburg. During a period of three weeks, the concept of mobile recycling centers was tested in Ale, Härryda, Kungälv and Mölndal in order to recognize the actual usage and success of it. Dalek further described that the preliminary aim was to locate the mobile recycling centers in close connection to apartments. According to Dalek, an assumption is that this group of residents normally does not have access to a car to the same extent as residents in houses. Hence, it can

[6] David Dalek, Business Developer Renova, Interview March 13th 2019

become more complicated to transport bulky waste to a recycling center since there is more or less a need for a car when going to a recycling center. The mobile recycling centers partly aimed to fill this gap by getting closer to residents living in apartments.

David Dalek described:

"It was a part of my job to recognize different development projects and we had a workshop together with the municipalities where we discussed potential ideas for improvement. A suggestion to consider a mobile recycling center in order to get closer to inhabitants not owning a car was mentioned. There is a need to dispose items, despite the usual household garbage, even if you live in an apartment. That was the start, and I had the responsibility to look into how this would be practically possible. We suggested that a pilot project would be a good start"

The pilot project enabled Renova to gain useful information and experience about the concept. Variables such as what kind of materials the inhabitants would dispose, in what quantities and the popularity of the project contributed to a holistic understanding. Also, it increased the understanding for what kind of equipment, containers and workforce being required on the mobile recycling centers. This was useful information due to the unexplored area and it was essential to understand whether it was a successful concept. Dalek described during the interview the complexity and many aspects to take into consideration when introducing a new concept. Factors such as suitable and appreciated locations for the mobile recycling centers as well as the actual layout of the place in order to enable a smooth flow was important to find out. Dalek said:

"This was a project and then there is a possibility for continuous improvements. If you have a permanent concept it must work in another way"

The pilot study turned out to be successful and the initiative was appreciated amongst the visitors. Some useful and important knowledge were gained from the project. The most disposed material at the mobile recycling centers turned out to be inert materials such as glass, chinaware, ceramics and metal. The opportunity to leave items for second hand were also highly appreciated and utilized. Another insight Renova gained was that persons living in apartments with access to a garbage room for bulky waste were still demanding and appreciating the mobile recycling centers. It was also identified that people living in houses had larger amounts of waste than people living in apartments. In addition, David Dalek described that many visitors came with items they had stored for a while.

"Many seniors brought big quantities of old skillets that they had collected and stored in bags during a longer time since they could not get rid of it"

Moreover, it was recognized that people from urban areas visited the mobile recycle centers to a higher extent compared to people in the countryside. How visitors got there varied, some

walked, some with wheelbarrows to ease the transportation of items, others arrived with car. Dalek stated during the interview:

"How to get there differed depending on where the recycling center was located. Locations outside the urban areas were mainly visited by car, but if we were placed on a square, the visitors came by foot or with a trolley"

Further, when planning for the locations for the mobile recycling centers, practical factors were considered. For example, the infrastructure around the locations and the design of a logistics system for a smooth functionality were analyzed. Dalek highlighted the importance of creating an efficient flow for the visitors through the whole experience. It should be accessible for residents nearby and be easy to use as well as understand where to dispose different kinds of materials.

Before the mobile recycling centers were placed in each municipality, Renova communicated the location and opening hours through different channels to the residents. The communication tools were decided by each municipality, which means, the information reached residents in different ways. For example, they informed about the project on the different municipalities' web pages. Moreover, the local newspaper was used as well as, in two municipalities, the post. It was also advertised on signs in the municipality.

The mobile recycling centers were open between 4 pm to 9 pm or 4 pm to 8 pm depending on location. Dalek, described that these hours were applied since they wanted to be accessible after the regular working hours for residents and enable as many as possible to come visit. In the report of Dalek (2017), it was stated that the rush hours were between 4pm and 7pm, in average 87% of the visitors came during these hours.

Dalek[7] further described, the idea of a mobile recycling center was appreciated by inhabitants in the municipality. Regardless age and if they owed a car or not, the visitors wanted this concept to continue. Further, Renova considered the mobile recycling centers a good opportunity to educate in recycling behaviour. Dalek does not think people reflect much about their recycling behaviour in regard to bulky waste. People know they want to get rid of things but they do not spend much time thinking about a new solution easing the process of recycling bulky waste. Hence, Renova found this project a great opportunity to get closer to users. Currently, a mobile recycling center is implemented in Kungälv and this is not considered a project any longer, rather a realized solution. Dalek summarized the situation as follows:

"We are satisfied with the mobile recycling center in Kungälv today. There are very few problems. This is a service we actually offer the municipalities. There is a standardized and applied price models and a description of the concept for the interested. There is always possibility to improve the product, however, we are satisfied with it, it operates well and generates only minor complications"

[7] David Dalek, Business Developer Renova, Interview March 13th 2019

4.3.2 The Obelix project in Stockholm

During the interview with Jonas Selander Lyckeborg, the Obelix project in Stockholm was discussed. Selander Lyckeborg[8] described that during spring 2006, Stockholm Waste and Recycling initiated a project called "Obelix". The main idea with Obelix, was to increase the convenience for recycling of bulky- and hazardous waste in the city center of Stockholm by providing a recycling boat. There were different motives behind the initiative. One of them was described as a natural consequence due to the increase in urbanization in the city. Another essential aspect relevant in order to initiate the project was the distance to the recycling centers. The current solution required a car in order to get to a recycling center. Selander Lyckeborg worked as a project manager during the time and dealt with both the operations and development of the recycling boat. Selander Lyckeborg described the purpose of the project:

"The purpose of the Obelix project was to increase the accessibility in the inner city of Stockholm. The target group was primarily the ones without access to a vehicle. -//- The intention was to provide pick up points for bulky waste in the core city where it is difficult to establish other collection systems"

Moreover, Selander Lyckeborg stated there had been some difficulties with bulky waste in Stockholm due to the high competition of unutilized space. There were to some extent garbage rooms for bulky waste, however, they were described as easy to neglect. Landlords often prioritize to use the space for other purposes than recycling of bulky waste and thereby refer to recycling centers. Hence, there was an identified need for improved solutions for the recycling of bulky and hazardous waste. Good motives existed for the implementation of a recycling boat for bulky waste in the inner city.

