Improving waste sorting- and collection systems

An Action Research study in Borås, Sweden

Master's thesis in Industrial Ecology

FRIDA BLOMÉR AND ANN JANSSON

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Recycling station in Borås, Sweden. ©Frida Blomér and Ann Jansson, 2015.

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ABSTRACT

There are different ways to work towards a more sustainable future – a developed waste management system could be one part of the solution. In Sweden, municipalities are responsible for collecting household waste. Borås, a medium-sized city in western Sweden, has a sorting system where food waste is sorted into a black bag and waste for incineration is disposed in a white. The bags are sorted optically at a treatment plant. Recyclables and bulky waste should be disposed at a recycling station or center. A lot of material is miss-sorted, and the supplier of waste management services, Borås Energi och Miljö (BEM), thus wants to investigate how to increase the sorting quality and still keep a high customer satisfaction. The main research question in the thesis has thus been: How can an already developed waste management system be improved in order to achieve high customer satisfaction and high sorting quality?

To find area specific solutions, BEM chose four geographical areas with varied preconditions as base for the study. The Action research method was used throughout the work. Data was gathered through literature studies, interviews, focus groups and observations. Also results from a waste composition analysis were used.

Data showed that Borås' inhabitants are satisfied with the white- and black bag system but that the waste quality in the bags could be improved in all areas. General improvements needed are; maintenance at the recycling stations, distribution of information and attitudes toward waste sorting. It was shown that safety is an important aspect to consider when developing the system. The waste sorting- and collection system recommended for the first area is to divide the collection into one bin for white and another for black bags, and further to build an environmental room for recyclables. For the second area the proposed system includes keeping the waste chutes for white- and black bags and to reinstate the environmental room in the house. For the third area it is suggested to remove the waste bins in the yards and to collect waste inside the buildings. For the fourth area it is suggested to offer the inhabitants collection of recyclables at the house. Informing people about why the changes are happening is crucial. When implementing the changes, it is an opportunity for BEM to spread updated sorting instructions and to promote their sorting guide and phone-app.

Key words: Waste sorting- and collection system, Waste, Area specific waste solutions, Household waste, Customer satisfaction, Sorting quality, Indicators, Action Research, Borås waste management system

Förbättringar av avfallsinsamlingssystem
En aktionsforskningsstudie i Borås, Sverige
Examensarbete inom masterprogrammet *Industriell Ekologi*
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SAMMANFATTNING

Det finns olika sätt att jobba för en hållbar framtid – där ett välutvecklat avfalls-insamlingssystem kan vara en del av lösningen. I Sverige är kommunerna ansvariga för insamling av hushållsavfall. Borås har ett avfallsinsamlingssystem, där matavfall sorteras i svarta påsar och där brännbart avfall ska sorteras i vita. Källsorterings-material och grovsopor ska slängas på en återvinningsstation eller central. Mycket avfall är idag felsorterat och därför vill leverantören av avfallsinsamlingssystemet Borås Energi och Miljö (BEM) undersöka hur sorteringskvaliteten kan höjas, och samtidigt behålla en hög kundnöjdhet. Ett fokus är att hitta områdesanpassade lösningar. Frågeställningen i detta examensarbete har därför varit: Hur kan ett utvecklat avfallsinsamlingssystem förbättras för att uppnå hög kundnöjdhet och sorteringskvalitet?

För att hitta områdesanpassade lösningar valde BEM fyra bostadsområden med olika förutsättningar som bas för studien. Metoden Aktionsforskning användes genom hela arbetet. Data samlades in genom litteraturstudier, intervjuer, fokusgrupper och genom observationer. Även resultat från en plockanalys användes.

Insamlad data visade att Borås invånare är nöjda med de vita- och svarta påsarna i det nuvarande avfallsinsamlingssystemet. Kvaliteten på avfallet i påsarna kan dock förbättras i samtliga fyra områden. Viktiga aspekter att förbättra är; underhåll på åter-vinningsstationerna, distribution av information och utbildning, samt attityder till sop-sortering. En annan viktig aspekt att ta hänsyn till när systemet utvecklas är säkerhet.

Avfallsinsamlingssystemet som rekommenderas för första området är att dela upp insamlingen av de vita- och svarta påsarna och att bygga ett miljöhus för källsor-teringsmaterial. För det andra området rekommenderas att behålla sopnedkastet för vita- och svarta påsar och att återinföra det miljörum som funnits i huset tidigare. Det som rekommenderas för det tredje området är att ta bort sopkärlen mellan husen och istället ha avfallsinsamling i fastigheterna. I det fjärde området rekommenderas ett system där invånarna erbjuds fastighetsnära insamling av källsorteringsmaterial. Det är mycket viktigt att informera invånarna om varför ändringarna görs. Genom dessa ändringar kan även BEM skicka ut uppdaterade sorteringsinstruktioner och marknads-föra sin mobilapplikation och befintliga sorteringsguide.

Nyckelord: Avfallsinsamlingssystem, Avfall, Hushållsavfall, Kundnöjdhet, Sorteringskvalitet, Indikatorer, Aktionsforskning, Borås

Acknowledgements

Contents

The appendices are excluded in the report, due to confidentiality reasons. If there is an interest to get the appendices, please contact the authors; Frida Blomér, blomerfrida@gmail.com or Ann Jansson, ann.jansson@outlook.com.

1 Introduction

In this chapter the background, purpose and research questions are introduced. Delimitations of the thesis are also presented.

1.1 Background

There is a rapidly growing population in the world, and the increasing consumption are causing a decrease in the world's resources (OECD, 2012b). According to Pacheco-Torgal, Cabeza F., Labrincha, & Giuntini de Magalhaes (2013) resource depletion is becoming a serious problem for many materials. As an example the reserves of copper are estimated to be empty in approximately 35 years – if the production ratio continues and no new reserves are found. From a sustainability point of view this indicates that people living today are using future generations' resources. This risks their ability to satisfy their needs, which is a part of the definition of sustainable development from the report Our common future (World Commission on Environment and Development & Brundtland, 1987). OECD (2012b) suggests different ways to work towards a more sustainable future, where well-working and developed waste management systems could be seen as a part of the solution. A waste management system could include prevention, collection, handling and treatment of waste (Defra, 2013). In the Theory Chapter 2, it is further described what is included in a waste management system.

OECD (2012a) states, that in order to achieve a sustainable future, many stakeholders need to participate and act across borders. That includes stakeholders on international, national and regional levels – for example the European Union (EU), municipalities and citizens. According to The Swedish Waste Association (2014) waste strategies are set both on an international level in the EU and in Sweden. The strategies are set in order to handle, prevent and recycle waste. A framework has been developed in accordance with the strategy for preventing generation of waste, together with improving the recycling. The framework is called Waste hierarchy, and its main purpose is to prevent waste to larger extent. The waste hierarchy is further developed in the Theory, Section 2.1.1.

In 1999, the Swedish environmental legislations were gathered in the Environmental Code, with purpose to encourage sustainable development in both short- and long term (The Swedish Environmental Protection Agency, 2015b). The same year, the Swedish Government founded national environmental goals that can be seen as targets to strive for in order to reach a sustainable future (The Swedish Environmental Protection Agency, 2015a). According to the Swedish Waste Association (2014) the Environmental laws and ordinances regarding waste consider aspects such as Extended Producer Responsibility and the responsibility of the Swedish municipalities. All municipalities are obligated to handle and collect household waste that is not included by the Extended Producer Responsibility. Municipalities further need to have a waste management plan that states how they work with prevention and reduction of waste.

According to the Municipal Executive Board in Borås (2012), Swedish municipalities are responsible for collecting household waste. Package material, such as plastics and cardboard, is covered by the Extended Producer Responsibility which Förpacknings- och tidningsinsamlingen (FTI) is responsible for. FTI and Swedish municipalities – including stakeholders like politicians, decision-makers and inhabitants – thus have an important role in achieving a successful waste handling. The focus of this report will be on how a medium-sized city in Sweden can improve the waste sorting- and collection system with regards to waste quality and customer satisfaction.

1.1.1 The authors

We, Frida Blomér and Ann Jansson, authors of this thesis, are students at the Master's programme in Industrial Ecology at Chalmers University of technology. We both became engaged in the field of waste management early in life since source sorting was regarded as important in the families we grew up in.

Frida started her studies at Örebro University in 2008, where she got a Bachelor's degree in Mechanical Engineering in 2011. After working as a mechanical designer for almost two years, she moved to Gothenburg to deepen her knowledge regarding environment and began her master studies at Chalmers University of technology.

Ann started her studies at Linköping University in 2010, and got in 2013 a Bachelor's degree in Energy and environmental technology. After three years in Linköping she moved to Gothenburg to continue her master studies at Chalmers University of technology.

Before the thesis begun, we had discussions on what topic to write within. Rather soon it got clear that waste and waste management systems were interesting areas to both of us. We both see people around us not sorting their waste properly. The reasons are many: it can be too complicated or too time consuming, the packages take up too much space in the kitchen or it is simply not important enough to do. With the environmental benefits connected to recycling in mind, together with our own passion in the field, it became interesting to further investigate what would be the key to get people to start sorting their waste. Through a contact we got in touch with Sweco, a consultancy company offering services within many different areas, Environment being one of them. Sweco cooperates with Borås Energi och Miljö (from here on called BEM) through technology development projects, where the goal is to improve current solutions and investigate new ideas. BEM is interested in developing the waste management system in order to increase the recycling ratio and minimize the amounts of waste for incineration. Through our supervisors at Sweco, Arvid Jogbratt and Robert Olsson we got involved in this project and found this both challenging and interesting – and very much in line with our own curiosity in the field. Since the task involves many different stakeholders and personal interests, it is important to integrate different participants, gather information and learn from each other, which is central in Action Research – one of the methods used in this thesis. An important part of action research is for the researchers to reflect throughout the work process. Our reflections are in this thesis presented in

grey boxes; see Figure 1 for an example. The city of Borås and the case is further introduced below while the method of action research is further developed in the Theory Chapter 2.

> **Reflections – being an action researcher**
>
> *It is a challenge being an action researcher. There are many stakeholders involved in this thesis work and there is thereby a need to be very responsive and interact with many different people.*

Figure 1. The figure is an example of a Reflection box that is used in the thesis for thoughts and comments by the authors.

1.1.2 Case background – Borås

Both possibilities and challenges are connected to the waste strategies mentioned earlier. On a regional level, waste management is a tough question for municipalities in Sweden. Borås is a municipality located in south west Sweden where the municipality has worked actively with waste handling for over 20 years. BEM is owned by Borås Stadshus AB and responsible for the waste collection in Borås (Municipal Executive Board Borås, 2012). BEM offers solutions regarding the waste management system but also solutions regarding energy supply, water and sewer distribution.

In Borås' Waste management plan, the Municipal Executive Board Borås (2012) writes that currently the waste management system is based on a system where the inhabitants sort household waste into white- and black bags. Food waste should be placed in the black bag while waste for incineration should be placed in the white bag. Both bags are put in the same bin at the household but sorted, through optical sorting, at the waste processing plant at Sobacken, Borås. The content in the black bag is first refined before it is processed into biogas and organic residue. The content of the white bag is crushed and transported to Ryaverket in Borås, a combined power and heating plant, where it is incinerated. The white- and black plastics bags are made from recycled plastics (Schön, 2015). In addition to the system with the plastic bags, there are 80 sites for recyclables where Borås inhabitants can drop off package material (glass, paper, plastic and metal), newspapers and batteries. The property owners of apartment buildings can request bins for recyclables to be placed near the building, so called property close collection (PCC). Bulky waste, such as gypsum, garden waste and broken refrigerators, should be handed in at a recycling center, of which there are five in Borås.

Accordng to Schön (2015) BEM works actively with spreading information about how to sort at the recycling stations and recycling centers. BEM has together with Arbetslivsförvaltningen Borås Stad (the work life administration association) initiated an organization called Mobile info center, where also AB Bostäder and Södra Älvsborgs Räddningsförbund (the emergency rescue association) have helped financing the organization. The employees at Mobile info center are educated within waste handling and work with spreading information about how to sort correctly at the recycling stations in Borås.

The existing waste management system, with white- and black bags, has been in use since 1991, though the first years food waste was composted (Carlsson, Rousta, & Schön, 2015). Still today, about 25 % (ratio calculated based on an investigation by Moghadam & Karimkhani (2011)) of the food waste is placed in the white bag instead of in the black. Additionally, approximately 20 % (ratio calculated based on an investigation by Moghadam & Karimkhani (2011)) of the content in the black bag should have been sorted as either recyclables or been disposed in the white bag.

Research by Rousta and Ekström (2013) shows that wrongly sorted waste costs Borås approximately 13 million SEK every year. They therefore suggest the following areas to be further investigated:

- The inhabitants' (BEM's customers) behavior together with success factors for influencing behaviors.
- The possibility to put the recycling stations closer to the residential areas.
- Education and communication with inhabitants about the societal profits of correctly sorted waste in order to improve the ratio of correctly sorted waste.

Furthermore, Christensen (2010) suggests that it would be beneficial to research waste collection systems suitable for a variety of housings. He believes that it is a possibility that different systems for different residential areas could lead to an economical and successful waste collection system. Other choices to consider are to what extent the customer should be involved and also what types of materials that should be picked up at the kerbside and what types that should be dropped off at a recycling station.

To sum up, it is of interest to evaluate customer satisfaction with the waste management system in Borås and find areas of improvements. It is also of interest to evaluate how to improve the ratio of correctly sorted waste in the white- and black bags. Indicators for waste quality could be used as help when developing waste sorting- and collection systems for different areas and types of houses in the city. In the thesis, four neighborhoods of different shaping and demographics are used as base for the investigation which is a request from BEM; see Section 3.1.1.1 and Appendix I for a deeper description of the areas.

1.2 Purpose

The purpose of the master thesis is to support BEM to evaluate and improve the waste management system for household waste in Borås – with focus on sorting and collection of waste through area specific solutions. It is thus to identify indicators for high sorting quality and factors for high customer satisfaction.

1.3 Research questions

The purpose includes an investigation and evaluation of possible improvements of the waste management system in Borås. The thesis is based on one main research question with five under-questions, where some under-questions also have their own under-questions. In the section

below, each research question is described to understand what the objective and motivation of the question is.

> *Main RQ)   How can an already developed waste management system be improved in order to achieve high customer satisfaction and high sorting quality?*

To start with, the main research question considers the entire waste management system, including for example reduced waste generation. The focus of the question lies within customer satisfaction and sorting quality. It is a broad question which is further divided into five under-questions.

> *1) How can the waste hierarchy be applied to improve a waste management system?*

Research question 1) is conceptual and is asked to understand and evaluate how the waste hierarchy can be used to prevent and reduce waste generation. It is further to assess the consciousness regarding environment and waste among the inhabitants in their everyday life.

> *2) How can the quality in the white- and black bags be measured and compared?*

Research question 2) is asked to understand what tool can be used to understand and evaluate a waste sorting- and collection system with regards to contents in the white- and black bags. It is asked to be able to evaluate correctly sorted household waste and compare results from different areas.

> *3) What factors regarding sorting- and collection of waste are influencing customer satisfaction?*

> > *a. What is working well in the current sorting- and collection system in Borås?*

> > *b. What are the most important aspects to improve in the current sorting- and collection system in Borås?*

Research question 3) is asked to map and understand what known factors that influence customer satisfaction. It is also asked to gain a better understanding for what a successful waste sorting- and collection system is. Question 3a) and 3b) are asked to help answering question 3) where focus is on the inhabitants of Borås.

4) What is needed technically, socially and economically to improve the ratio of correctly sorted waste in the white- and black bag?

Research question 4) is asked to evaluate what is needed to improve the waste sorting and collection, and thereby the quality of waste in the white- and black bags. This question is asked with regards to technical, social and economic improvements. This focus is chosen since the three categories can be linked to the three pillars of sustainable development; societal, economic and environmental development (United Nations, 2011).

5) How can the sorting- and collection systems be developed depending on the type of houses and inhabitant demographics in an area?

> *a. What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Sjöbo?*

> *b. What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in City center?*

> *c. What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Hässleholmen?*

> *d. What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Brämhult?*

Research question 5) is asked to be able to give recommendations to BEM of area specific solutions for the waste sorting- and collection systems. The previous research questions will generate a deep understanding for how the design of the waste sorting- and collection system might differ between types of houses and demographics in different areas. The four under-questions are asked to help answering question 5) and to better understand how the system can be adjusted depending on house types and inhabitant demographics.

These research questions are used as base for the investigation and answered throughout the thesis.

1.4 Delimitations

A number of delimitations have been made throughout the thesis. Some were predefined while some developed during the work procedure. The bullet list below is a summary of the delimitations:

- The time scope of the thesis is limited to 20 weeks.
- Only household waste is considered – waste generated by companies and industries is not included. This was decided by BEM.
- The focus lies within waste sorting- and collection, which was decided in cooperation with BEM. The difference between a waste management system and a waste sorting- and collection system is further described the Theory Chapter, see Section 2.1.
- The evaluated areas in Borås were chosen by BEM and the researcher Kamran Rousta.