In 2006, the Obelix project was realized. The boat was equipped with containers intended for different kinds of materials. It docked at several locations; Norra Mälarstranden, Södra Mälarstranden, Skeppsbron and Hornstulls strand. Various factors impacted the selection of locations to dock at. The top priority was to dock at quays close to where people live in dense areas. Thereby industrial areas were excluded. However, Selander Lyckeborg mentioned the many challenges when choosing locations. Firstly, they had to adjust to existing permissions and it was tedious to legally be able to dock at quays. Hence, there was a high competition in regard to accessibility to quays. Secondly, the characteristics and quality of quays had to keep a good standard. It was crucial to find a quay where the ramp from the boat could be lowered. This was a complication since not all quays had the suitable infrastructure for the ramp. It was also important to consider the infrastructure around the quays, since it should be easy for the visitors to bring bulky items there without using a car. Finally, the sea level played an important role, since it could affect the operations of the boat. For example, if the sea level was too low, the boat could not dock. Selander Lyckeborg stated the following:

"We docked where it was possible. Stockholm has a high number of quays, however, it turned out that it was very difficult to find suitable locations to dock"

[8] Jonas Selander Lyckeborg, Project Manager Obelix, Interview March 22nd 2019

Selander Lyckeborg described that the initiative was highly appreciated amongst the citizens. Some reflections were made after the project finished. The opportunity to leave items for second hand was very popular. Large quantities were handed in and clothes were generally the most frequent item to leave. The Obelix project had collaborations with charity organizations responsible for the second hand containers. Although, it was described that large quantities of second hand items were difficult to handle. When it came to bulky waste, the most disposed items were pieces of furniture and electronics. Visitors used different means in order to carry bulky items to the boat. Selander Lyckeborg described:

"*Some visitors walked to the boat, carrying their bulky items on strollers, trolleys or bags. Some came with a bike with their stuff. And in some cases, they arrived by car"*

Selander Lyckeborg also had the impression that people in general do not spend much time thinking about their recycling behaviour. They know they want to get rid of things fast, but do not think much about how. Utrednings- and Statistikkontoret (2006) investigated some results from the recycling boat. One interesting finding was that many people said they did not possess any bulky waste. This was the most common reason for why citizens did not use the recycling boat. Another finding in the report was that the majority of the respondents in Stockholm, 70%, had gained the knowledge about the barge in local newspapers (ibid).

Nevertheless, due to different factors the project had to shut down according to Selander Lyckeborg[9]. It was especially difficult to motivate the high costs for the Obelix project. It turned out that the recycling boat had a significantly higher cost per ton in comparison with the handling cost on ordinary recycling centers in Stockholm. However, Selander Lyckeborg said that this reason would probably be considered differently today. The social benefit and value of communication promoting a sustainable recycling would probably be considered higher.

[9] Jonas Selander Lyckeborg, Project Manager Obelix, Interview March 22nd 2019

5. Analysis

In the following chapter the theoretical- and empirical framework will be compared into an analysis. The first section is a general analysis regarding the topic. Later, differences as well as similarities will be highlighted based on each research question.

The DenCity Project

The purpose of the DenCity project is develop transportation and mobility solutions that can result in a reduction of cars in the city center of Gothenburg and thereby increase the living standard for inhabitants. This is in line with the ongoing discussion Woodburn and Whiteing (2015) mention, roads are used over capacity and there is a need to reduce the amount of traffic on roads. A change from road to other modes of transportation can also have positive effects on the environment, such as a decrease in congestion, pollution and an increase in space for citizens. The DenCity project focuses on handling the negative impact cars cause at the local level described by Giuliano (2018). City of Gothenburg (2015) describes the upcoming projects in regard to the construction of new apartments, buildings and infrastructure. This will lead to new urban challenges, since the number of parking lots is expected to decrease significantly. A barge for recycling will represent one solution for waste handling without using a car. In addition, a barge is a better traffic mode compared to trucks or cars due to the social benefits as well as decrease in congestion (Woodburn & Whiteing, 2015). Konings (2009) also highlights the benefits with using a barge. A barge is a flexible traffic mode that can handle large quantities. In this project, a barge is suitable since it requires managing uncertainties.

In the DenCity project, several actors from both the public- and private sectors are involved. According to Taniguchi and Thompson (2015) as well as Lindholm and Browne (2015), collaboration and communication between different sectors are essential in efficient planning and operation of urban logistics. The role of the public sector is especially important since they often have resources and the power to make decisions for the city. This is further confirmed by Williams (2015), who states the importance of several actors collaborating to handle challenges in regard to urbanization more efficiently. Williams (2015) describes waste handling as essential to focus on. It is important to adapt a more sustainable living standard and move towards prevention in the waste hierarchy. Several benefits are highlighted when moving up in the hierarchy, primarily it will generate a positive effect on public health and the environment. When going towards waste prevention it is initially going to affect on a local level but in the long run also have a positive impact on a regional and global level. As stated above, DenCity is primary performing projects in Gothenburg, focusing on the local level. Hence, the recycling barge will have an effect on local level. It is meant to be used by citizens in Gothenburg and infrastructure around the project will be applied due to the specific characteristics of the city. Since Gothenburg is a port city with a river, a barge can be included in the existing urban infrastructure to a large extent. This is not possible to apply to other cities with no access to water.

5.1 How do residents recycle bulky waste today?

Several factors impact the recycling behaviour amongst residents in Älvstaden, these are analyzed and presented in this section.

Current handling of bulky waste

According to Eklund et al. (2010), recycling centers are often located outside of city centers and the need of a car is more or less essential in order to get there. This is the case in Gothenburg. Today, the logistics related to recycling of bulky waste is based on the usage of a car. The recycling centers are located in Alelyckan, Bulycke, Högsbo, Sävenäs and Tagene which are outside the dense areas of Gothenburg (City of Gothenburg, 2019). During the interviews with Dalek and Selander Lyckeborg they confirmed the need of a car when going to a recycling center. In the survey, a question regarding the handling of bulky waste was asked. An often-mentioned answer indicated that respondents not owning a car found it difficult to dispose bulky waste without help. Further, some respondents punctuated the inconvenience with recycling centers due to the complexity to get there.

According to Bernstad (2014), convenient systems are important in order to make people recycle. Currently, the majority of the respondents in the survey went to a recycling center outside of Gothenburg to dispose their bulky waste. Since it is more or less a need to use a car, one can assume that the respondents find solutions based on the usage of cars convenient. Further, garbage room for bulky waste or containers provided by the landlord was the two second most common answers. A minor part of the respondents said they left items for second hand or disposed it in the ordinary garbage room, others still store it at home. Garbage room for bulky waste and containers are located close to households. In terms of distance, this is convenient for residents. This goes in line with what Bernstad (2014) describes. It is important to have recycling options located close to where people generate waste. In addition to this, the city of Gothenburg (2019) has stated that inhabitants living in apartments should be provided with options, such as containers or garbage rooms for bulky waste. Although, the survey indicates that this is not used to the same extent that one might expect due to statement from the City of Gothenburg (2019).

Some of the respondents also used a service to get rid of their bulky waste. The service could for example be a charity organization picking up items from peoples´ home or a company delivering a new dishwasher removing the old one as well. One could assume that people without a car would use these services to a higher extent than people not having a car. Although, the results from the survey indicate the opposite. People without a car did not use these services more than people with car. However, people in general like convenient solutions and pick up services from home is really convenient.