Reflections – start up

As in all projects, the beginning of the thesis work included many uncertainties and some anxiousness of what results the thesis would contribute to. This confusion was rather strong during the first couple of weeks. The office, colleagues and the city of Borås were all new to both Frida and Ann, thus it costed some energy to settle and feel confident in the way things worked. Within a month from the start, the task felt clearer and the work could take off for real.

2 Theory and previous studies

In order to answer the research questions, it is important to define the theories and key concepts linked to them. It is also important to build on previous research and on what answers other authors have found to these questions. This chapter presents several theories linked to waste management and influential factors that can characterize a successful waste management system. Different technological aspects of waste sorting and types of waste collection systems are explained. The chapter ends with a summary of theories linked to the used methods in the thesis.

2.1 Waste management

In the thesis, focus is upon waste sorting at the household and waste collection by the municipality. A waste management system includes many other aspects as well. Defra (2013) defines Waste management in Waste management plan for England as

> *"The collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker."*

The focus of the thesis is on waste sorting- and collection, which is shown in Figure 2 below.
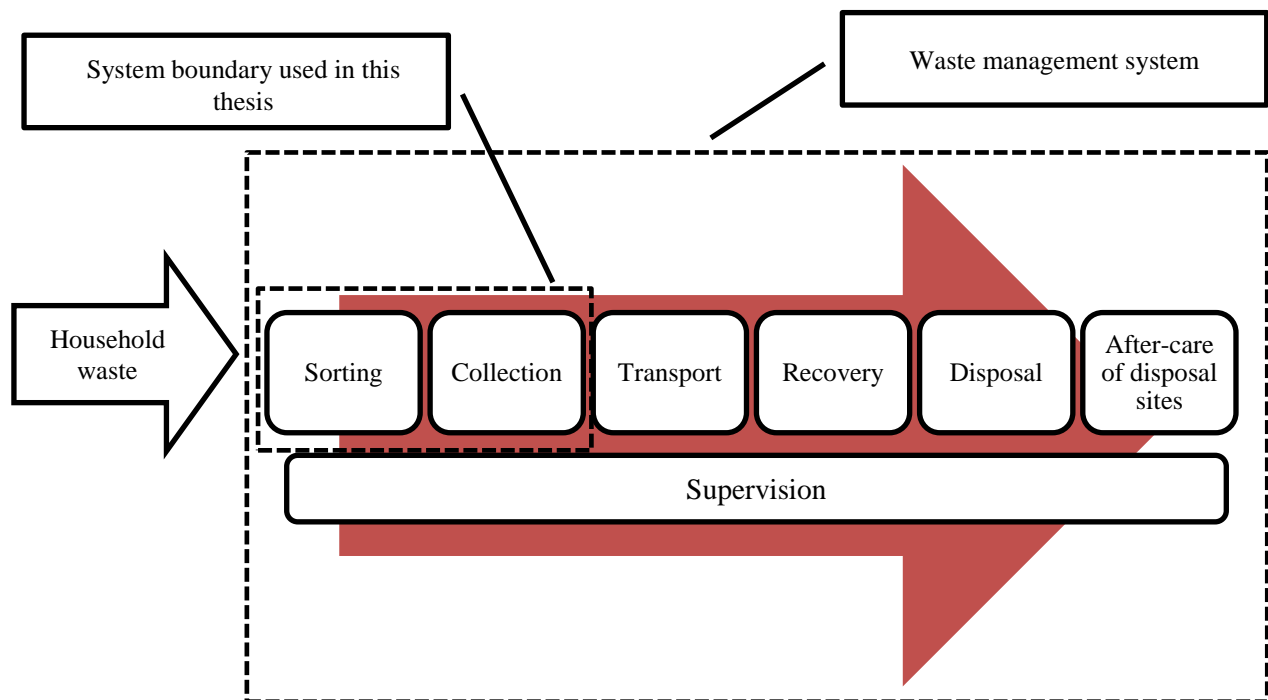
Figure 2. The figure is a schematic picture of a waste management system; also the system boundary used in this thesis is marked. The thesis has waste sorting- and collection system in focus. Image source: The picture is inspired by the above described definition by Defra (2013).

The previously mentioned Waste hierarchy, implemented by the EU can be used as a guide for waste management. The following sections provide definitions and reference to other research connected to research question 1).

1) *How can the waste hierarchy be applied to improve a waste management system?*

First the hierarchy itself is introduced. It is later followed by how it is applied in Borås.

2.1.1 The waste hierarchy

According to the European Commission (2010), EU's waste policy has developed during the past 30 years. In 2005 a long term strategy on waste was developed which has modernized the way to think about waste; from a burden to a useful resource. One part of the strategy is the Waste hierarchy which can be seen in Figure 3. There are five steps in the hierarchy; prevention, re-use, recycling, energy recovery and disposal through for example landfill. Prevention is the most preferable option while disposal is the least preferred option. The goal is thus to move waste management up in the hierarchy.

Figure 3. The waste hierarchy. Image source: The European Commission (2010)

2.1.1.1 The waste hierarchy in Borås' Waste management plan

According to the Municipal Executive Board in Borås (2012), the waste hierarchy is part of the Swedish Environmental legislation. It is included in Borås' Waste management plan, where it has goals and activities within three areas of focus that Borås wants to reach by 2020. They are all linked to the waste hierarchy and are:

- To reduce the amount of waste.
- To regard waste as a resource.
- To make the inhabitants satisfied with the sorting- and collection system.

2.2 A successful waste sorting- and collection system

As research question 3) indicates, there are factors that influence how satisfied the customers are with sorting and collection of waste. The aspects could differ depending on for example demographics, location and culture. The purpose of the thesis is to give BEM a recommendation of what sorting- and collection system to use in different areas. The following sections are presented to answer research question 3).

> 3) *What factors regarding sorting- and collection of waste are influencing customer satisfaction?*

Many authors have defined factors that influence a waste management system. The authors and studies reviewed in the thesis include: Dahlén & Lagerkvist (2010), Rousta & Dahlén (2015), Rousta & Ekström (2013), Gallardo, Bovea, Colomer & Prades (2011), Villaägarnas riksförbund (2010), Finnveden et al. (2007), Bernstad (2014), John et al. (2011), Timlett & Williams (2009), Hage et al. (2009), Dahlén et al. (2009) and Borås Renhållning (2004). The factors are further described below and at the end of the chapter summarized into a figure, see Figure 4.

2.2.1 Factors that influence a waste management system

Gallardo et al. (2011) found that several important factors have to be considered to achieve a successful waste sorting- and collection system. They have categorized the factors according to how they affect the separation rate and the quality in the containers for recyclables. These terms are further described in Section 2.4.

Dahlén & Lagerkvist (2010) discuss factors influencing waste flows and state that individual behaviors vary and thereby cause variations in the waste flows. They have listed 43 different factors that influence the households' waste composition and have divided them into 3 categories;

- factors that can be controlled by local/regional waste management strategies, such as: waste management objectives, technical design of collection equipment and vehicles
- factors that can be controlled by national waste management strategies, such as: legislation, environmental objectives and levels of public education and awareness of waste issues
- factors that are beyond the control of waste management strategies, such as: household economy, residential structure and other cultural and socio-economic differences

A successful example of influential factors is given by Rousta et al. (2015). They study the households' participation in source separation schemes and how this can be improved by two interventions; shorter distance to the collection point and better accessibility of information about how to sort waste correctly. The studied area is an apartment building situated in Borås which had a very high ratio of miss-sorted materials before the study. Through waste composition analyses, the study measured the ratios of miss-sorted materials in the white- and black bags, before and after introducing an environmental room in the area. The room was placed in the

backyard of the multiple apartment building and had bins for package materials. The study also included giving better information regarding how to sort food waste in the black bag. It was done through exchanging old trash cans with misguiding information to new cans with updated stickers with correct information. According to this study, a shorter distance to the drop-off point can improve the ratios of miss-sorted materials in the white- and black bags significantly. The study concluded that package materials and newspapers decreased in the residual waste by 28 % compared to before. The distribution of information through updated stickers on the trash cans generated 70 % less wrongly sorted materials in the black bags.

Another article by Rousta & Dahlén (2015), conclude that the factors influencing people's participation in a waste sorting scheme can be categorized as internal factors, external factors and socio-demographic factors. Examples of internal factors can be attitudes, values, behaviors and knowledge, while examples of external factors can be convenience, storage space at home, social- and cultural norms and infrastructure. The socio-demographic factors are for example gender and income level. Rousta & Dahlén (2015) recommend including the social factors when developing a source separation system and to use waste composition analysis as a tool to measure waste quality.

Another article by Rousta & Ekström (2013) studies factors that influence the inhabitants' participation in recycling schemes. It concludes the importance of convenience and accessibility of recycling stations in order to increase the inhabitants' participation. They further mean that regulations and policies are important, and that the collaboration between FTI and the municipalities needs improvements. They also mean that further research is needed regarding how different factors affect the inhabitants' behavior. A study by Villaägarnas riksförbund (2010) brings up the aspect of differing interests between the municipalities and FTI. FTI's driving force is mainly economic which results in reaching targets at the lowest costs. Villaägarnas riksförbund (2010) also stresses a weakness in the current collection system since it is not adjusted to all groups in society. For example people who do not have cars or people who have trouble to carry materials. Gallardo, Prades, Bovea, & Colomer (2011) mean that a challenge when implementing a waste sorting- and collection system is to make it both convenient for the inhabitants and not too expensive for the municipality. There is a need to find a good balance between those two.

Finnveden et al. (2007) discuss human attitudes and behaviors regarding waste collection. They conclude that the key factors to succeed are; accessibility and proximity of the recycling station as well as easy sorting through good information. Some of the findings from a study by Bernstad (2014) contradict this, since it shows that for example written information in an information campaign does not increase the collection rate of food waste. It further states that social norms and a "normalization" of the recycling behavior can be as important as the increased convenience. The study though confirmed that convenience by installing sorting equipment in the kitchens directly improved the recycling behavior. This can be linked to the framework of "nudging".

"Nudging" is further discussed by John et al. (2011). It is about changing and improving individual behaviors with help from information and social cues. John et al. (2011) conclude how nudging can affect recycling behavior, for example through feedback. However a limitation is that the effects of nudging are rather small in areas where the inhabitants already are engaged in recycling programs. It is more effective to "nudge" when there is a need for behavioral change.

A survey conducted by Timlett & Williams (2009) say that it takes approximately three years for people to get used to the waste collection system and to make recycling a regular behavior. A challenge is therefore to get new inhabitants to participate in the waste management system sooner. They further state that the reasons for not participating in recycling programs have rather to do with a lack of service or personal interests rather than to a lack of information.

Many articles, for example by Hage et al. (2009) and Dahlén et al. (2009), have concluded that convenience is important, since it increases the collection rate of recyclables. A pre-study conducted by Borås Renhållning (2004) investigated the attitudes and behaviors towards recycling among Borås' inhabitants. It concluded that the main reasons for not participating in recycling were laziness and lack of interest rather than lack of information. Furthermore, Dahlén et al. (2009) state that no correlations are found when looking at inhabitants per recycling station. However, it was found that the longer distance to the recycling station, the less material was recycled. Borås Renhållning (2004) also concluded that closer distance to the recycling station and an increased accessibility with property close collection would increase the inhabitants' recycling behavior in Borås. An additional factor was also more motivating information about what happens with the collected recyclables and about the environmental benefits related to recycling, which could trigger the values and attitudes of the inhabitants.

2.2.2 Summary of influential factors

As described, there are many factors that influence how successful a waste management system is. In Figure 4 the factors are divided into six categories; economic, social, environmental, political, legal and technological. These factors can be seen as necessary to take into account to achieve a successful waste management system. As research question 4) indicates, the main focus in this study is on social, technical and economic factors.
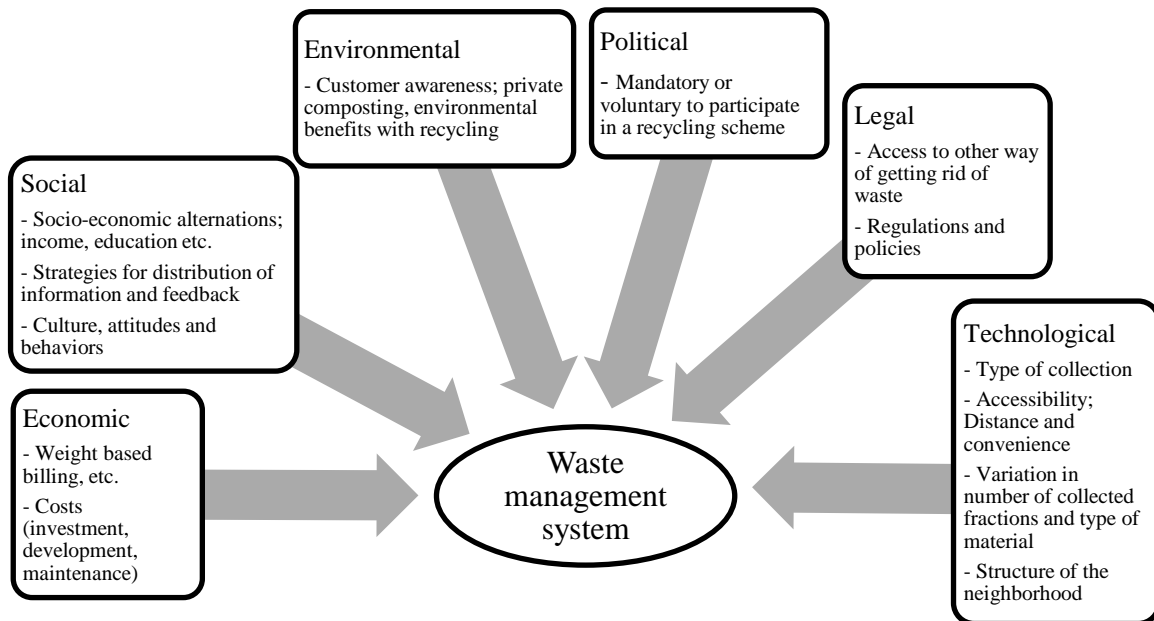
Figure 4. The figure shows six different categories of factors that influence the waste management in society. The above mentioned factors are listed into the six categories. Image source: Picture inspired by the articles described above.

Reflections – factors

The topic of factors influencing waste sorting- and collection systems seems to be well investigated and evaluated. The question is whether the thesis will contribute to any new findings or find that some factors are more important than others.

From this point of view, a waste management system seems very complex. In general, some of the factors seem to be easier to evaluate than others. For example it could be quite difficult to evaluate and measure how different cultures influence the participation in recycling programs, while it seems easier to evaluate and measure how different distances to a recycling station affect the participation. It would also be interesting to understand how, if and/or which of these factors are actually considered when developing a waste management system.

2.3 Sorting- and collection systems

The thesis has a social, economic and technological focus. In the sections below follow brief technical introductions to different ways of sorting- and collecting waste. The information provided below will be used as background and help to answer research question 5, 5a-d.

> 5) *How can the sorting and collection systems be developed depending on the type of houses in the area?*

> a. *What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Sjöbo?*

> b. *What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in City center?*

> c. *What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Hässleholmen?*

> d. *What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Brämhult?*

2.3.1 Ways of sorting

Four methods to sort waste at the household are introduced. There are variations within how the methods can be applied in, thus only the main characteristics are presented in Table 1 below.

Table 1. The table is a summary of different ways to sort waste.

Way of sorting	Description	
Two-bin system	This system includes two bins; usually one bin is for combustible waste and another for organic waste, see Figure 5. (Vänersborg, 2015)	*Figure 5. Two-bin collection. Image source: Vänersborg (2015)*

Optical sorting	According to Rousta & Dahlén (2015), optical sorting means that household waste is sorted into bags of different colors, see Figure 6. This is not common in Sweden but was implemented in 2011 in Eskilstuna. Each color of bags corresponds to a certain material; grey for metal, orange for plastics, etc. When the bags are full, they are placed in the same bin at the household and are later picked up by a truck and transported to a sorting facility.

Figure 6. Example of optical sorting. Image source: Rousta & Dahlén (2015) |

According to Envac AB (2012), supplier of bags and optical sorting facilities, their system can manage several different fractions. The most common is thus to have two fractions, food and residual waste, which is the existing system in Borås.

Multiple fractions	In this sorting method, every household has source sorting bins at the house. This is most common for single family houses and not yet applied in multiple apartment houses. It can consist of two big bins separated into four fractions each, with room for recyclables, food- and residual waste; sometimes also with small buckets for batteries, light bulbs and electronics, see Figure 7. The number of fractions could differ between, and within cities, since the customer often can choose deals to suit their specific needs. The bins are emptied by a special designed truck. (Rousta & Dahlén, 2015)

Figure 7. Example of four fractions sorting. Image source: Rousta & Dahlén (2015) |

Mixed fractions	As the name indicates, this system allows the customer to sort all recyclables in the same bag, see Figure 8. It is thus necessary to separate food waste and waste for incineration in other bags. That is done to simplify the automatic- and manual sorting that take place after the bag with recyclables is picked up, and dropped off at a sorting facility, by truck. (Kretsloppskontoret, 2012)	*Figure 8. Example of mixed fractions. The figure is inspired by the image source: Vänersborg (2015)*

2.3.2 Ways to collect

There are several waste collection systems in use today with different functions and logistics. The waste collections systems that are studied and considered are listed in Table 2 below.

Table 2. The table is a summary of different ways to collect waste.

Collection type	Description
Bin collection	This system consists of bins for waste collection, see Figure 9. According to Rousta & Dahlén (2015), it is one of the most common systems in Sweden, which is used together with a stations and centers for recyclables. The bins can also be used in an environmental room with room for residual waste and package materials. *Figure 9. Example of bins for collection. Image source: Vänersborg (2015)*

Container collection	Containers can be used to collect waste, see Figure 10. In Sweden, they are commonly used to collect package materials at recycling stations. (FTI, 2015)

Figure 10. Example of container collection. Image source: Blomér & Jansson |
| **Deep collection** | There are several types of deep collection bins. A common type is from the company MOLOK, seen in Figure 11. When the bins are full, they are picked up by a specially adapted heavy truck. (The International Solid Waste Association, 2013) |

Figure 11. Example of deep collection bins. Image source: The International Solid Waste Association (ISWA) (2013) |
| **Automated vacuum collection with pipes** | As can be seen in Figure 12, the waste is thrown in a waste inlet or waste chute and thereafter sucked by pipes to containers. When the containers are full, a collection truck picks it up. (Envac AB, 2012) |

Figure 12. Example of automated vacuum collection. Image source: Envac AB (2012) |
| **Mobile vacuum units** | The waste is thrown into inlets or chutes and is sucked up from containers that are placed underground, as seen in Figure 13. (The International Solid Waste Association, 2013) |
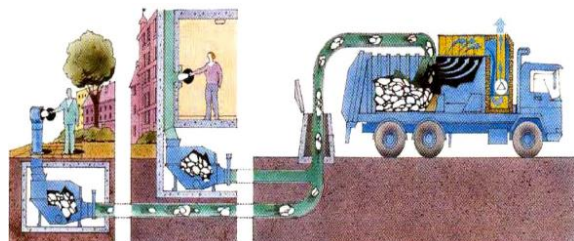
Figure 13. Example of a mobile vacuum unit. Image source: The International Solid Waste Association (ISWA) (2013) |

Food grinder to tank or sewage system	A food grinder can be used to grind food waste, which is installed in the kitchen sink as seen in Figure 14. The grinded waste is mixed with water and can be lead to either a tank or to the regular sewage system. This waste collection type is rather unusual in Sweden. (Fastighets-ägarna Stockholm, 2014)	*Figure 14. Example of food grinder. Image source: Miljökvarnar Nordic AB (2015)*
Reversed collection	The collection type is part of an EU-project tested in Arnhem, Netherlands. The inhabitants in single-family houses have three mini-bins outside the house, see Figure 15. One bin is for organic waste, one is for paper/cardboard and one is for plastic packages. The inhabitants are responsible to dispose their residual waste into underground collection bins further away in the neighborhood, see Figure 16.	*Figure 15. The three mini-bins. Image source: Gemeente Arnhem (2014)*
	Inhabitants in multiple apartment houses dispose their waste in underground collection bins in the neighborhood, see Figure 16. One of the objectives of the project is to motivate the residents to separate the waste. (Gemeente Arnhem, 2014)	*Figure 16. The underground collection bins. Image source: Gemeente Arnhem (2014)*

Reflections – waste sorting – and collection systems

As shown above, there are many ways of sorting- and collecting waste. There are multiple ways of combining the way of sorting and the way of collecting. Since the system in Sweden relies on the municipalities and the cooperation with FTI, it can seem to be most natural to always have recycling stations for collection of recyclables. However, it is important to dare to test new methods and ways of sorting- and collecting waste. It was especially interesting to read about the new sorting- and collection system in Arnhem, Netherlands, where they test a new systems to see how this affects the participation in the waste management system.

Sometimes, anxiousness about how to find good solutions to suggest in the end of the thesis occurred. It felt necessary to contact different waste experts to get help and to understand the waste systems better.

2.4 Indicators for waste management

This section starts with an introduction to indicators and their functions – after follows a short summary of selected indicators for the thesis. Indicators can be used to answer research question 2). Three articles that define indicators for waste management have been studied and used – further summarized in Section 2.4.2 below. A more thorough summary can be seen in Appendix II.

> *2) How can the quality in the white- and black bags be measured and compared?*

2.4.1 The functions of indicators

Indicators can have several functions. According to Palme (2007), they can be used to describe the current situation, to evaluate what actions that are needed for the future, to learn and structure understanding and to communicate. Indicators are thereby thought to be an efficient tool for the thesis.

Elander, Holmström, Jensen, Stenmarck, & Sundberg (2013) focus on indicators about waste management systems and conclude they are useful tools for answering questions such as; how efficient a waste collection system is and how to measure improvements. They further state that indicators can be used to:

- Show changes in complex systems
- Follow up how environmental and sustainability goals can be reached on national and international levels
- Follow up both the present and future waste handling
- Point out and measure different aspects
- Be used as a tool for communication and decision-making

2.4.2 Summary and selection of the indicators

As described in the section above, three articles regarding indicators and waste management systems were studied. They were chosen since they include valuable input with different focuses to the field of indicators for waste. The first article by Elander et al. (2013) has defined indicators that are linked to the waste hierarchy. The second article by Gallardo et al. (2012) has defined indicators for materials in containers for recyclables. The third article by Dahlén & Lagerkvist (2010) has defined indicators for materials in residual waste. The indicators for the thesis were selected based on available data.

Elander et al. (2013) have chosen to divide indicators for waste management into four categories and linked them to the waste hierarchy. The four categories are; moving indicators, background indicators, step indicators and theme indicators. The first three indicators are not considered to be sufficient for this study. This since they focus on the bigger picture with a wide system boundary. However, the last described indicator, theme indicators, could be seen as the main

category for the indicators described by Gallardo et al. (2012) and Dahlén & Lagerkvist (2010), se next section.

An indicator defined by Dahlén & Lagerkvist (2010) was selected to be used in the thesis. It is called the ratio of materials in residual waste (MR). The MR_i will be used as an indication of how well the inhabitants sort recyclables and will be evaluated for the different areas due to comparative reasons. The MR_i is defined as follows, see Equation 1 below:

$$MR_i = \frac{Amount\ of\ material\ i\ in\ the\ residual\ waste}{Total\ amount\ of\ residual\ waste} \ (weight - \%) \qquad (Eq.1)$$

Two of the indicators defined by Gallardo et al. (2012) were selected, where the first was the annual generation rate (AGR). The AGR for a specific material could be used to identify what types of materials that are being used to a larger extent in certain areas. It would be of interest to investigate if the AGR varies for different materials in different neighborhoods. The AGR is defined as follows, see Equation 2 below:

$$AGR_i = \frac{Total\ amount\ of\ material\ i\ generated\ in\ a\ year}{Number\ of\ inhabitants} \ kg/(inha * year) \qquad (Eq.2)$$

The second selected indicator by Gallardo et al. (2012) was the quality in container rate (QCR). The QCR_i could give an indication of how clean fractions of materials that are achieved at the recycling stations within the areas. It is thus a measure of how exact and neat the inhabitants are with regards to waste sorting. The QCR_i is defined as follows, see Equation 3 below:

$$QCR_i = \frac{Amount\ of\ waste\ collected\ correctly\ in\ container\ for\ material\ i}{Gross\ amount\ of\ waste\ collected\ in\ container\ for\ material\ i} \ (weight - \%) \qquad (Eq.3)$$

How the indicators are applied in the thesis can be seen in detail in the Findings, see Chapter 4, and Discussion, see Chapter 5.

Reflections – indicators

The above described indicators are likely based on waste composition analyses. Since the waste composition analysis used in this thesis is conducted by Kamran Rousta, the choice of indicators is limited to the data he provides. Also data from FTI, of for example QCR, is desirable but might not be accessible.

2.5 Theory linked to methods

Important theories behind the methods used in the thesis are explained in this chapter.

2.5.1 Action research

The method of action research is applied throughout the thesis. Zuber-Skerritt (2012) states action research to be an efficient framework to change and include stakeholders. Reason & Bradbury (2001) further mean that action research consists of many aspects, such as knowledge, reflections and understanding. These are necessary to be able to combine and generate, both actions and theories. Action research generates a slightly different and often better purpose than a regular academic research, since it includes opinions and interests of the stakeholders that are directly affected or concerned.

According to Greenwood & Levin (2007), an action researcher needs several skills to be effective, such as social skills and to be both planning and spontaneous. The action researcher further needs to be "a friendly outsider" to make groups of people open-up and share personal opinions. It is also necessary to have integrity, be willing to take risks and to be patient. Action research works as a bridge between local-, insider- and outsider knowledge. (Alänge & Scheinberg, 2014)

2.5.1.1 Change management as a part of action research

Since the purpose of the thesis is how to improve and change a waste management system, it is valid to include the issues of change management. According to Schein (1995), change can be described as learning, where organizations and systems must learn how to change to be able to survive. To change a system and avoid learning anxiety, there is a need to involve and include different stakeholders in the process on an early stage. To understand a complex and dynamic system and how to change it, the researchers need to intervene with the system. The intervention is a learning process in many aspects and can be done through interviews, observations and by questionnaires.

2.5.1.2 Action research and stakeholders interaction in the thesis

According to Pintér, Hardi, Martinuzzi, & Hall (2012), it is important to include a wide range of stakeholders to get accurate results and to know what changes that fit the stakeholders' needs. In the thesis multiple stakeholders are included, such as consultants at Sweco, employees at a strategic level at BEM, the inhabitants and the city planners in Borås. They need to be considered to be able to understand, evaluate, learn and improve the system.

As students being action researchers, the stakeholder interactions are part of a learning process. The conductors of this study are employed by Sweco, and can both be seen as consultants and researchers. The different roles can have both advantages and disadvantages depending on the situation. This issue is further discussed by Herr & Anderson (2005) who mean that it is important to be aware of the different roles and to reflect upon aspects such as values, beliefs, hierarchy and the roles' impact. The reality is complex and it is therefore important to keep track

of decisions, the increased understanding along the way and other reflections that occur (Alänge & Scheinberg, 2014). This further motivates the use of the grey reflection boxes along the report and thesis.

2.5.2 Focus groups

According to Parker and Tritter (2006) a focus group can be used to gather a lot of qualitative data in a time efficient way. The participants in the focus group should have something in common to create a well working discussion, for example in this thesis; being a user of the waste collection system in Borås. Parker and Tritter (2006) also claim that in comparison with an ordinary interview method, the leader of a focus group works as a moderator who makes sure the discussions are between the participants, instead of a discussion between the leader and the members. There are also important ethical aspects to consider when conducting focus groups, such as data sensitivity, confidentiality and informed consent (Parker & Tritter, 2006). These issues are later discussed in Section 3.3, Research ethics.

According to Kungsbacka Municipality (2012), an important aspect is to prepare the focus groups well; from initiation and selection of participants to the performance of the focus group. A mix of different people from different target groups is preferable. The method facilitates to gain a deeper knowledge in a cost-effective way. Disadvantages are that the method relies on the leaders' ability to steer the focus group and the results, and further that the participant recruitment often is time consuming.

According to Pettersson (2015) the focus group method is a time efficient method used to collect data from a wide range of stakeholders. It is important to get all participants' opinions and not only focus on the most verbal people. To collect data in a neutral and ethically correct way, it is important to get the personal opinions from the participants and to avoid influences from one another. The leaders of the focus group have to be responsive, flexible and to be able to adjust language according to the participants.

2.5.3 Interviews

To gather data from different stakeholders, interviews are planned to be conducted. Wilson (2014) writes that a semi-structured interview could be used to collect information about ideas and opinions on a specific topic. It could also be useful when investigating problems where the main difficulties are somewhat known. He strongly recommends recording of semi-structured interviews, or using help from a person taking notes.

Wilson (2014) proposes that a semi-structured interview could last for between a few minutes to numerous hours. Too short interviews could be seen as a disadvantage that could lead to shallow answers since not enough time to create trust and connection is provided.

2.5.4 Research ethics

According to Herr & Anderson (2005) action research often brings several ethical issues that can appear in all parts of the study. According to Alänge & Scheinberg (2014) it is important to be

aware of them and thereby make it possible to take them into consideration along the study. Having people participate in the research is always a risk, since it is difficult to know in advance what risks and benefits the study will generate. Herr & Anderson (2005) and Alänge & Scheinberg (2014) propose that the participants always need to have the opportunity to not participate in the study and further need to be informed about what expectations that the study requests.

Parker & Tritter (2006) also discuss the ethical issues with the action research process. They state that the ethical perspective often can be complex. It is necessary to be able to handle unexpected results that appear along the process. The ethical and political aspects that have been considered in this study have been discussed according to Alänge & Scheinberg (2013) and are explained further in Section 3.3. Some reflections regarding the research ethics are also elaborated in the reflection box in that section.

2.6 Summary of theories and previous studies

To sum up, the above mentioned theories are used to help answering the research questions. The theories are however used on different levels; some theories almost answer conceptual research questions directly, while other theories are necessary to gain a better understanding and to understand how to design the study. How the theories are used, how the different research questions are answered and how the study is designed and conducted, are further explained in Chapter 3.

Reflections – theories and previous studies

The theories within the field of the thesis consider a wide scope; from methods such as action research to different waste indicators. It proves how complex the study is. Due to the complexity, it has been difficult to make the wide scope of theories to make sense. The structure of how the different theories are linked to the research questions was developed to make the chapter as clear as possible.

3 Method

This chapter presents how the study was designed, developed and conducted in order to answer the research questions. It also presents research ethics and the analysis strategy. Due to the complexity of the study, many different types of data had to be gathered, various stakeholders had to be involved and several methods had to be used. The chapter starts with Design of the study, see Section 3.1, which includes a Plan of data, Stakeholders and Methods, see Table 3 below. The chapter continues with a description of how the study was conducted, see Section 3.2, a section on Research ethics, see Section 3.3 and a section on Method limitations, see Section 3.4. The chapter ends with the analysis strategy, see Section 3.5.

3.1 Design of the study

The first step was to decide what data to gather, what stakeholders to sample in order to collect it and to decide a strategy on what methods to use. The data was categorized into four different areas that are further explained in Table 3 below.

The type of data needed was decided in cooperation with BEM, Sweco, the supervisor and the examiner. Also the stakeholders and the methods were decided together with the previously mentioned.

Table 3. The table shows a list of desired data, what stakeholders that can provide information and what methods to use.

Data	Stakeholders	Method
Information about Borås	- BEM - Statisticians at Borås Stad - City planner at Borås Stad	- Interviews - Literature studies - Observations
Waste sorting- and collection systems	Waste experts	- Literature studies - Interviews
Waste composition	- Researchers - FTI	Waste composition analysis[1]
Customer satisfaction	Inhabitants of Borås	- Focus groups - Survey

[1] The waste composition analysis will be conducted by Kamran Rousta at The University of Borås – only the results from the investigation will be used in the thesis.

Below follows a description of the planned method and sample of stakeholders for every type of data. The descriptions are based on the column called Data in Table 3, and divided into Desired data, Stakeholders that can help to provide the necessary data and Strategy to collect it.

3.1.1 Information about Borås

In this section, the first type of data Information about Borås is presented. The desired data is listed as well as the stakeholders that can help to answer questions. Also, a strategy on how to collect the data is presented and motivated.

3.1.1.1 Desired data

Desired data regarding information about Borås is needed to gain a better understanding for the city of Borås. It is further needed to understand the current situation and what Borås wants to achieve in the future. The collected data will therefore consider:

- Background information about Borås
- Statistics for the different areas
- How the current waste collection system has developed over the years
- Own observations in the four areas

The study will be based on four different areas in Borås and the criteria for choosing them were pre-chosen by BEM and could not be influenced by the thesis. A map of the city is showed in Figure 17.
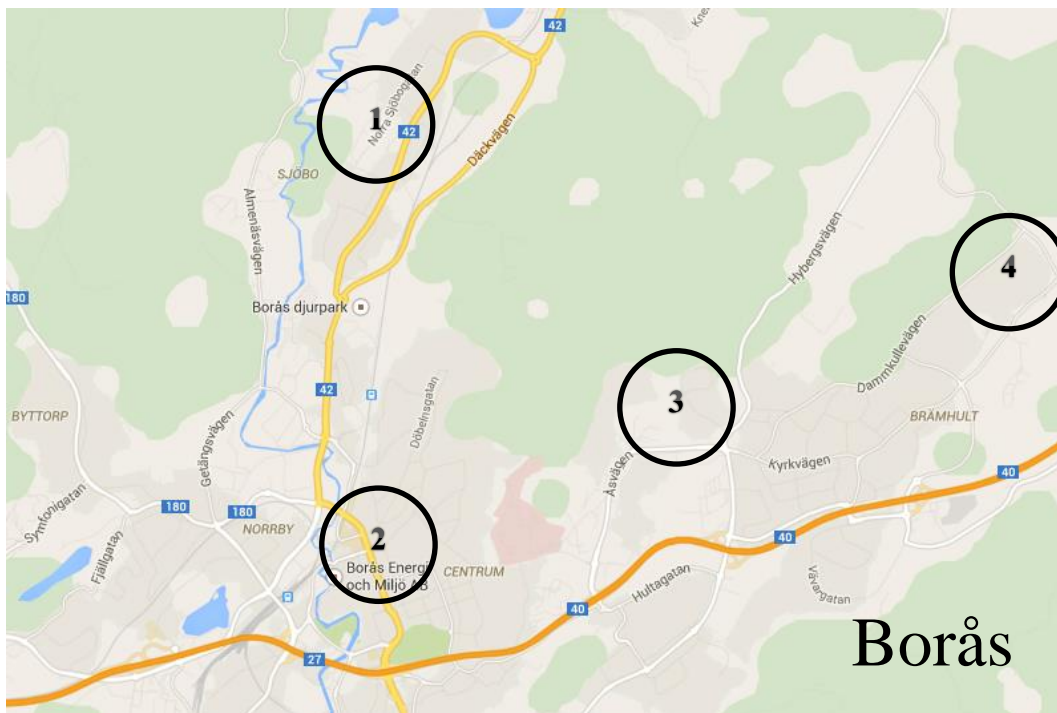
Figure 17. Map of Borås city; 1) Sjöbo, 2) City center, 3) Hässleholmen and 4) Brämhult. Image source: Google maps.