Residents knowledge about bulky waste handling

The results from the survey indicated that 92% of the respondents have been in need of disposing bulky waste at least once during the five latest years. In the Obelix project, 52% of their sample mentioned that they did not have any bulky waste and this was the reason why

they did not use the recycling boat. However, the survey in this research find the opposite in Gothenburg, which means that there is a need for recycling systems handling bulky waste.

Moreover, the survey showed that 30% had a poor understanding of where to dispose a certain item classified as bulky waste. Nearly half of them stored the material since they did not know what to do with it. In addition, the majority of the respondents have access to a storage room where they can leave bulky waste before they dispose it. This can be linked to the phenomena described by Halldórsson et al. (2018), since they argue that bulky- and hazardous waste typically is stored longer. Further, this can also be confirmed by Dalek since this was the case in the mobile recycling centers project. Many visitors brought items they have stored for a while since they did not have any opportunity to get rid of it.

Other answers in the survey indicated residents chose to leave bulky waste in the ordinary garbage room due to the lack of knowledge. Again, this shows that people want convenient solutions and do not spend time searching for information about it. Selander Lyckeborg mentioned during the interview that information regarding the handling of bulky waste is not communicated to the same extent as household- and food waste. This could be an explanation of the lack of knowledge amongst residents. According to Bernstad 2014, people need convenient options in order to recycle. Therefore, one can assume that if there is no option close to the household, people make the minimum effort to get rid of the waste. Hence, they take the most convenient option by either storing it or leave it in the ordinary garbage room for household waste.

Recycling opportunities for residents living in Älvstaden

According to Eklund et al. (2010), it is more common for people living in houses to visit a recycling center. However, the literature barely mentions recycling habits amongst people living in apartments. Answers from the survey indicate that there exists a relatively high need for disposing bulky waste even when living in apartments. It is a large group of people living in Älvstaden that generates bulky waste and need to get rid of it. It is mainly apartment buildings in Älvstaden and in comparison to houses, there are less parking spots as well as few households with gardens. One can assume that people living in apartments have other kinds of waste and cannot as easily get rid of it. Again, there is a need for a car when visiting a recycling center, since they are located in suburban areas of Gothenburg. As identified in the survey, people living in Älvstaden need to recycle bulky waste. Due to the large number of residents living in this area, it is important to encourage these to recycle in order to strive for a sustainable future. This group of people cannot be forgotten. The recycling barge on Göta River is one way to get closer to the residents in Älvstaden. In addition, due to the planned constructions, the logistics flow and infrastructure need to be considered and adjusted to the new conditions. Further, Williams (2015) states the importance of collaboration between different stakeholders in order to reach for a sustainable waste management. In this case, there is a pressure on both residents in Älvstaden as well as the municipality of Gothenburg to take responsibility together to reach a sustainable waste handling. The municipality of Gothenburg does this by providing a recycling barge that comes closer to the citizens compared to the traditional recycling centers. However, it is important the residents also make an effort to use the barge.

Level of satisfaction with the current recycling situation

In the survey, the respondents were asked to rank their level of satisfaction in regard to their current recycling situation for bulky waste. As stated in the empirical framework, 56 % of the respondents were satisfied, the rest were dissatisfied or had no opinion. The most frequently mentioned answer motivating why they were dissatisfied, was the long distances to a recycling center and the need for a car. Again, the statements from Dalek and Selander Lyckeborg are confirmed since they also describe this as an implication. Moreover, as Miliute-Plepiene, et al. (2016) state, it is necessary to provide residents with convenient recycling systems in close connection to households. They further describe the benefits with this, since it motivates residents to recycle more. Hence, the level of satisfaction would most likely increase if recycling options were located closer to their households. Interesting to notice, amongst the respondents that were satisfied with their current situation, did the majority have access to a car. One can assume that with today´s solutions for recycling of bulky waste, a car enables the most convenient option.

5.2 What do residents in Älvstaden demand in order to recycle bulky waste on the recycling barge?

The residents in Älvstaden did not reflect much upon what they demand in regard to systems for bulky waste handling. Although, some essential factors emerged from the theoretical and empirical framework. These are analyzed in the following section.

Lacking interest and the importance of convenience

According to Dalek and Selander Lyckeborg, people do not reflect much upon their recycling behaviour. People want to get rid of their waste, however they do not actively think about new possible solutions. In the survey, it showed that 42% of the respondents could not come up with any ideas in regard to services that could ease the movement of bulky waste to the barge and thereby initiate the first mile. This supports Dalek´s and Selander Lyckeborg´s statement.

Further, the survey examined the attitudes towards using the recycling barge. The data showed that 77% were willing to use the barge when leaving smaller items. However, only 48% of the respondents were keen on using the barge when bringing larger bulky items. In general, the lacking willingness was motivated with the inconvenience to bring items to the recycling barge without using a car. People with a negative attitude towards bringing smaller items to the barge, mainly explained that they were satisfied with their current solution for disposing bulky waste. For example, they mentioned that they had garbage room for bulky waste close to their household. The lacking willingness to bring larger items were motivated by the characteristics of the items. This kind of items could be unmanageable and too heavy to carry to the recycling barge. The negative attitudes towards using the recycling barge indicated, again, the importance of convenience.

Nevertheless, even if there existed a group of people with a negative attitude towards the recycling barge, there is still a demand for it. The majority of respondents had a positive attitude

to bring smaller items to the recycling barge and approximately half were willing to bring larger items. The opinions regarding the barge differ to some extent in the three different areas. Residents in Klippan and Eriksberg were more likely to use the barge for both small and large items. Interesting to notice, Eriksberg is the location with the highest access to cars. As discussed above, residents demand convenient solutions and cars are often mentioned as a convenient option. Therefore, one could assume that residents living in Eriksberg would prefer to use their car and go to a traditional recycling center instead. However, the results show that the access to cars do not affect the willingness to use the barge as much as one might think.

Service that could increase the willingness to use the recycling barge

Residents in Älvstaden can be considered as the initiators to a reverse waste flow, first mile. According to Macioszek (2018) this flow starts when individuals decide to get rid of an item. In this case, the potential users of the recycling barge initiate the reverse flow when they take items from their household. The first mile in this case is sensitive because the residents are the ones deciding how the first mile is created and to which destinations. In the survey, it turned out that a service would increase the willingness to use the recycling barge for some respondents. By providing a service that could ease the movement of bulky waste, it could trigger the first mile. A group of 32% wished for a service picking the bulky waste directly from home to the barge. Again, this shows that many people desire convenient solutions. Some respondents also wanted the possibility to rent a cargo bike or trolley. It is important to consider this and meet the demands of a service so that more people use the barge.