The areas represent a variety of houses, inhabitants and framing, and are further described below, see Table 4.

Table 4. Areas of interest. Image source: Blomér & Jansson

Area	Description	
Sjöbo	Sjöbo is a neighborhood located in the northern part of Borås and has an aging population. The street Nolhagagatan consists of rental flats and has been selected to be part of the waste composition analysis, see Figure 18.	 *Figure 18. The figure shows Sjöbo.*
City center	Four streets in the City center of Borås have been selected to be part of the waste composition analysis. The streets are Holmsgatan, Lilla kyrkogatan, Skolgatan and Öster-långgatan. The apartment building at Skolgatan is shown in Figure 19.	 *Figure 19. The figure shows Skolgatan.*
Hässleholmen	The area Hässleholmen is located approximately 5 km northeast of Borås' city center. The street Mark-landsgatan has been selected to be part of the waste composition analysis, see Figure 20. There are only rental flats on the street. The inhabitants come from a variety of countries.	 *Figure 20. The figure shows Marklandsgatan.*
Brämhult	Brämhult is an area in the north-eastern part of Borås and consists to large extent of single family houses. Two streets, Jute- and Hampgatan, are part of the waste composition analysis and consist of only single family houses. Some of the houses at Jutegatan can be seen in Figure 21.	 *Figure 21. The figure shows Brämhult.*

3.1.1.2 Stakeholders who can help answer questions

There is a wide range of stakeholders that are involved in the waste management system and can provide information about Borås. The criteria to select the sample of stakeholders were identified during a brainstorming session where Ann and Frida separately listed possible stakeholders who knew various aspects of Borås' waste management system. These where then organized into groups of what type of data they could help answering. The criteria for the sample are listed in Table 5 below.

Table 5. Criteria for selection of sample regarding information about Borås are presented in the table.

Data type	Number of experts	Organization
General background information about Borås	1-2	BEM
Demographics of the four areas in Borås	1-2	Borås Stad
Information about the waste sorting- and collection system in Borås	2-3	BEM, Researchers from academia

Table 6 shows more detailed information about what stakeholders that will be interviewed to collect information about Borås. The table also includes a Why-column that describes why the person is interesting to contact. Due to confidentiality, the names of the contacted stakeholders are not listed in the report and are only listed in an appendix, see Appendix III. The employees at BEM and Kamran Rousta are a big part of the thesis who will be contacted continuously in the work process, therefor their names are mentioned in the report.

Table 6. Stakeholders of interests to contact are listed in the table.

Stakeholder	Type of data	Why?
Anna-Karin Schön Project manager, Strategic development BEM	Background information about Borås	Anna-Karin works with strategic development and has great knowledge about BEM's work. She is the main contact at BEM.
Pär Carlsson Manager, Strategic development	Background information about Borås	Pär works with strategic development and has great knowledge about BEMs work. He has knowledge of what

BEM		stakeholders to include in the thesis.
Kamran Rousta Researcher and lecturer University of Borås	Borås' waste management system	Kamran is an expert in the field of waste management with great insights about the current situation and Borås' waste management.
Waste expert Chalmers University of Technology	Borås' waste management system	The waste expert at Chalmers University of Technology has a lot of experience in waste management. The expert has previously worked with developments of the waste management system in Borås.
Project leader BEM, Sobacken	Borås' waste management system	The project leader coordinates the routes of the waste collection trucks in Borås. The project leader has good insights in the different areas in Borås and has knowledge of how waste is collected.
City planner Planning administration Borås Stad	Borås city and its development	City planners in Borås are an important stakeholder group to include since they create the prerequisites and conditions for the design of the waste collection system.
Statistician & strategic developer Strategic city development department Borås Stad	Demographics of Borås	The statistician has information about demographics and statistics about the different areas in Borås.

3.1.1.3 Strategy to collect the data about Borås

Data will be collected through visits in the four areas, through continuous contact with employees at BEM and through contact with statisticians and interviews with experts.

The atmosphere and impressions of the areas will be documented through visits in the neighborhoods, through notes and photographs. The following aspects will be looked into when conducting the observations:

- The impression/atmosphere of the neighborhood – friendly, safe, hostile, etc.
- Cleanliness – litter on the ground, clean, etc.
- Status of the closest recycling station – over full, empty, clean, messy, bulky waste, etc.

- Waste disposal bins for white- and black bags – over full, empty, messy, etc.
- Attitudes and how engaged the inhabitants are to the study
- Other observations that could affect waste sorting and collection

The goal is to visit every area three times to get a trustworthy and to some extent objective picture of the situation.

Data collection from employees at BEM will both be held through a start-up interview and continue through continuous discussions. This method is chosen since it is important to create a relationship with BEM and to have close contact.

Data collection from waste experts will be conducted by interviews either in person or via mail. An interview guide will be designed to create a good structure of the interviews with different people. It will start with an introduction of the thesis and a reflective question. It will continue with more specific and detailed questions about their field of expertise. In order to understand how the stakeholders in Borås cooperate, one question will consider mapping of how the organizations work and exchange information with each other. This is an interesting aspect to include in the thesis, to make sure that all necessary stakeholders are understood. An example of an interview guide can be seen in Appendix IV. How the interviews were actually conducted can be seen in Section 3.2.1.2.

3.1.2 Waste sorting- and collection systems

In this section, the method for collecting data about waste sorting- and collection systems is presented. It starts to present the desired data and continues with the stakeholders who can help answering the questions and provide information. The section ends with a strategy on how to collect the data.

3.1.2.1 Desired data

Desired data regarding waste sorting- and collection is needed to identify and understand different types of waste sorting- and collection systems in Sweden and internationally. The data mainly considers technical aspects of the different systems. This type of data is needed to be able to give a recommendation of area specific systems to BEM at the end of the project work. The collected data will therefore consider:

- General data about waste sorting- and collection systems
- Main characteristics of different waste sorting- and collection systems

3.1.2.2 Stakeholders who can help answer questions

Several stakeholders will be contacted to provide information about this data. Also here the stakeholders were identified during a brainstorming session where possible stakeholders were listed on post-it notes. These where then organized into groups of what types of data they could help answering. The criteria for selecting the type and number of stakeholders are listed in Table 7.

Table 7. In the table, criteria for the sample of experts to contact are listed.

Field of expertise	Number of expert	Organization
The waste sorting- and collection system in Borås	1-2	Academia
National waste sorting- and collection systems	1-2	Companies and academia
International waste sorting- and collection systems	1-2	Companies and academia

Three waste experts will be contacted. An environmental- and waste consultant at Sweco will be contacted, since the expert has knowledge about the different waste sorting- and collection systems with both a national and international perspective. The researcher Kamran Rousta was suggested to contact by BEM since he has great insights in the waste system in Borås. The waste expert at Chalmers University of Technology will be contacted since he has knowledge of how the waste management system in Borås has been developed. In Table 8 below, the stakeholders to contact are listed. The names of the contacted stakeholders can be seen in Appendix III.

Table 8. The table shows a list of waste experts planned to contact.

Stakeholder	Why?
Environment- and waste consultant Sweco	The consultant can provide general information about waste management systems.
Kamran Rousta Researcher and lecturer University of Borås	Kamran is an expert in the field of waste management with great insights in Borås' waste management.
Waste expert Chalmers University of Technology	The waste expert at Chalmers University of Technology has a historical view of how the waste management system was developed in Borås.

3.1.2.3   Strategy to collect the data

Data about waste collection systems will be gathered through literature studies, but also through interviews. Literature studies seem to be an efficient method to understand the different systems while interviews are an efficient method to collect the data from stakeholders. Data will also be gathered through email- and phone-contact.

3.1.3 Waste composition analysis

In this section, the third type of data about waste composition analysis is presented. It starts with the desired data, the stakeholders that can provide it and ends with the strategy on how to collect it.

3.1.3.1 Desired data

An important aspect to take into account is how to improve the waste quality, thus an analysis of the contents in white- and black bags is required. Also data about the collection of package materials is of interest. Collected data on waste composition analysis will consider:

- Ratio of miss-sorted waste in the black- and white bags for every area
- Type of waste that is miss-sorted in the black- and white bags for every area
- Statistics from the recycling stations, for example amount of package materials that are handed in at the stations

3.1.3.2 Stakeholders who can help answer questions

The criteria for data selection are limited to the waste composition analysis and are therefore given by BEM. The focus will be on waste composition data from four areas in Borås that represent different types of houses and demographic groups. The four areas are: Sjöbo, City center, Hässleholmen and Brämhult which were briefly described in Table 4 above, and further described in Appendix I.

The waste composition analysis will be conducted by Kamran Rousta who works with waste management at the University of Borås. BEM has a well-established contact with Rousta and they suggested contacting him due to his knowledge of waste management systems. He has knowledge of waste on both a local- and national level. Rousta also takes in behavioral- and social aspects regarding waste in his research, which can be used as valuable input to this study.

Furthermore, FTI will be contacted to get statistics and data for the different recycling stations in Borås. BEM suggested contacting the regional manager at FTI. The stakeholders are listed in Table 9 below. The names of the contacted stakeholders can be seen in Appendix III.

Table 9. The table shows a list of stakeholders that will be contacted.

Stakeholder	Why?
Kamran Rousta Researcher and lecturer University of Borås	Kamran is an expert in the field of waste management and will conduct the waste composition analysis for the four areas.
Regional manager FTIAB	The regional manager at FTI was recommended to contact in order to get statistics for the recycling stations in Borås.

3.1.3.3 Strategy to collect the data

Data about the waste composition will be collected from four already planned waste composition analyses during the beginning of the thesis. The thesis does not consider the methods for the waste composition analysis, instead data will be used as a result from the waste composition analysis performed by Rousta. The method to be used for the waste composition analysis is a common practice from the Swedish Waste Management Association and is further described by Avfall Sverige (2013). One of the waste composition analyses will be visited to create an understanding of the results.

3.1.4 Customer satisfaction

In this section, the fourth type of data about customer satisfaction is presented. It starts with the desired data and continues with the stakeholders who can provide the data. It ends with the strategy on how to collect data on customer satisfaction. The data collection will consider two different parts – focus groups and a survey. The focus groups will give a deeper, qualitative, understanding while the survey will be conducted by a company and be used as quantitative support to the investigation.

3.1.4.1 Desired data

Desired data regarding customer satisfaction needs to be investigated and understood. This since it is important to find what the customers, i.e. the inhabitants in Borås, think of the current waste sorting- and collection system. It is also of importance to investigate what would make the inhabitants more satisfied with the waste sorting- and collection system. Other data of interest are behaviors and attitudes toward waste sorting and collection. The desired data is therefore:

- Opinions, thoughts and ideas regarding the current and future waste sorting- and collection system from the inhabitants in Borås in general
- Opinions, thoughts and ideas regarding the current and future waste sorting- and collection system from the inhabitants in the four different areas

3.1.4.2 Stakeholders who can help answer questions

Data about customer satisfaction will be gathered through contact with the inhabitants of Borås. As criteria for the sample, the study will consider inhabitants from the four different areas. Input will be collected from 16-20 people per area since it would generate a representative sample. The goal is to have 50 % men and 50 % women and to have inhabitants that are 18 years and older with varied backgrounds. With backgrounds, it means that the inhabitants will come from different countries, will have varied incomes and will be of different cultural background. The criteria are listed in Table 10 below.

Table 10. Criteria for selection of stakeholders in the different areas are presented in the table.

Area	Number of participants	Gender	Age range	Background (income etc.)
Brämhult	16-20	50/50	18-99	Varied
City center	16-20	50/50	18-99	Varied
Hässleholmen	16-20	50/50	18-99	Varied
Sjöbo	16-20	50/50	18-99	Varied

To get in contact with the inhabitants in the four areas, BEM recommended talking to associations and key people in the areas. These are listed in Table 11 below. The names of the contacted stakeholders can be seen in Appendix III.

Table 11. Key people and associations in the four focus areas are shown in the table.

Stakeholder	Why?
Operation Manager AB Bostäder	The operation manager is responsible at AB Bostäder for the multiple family houses at Marklandsgatan in Hässleholmen.
Two of the responsible at Framtid Sjöbo	The two responsible at the association Framtid Sjöbo in Sjöbo, Borås, might be able to help with location for the focus groups in Sjöbo and to register participants.

3.1.4.3   Strategy to collect the data
The strategy that will be used to collect the data is based on the results from a survey and through focus groups. Both methods are further motivated below.

3.1.4.3.1   Survey
To gain a general understanding of the Borås inhabitants' thoughts and satisfaction with the waste sorting- and collection system in Borås, the results from a survey will be used. The survey is conducted by TradeWell Group AB in February 2015. The questions touch upon many aspects such as recycling in general, recycling stations and customer satisfaction in general. However, the design of this method is not included in the thesis since it was on forehand decided by BEM and TradeWell Group AB. The survey is conducted on phone and includes 300 respondents from all over Borås. The survey will thus be used to support the results from the focus groups, but not be seen as key data to identify area specific solutions. The survey questionnaire can be seen in Appendix V.

3.1.4.3.2 Focus groups

Focus groups will be conducted in the four different areas to collect area specific data on customer satisfaction and to gain a deeper understanding of the inhabitants' opinions, behaviors and attitudes towards waste sorting. It is thought to be a good method since BEM wants to create relationships with the inhabitants to exchange information and learn from each other. Two focus groups per area will be held, with approximately eight participants per group. The groups are planned to last for one-two hours.

The plan is to conduct only focus groups in all areas and to the larger extent conduct them in the same way, described below. However, it is further decided that if a focus group will have many registered participants, the way of conducting the focus group will be adjusted to the method according to Pettersson (2015), see Method Section 3.2.4.1.2. It is mainly since it is considered interesting to test two ways of conducting focus groups and to learn more about this method.

A focus group guide with questions will be created. It will consist of an introduction to the thesis and the topic of waste sorting- and collection for approximately 5-10 minutes. The first question will be reflective, to get the participants into the right mind-set and get them to start reflecting. The guide will further consist of a list of questions to discuss. In the end, the participants will be asked if they would like to add anything. The learnings will be summarized and concluded at the end of the focus group. The next step in the project will be explained and the participants will be invited to participate in a feedback workshop, further explained below. The focus group guide can be seen in Appendix VI.

A common feedback workshop for participants from all four areas is planned in the end of April. It is planned to be a one hour session. According to Alänge & Scheinberg (2014), the purpose is to present the results and get feedback from the participants, to hear further reflections, to validate the collected data and to be sure nothing has been missed. In addition, it is included in order to deepen the learning and to create engagement. The feedback workshop is an important step in supporting a more active participation of inhabitants in the waste management process. Registration to the session by either mail or telephone will be used to be able to plan.

A feedback workshop guide with questions will be created. It will start with an introduction to the thesis and the purpose of the feedback workshop for approximately 10 minutes. The results and questions to discuss with the participants will be based on the gathered data and findings. In the end, the participants will be asked if they would like to add anything. The learnings will be summarized and concluded at the end of the feedback workshop and also the next step will be explained. The feedback workshop guide can be found in Appendix VII.

Reflections – design of the study

Planning the study was a challenge. It was hard to think through all required steps and address possible difficulties. The Action research method was chosen to support a deeper understanding of the inhabitants in Borås. It will also give the opportunity to include the inhabitants in the change process, to make them co-researchers and to engage them in the topic.

There were a lot of impressions and things to keep in mind when planning the study. In the beginning, it was not easy to feel confident in the process, but it was helpful to talk about this with the other researcher. It also made it easier to reflect and criticize the stages. Already from the beginning, the authors felt trust for each other and could rely on that the other person always tried to do her best.