The possibility to leave items for second hand is a demand

The majority of the respondents desire the possibility to leave items for second hand or charity on the recycling barge. This was the case in earlier projects as well. In the Obelix project the opportunity to leave items for reuse was highly appreciated and the staff could barely manage to handle the inflow of items. In addition, Dalek described that this opportunity was popular in the mobile recycling centers as well. According to Naturskyddsföreningen (2018), it has become more popular during the later years to leave items for reuse. More and more people are purchasing clothes and other items from second hand stores which can be seen as a positive trend. Williams (2015) describes that the key objective in waste and resource management is to reach for the top levels in the waste hierarchy. Second hand items are included in the reuse level, which is considered as the second most favorable option. By providing the opportunity to leave items for reuse on the recycling barge, this positive trend will be encouraged.

Importance of a sustainable mindset

Taniguchi and Thompson (2015) discuss that the mindset amongst companies is essential to change in order to achieve a more sustainable urban logistics. In this research, the involved companies in DenCity have understood the importance of a sustainable way of thinking. However, it is crucial to encourage the residents to share the same visions in an effort to reach a more sustainable city. Thus, it is crucial for individuals to leave their comfort zone and adapt a more open-minded way for waste handling. This concept is also described by Williams (2015), since he highlights the significance of all actors' involvement in sustainable waste management. Further, Williams (2015) stresses that individuals constitute an equal role as other

stakeholders in the development process. This reasoning goes in line with the above stated, that residents need to change their mindset as dense areas must be used more efficiently. Arvidsson et al. (2017) states that roads in cities are already exceeding the capacity which leads to negative environmental effects. In addition, City of Gothenburg (2015) describes all upcoming constructions in Älvstaden. This will most likely happen at the expense of the road network and lead to increased challenges in urban logistics, for example, in terms of more congestion and less parking space. According to Rose et al. (2017), an efficient urban logistics system is important to develop in order to meet these challenges. This statement is supported by Browne et al. (2018). The recycling barge is one solution for a more efficient logistics, since it operates on water and relieve traffic from the roads in urban areas.

5.3 How should the logistic system, connected to the recycling barge, be designed in order for residents in Älvstaden to use it?

The analysis has revealed that a barge must be designed to handle the following aspect: logistics flow, characteristics of waterways, infrastructure, operations, first mile and the way of communication.

There must be an efficient logistics flow

In order to make people use the barge and return a second time, an efficient logistics flow is essential. During the interview with Dalek, the importance of designing an adequate logistics flow was highlighted. Further, the way to the recycling center as well as the impression of the visit were described as two important factors in order to attract visitors. Hence, when designing a logistics system for the recycling barge, the overall experience from the visitors' point of view is crucial in order to make them return. In addition, it is essential to meet the new conditions Älvstaden are facing with new constructions and less parking lots (City of Gothenburg, 2015). Hence, there are several factors to take into consideration when designing a logistics system.

Taking the characteristics of waterways into consideration

Urban logistics are facing challenges due to climate change (Woodburn & Whiteing, 2015). The roads are used over their capacity and there is a need to change the traffic mode to make cities more sustainable. The waterways in Gothenburg is currently not used to its full extent and it could be utilized to a higher degree (Arvidsson et al. 2017). The implementation of the recycling barge on Göta River is one way of using the waterways more efficiently. Instead of developing systems based on road traffic, this project is using the waterways. According to Browne and Woxenius (2018), it is not necessary to use roads when there is easy access to waterways. Hence, Gothenburg have the right conditions to use urban freight on waterways. In addition, waterways have many benefits in regard to the environmental aspect and can be one solution for a more efficient urban logistics. Both Arvidsson et al. (2017) and Woodburn and Whiteing (2015) highlight the advantage with utilizing waterways. For example, they mention the decrease in congestion. From an environmental perspective, a barge can improve the environment in the city center. In the long run, this can increase the living standard for the inhabitants and it is one step towards a more sustainable Gothenburg. One could hope that

residents´ willingness to use the barge would increase if they acknowledge the environmental benefits with utilizing the waterways. Moreover, as Williams (2015) states, waste management should be more about attitudes and lifestyle choices rather than just the waste and its handling. Again, this mindset must be embraced amongst residents. If a sustainable approach becomes natural, it is more likely that recycling systems reach towards its´ full potential.

The infrastructure of and around the quays is a crucial factor

When designing a logistics system for the recycling barge, the access to as well as the infrastructure around the quays are crucial. The barge will operate in Älvstaden and dock at predetermined locations. During the interview with Selander Lyckeborg, it appeared that finding suitable quays in Obelix project was more difficult than it seemed in Stockholm. For example, permission to utilize specific quays and the infrastructure and quality of them were described as main issues. Further, it was important to find quays located close to where people live and with easy access to go visit the recycling boat. The sea level was also described as a challenging factor to consider. This is useful information when designing a logistics system for the recycling barge in the DenCity project. The results from the survey also show the importance with quays having easy accessibility. Throughout the answers, it is obvious that a major concern in order to use the recycling barge, is convenience. Several respondents indicated that the location of the quays is a crucial factor since they do not want to walk long distances with bulky items. This supports the statement from Macioszek (2018), the first mile is sensitive in the logistics flow. Moreover, due to the characteristics of bulky items, it is understandable that the distance and access to the barge are essential in order to get there. Even though there exist several quays in Älvstaden, close to where people live, the learnings from Obelix must be considered. It is not certain the recycling barge is allowed to dock there due to permissions. The infrastructure around the quay and quality of it can also restrict the barge to dock. For example, the quality of a quay might be poor and unsafe to use.

The operations of the barge must be adjusted to the demands from the residents

The recycling barge in the DenCity project needs to handle relatively large quantities of bulky and hazardous waste. The barge must have containers for the incoming materials and these must be easy to empty. According to Konings (2009), the handling of large quantities is of the main benefits with a barge. Another benefit mentioned, is the reliability, a barge can utilize waterways to a higher extent than other traffic modes on water, since it can run and dock at many places. This is suitable in the DenCity project since the barge is going to dock at several locations where, for example, a ferry cannot dock. Further, the barge is supposed to go on Göta River to Skräppekärr, located north of Gothenburg, to unload the waste. Skräppekärr has the right conditions for a smooth unloading of containers from the barge. Again, this traffic mode contributes to the simplicity of operation. Konings (2009) describes that a barge runs at a low speed. However, this characteristic does not affect the operations of the recycling barge negatively, since waste is normally not urgent to transport. The waste handling is a part of a reverse waste management flow and is not sensitive to delivery dates. The characteristics of a barge enable flexibility to dock at different locations, which increases the chances to stay close where people live. This can increase the willingness to use the barge. In addition to this, it is essential to consider the scheduled route for the recycling barge when designing a logistics

system. Several elements need to be organized, for example there must be a routine for unloading the waste. Visitors have the power to influence the reputation of the barge and it is therefore important that their experience is good. Since the purpose of the recycling barge is to receive bulky waste and people might have carried the items quite a distance, the barge cannot be full. A visitor should not be rejected to leave items on the barge. This could impact the reputation and the willingness to use the barge again. Further, the unloading of waste must be combined with the opening hours at the different locations to make sure that the barge is not full. In order to plan this route and how to optimize the usage of the barge, a question regarding preferred opening hours was asked in the survey. The majority said that it is crucial that the barge is opened during weekends in order for them to use it. Hence, the opening hours needs to be adjusted to this request.