3.2 Conducting the study

Below follows a description of how the study was conducted. The description is based on the four types of data that were presented in Design of the study. Some changes from the original design had to be done. The bullet list below is a short summary of the different parts of the method and gives an overview of the flow.

- Information about Borås
  - Literature studies
    - Borås' waste management plan
    - Other literature
  - Interviews with
    - City planner
    - Project leader at Sobacken
    - Strategic developer
  - Continuous contact with
    - Anna-Karin Schön at BEM
    - Kamran Rousta at University of Borås
  - Own observation in the areas
- Waste sorting- and collection systems
  - Literature studies
  - Information from experts
    - Environmental- and waste consultant
    - Researcher
- Waste composition analysis
  - Conducted by Kamran Rousta
    - Visited to get an understanding
- Customer satisfaction (Borås' inhabitants)
  - Focus groups
  - Interviews
  - Results from survey

3.2.1 Information about Borås

The methods used for collecting data about Borås were literature studies, continuous contact with key people, own observations and interviews with experts. Below follows a description of how data was collected.

3.2.1.1 Literature studies

Data was collected through searches online and in literature. It was mainly through recommended articles, journals and brochures from BEM. The webpage mainly used was the homepage of Borås Stad. Also the Borås´ Waste management plan was used to a great extent.

3.2.1.2 Interviews with experts and continuous contact

The interviews were mainly held in person during a meeting. Main questions were sent in advance to give the interviewee the possibility to prepare. The interviews were recorded, after approval by the interviewee. In order to create consistency and make sure no information was disregarded, both Frida and Ann participated in every interview. One person took notes while the other person asked the questions. A summary of the main findings was sent to the interviewee after the interview to be able to validate the data. In Table 12 the contacted stakeholders to collect information about Borås are listed. The table includes a short description of what information people provided. The names of the contacted stakeholders can be seen in Appendix III.

Table 12. The table shows a list of contacted stakeholders to collect information about Borås.

Stakeholder	Type of contact	What information?
Anna-Karin Schön Project manager, Strategic development BEM	Continuous contact	Anna-Karin has provided information about BEMs work and contact information to the researcher Kamran Rousta.
Kamran Rousta Researcher and Lecturer University of Borås	Continuous contact	Kamran shared knowledge based on his research and about the current situation in Borås.
City planner Planning administration Borås Stad	In person (interview)	The city planner provided information about how they consider the waste management system in the planning process when they develop Borås and how the city can be developed in the future. The city planner also gave contact information to the strategic developer, see

		next row.
Strategic developer Strategic Development Department Borås Stad	Telephone	The strategic developer gave information about the strategic development about Borås.
Project leader BEM, Sobacken	In person (interview)	The project leader provided information and insights about how the waste is collected in the different parts of Borås.
Waste expert Chalmers University of Technology	In person (interview)	The waste expert shared knowledge about how the system in Borås has been developed. This has not considered as a result, but generated a better and deeper understanding.
Statistician and strategic developer Strategic city development department Borås Stad	E-mail	The statistician provided demographic and statistics about the different areas in Borås.

Reflections – interviews with experts and continuous contact

The relationship with BEM has been a close working relationship. It has been a good collaboration built on trust, respect and exchange of valuable information.

It was both exciting and nervous to get in contact with multiple stakeholders. One thought that occurred was if the organizations and stakeholders have had any contact with each other before, especially those within the waste field.

For interviews with experts, most of the contacted people where suggested by BEM. That could have led to choices of personal preference. It is though something that is hard to affect in this kind of studies since there is a need to get help from the "inside".

3.2.1.3 Own observations in the areas

All areas, chosen for the waste composition analysis, were visited several times to get an understanding and feeling for the different neighborhoods, see Table 13. They were visited during different times in the day which is marked with either am or pm in the table. Pictures, notes and comments were documented as described in the Design of the study in Section 3.1.1.3 and according to the categories below. A summary of the notes can be seen in Appendix VIII.

- The impression/atmosphere of the neighborhood – friendly, safe, hostile, etc.

- Cleanliness – litter on the ground, clean, etc.
- Status of the closest recycling station – over full, empty, clean, messy, bulky waste, etc.
- Waste disposal bins for white- and black bags – over full, empty, messy, etc.
- Attitudes and how engaged the inhabitants are to the study
- Other observations that could affect waste sorting and collection

Table 13. The table shows a list of the visits in the four areas.

Neighborhood	Visits
Sjöbo	11th Feb am, 4th Mar pm, 11th Mar am
City center	11th Feb am, 24th Feb pm, 11th Mar pm
Hässleholmen	11th Feb pm, 4th Mar am, 10th Mar pm
Brämhult	11th Feb pm, 4th Mar am, 11th Mar pm

Reflections – own observations in the areas

It felt necessary to visit the areas multiple times and on different times during the day since the people and the amount of people being outside vary. The areas could have been visited a couple of more times, but it was decided that enough observation was gathered after the visits since it also required a lot of time.

It was interesting to walk around in the area, since this generated a better understanding of many aspects. The visits also generated a feeling of what people who lived in the neighborhoods. It was a very efficient way of collecting data about the areas. It was surprising how the recycling stations often were messy and did not look so well maintained. This generated reflections regarding the design of the stations; some colors and new signs would make many stations look so much better.

3.2.2 Waste sorting- and collection systems
The methods used for data collection about waste sorting- and collection systems were literature studies and information from experts. Below follows a description of how data was collected.

3.2.2.1 Literature studies
To collect data about waste sorting- and collection systems, the webpages used to a large extent were Chalmers library site and the database Scopus. Search words to find reports, e-books and journal articles were; waste management, sustainable development and waste management, waste collection systems, indicators, waste management and indicators and action research. Other useful background information was gathered through recommended articles by the examiner Ulrika Palme, by the supervisor Sari Scheinberg, and by waste experts.

3.2.2.2 Information from experts

To collect further data about the waste sorting- and collection systems, two experts were contacted, see Table 14. The waste consultant at Sweco, was contacted to get input on possible waste sorting- and collection solutions. The expert provided a list of systems used today and has also given continuous input to the project work due to the expertise in the field.

The researcher in waste science at Luleå University of Technology was contacted since she is a known researcher in field of waste management. She gave some short input through email, and also recommended some literature. The names of the contacted stakeholders can be seen in Appendix III.

Table 14. The table shows a list of contacted stakeholders to collect data about waste sorting- and collection systems.

Stakeholder	Type of contact	What information?
Environment- and waste consultant Sweco Environment	Continuous contact	The consultant gave information about possible solutions for sorting and collection of household waste.
Researcher in waste science Luleå University of technology	E-mail	The researcher provided information about general ideas and comments regarding different waste management systems in Sweden. The researcher further referred to Kamran Rousta for more information and literature.

Reflections – waste sorting- and collection systems

The literature studies and interviews with experts have generated a good understanding of the many ways to sort and collect waste. It has been useful to have contact with several experts within the field; from companies to the academia. They gave a lot of valuable input and contributed to different perspectives in this topic.

It was interesting to get in contact with the researcher at Luleå University of Technology, since the researcher has written many articles that have been read in this thesis. The researcher seemed very engaged and nice, which made the researchers to feel even more engaged in the topic.

3.2.3 Waste composition analysis

The method used for collection of data on waste composition was a waste composition analysis by Kamran Rousta. Frida and Ann joined to watch, learn and get an understanding for how a waste composition analysis is made in practice. However, the actual method for the analysis is not considered in this thesis.

FTI was contacted to get information about sorting quality and pick-up frequency at the recycling stations in Borås and provided information about the collection frequencies. It was however difficult to get more statistics from FTI. It seemed to be sensitive data and the contact person had to get an approval by bosses higher up in the organization. Even if the contacted person was reminded several times, the asked information was not provided. It was therefore decided to exclude this type of statistics in the thesis.

Stakeholders to collect information about waste composition analysis are listed with a short description of what information they provided in Table 15 below. The names of the contacted stakeholders can be seen in Appendix III.

Table 15. The table shows a list of contacted stakeholders to collect data about the waste composition analysis.

Stakeholder	Type of interview	What information?
Kamran Rousta Researcher and lecturer University of Borås	In person	Kamran conducted the waste composition analysis used as input to the thesis.
Regional manager FTIAB	E-mail	The regional manager at FTI provided information about the collection frequency gathered from the different recycling stations and centers in Borås. He could not help to provide information about any other statistics over the recycling stations.

Reflections – waste composition analysis

It was very interesting to join in the waste composition analysis. It gave both understanding for the subject and a perspective of the reality. Thoughts like "this is horrible" and "is this for real?" occurred. After leaving the analysis, the main feeling was disappointment. It was sad to see how bad people are at sorting waste.

Another interesting thought was about other cities in Sweden and how well they sort. It would be interesting to see and compare waste composition analyses for other cities as well and how well the inhabitants sort in Borås are in comparison.

It was difficult to get the desired data from FTI. They seemed very slow and busy and when they answered they did not provide the correct information. It took longer time than expected and caused frustration. FTI's slow response time also generated thoughts about the collaborations between FTI, the municipalities and other stakeholders and how well they are working. It must be frustrating to work with them if they always are so difficult to reach.

3.2.4 Customer satisfaction

The method used for collection of data regarding customer satisfaction was planned to be focus groups. Below follows a description of how the focus groups were conducted.

3.2.4.1 Focus groups

The method of focus groups was used since it is an efficient method to create relationships with the inhabitants. It was also used to learn how satisfied the inhabitants are with the current waste sorting- and collection system and what the most important aspects are to improve. Below follows a description of the interaction with participants and how the focus groups were held. The final sample is presented in Section 3.2.4.1.4.

3.2.4.1.1 Interaction with participants

To get in touch with people in the neighborhoods an introduction letter was formed, see Appendix IX-XII. The letter was distributed within the areas, and also visits to the neighborhoods were made to recruit participants to the focus groups. Table 16 shows a summary of stakeholders that helped getting in touch with inhabitants from the different areas. The listed people where either found through searches online or proposed by BEM. The names of the contacted stakeholders can be seen in Appendix III.

Table 16. The table shows the people who were contacted to get in touch with the inhabitants in the different areas in Borås. The column to the right provides a short note about what information the person gave.

Stakeholder	Type of contact	What information?
Operations Manager AB Bostäder	Phone	The operation manager gave contact details to the project leader at VI-Hässleholmen and approved to hand out and put up information letters at Marklandsgatan.
Two responsible leaders at Framtid Sjöbo	In person	Two responsible people at Framtid Sjöbo helped to get in touch with the inhabitants of Sjöbo.
Project leader at the association VI-Hässleholmen	Phone	The project leader provided information about different possible locations for holding the focus groups around Hässleholmen and Brämhult.
Property manager Willhem Fastigheter	In person	The property manager provided information about Skolgatan. The manager helped getting in to the building and to get in contact with the inhabitants.
Partum AB Property manager Lilla Kyrkogatan 26	n/a	Partum AB did not answer to any phone calls and did therefore not provide any information.
Manager Odenslunds 4H-gård	Phone and in person	The manager at Odenslunds 4H-gård provided the location for the focus groups for Brämhult and Hässleholmen.

3.2.4.1.1.1 Design of information letter

The first step in the recruitment was to form introduction letters, see Appendix IX-XII to be used for creating awareness of the project and wake interest among the inhabitants. The letters were written in both Swedish and English to increase the chance that all inhabitants would understand. The text was developed with feedback from Sari Scheinberg (Scheinberg, 2015), Arvid Jogbratt (Jogbratt, 2015), Robert Olsson (Olsson, 2015), and Anna-Karin Schön (Schön, 2015).

The letters were developed to be slightly different from one area to another to suit the shaping and demographics of the areas. In Sjöbo, a meeting was held with two of the responsible at Framtid Sjöbo which is an association formed to create bonds between the inhabitants in the neighborhood. The association has a meeting place called Framtid Sjöbolokalen where people can attend activities and drink coffee. One of the responsible leaders at Framtid Sjöbo suggested the information letter to be shortened due to the high share of old people living in the area. The feedback was taken into account and the letter intended for Sjöbo was shortened and the font size increased, see Appendix IX. Also the English version was deleted since it was thought to be confusing for the inhabitants. The phone number to Framtid Sjöbolokalen was added to the letter since they agreed to help take registrations to the focus groups. Both location and time for the focus groups were given on the information letter to Sjöbo.

The locations and times for the focus groups in the other areas were not known when the information letters were written. Thus, no such specific information was provided. Instead the letter explained that the groups were to be held in the end of March -15 at a location near the neighborhood. All information letters included email-addresses to Frida and Ann, where people were encouraged to register to the focus groups. The letter also provided information that their neighborhood would be visited the coming week to give more information and take registrations. A phone number might have been preferable, but since only personal numbers existed, no phone number was added to the information letter.

3.2.4.1.1.2 Recruitment to focus groups
The first interaction with the inhabitants occurred through spreading the information letters in the hallways of the multiple apartment houses and in mailboxes for the single family houses.

In Sjöbo, at Nolhagagatan, the information letter was put up in the hallways of the houses chosen for waste composition analysis. The information letter was also distributed to the inhabitants of Sjöbo in cooperation with Framtid Sjöbo who agreed to promote the focus groups and take registrations at the meeting place. About a week after the information letter was put up, the neighborhood was revisited. The recruitment occurred both through knocking on doors and by talking to people walking in the area. Some registrations were taken at Framtid Sjöbolokalen where a Bingo session was visited. An overview of the recruitment process is shown in Appendix XIII.

At Hässleholmen the information letter was put on entrance doors of the multiple apartment houses. About a week later, the area was visited to meet inhabitants and take registrations for the groups. Two different times were suggested. The visit occurred from morning to afternoon to catch as many participants as possible. Communication was a challenge due to the many cultures and backgrounds in the neighborhood. The recruitment was done both through catching people walking in the area and by knocking on doors to promote the discussion groups. Though after only a few doors, the knocking was stopped due to safety reasons. Because of a very low registration rate to the focus groups, the area needed to be revisited. The revisit was made later

the same week to promote the discussion groups at VI-Hässleholmen and to hand out a shorter information letter containing both email addresses and a phone number for registration. A Master thesis cell phone number had been arranged which made it possible to give out a phone number. Time and place for the discussion were provided to make it possible for people to register. The recruitment process is shown week by week in Appendix XIII.

During the recruitment process in Brämhult the information letter was first posted in the mailboxes. About a week later the area was visited to knock on doors and take registrations. See Appendix XIII for a deeper description.

In the City center, the information letter was put up on the entrance doors at the chosen hallways at Skolgatan. No information letter was put at the other three addresses due to several reasons. The property manager of Lilla kyrkogatan 26 could not be reached. For Österlånggatan 44, no property manager could be identified; while for Holmsgatan 15, it only seemed to be a fast food restaurant and no entrance for apartments at that address.

The recruitment at Skolgatan was mainly conducted through knocking on doors during two to three times. One time was in the afternoon, where many older people opened. To reach and recruit younger participants or people that were working during the day, the recruitment continued later in the evening when people were home from work. Some people registered and some had to check their schedule, while others were not interested. An additional recruitment process was conducted the same day as the focus groups were held to try to get even more participants. In Appendix XIII, the recruitment process is shown week by week.

In all areas, many people wanted to leave comments, wishes and opinions, even though they did not want to or could join the discussion groups. The comments were written down and will be presented in the Findings Chapter, see Section 4.2.

3.2.4.1.1.3 <u>Sample</u>

The results from the recruitment process differed a lot. Table 17 below, shows how many registrations that were achieved in total, with gender distribution and approximate age range.

In **Brämhult** most registrations were achieved through knocking on doors to the houses that had gotten the information letter in the mailbox. Most had read the information and knew the purpose of the visit. Knocking on doors in the multiple apartment houses was not as effective but still the most effective method to get registrations in the **City center**.

At **Hässleholmen** the recruitment through knocking on doors was stopped due to safety reasons. Many criminal incidents happened within the area during the recruitment process. The inhabitants did not feel safe to go outside thus it was very hard to motivate people to get engaged in waste handling.

In **Sjöbo**, most registrations were achieved at a Bingo session at Framtid Sjöbo. The remaining of the registrations was achieved by stopping people in the street.

Table 17. The table shows a compilation of the achieved registrations for every area.

Area	Number of registrations	Gender		Age range
	Total (Group 1+Group2)	W	M	
Sjöbo	11 (4+7)	10	1	20-89
City center	6 (3+3)	2	4	26-83
Hässleholmen	5 (4+1)	1	4	25-74
Brämhult	11 (7+4)	7	4	25-74
Total	33	20	13	

Reflections – interaction with participants

Many reflections occurred during the recruitment process. The most considered why it was so difficult to get people to participate in the discussion groups and how to re-design the study in order to collect the data in other ways. The interest to participate in the discussion was especially low in the area Hässleholmen. Only a few registrations were achieved, for example to the second focus group there was only one registered member.

The reasons to not participate were many and varied. To mention a few reasons: they did not have enough time due to work or family, they were not interested in the topic or they could not speak Swedish. Other reasons were that they did not know enough about this topic or that they did not know if they were available on the day for the focus group but that they would check this up and return with an answer by phone or email. The same reasons were received by inhabitants in all four areas. Even if many reasons were heard, it is not sure that all aspects have been understood. One reflection that occurred was that an underlying reason to the lack of participants could be due to lack of engagement and public participation from BEM before.