A service can trigger the first mile and convenience is crucial

In Sweden recycling centers are an important part of the total recycling system and according to Sundin et al. (2011), it is therefore crucial to continuously develop the centers. The recycling barge on Göta River is an attempt to change the traditional view of how recycling centers should operate. However, it is essential that recycling centers are used since it is a big part of the total system. By providing a mobile recycling center on a barge at Göta River, the opportunity to recycle gets closer to residents in Älvstaden and thereby where their waste is generated.

The result from the survey indicates that the respondents want convenience in order to use the barge. A logistics system must be adjusted to their requests in order to be utilized to its full extent. The complexity of bringing bulky items to the barge is one aspect that needs to be considered. In the survey, respondents were asked to mention solutions that could ease the movement of goods from their households to the barge. Many respondents wanted some sort of service. For example, a pick-up service where someone picks bulky waste up directly from home or the opportunity to rent or borrow a cargo bike or trolley. Again, this kind of service could initiate the first mile in the reverse flow. This phenomenon is described by Macioszek (2018). These services could trigger the first step that motivates residents to use the barge. The respondents wishing for a pick-up service want the most convenient solution as possible. As Bernstad (2014) and Miliute-Plepiene et al. (2016) explain, more people are likely to recycle if recycling systems are developed close to households. A pick-up service will therefore, most likely, engage more people to recycle. This solution could also be beneficial, since there will be a complete control over the reverse flow and the environmental aspect can be prioritized.

The suggestion regarding cargo bikes and trolleys, would likewise be a sustainable solution for bringing bulky items to the barge. Kohtamäki and Rajala (2016) describe that households can have a crucial role in the reverse flow, since they initiate the first mile. Halldórsson et al. (2018) further elaborate on waste as one possibility to trigger this flow. The idea of using cargo bikes or trolleys can be a successful tool for motivating residents to start the first mile from their households. Also, one can assume these kinds of services can lead to an increased willingness for using the barge. Interesting to highlight, there existed a willingness to pay for a service. This shows that a group of people still wants to use the barge even if they would have to pay a service fee. It also indicates that people are willing to pay for convenience.

Kara, et al. (2006) describe reverse flows as more complex compared to forward flows due to the uncertainty regarding quantity and quality of items. This challenge needs to be considered when planning for the recycling barge. One must be flexible in order to tackle a high degree of uncertainty connected to quantity and quality. However, information from earlier projects, Obelix and Renova´s pilot study, as well as the traditional recycling centers can give some indications of the expected materials. Konings (2009) describes that a barge is able to carry large quantities. This characteristic can help ease the uncertainty of incoming materials. Even if it is not possible to fully plan for the inflow of items, organized planning and flexible solutions can increase the preparation. Moreover, a barge has low operating costs (Konings, 2009), which enables a relatively low cost per container. This is essential in this project since it is a top priority to manage the uncertain flow and quantity of bulky waste. Again, it is important for the reputation of the barge to not reject any visitors wanting to dispose waste.

Information about the barge must be provided

Dalek described during the interview the importance of communication in order to make people use the barge. This was a crucial factor in the mobile recycling center project. In their pilot project, various communication tools were used to inform about the barge. In addition, Utrednings- and Statistikkontoret (2006) stated that as high as 70% of the respondents in the Obelix project, found out about the existence of the recycling boat by local newspaper. The ways to communicate about the existence of the barge must be considered in the DenCity project as well. In the survey, respondents were asked to state the most preferable communication channel. The most favourable option was to get the information by post. Nevertheless, since the most successful communication tool in the Obelix project was the local newspaper, this should also be recommended in the DenCity project. Communication is a crucial factor when design this logistics system since this is the part that makes residents aware of the concept and existence. If residents do not know about the barge, they will not use it and the other parts of the logistics system will matter.

6. Discussion

In this chapter, the authors of this thesis elaborate and reflect on the gained knowledge from the whole research. Different angles in regard to the topic are questioned and discussed. Unexpected findings are also elaborated on. The last section of the discussion presents the different recycling alternatives. These are also summarized in two tables.

This thesis contributes to the literature, since the focus is on bulky waste generated in apartments. Previous literature is mainly examining recycling behaviours in houses and on household waste. In addition, there has not been much information regarding recycling barges since this is a new project.

When analyzing the results from the survey, we noticed that recycling habits and behaviours are not topics people usually reflect upon. People in general do not spend much time thinking about their recycling behaviour or new possible recycling solutions. We think this is a valid, since this topic generally not trigger strong emotions and they probably have a neutral opinion about their demands. The replies in the survey reflected the instant impression of the respondents, however, this can be changed when getting more detailed information. We think the first impression as well as reputation about barge can affect the willingness to use it. This can be an opportunity for the project group running the barge, to constantly encourage and mediate the many benefits of using it.

Further, it is interesting to discuss whether the sample in the survey can represent the entire population in Älvstaden. The results might have been different if 206 other respondents were asked the same questions. Afterall, approximately 45 000 inhabitants live at the chosen zip codes, hence the possibility for other opinions is relatively extensive. When planning for the recycling barge it is important to understand other opinions can occur amongst the residents. However, a random sample was selected and we do not think the answers would differ remarkably. Once again, people in general do not have any strong opinions about their recycling behaviour. Hence, we believe the results from the study can be generalized and be applied for the whole population in Älvstaden. Also, since this is a new project, we think the actors behind the barge will learn most by doing.

Another interesting perspective to mention from this research is the fundamental problem in waste management. Huge amount of waste is generated in dense areas, therefore there is a need for developing more convenient recycling solutions. Although, this does not eliminate the fundamental problem. It would be even better to go to the bottom of the problem and prevent the waste from even being generated. Prevention is also the most favorable option in the waste hierarchy. Nevertheless, it is difficult to fully eliminate the fundamental problem, but it must still be kept in mind. However, we think the implementation of the barge is one step in the right direction since it offers recycling centers closer to the inhabitants compared to the current situation. This can also make people reflect more upon their recycling behaviour. One can

assume that the fundamental problem will increase with growth in population in Älvstaden. Therefore, it is important to act proactively in order to create the most sustainable basis as possible due to the upcoming challenges.

Today, home delivery or pick up services are a common phenomenon in other sectors used by many residents. Examples could be home delivery of groceries and replacement of electronics and appliances. One interesting thought for decreasing the number of cars in cities, could be to combine services from different sectors. For example, when a company deliver furniture, they can pick up waste as well. The theory stresses the importance of integrating the reverse- and forward flow. This desired scenario could be a good opportunity to integrate the two flows. Also, it would allow companies to take a more holistic responsibility throughout the whole supply chain. We believe this could be the future for bulky waste handling which hopefully could encourage more people to recycle properly. Further, the DenCity project can also collaborate with actors providing cargo bikes or similar, which can ease the movement of goods to the barge.

Discussion about different alternatives for bulky waste handling

There are various ways to get rid of bulky waste today. We think it is relevant to understand the characteristics of each in order to recognize the optimal logistics system that suits everyone. Although, each option has several characteristics containing both strengths and weaknesses. Hence, one alternative is not suitable for everyone. In an attractive dense city, it is crucial that all citizens have the possibility to recycle and dispose bulky waste. An increase in recycled items can have a positive environmental impact as well as contributing to social benefits and more sustainable cities. In order to include all citizens, it is crucial to create a logistics system combining different alternatives. We believe that one alternative will not work alone, but must supplement one another for a sustainable long-term solution. During the research process of this thesis, we have gained knowledge and insights in different recycling alternatives. In this section, we have discussed the characteristics of each alternative based on our own opinions. These are summarized in table 2 and table 3.

Traditional recycling centers are well-tried systems with a smooth logistics flow. There is a broad knowledge regarding the existing system, since it has been developed during a long period of time. Therefore, developed methods for the operations and an efficient logistics flow exist. This can be considered a strength since it requires little planning and low associated costs for SWW. However, the traditional recycling centers are often located in the suburban areas and it is more or less required to have a car. Since everybody needs to drive a car to the recycling center, each transport contributes to both emissions and congestion. This alternative is not adjusted for citizens without access to a car.

A recycling barge on the other hand, is a new concept and the design of the logistics flow is therefore uncertain. For example, there are no forecast in regard to quantities and the route planning is not decided. The barge will be dependent on suitable quays, both in terms of distance to households and permission to dock. A major strength with this alternative is the utilization of waterways, which allows for reduced congestion and thereby a more attractive urban area.

Nevertheless, this alternative is not aimed for citizens living far from waterways. Moreover, just like the Obelix project, the recycling barge will probably be more expensive than the traditional recycling centers´ operations. However, we think it is important to focus beyond the cost perspective and rather focus on the environmental and social gains.

A mobile recycling center is a relatively simple alternative that needs to be adjusted to the prerequisites of each location. It requires enough space to fit both containers and visitors. Although, it is difficult to find locations like this in the dense areas. This alternative also provides convenience for citizens living close by, but is thereby only intended for a specific area. It also enables a reduced environmental affect since citizens have the possibility to walk there.

The alternatives regarding containers and garbage rooms for bulky waste can be seen as simple and convenient for residents since they are located close their households. They are two established concepts which SWW know how to handle. Although, the cost can be high due to the increased handling cost. These concepts are only intended for residents living where it is offered.

A pick-up service can be seen as the most convenient option from the citizens´ point of view since it allows them to stay at home and still recycle bulky waste. Also, this alternative does not exclude any specific areas like the other options, neither requires a car. Although, this can be complex to plan from SWW point of view, since it can be challenging to optimize truckloads and consolidate waste.

To summarize, a recycling barge is a good solution for disposition of bulky waste. Although, this cannot be the only solution when creating an attractive city since it is not intended for everyone neither all kind of bulky waste. The combination of the different recycling alternatives enables to include everyone in the city. However, we believe a recycling barge is the most sustainable in terms of social benefit. It is a new concept in Gothenburg that hopefully will make citizens realize the simplicity of handle bulky waste more sustainable. This can inspire them to recycle more.

	Logistics flow	Infrastructure	Residents demand	Cost	Environmental impact
Traditional recycling center	Smooth because it is a well-tried system	Located in suburban areas which leads for longer distances for citizens	Shorter travelling distances Car should not be needed	Low for SWW High for citizens	Higher because the need of a car
Recycling barge	Uncertain because it is a new concept	Suitable quays	Easy access Convenience	High for SWW Low for citizens	Lower since it is walking distance
Mobile recycling center	Relatively simple Adjusted to the location	Enough space for containers and visitors	Easy access Convenience	High for SWW Low for citizens	Lower since it is walking distance
Garbage room for bulky waste/container	Simple because it is well tried	Space in close connection to households	Convenience	Depends on situation	Lower since it is walking distance
Pick- up service	Complex for SWW Easy for residents	Access to households	Reasonable prices Convenience	High for SWW High for citizens	Higher since it requires a vehicle Lower if waste is consolidated

Table 2: Characteristics of recycling options

	Strengths	Weaknesses
Traditional recycling center	Well-tried system Requires little planning Relatively low costs Can handle all kinds of materials and large quantities Lower associated costs for SWW	Located in suburban areas Requires a car
Recycling barge	Utilizes waterways Reduces congestion Located in the dense city Free visits for citizens	Limited possibility to handle all materials and large quantities Intended for citizens living around Göta River Higher associated costs for SWW
Mobile recycling center	Located close to citizens Appreciated concept Free visits for citizens	Limited possibility to handle all materials and large quantities Higher associated costs for SWW
Garbage room for bulky waste/container	Located close to residents Convenient citizens	Limited possibility to handle all materials and large quantities Not provided for everyone Higher handling cost for SWW
Pick- up service	Do not need to leave the household Convenient for citizens	Higher cost for citizen Challenging to optimize truckloads

Table 3: Strengths and Weaknesses with recycling options

7. Conclusion

This final chapter presents the conclusions drawn from this research and each research question is answered. Finally, future recommendations for this area of research are presented.

The purpose of this thesis was to identify the current recycling behaviour in regard to bulky waste for citizens in Älvstaden. Also, what residents demand to use the recycling barge. Finally, to examine how the logistics connected to the recycling barge should be designed in order to create the most preferable solution.

First of all, residents in Älvstaden do not reflect on their recycling behaviour. When generating bulky waste, the action to dispose is an unforeseen process. Nevertheless, in general, people know what to do with their bulky waste and the majority goes to a recycling center to dispose it. Also, in some places there are opportunities to dispose bulky waste in specific garbage rooms or containers provided by the landlord. The majority of respondents were satisfied with their current recycling situation. Although, there is a group of people that is dissatisfied and some do not even know what to do with the items. When this occurs, there is a tendency to store the waste in the apartments longer, before getting rid of it. Today, when visiting a recycling center, there is a need for a car due to the long distances. Convenience is the factor influencing and determines the recycling behaviour of residents. Those having a car, can more easily dispose bulky waste with the current solutions, whilst those without access to a car are limited to solutions closer to their apartments. Thus, there is room for improvement for more convenient recycling systems in Älvstaden.