It was tried to be understood why inhabitants were not interested in the topic, but since these answers often generated frustration and disappointment, it was not always easy to continue the dialogue. Also, very few of the inhabitants who would return actually returned. The inhabitants that thought they knew too little about waste handling, were tried to be convinced that it was a learning process and that it was important to get everyone's opinions and to learn from each other. Unfortunately the persuasion failed in most cases.

In Brämhult people registered via e-mail before the area was visited to recruit to the focus group. That was an indication that there was an interest for the subject within the area. At the visit, people were welcoming and prepared for the visit. Many of the inhabitants had read the introduction letter. It was a bit surprising that the inhabitants in this area were prepared for this visit. However, it was difficult to recruit people in this area as well and many gave the same reasons as described above.

The recruitment was thus a challenge since it required different approaches, and both flexibility and patience. Another thought is that the recruitment process could have proceeded for a much longer time, though that was not an option due to the time scope of the thesis.

3.2.4.1.2 Conducting the focus groups

The focus groups were held during a two-week period in the end of March. The exact dates and times for the sessions were decided depending on availability of the locations where the focus groups were held. One focus group differed from the others, where an additional method was tried. A deeper description of the focus group sessions follows below.

The participants that had given their phone number were called or texted one day in advance in order to remind them about the focus group. At the first focus group in every area, the participants were asked to spread the word about the next focus group for reaching out to the neighbors and to recruit more people.

The first focus group in Brämhult got many participants and was therefore based on the method where "one question" is discussed. The method was proposed by Pettersson (2015). The question was tested by asking it to random people in the street. It was done in advance to evaluate if it was clear enough and easy to understand. The results from the test can be seen in Appendix XIV. The question was:

- From your perspective, what characterize a good waste system?

The focus group was arranged around a table in front of a whiteboard. One of the leaders sat down at the table among the group while the other leader wrote on the whiteboard. Pens and post-it notes were handed out to each participant. First, the participants wrote down factors that they thought answered the question. The factors were thereafter listed in the mentioned order in a table on the whiteboard. The participants were then asked to weight the importance of the factors on a scale between 1 and 6. The weights were listed in the table. The participants were further asked to grade how well the factors worked in the current system. The results of the grades were also listed in the table on the white board. Some additional questions, based on the focus group guide, were thereafter discussed, see Appendix VI. When the discussion was done, the participants were invited to the feedback workshop, further described below. Also, the sorting guide by BEM was handed out. The sorting guide is a booklet with information about BEMs work and how different materials should be sorted.

For two of the conducted focus group areas, Sjöbo and City center, the method of semi-structured interviews to collect data and create discussion was used. This method was also used for the second focus group in Brämhult. The discussions were held around a table and were based on the Focus group guide, see Appendix VI. One leader led the discussion while the other took notes. All focus groups where recorded after approval from the participants.

In the last area, Hässleholmen, another method to collect data had to be used. This was due to that none of the registered participants showed up at the first planned focus group. The method was therefore adjusted to Interviews with inhabitants, see Section 3.2.4.1.3 below.

Reflections – conducting the focus groups

It was a lot of fun having discussions with the inhabitants, though it required commitment and energy. Meeting the participants gave many interesting thoughts and reflections – on waste sorting and collection but also on other aspects in society.

There are many things that might have influenced the results from the focus groups. There was a time limit for the recruitment process that likely influenced the number of registrations. With more time, it would have been possible to promote the groups more, through for example advertisement in the local newspaper and more attendance in the areas to create bonds with the inhabitants.

The time for the focus groups was a limiting factor. It was hard to find times that would suit peoples' work schedules and life in general. It would have been preferable to have at least one focus group during the evening for all areas – in Sjöbo there where only groups in the daytime due to the opening hours at Framtid Sjöbolokalen. That was also likely to be the reason for only getting older participants.

Parker & Tritter (2006) discuss that the relationship between the researcher and participants are of high importance when it comes to conducting focus groups. This could be a weakness of the method since not much time to create bonds was available during the study.

Due to the low interest in participating in the groups, a selection of participants was not possible to do. This resulted in a high age range of the participants – which of course influenced the results. The sample was tried to be more spread, through conducting interviews in the street, see Section 3.2.4.1.3 below.

It was frustrating when people who had signed up, did not show up at the meetings. An example is Hässleholmen where none of the registered participants showed up, and the focus group was cancelled. Preparing for the groups took time, and was expected to give valuable input to the study. When people did not show up, both time and results failed. It was thereby not considered to be time efficient, instead data collection through short interviews in the streets were added to the method.

3.2.4.1.3 Interviews with inhabitants

Interviews with the inhabitants were determined to be an effective tool in the data collection when inhabitants did not show up for the focus groups. In this study, the main issues were rather known, but not fully understood, and the topic was to investigate the inhabitants' thoughts of the waste sorting- and collection system. Data was therefore collected through semi-structured interviews with inhabitants walking around in the chosen areas. They were held outdoors by one interviewer, who both asked questions and took notes. See interview questions in Appendix XV.

Conducting long interviews was not possible while circulating in the neighborhoods. Instead the interviews took 3–20 minutes. Having longer interviews was hard to achieve due to the setting, i.e. asking people walking in the area, and it was thus hard to motivate to a longer interview. To

minimize the risk that information was disregarded all interviewees were asked if there was anything else that they wanted to add at the end of the interview.

No taping or videoing of the interviews was done but only notes were taken by the interviewer. This was done as a direct result from the short amount of time provided for every interview. It might have been preferable to use a note-taker, but due to the limited amount of time, it was more effective to split up and conduct interviews separately. Being one interviewer could also be seen as an advantage since people might have found it easier to talk to one person rather than to two.

The semi-structured interviews and circulation in the neighborhood were stopped when no new aspects where received during the interviews.

Reflections – interviews with inhabitants

It was a lot easier to get people to participate in short interviews in the street than to get them to join a focus group at another time. The spontaneous thought was that almost everyone had something to say about waste sorting and collection, thus a lot of interesting thoughts and comments came out as results from the interviews. This method was more time efficient than conducting focus groups. A drawback could however be that the discussion between participants did not occur and that deeper thoughts and comments thus were missed. As an advantage, the interviews mean less commitment from the participants. That could give that also those who are normally not committed to waste sorting and collection choose to participate. The attitude of the sample could thereby be more varied.

Sometimes the language created a barrier when talking to inhabitants in Borås. It was difficult to deal with different languages in the different areas. Since the focus groups only were conducted in Swedish, only Swedish speaking participants were registered. However, the interviews with the inhabitants were sometimes conducted in English, to be able to gather information from a wider sample of inhabitants. It was noted that it would have been interesting to understand inhabitants that recently had moved to Sweden from abroad and were new to the system.

3.2.4.1.4 Final sample

Table 18 below shows a summary of the final sample, with number of participants, gender and age range. The following sections shortly describe the differences in number of registrations and participants. Approximately 60 % of the registered participants did not show up.

Four participants were registered to the first focus group at Hässleholmen, however, none of them showed up. To the second focus group, there was only one registered participant who did not show up. There was also a late registration by two participants (a couple). Together with the two, it was decided to conduct an interview instead of arranging a focus group.

The first group in Brämhult had seven registrations, of which six people showed up. To the second group, which had four registrations, only two showed up.

In Sjöbo, four people had signed up for the first group, but only one came. Instead two other participants, recruited at Framtid Sjöbolokalen, joined the group. The second group in Sjöbo had seven registrations, but only one came to the group.

In the City center, three people had registered for each group. To the first group, two people showed up, and to the second group only one person came.

Table 18. The table shows the final sample of participants for the focus groups.

Area	Participants		Gender distribution		Age range
	Gr. 1	Gr. 2	W	M	
Sjöbo	3	1	4	0	77-89
City center	2	1	0	3	69-83
Hässleholmen	0	0	-	-	-
Brämhult	6	2	2	6	68-75
Total	15		6	7	

Approximately 20 semi-structured interviews were held in Sjöbo, 10 in City center, 20 at Hässleholmen and 0 in Brämhult. Table 19 below shows the final sample from interviews and the number of people who gave additional comments. The results from the interviews are presented in Chapter 4, Findings.

Table 19. The table shows the number of people who were interviewed in the streets of the neighborhoods. Noted are also those who wanted to give a comment connected to waste management system in Borås.

Area	Type of data	Number of participants	M	W	Age range
Sjöbo	Additional comments	13	5	8	18-75
	Interviews with inhabitants	21	8	13	12-88
City center	Additional comments	14	6	8	25-90
	Interviews with inhabitants	9	3	6	19-74
Hässleholmen	Additional comments	20	11	9	20-80
	Interviews with inhabitants	20	8	12	19-73
Brämhult	Additional comments	12	6	6	35-70
	Interviews with inhabitants	0	0	0	-
Total	Additional comments	59			
	Interviews with inhabitants	50			

3.2.4.1.5 Feedback workshop

The feedback workshop was held in April during one hour in early evening. All people who registered for the focus groups, to whom there were contact information, were reminded by phone, text message or email. Also those who had registered to a focus group but did not show up were invited to the feedback workshop. A person who had shown great interest in waste sorting and collection during an interview in the street was invited by email. Anna-Karin Schön at BEM, was asked to spread the word about the workshop in order to get participants. An invitation to the workshop was sent to Framtid Sjöbolokalen who put it up at the meeting place. Also the staff was invited by phone. Friends to Frida, living in Borås, were invited to participate in the feedback workshop. Table 20 below shows both how many who registered for the feedback workshop and how many who showed up. Anna-Karin Schön from BEM, also joined the feedback workshop. She is not included in the table below.

Table 20. The table shows the registrations to the feedback workshop and the actual number of participants.

Area	Number of registrations	Number of participants
Sjöbo	0	0
City center	3	3
Hässleholmen	1	0
Brämhult	4	4
Total	8	7

The feedback workshop guide and a presentation were developed, where results were mixed with questions to discuss. The feedback workshop guide can be found in Appendix VII. The results were from focus groups, interviews and waste composition analysis. These were discussed with the group and notes where taken. The feedback workshop was recorded after approval from the participants.

Reflections – feedback workshop

The participants at the workshop felt interested and engaged. It was a good atmosphere and people asked questions along the workshop. It still would have been preferable to have participants from all neighborhoods. But since that was not possible, the goal was to get as much feedback as possible from those who had come. The feelings after finishing the workshop were relief, happiness and satisfaction.

3.2.4.2 Survey

The survey design and performance were conducted by Tradewell Group AB where BEM approved and gave input to the questions. The number of questions and respondents were decided by Tradewell Group AB. The survey could thus not be influenced by the thesis. The questionnaire can be seen in Appendix V.

According to Schön (2015) the company had to make 3 878 calls, to 1 967 people, in order to get 300 responds.

3.3 Research ethics

Like other action research studies, the thesis had a number of predetermined and set rules for each phase. But as it was 'action research' it required ongoing reflection, adjustment and good judgement by the authors. The study has been a learning process that has required reflections and criticizing upon the different phases. The authors have tried to be conscious of the used methods and to a large extent been aware of the limitations. As in other studies it has been important to create transparent methods and results. The study has concluded reflections regarding how to conduct it, to make it possible for others to redo. It has been very important to document everything, to be able to show others what have been done. Another important part has been to express how the results have been transformed from raw data through analysis and to the final key findings.

In action research, everyone has a voice and a part to play. Several stakeholders were therefore contacted to create commitment, participation and participative learning. When the stakeholders, such as inhabitants in Borås were contacted, the study was always introduced and explained, and they were asked if they wanted to participate since everyone has a free will. Sometimes, this part of the study caused frustration, since the participation rate was low. Getting people to participate will be further discussed in the discussion, Chapter 5.

To be able to create change, it is necessary to understand the participants and to create a culture of sharing where people feel they can be open and honest. To get everybody to share their thoughts, it has been very important to create trust and trustworthiness (Alänge & Scheinberg, 2014). It has been done through giving an honest introduction about the authors, the thesis and to make the participants understand that no answers are wrong. It was important that the participant understood that there was no political agenda and that the thesis work was neutral. The researchers have also been aware of the need to stay objective when conducting the study and to avoid influencing the participants during the discussions and interviews. This was also considered when the focus group- and interview-questions were formed, to avoid too complicated or leading questions. Another important aspect to consider was that people could give the social desirable answers i.e. the answers that the participants thought were expected by them. It has been considered through asking follow-up questions and asking them for concrete examples. (Alänge & Scheinberg, 2014)

The inhabitants who participated in the interviews or focus groups were informed that their participation, and the results, were to be treated with anonymity and sensitivity. It has been an important aspect to create confidentiality in all aspects of the study. This has been done through guaranteeing that the gathered information from interviews and focus groups with inhabitants is presented as group results – not individually. A feedback workshop was held to give the inhabitants opportunity to confirm that their opinions had been correctly interpreted. It was also an important part to be able to follow up the participants' reflections and additional comments, since it has been a learning process for them as well.

Results from the interviews with experts, presented in Findings, Chapter 4, were sent to the interviewee after the interview. This was done to avoid misunderstandings and to maintain a high quality of the work.

Further on, the study included parts where it was difficult to know what the different roles would generate as result; being researchers, being students and/or representing BEM/Sweco. In order to create trustworthiness and good relationships, it was important to inform the participants about the research as part of the thesis but also as a part of BEM's and Sweco's work.

Reflections – research ethics

It has been important to be honest to all participants and stakeholders and to create trust in the relationships. That has not always been easy, since it has occurred that people have lied to the researchers through for example giving false telephone numbers. Another example is everyone who registered to the focus groups and did not show up. This generated a sense of lacking trust and further affected the strength of the relationship with all inhabitants in Borås.

It was not so easy to get everyone to participate by free will. Sometimes the researchers felt it would be easier to force or to pay everyone to participate but realized that this would get expensive and would not feel right. The idea that there must be other ways of doing this occurred more than once. The method required a lot of flexibility, creativity and energy. However, it felt like the researchers learnt along the process and that this could improve the settings if a similar study would be conducted again.

It has sometimes been difficult to understand why some decisions have been made, since the study often has been shaped after opinions by BEM, Sweco, the researchers or other participants. It has therefore been important to keep track of thoughts, ideas and discussions by good documentation.

3.4 Method limitations

The limitations of the used methods have been included and discussed in the grey reflection boxes along the chapter, and will therefore not be further developed.

3.5 Analysis strategy

In this section a description of how the collected data was analyzed is presented. The analysis strategy follows the same structure as the Method Chapter – divided into four sections: 1) Information about Borås, 2) Waste sorting- and collection systems, 3) Waste composition analysis and 4) Customer satisfaction.

In Table 21 below, the specific collected data is presented and organized into the above mentioned main categories, which were previously presented in the Method Chapter. The table also shows how the collected data was used – distinguishing between "data collected as a basis for general understanding" or "data collected as a contribution to the results". The data collected "for general understanding" will be treated only as input for the authors' own pre-knowledge and understanding, and will therefore not be analyzed in the thesis. However, the remaining data, will be treated as relevant information that contribute to the results, which will be analyzed in the thesis and presented in the findings.

Table 21 also shows who collected the data – a distinction can be made between what data that was collected by the authors and what data was collected by other researchers. As seen in Table 21, most of the data has been collected by the authors. The exception is: the Waste composition data – was collected by Rousta and the Survey was collected by Tradewell AB. The analysis strategy for the four data categories is presented below.

Table 21. The table lists the main category of data, the collected data, what the data was used for and who gathered it.

Main category	Collected data	Data used for	Collected by
Information about Borås	• Background data on Borås • Statistics for four areas • Results from interviews with experts • Observations in the four areas	Understanding Understanding Contribution to results Contribution to results	Ann and Frida Statistician Ann and Frida Ann and Frida
Waste sorting- and collection systems	• Results from interviews with experts • Data from literature	Understanding Understanding	Ann and Frida Ann and Frida
Waste composition	• Waste composition analysis based on four areas	Contribution to results	Rousta

Customer satisfaction	• Survey results	Contribution to results	Tradewell/BEM
	• Focus group results from four areas	Contribution to results	Ann and Frida
	• Results from interviews with inhabitants	Contribution to results	Ann and Frida

3.5.1 Information about Borås

Specific data sets that were collected to get information about Borås are:

- Background data on Borås
- Interviews with experts
- Observations in the four areas
- Statistics for four areas

Below follows a description of how every dataset was analyzed.

3.5.1.1 Background data on Borås

Background data, such as number of inhabitants, age and income, and also information about the historic and present collection system were collected in Borås. This data was primarily used to develop understanding and did thus not require any deep analysis.

3.5.1.2 Interviews with experts

Interviews with City planner, Project leader at Sobacken and Strategic developer were analyzed according to the the steps below. Raw data and notes from interviews can be seen in Appendix XVI-XVIII. An example of how the analyses were done, can be seen in Appendix XIX. A summary of the analyzed data can be seen in Appendix XX.