In general, the residents in Älvstaden do not spend much thought on solutions that could improve their current recycling situation. The recycling barge is a possible solution for them.
In order to make the residents use the barge, the demand of convenience in terms of accessibility, distance and opening hours must be met. Due to the characteristics of bulky waste, residents demand short distances to the barge and some even wanted a service to ease the movement of items. A service could initiate the first mile which is considered a sensitive part in the reverse flow. Smaller items are to be expected on the barge, since it is easier to carry. Another desire from citizens, is the possibility to leave items for second hand. This is an opportunity for the project group to increase the willingness to use the barge. In general, the respondents demand convenience, however, this does not necessarily mean that they will not use the barge if some inconvenience is faced.

Today, the logistics system is based on the usage of cars, but the future systems needs to be adjusted for non-car users. In addition, it is crucial to consider and develop a proper logistics system that can contribute to an efficient logistics flow and a good overall impression on visitors. Several factors have been identified in order to design a logistics system connected to the barge, that residents will use. Firstly, suitable quays close to households and with easy access must be fulfilled. Waste is generated in the households and by implementing a recycling

option closer to the residents, they can be more encouraged to recycle. Secondly, the barge must be opened at least during weekends since this is requested from the residences. A proper route planning containing unloading of waste, needs to be adjusted to the requested opening hours. This component contributes to a good impression for the visitor, hence it can also increase the chance they will return. Also, it is essential to highlight and mediate the environmental benefits a recycling barge can bring to Gothenburg. Inhabitants might use the barge to a higher extent if they are aware that they contribute to a sustainable future, since the waterways are used instead of the road networks. Communication should be prioritized since it can have a primary impact on the knowledge about the barge. The initial stage in a logistics system is the first mile, this is initiated by the residents. A service could trigger the first mile and make the people keener on using the barge. The later steps in the logistics system is dependent on this step.

7.1 Future recommendations

In this thesis, the handling of bulky waste has been highlighted. Although, it exists a lack of research done within this field compared to the handling of household waste. There is a need for an increased knowledge concerning how bulky waste should be recycled. Currently, a lot of information reaches the residents regarding the managing of household waste, but little about bulky- and hazardous waste. Additionally, people do not reflect much on their recycling habits and needs. It is therefore important to raise the awareness in order to develop the system. A majority of the previous research is focusing on recycling behaviours in houses and not apartments, hence this is an area of improvement.

An interesting perspective for future research is to focus on the fundamental problem in waste handling. The core issue is to find out how to prevent waste from even being generated and thereby climb the waste hierarchy. Various means can be used to manage the reuse and recycling process but little has been developed for the prevention process.

Further, it could be interesting to perform an interview with someone responsible for picking up waste from household in order to recognize if they consider the situation as critical. They have exclusive knowledge about the actual behaviour of residents and what they throw away with the household waste. This would increase the number of perspective and thereby the overall impression.

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Appendix 1.

The checklist

Information gathered from Forza (2002) and Collis & Hussey (2014)

- Design the instructions for the survey carefully
    - inform about the purpose of the survey
    - give a context of the survey to the respondent
    - be objective
    - offer the respondent anonymity

- Consider the way you formulate the questions
    - the questions should be relevant for the area of research
    - type of wording, adjust to the target group
    - do not lead the respondent in a particular direction, be objective
    - do not derive answers, be objective
    - consider the number of questions

- Consider the order the questions are presented
    - it should be a logic order of the questions

- Pilot test the questions in the survey
    - gather opinions, inputs and feedback from experts

- Use the results in an ethical way
    - do not distort the results from the interviews
    - respect the answers from the respondents

Appendix 2

Survey

Hi! My name is… I am calling on the behalf of the municipality in Gothenburg, they want to know the opinions about a mobile recycling centers from inhabitants in Gothenburg. I would appreciate if you can answer a few short questions in regard to that. Your answers are of course anonymous and will help to develop the recycling system in Gothenburg.

1. Living area

Eriksberg
Klippan
Rosenlund

2. Have you sometime during the 5 latest years needed to dispose of bulky waste like furniture or special items like porcelain, tools, toys, electronics, things you cannot throw away in the household waste or at a recycling station?

3. If yes, where and how did you get rid of it?

4. Have you sometimes during the last 5 years wanted to get rid of something you cannot throw away in your household waste or at a recycling station but do not know how?

5. If yes, what did you do with the item?

6. Have you used any service that have helped you to get rid of bulky items? *For example, a company pick up your old sofa or dishwasher when you buy a new.*

7. If yes, what type of service and why?

8. Can you specify how satisfied you are with your current situation in regard to the handling of bulky waste. We use a scale from 1-5 where 1 means very dissatisfied and 5 means very satisfied.

9. If dissatisfied (1-3), can you motivate your answer? Why are you dissatisfied?

10. Do you have a storage room in the building where you live that allows you to store things before you transport them to a recycling center?

11. Is there a car in your household?

12. If no, have you ever used a car that is not yours for throwing away bulky waste?

So, the idea about the municipality's plan is to have a boat on the river that moves between quays. Here, everyone in this community should be able to dispose of bulky waste items such as furniture, or special items like porcelain, tools, toys, electronics etc. without having to leave the city center to do it.

Imagine that you have a bag with smaller items at home with things you need to go to the recycling center with to get rid of and the recycling boat arrives at the quay in XXX on a predetermined time.

13. Would you take the bag with smaller items to the recycling boat?

Imagine that you have a large bulky item at home that you want to get rid of and the recycling barge arrives at the quay in XXXX on a predetermined time.

14. Would you bring the item to the recycling barge?

15. Is there any service that would ease the movement of your bulky waste from your household to the recycling boat? *E.g., cargo bike, trolley or other?*

16. What would be an appropriate cost for a service like that?
Only ask respondents interested in any kind of service.

You answered that you have a positive attitude towards the recycling barge, would you also have the possibility to …

17. Leave items for second hand/charity on the boat?

18. If yes, what kind of items would you leave for charity?

19. Which days would you say is the best for the recycling barge to operate?

20. How crucial is it for you that the boat is there on the weekend for you to leave things there? We use a scale between 1-5, were 1 means not crucial at all and 5 means absolutely crucial.
Only ask respondents who answered a weekend day.

21. How would you like the municipality of Gothenburg to send information about the recycling boat?

22. Finally, if you are thinking on both bulky waste and household waste, do you demand any other kind of service that would make it possible to throw away waste without using a car?

23. If yes, what kind… what is your suggestion?

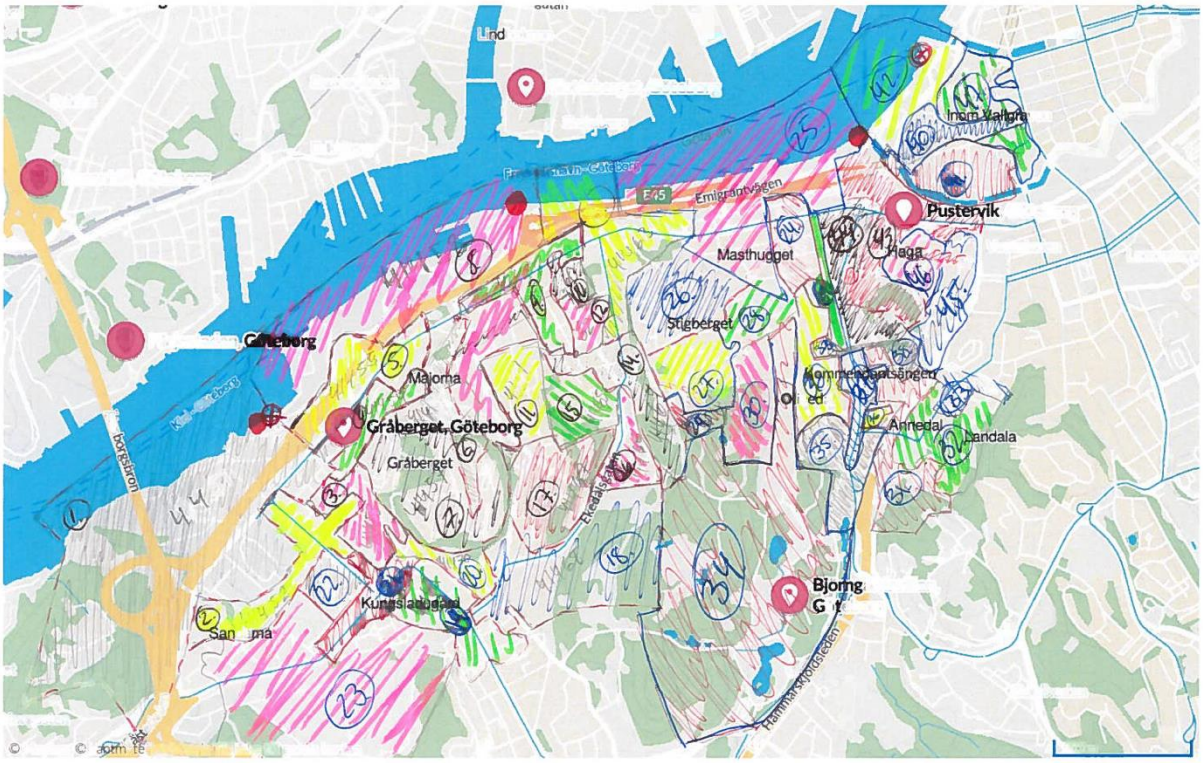
24. May I ask you how old you are?

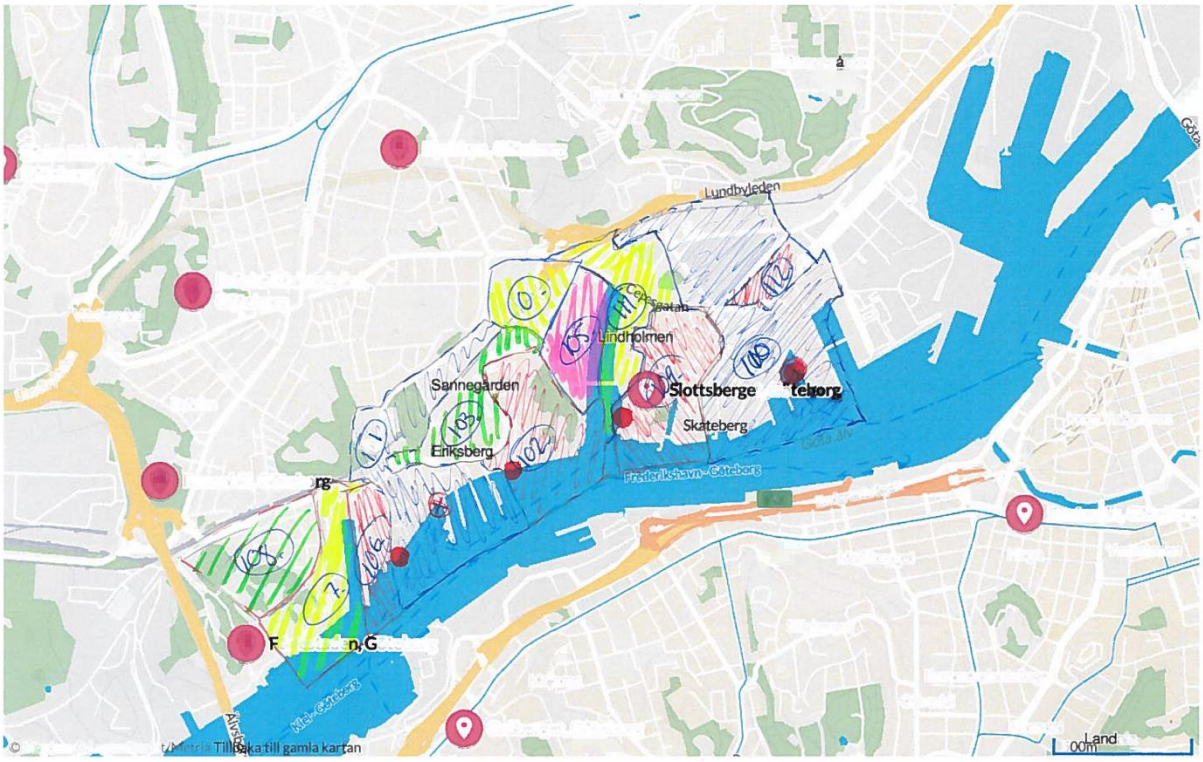
25. Gender
Female
Male

26. How many adults and how many persons under 18 lives in your household?

Appendix 3

Zip code areas





Appendix 4

Interview questions to David Dalek and Jonas Selander Lyckeborg

What was your job position in the project?

How does the recycling system look like today? (Gothenburg/Stockholm)

What was the purpose behind the project?

How did the operation look like?

How did you select locations to operate?

How did people get there?

Do you think people in general reflect on their recycling behaviour in regard to bulky waste?

What/which items were mainly disposed?

Was it possible to leave items for second hand on the mobile recycling center/recycling boat?

If you redid the project, what would you have done differently?