1. Notes taken on computer at the interview were printed out
2. The notes were read through to get an overview of the information
3. Information regarding the same areas was marked with the same color
   Considered aspects for City planners:
   - The working procedure for city planners
   - Co-operation with others
   - Planning and building of recycling stations
   Considered aspects for Project leader at Sobacken:
   - The working procedure at Sobacken
   - Co-operation with others

    o   Present and future aspects on waste collection

Considered aspects for Strategic developer:

    o   The working procedure for Strategic developers

    o   Co-operation with others

    o   Future plans for Borås

4. Text marked with the same color was put together and written into a summary of the results
5. The text was sent to the respondent for approval
6. Changes according to the respondent were done before the results were summarized into three tables in Section 4.1.

3.5.1.3 Own observations in the areas

The observations made in the selected geographic locations were analyzed in two steps:

1. Analyzing the photos from the areas according to the categories previously reviewed in the method, Section 3.2.1.3. These were the following:
   - The impression/atmosphere of the neighborhood – friendly, safe, hostile, etc.
   - Status of the closest recycling stations - full, empty, clean, messy, bulky waste, etc.
   - Waste collection bins for black- and white bags
   - Cleanliness – litter on the ground, etc.
   - Attitudes and how engaged the inhabitants are to the study
   - Additional comments
2. Notes from the areas were read through and the same categories as mentioned above were used to categorize the raw data. The raw data and its transformation can be seen in Appendix VIII.

3.5.2 Waste sorting- and collection systems

Specific data was collected regarding waste sorting- and collection systems – they were:

- Information from experts
- Data from literature studies

As indicated in Table 21 above, data from literature and information from experts were mainly used to get an understanding for what types of sorting- and collection systems exist. A deep analysis was thus not made. However, in the conclusions, where all results lead up to a recommendation to BEM, this information is used to be able to suggest improvements to and synergies with the current system.

3.5.3 Waste composition analysis

Collected data on waste composition was:

- Waste composition results based on four areas

Since the waste composition analysis was conducted by Rousta, and only the results are used, no deep analysis is done of the findings. The results were presented as diagrams which were printed in two copies. To analyze them, the following aspects were marked:

- What area sorted best and worst
- What seemed hardest to sort
- Other interesting aspects

3.5.4 Customer satisfaction

Specific data sets that were collected regarding customer satisfaction, this data included:

- Focus group results from the four areas
- Results from interviews with inhabitants
- Results from feedback workshop
- Survey results

First raw data from the four data sets were processed. Raw data from the focus groups were recordings and tapes. First, the tapes from the focus groups were listened to, at the same time as that the notes from the sessions were looked through and completed. This was done to see that the notes brought up everything that had been said and add things that had been missed. To see the notes from the sessions see Appendix XXI-XXIV. The same proceeding was conducted for the feedback workshop session. The notes can be seen in Appendix XXV.

Raw data from the interviews with the inhabitants were documented through notes that were structured based on the asked questions. For each area, answers were listed into an excel sheet and categorized based on the questions. For example, answers to question 1 were listed first, then all answers to question 2 followed and the rest of the notes continued according to this structure, as can be seen in the examples in Appendix XXVI.

Raw data from the customer survey was received from Schön (2015) in the form of a word document. This word document presented the results based on age and type of housing for the participants.

The four data sets to explore customer satisfaction were then analyzed by a similar strategy. The analysis of data collected from the focus groups, interviews with inhabitants, feedback workshop and the survey were analyzed according to research questions 3a and 4 below, to understand what is working well in the current system and to understand what improvements that are needed.

> *3a. What is working well in the current sorting- and collection system in Borås?*

> *4) What is needed technically, socially and economically to improve the ratio of correctly sorted waste in the white- and black bag?*

The analysis strategy followed the following steps presented below. Examples and a deeper explanation of how the raw data was processed can be seen in Appendix XXVI.

1. The notes were marked with five different colors:
   a. "Things to keep" were marked with one color – based on research question 3a.
   b. "Things to improve" were divided into three under-categories; socially, technically and economically. The three aspects were marked with three different colors – based on research question 4.
   c. Other interesting aspects, solutions and ideas that did not fit into the above mentioned categories were highlighted in another color.
2. The findings were summarized based on above described categories. These can be found under each geographical area below. Since the survey was conducted for Borås in general, those findings are presented in a separate section.

Reflections – analysis strategy

It felt quite natural that the analysis strategy and the different marked aspects are based on the two mentioned research questions. Furthermore, data on customer satisfaction will be combined with results from the waste composition analysis in order to evaluate whether any correlation between the two can be found. It will be really interesting to evaluate, since it seems rare to compare customer satisfaction with waste quality.

All data will at the end contribute to the final result – a recommendation to BEM of what to improve in every neighborhood. It feels quite difficult since the study is complex and has a lot of different data types. It will be interesting to continue with the findings and see what recommendation the study will generate.

4 Findings

In this chapter, results from the interviews with experts are presented. Thereafter follow findings based on the four geographical areas. After the individual geographic review, a comparison between the areas and a summary of the findings are presented. The chapter continues with a presentation of the results from the data collected by others; the survey and a general comparison from the waste composition analysis. The chapter ends with results from the feedback workshop.

4.1 Interviews with experts

Three experts were interviewed; a city planner, a strategic developer and a project leader for waste handling. They were interviewed to better understand how the current waste management system works and what prerequisites that should be considered when developing the system. This information was needed to be able to answer research question 5 below.

> 5) *How can the sorting- and collection systems be developed depending on the type of houses and inhabitant demographics in an area?*

The interviews with experts generated findings that can be seen in short summaries in the tables below. Full summaries of the interviews can be seen in Appendix XX. The summaries below are based on the three aspects mentioned in the analysis strategy in Section 3.5.1.2:

- Work procedures with regards to waste handling, as seen in Table 22
- Co-operation with others, as seen in Table 23
- Future aspects important to consider when developing the waste management system, as seen in Table 24

Table 22. The table shows a short summary of the experts' work procedures.

Expert	Work procedure
City planner	BEM gives the city planners input if a recycling station needs to be built in a new area. "We city planners only initiate planning for a recycling station if we claim an area where there is an existing recycling station. BEM provides information about distances between houses and recycling stations."
Strategic developer	The department works with Comprehensive planning for Borås. "Strategic development has a general perspective where details are taken into account, but not specifically presented. Waste handling is normally left to the Technical Department which is an organization that works with the concrete plans."

Project leader	The project leader at Sobacken works with planning and administration regarding waste pick-up in Borås. Regarding observations from the areas, he says that not much is put outside the bin, at least not when comparing to how much that is picked up. However, there is a big difference in waste amounts picked up before and after pay-date.
	"It feels like Borås inhabitants throw away their money."

Table 23. The table shows a summary of the experts' co-operation with other stakeholders.

Expert	**Co-operation with others**
City planner	The cooperation with BEM usually works well.
	"In the planning process we have meetings where BEM gives input regarding waste handling. To be able to meet the requirements connected to waste handling, it is important to get BEMs input at an early stage."
	The city planner also mentioned that it is difficult to get in touch with the inhabitants. The city planning office invites inhabitants to consultations, but often gets very few participants.
Strategic developer	The strategic developers have a close collaboration with the politicians, since the organization is driven by them.
	"The cooperation with BEM is working well. We exchange opinions and reflections at an early stage in different projects."
Project leader	"I would appreciate better communication with those who mishandle waste disposal. These people are hard to get in touch with, since they hide and just want to get rid of their waste. I believe that better contact, communication and contact routes with the inhabitants of Borås is a key to improve the collection."

Table 24. The table shows important future aspects to consider when developing the waste management system.

Expert	**Future aspects**
City planner	"There are often many public opinions regarding locations of recycling stations. An interesting aspect is that people often want a recycling station close to home but nobody wants to actually see it from their home."

Strategic developer	The plans for future Borås have one main focus and that is how to densify the city. "The plan is to develop the City center, and to triple its number of inhabitants by 2025."
Project leader	The project leader believes it is important to listen to individuals, but that the decision of how to collect waste should not be left to the customer. "The customers might not be familiar enough with the problems connected to waste sorting and collection, though it is very important to listen to the customers to hear their preferences and expectations. What is most important is to develop a system that encourages correct behavior."

To summarize, the three experts had different ways of working. That seemed reasonable since they work with different tasks. The main impression was that the two experts at Borås Stad had a good co-operation with BEM.

Reflections – interviews with experts

The interview conducted with the city planner generated an understanding for the development of the city through the local planning process, the organisation around it and what organisations they work with. The city planning office seemed to have a good cooperation with BEM. The experience of troubles finding participants for focus groups confirms the city planner's thoughts about getting inhabitants to their consultants about building projects.

The interview conducted with the strategic developer generated an understanding for the development of the city through the planning process and organisation around it. Just like the city planning department, strategic development seemed to have a good cooperation with BEM.

The interview conducted with the project leader at Sobacken generated a deeper under-standing of how waste in the different areas is collected. It created an understanding for the complexity connected to planning and pick-up frequency. The mentioned citation above, how it feels like the inhabitants throw away their money, gives a picture of how much waste is generated and how important it is to prevent waste in the first place.

Another interesting point was how important it is to include the inhabitants and to encourage the correct behaviour in all different areas in the city. In the following four sections, collected findings from observations, focus groups and interviews with inhabitants from the four areas are presented.

4.2 Findings from the four areas

In the following sections, the results found in each of the four geographical areas are presented: Sjöbo, City center, Hässleholmen and Brämhult. For each location, findings from own observations, focus groups and interviews are presented. After the individual geographical review, a summary of the key findings and a comparison of the areas are presented. As a reminder, the research questions answered by the findings are listed below. Findings related to customer satisfaction from the focus groups, interviews with inhabitants, feedback workshop and survey were retrieved to answer research questions 3, 3a and 3b.

> 3) *What factors regarding sorting- and collection of waste are influencing customer satisfaction?*

> a. *What is working well in the current sorting- and collection system in Borås?*

> b. *What are the most important aspects to improve in the current sorting- and collection system in Borås?*

Findings from focus groups, interviews with inhabitants, feedback workshop and survey were also needed to answer research question 4 below.

> 4) *What is needed technically, socially and economically to improve the ratio of correctly sorted waste in the white- and black bag?*

The answers to the previous mentioned research questions 3, 3a, 3b and 4 were needed to find suitable area specific solutions as asked for in research question 5 and 5a-d.

> 5) *How can the sorting- and collection systems be developed depending on the type of houses and inhabitant demographics in an area?*

> a. *What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Sjöbo?*

> b. *What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in City center?*

> c. *What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Hässleholmen?*

> d. *What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Brämhult?*

Below follows area specific findings that have been found in the investigation.

4.2.1 Sjöbo

Findings from observations, focus groups and interviews with inhabitants in Sjöbo are presented in the following sections. Lastly, results from the waste composition analysis conducted by Rousta are presented, and also demographics retrieved from the statistician.

4.2.1.1   Observations

The neighborhood was visited and observations were made in the general areas around and specifically close to waste collection bins and recycling stations. The area around Nolhagagatan and the multiple apartment houses was clean and gave a nice and safe impression, see Figure 22.

Figure 22. The area in Sjöbo was clean and felt safe. Image source: Blomér & Jansson

Some of the collection bins outside the buildings were open and full, see picture to the left in Figure 23. The recycling station at Sjöbo torg was visited several times. Sometimes it was full and messy while other times it was clean and the bins were empty, as shown to the right in Figure 23 below.

Figure 23. To the left: the figure shows collection bins for the white- and black bags at Nolhaga-gatan. The right figure shows the recycling station at Sjöbo torg. Image source: Blomér & Jansson

4.2.1.2 Focus groups and interviews with inhabitants

The first focus group held in Sjöbo had four registered participants. However, only one of them showed up. Therefore, two new participants were recruited spontaneously. This resulted in three participants. The second focus group had only one participant, since none of the other seven registered participants showed up. This group was turned into a semi-structured interview instead. Some reflections about this can be seen in the reflection box in the end of the section. Short interviews were also held in the streets due to the low interest in participating in the focus groups. The data was analyzed according to the strategy presented in Section 3.5.4. Aspects to keep and improve, retrieved from interviews and focus groups, are described below.

4.2.1.2.1 Important aspects to keep

The inhabitants in Sjöbo were in general satisfied with and wanted to keep the waste system with white- and black bags: "I think the black and white bag system works fine. I know where to put my waste."

4.2.1.2.2 Social improvements

Some inhabitants were unsure about how to sort: "I don't sort that much. I don't have time and I don't know where to find information about how to sort." Many people requested information and education regarding how to sort waste correctly in the white- and the black bags. Some also had ideas of how the information could be spread: "There should be information on the disposal bins of what should be placed in the white- and black bag."

People in Sjöbo also wished for a waste collection system that would minimize dependency on family and friends. Regarding dependency one person says: "I need help to carry my packages to the recycling station". People thought everyone should be able to get rid of their waste in the 'right way' – despite health conditions or age, trouble walking, etc.

Another issue was the attitudes towards waste sorting and 'other people': "I think people born in the 40s are the worst". People blame others for being worse. Many older people thought they had so little food waste that it was not sufficient to use the black bags: "I think the system with white- and black bags works okay, but I don't have so much waste since I live by myself".

4.2.1.2.3 Technical improvements

The recycling station at Sjöbo torg received a lot of complaints and comments. The comments were mainly regarding messiness and maintenance – especially since both people and restaurants seem to dump waste outside the bins and sort incorrectly: "It is obvious that different restaurants dump waste at the recycling station at Sjöbo torg". One person said "it is disgusting at the recycling station at Sjöbo torg".

Other comments were that the recycling station gets very dark in the evenings: "The station gets very dark and a bit scary at night. A solution could be to put up lights in the trees". Regarding if the inhabitants were satisfied with the distance to the recycling station at Sjöbo torg, it depended

on where the person lived; many were satisfied with the proximity of the station, while others who lived in the northern parts of Nolhagagatan thought: "It is far to a recycling station".

4.2.1.2.4 Economic improvements
None of the inhabitants requested any economic improvements.

4.2.1.2.5 Solutions suggested by the inhabitants
As mentioned, one suggestion regarding the recycling station at Sjöbo torg was to put up lights and surveillance cameras to decrease the dumping and punish those who do. Another suggestion was to spread information about charity organizations that pick up furniture: "Spread the information that charity organizations pick up furniture and other things that people want to get rid of". One inhabitant wondered what mobile info center was working with and it was suggested that BEM should investigate what they do: "I have seen them standing at the recycling station with the hands in the pockets and I do not understand what they are doing there".

A more general suggestion was to communicate better with the inhabitants through media, for example in Borås Tidning, on how good or bad people are sorting waste. That could increase the awareness and interest: "It should be written in the local newspaper that Borås is not so good at source sorting."

Another idea was to decrease package materials from the stores and that it would be good to apply the bottle refund system on glass bottles and other packages.

4.2.1.3 Waste composition
This section presents Sjöbo's results from the waste composition analysis conducted by Rousta. The results are presented through the indicator MR (Ratio of materials in residual waste). The waste composition analysis showed that the inhabitants in Sjöbo have large potential for improvement, especially with regards to the contents in the white bag. As seen in Diagram 1 below, only 40 % of the materials were correctly sorted in white bag. The bag contained large shares of both packages and food waste. However, Sjöbo is one of the best areas of the four with regards to the share of correctly sorted combustible waste in the white bags. This will be explained later in a comparison of the four areas, Section 4.2.7 below.
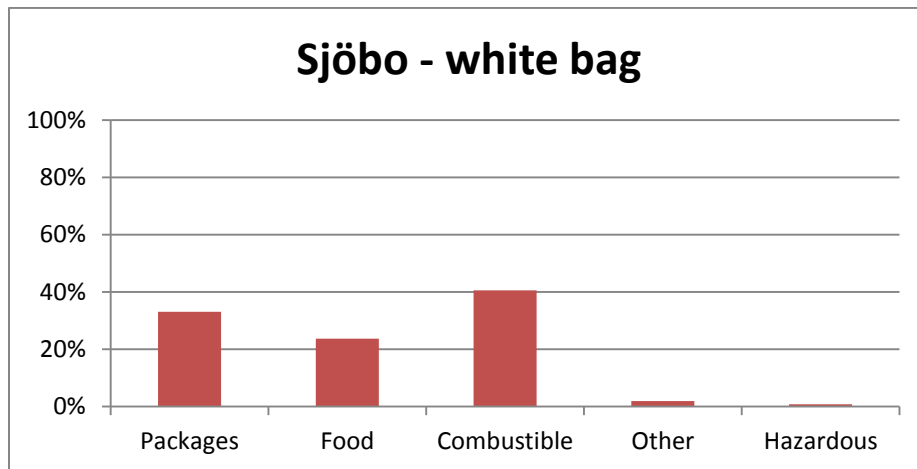
Diagram 1. Waste composition results from the white bags in Sjöbo. Source: Based on Rousta (2015)

In contrary to the white bags, the black bag had quite good results with around 70 % food waste, as shown in Diagram 2 below. However, the miss-sorted materials in the bags are 18 % combustible waste, of which 60 % is diapers that should have been sorted into the white bags.
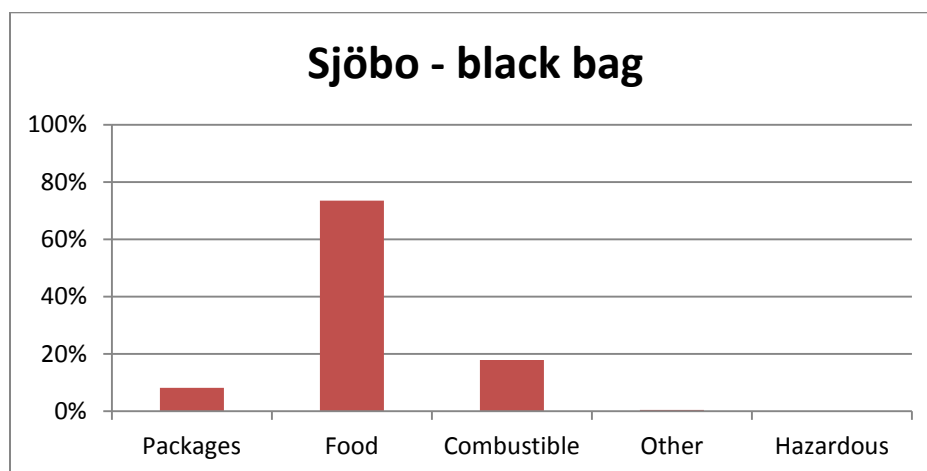
Diagram 2. Waste composition results from the black bags in Sjöbo. Source: Based on Rousta (2015)

4.2.1.4   Area demographics

Some of the area demographics from 2013 have been summarized and can be seen in Table 25 below. The data is from 2013, but according to Lindqvist (2015) it can be assumed that the number of people moving in and moving out in an area is about the same every year. Table 25 shows that the largest share of the population is between 25-64 years. It also shows that the smallest group is children between 0-5 years. About 33% of the inhabitants who have moved in have not used the waste system with the white-and black bags before.

Table 25. The table shows the age distribution of the inhabitants, the average income per family and "new to the system with white-and black bags". The later means the share of the new inhabitants that have moved to Sjöbo from other municipalities and from abroad. It is assumed that they therefore have not used the waste system before. The statistics were retrieved from (Lindqvist, 2015).

Age distribution	Share of population
0-5	7,5%
6-15	8,3%
16-24	20,5%
25-64	49,3%
65-w	14,4%
Average income per family	182 100 SEK
New to the system with white- and black bags	33,5%

4.2.1.5 Summary of findings in Sjöbo

A short summary of the findings is presented below:

- Several registered inhabitants did not show up to the focus groups.
- The inhabitants in the area were satisfied with the current system with white- and black bags.
- Many inhabitants thought the recycling station at Sjöbo torg needed to be better maintained – today it is too messy. They suggested social improvements such as decreased dependency on others – everyone should be able to get rid of waste without help from others.
- There is a large share of miss-sorted combustible waste in the black bags – a lot of it is miss-sorted diapers, even though there are quite few children in the area.

Reflections – Sjöbo

As earlier mentioned, it was difficult to get inhabitants to participate in the focus groups. It was frustrating and generated thoughts about why this occurred. A thought was that it could indicate that there is a lack of culture where all stakeholders see their role and responsibility in continuously assessing and participating in the improvement process.

*Another interesting aspect was to hear that some inhabitants thought that other areas are worse at sorting. If this is compared with the results from the waste composition analysis, it shows that Sjöbo can get much better at sorting. One inhabitant wondered what **mobile info center** is working with, since he/she had met them at the recycling station and did not understand their purpose.*

4.2.2 City center

In the following sections, collected findings from observations, focus groups and interviews with inhabitants in the City center are presented. Lastly, results from the waste composition analysis conducted by Rousta are presented, and also demographics retrieved from the statistician.

The property owners of Holmsgatan, Lilla Kyrkogatan and Österlånggatan could not be identified or reached and these addresses were therefore excluded from the thesis. The property owner Willhem Fastigheter for Skolgatan 17-19 was the only that property owner could be reached in this area.

4.2.2.1 Observations

In general, the multiple apartment building at Skolgatan 17-19 and the area around it appeared neat and well-maintained, see Figure 24 below.

Figure 24. The area around the property at Skolgatan 17-19. Image source: Blomér & Jansson

The property owner Willhem Fastigheter had put information at each drop off point for household waste. It was sorting instructions that encouraged throwing paper- and plastic packages, cans and other materials in the white bag, see Figure 25 below. The instructions thus tell the inhabitants to do wrong. Several people living in the building thought it felt wrong to follow the advice. The instructions likely contribute to why people sort wrongly, which can be seen in the waste composition analysis from the City center, see the Section 4.2.2.3 below.

Figure 25. The instructions given by Willhem Fastigeter are shown in the figure. Image source: Blomér & Jansson

The recycling stations below, see Figure 26, are those located closest to Skolgatan. When talking to the inhabitants, most of them seemed to use the one at Sa Kyrkogatan/Caroliskolan shown to the right.

Figure 26. To the left is the recycling station at Folkets hus. To the right is the recycling station at Sa Kyrkogatan/Caroliskolan. Image source: Blomér & Jansson

Figure 27 below shows the sign for clear glass at the container at Folkets hus – it urges people to do wrong. A broken wine glass should be disposed at a recycling center.

Figure 27. The figure shows the sign on the container for clear glass from the previous figure, see Figure 26. It gives wrong information since a wine glass should be disposed at a recycling center and not in the container for glass bottles. Image source: Blomér & Jansson

4.2.2.2 Focus groups and interviews with inhabitants

The first focus group in the City center had only two participants – two other people had registered but did not show up. The second focus group had only one participant since the two other participants did not show up. The participants in both groups had many questions about how to sort waste in the white- and black bag, and how waste is treated after collection. They got BEM's sorting guide "Sortera smart" with more information about how to sort correctly. The front page of the guide is shown in Figure 28 below.
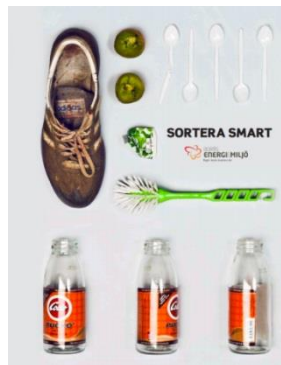
Figure 28. BEM's booklet about how to sort correctly is shown in the figure. Image source: Borås Energi och Miljö (2015)

Short interviews were also held in the streets due to the low interest for participating in the focus groups. Aspects to keep and improve, retrieved from interviews and focus groups, are described below.

4.2.2.2.1 Important aspects to keep

The inhabitants in the City center were in general satisfied with the current system with white- and black bags: "I think it works fine with the white and black bags."

Many were also satisfied with the proximity to the recycling station. They also thought the recycling center Boda was working well and that it was important to keep: "I think the recycling center is close enough".

4.2.2.2.2 Social improvements
The information and education requested in this area were regarding sorting instructions – both in Swedish and in other languages: "We need information in other languages about how to sort. Many of my friends are exchange students and they think it is hard to sort correctly" and "I wish more information about how to sort. For instance, should I throw coffee into the black bag?"

Another aspect discussed at the focus group was unnecessary package material that people bring home from the stores: "There is way too much waste".

4.2.2.2.3 Technical improvements
The technical improvements in the City center were mainly related to property-close collection and the recycling station. Many of the inhabitants asked for a property close collection point in either the basement or in a parking lot close to the building: "There used to be a property close collection in the basement in this building – that was much better."

The inhabitants commented mostly on the recycling station Sa Kyrkogatan/Caroliskolan, which is one of the closest. The comments considered the distance to the station, but also the location. People living at Skolgatan 17-19 have to cross Kungsleden with a lot of traffic, to get to the recycling station. They also thought that the recycling station could be better maintained with more fractions, such as a fraction for light bulbs: "The recycling station should be closer to the house. I do not have the energy to go away with my packages, so I throw them into the white bag. Also light bulbs, there is a need to be able to sort them somewhere."

4.2.2.2.4 Economic improvements
One inhabitant commented on that there is a lack of economic incentives regarding waste handling. The inhabitant thought it was strange the inhabitants pay multiple times for getting rid of waste: "I sort my waste at home and then walk to the recycling station with it. Others get paid for the recycled material – and for the work that I have done. I also pay to get rid of my garbage (in white- and black bags), which is burned. BEM sells the energy (heat, electricity and biogas) which I have to buy back."

4.2.2.2.5 Solutions suggested by the inhabitants
It was suggested that a property close collection point should be installed in the building. It could either be located in the basement or in the parking lot outside the building. Another suggestion was to improve the collection of hazardous waste and light bulbs, since these fractions currently are not possible to leave at the recycling station.

4.2.2.3 Waste composition

Results from the waste composition analysis are presented through the indicator MR (Ratio of materials in residual waste), which showed that the results from the white bags were quite bad. The combustible waste represented approximately 30 % of the white bags, see Diagram 3. The largest share of miss-sorted materials was packages. As mentioned earlier, the large share of packages in the white bag could be linked to the information that encourages inhabitants to sort their packages into the white bags, see Figure 25. It should be highlighted that there are other addresses than Skolgatan included in the results, which could mean that the problem with packages in the white bag exists also on other addresses in the City center.
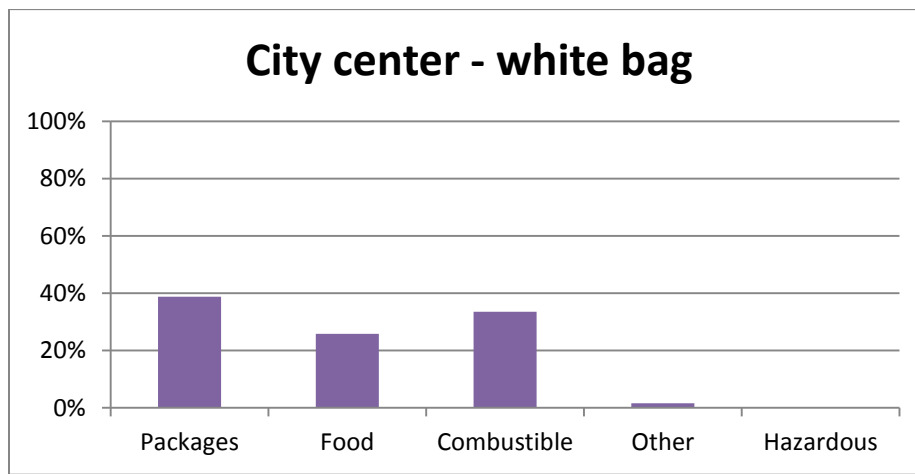
Diagram 3. Waste composition results from the white bags in City center. Source: Based on Rousta (2015)

The waste composition results from the black bags showed better ratios than in the white bags. Almost 90 % of the black bag consisted of food waste, see Diagram 4. In comparison with Sjöbo, all disposed diapers were sorted correctly into the white bags.
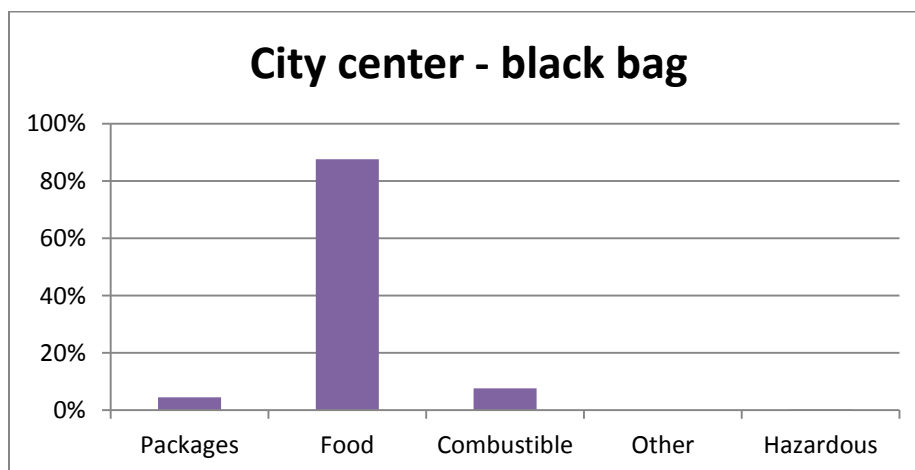

Diagram 4. Waste composition results from the black bags in City center. Source: Based on Rousta (2015)

4.2.2.4 Area demographics

Some of the area demographics from 2013 have been summarized in Table 26 below. It shows that the largest share of the population in the City center is between 25-64 years. About 26% of the inhabitants who have moved in have not used the waste system with white-and black bags before.

Table 26. The table shows the age distribution of the inhabitants, the average income per family and "new to the system with white-and black bags". The later means the share of the new inhabitants that have moved to the City center from other municipalities and from abroad. It is assumed that they therefore have not used the waste system before. The statistics were retrieved from Lindqvist (2015).

Age distribution	Share of population
0-5	6,3%
6-15	6,3%
16-24	11,0%
25-64	53,5%
65-w	22,8%
Average income per family	340 000 SEK
New to the system with white- and black bags	26,3%

4.2.2.5 Summary of findings in City center

A short summary of the findings is presented below:

- The inhabitants in the area were satisfied with the current system with the white- and black bags.
- The property owner had put up incorrect sorting instructions in the building at Skolgatan.
- The inhabitants suggested having property close collection.
- The location of the recycling station was not appreciated since the inhabitants had to cross a main road to reach it. Many inhabitants thought that the closest recycling station needed to be better cleaned. Also more fractions, such as light bulbs, were asked for.
- Information notes at the recycling station need to be changed since they show wrong instructions.
- There is a large share of miss-sorted package materials in the white bags.

4.2.3 Hässleholmen

In this section follows results from observations and interviews with inhabitants in Hässleholmen. The section ends with results from the waste composition analysis conducted by Rousta, and also demographics retrieved from the statistician.

4.2.3.1 Observations

Hässleholmen is a quite big area with many multiple apartment houses. It was a bit messy with cigarettes butts and other waste on the lawns between the houses, though between other houses, the lawns were cleaner, see Figure 29. The area had several criminal incidents during the time for the investigation. This generated an unsafe feeling in the neighborhood and as a result it was hard to motivate people to care about waste handling.

Figure 29. The figure shows an example of a lawn between the houses.
Image source: Blomér & Jansson

A common problem in the area was that people do not throw their white- and black bags in the collection bin outside the building. Some people first leave the bags outside the door, see Figure 30, before bringing it to the collection bin. Other observations were overfull bins, and that the recycling stations in the area were often messy and not well maintained.

Figure 30. To the left: A black bag is left outside the door at Marklandsgatan. In the middle: An example of an overfull bin at Marklandsgatan is show. To the right: The picture is showing the mess at the recycling station at Marklandsgatan. Image source: Blomér & Jansson

The inhabitants of Hässleholmen have multicultural backgrounds. Mobile Info Center, see Figure 31, is sometimes in the area to inform people about waste collection and sorting. They can inform the inhabitants in five different languages according to Borås Stad (2015).

*Figure 31. Mobile info center is informing at the recycling station at Hässle torg.
Image source: Blomér & Jansson*

There is information in different languages on the containers in the recycling station at Hässle torg, see Figure 32. That might be a good idea to have at the recycling station at Marklandsgatan as well.

Figure 32. The figure shows an example of the instructions at the recycling station at Hässle torg. Image source: Blomér & Jansson

The recycling station at Hässle torg has a surveillance camera, but according to the inhabitants there are still problems with dumping of packages and bulky waste outside the containers. Also outside the apartments at Marklandsgatan, people dump bulky waste by the collection bins, see Figure 33.

Figure 33. The bulky waste is often dumped at the collection bins or recycling stations. Image source: Blomér & Jansson

4.2.3.2 Focus groups and interviews with inhabitants

The first focus group held in Hässleholmen had four registered participants. Based on experience with participants not showing up in Sjöbo, the participants in this area were reminded with a text message in advance. However, even with the reminder, none of registered participants showed up. The second group had only one registered participant – who also did not show up. Therefore, due to the difficulty in collecting data using a focus group, the data collection strategy in this area

had to be revised as well. The new strategy aimed to conduct interviews with the inhabitants as previously described in method Section 3.2.4.1.3.

4.2.3.2.1 Important aspects to keep
The inhabitants in Hässleholmen were satisfied with the current system with white- and black bags: "The white and black bag system works fine, but people need help to understand how to sort and to get information."

4.2.3.2.2 Social improvements
The requested information and education considered information in other languages and to inform about how to sort household- and bulky waste: "I think the sorting can be improved through information face-to-face, for example through knocking on doors. Many people who just arrived here don't know how the system works and don't know the language" which was confirmed by another person: "I think it is hard to know what belongs where. I usually throw everything in the white bag".

Also the attitudes towards waste sorting could be improved. Some people thought others were too lazy to take part in the sorting- and recycling schemes: "People in the area are too lazy, have a lacking interest and think sorting is too time-consuming."

4.2.3.2.3 Technical improvements
Opinions about the recycling stations were mainly regarding maintenance. People thought that the recycling station at Marklandsgatan was often messy and the containers were often full: "The recycling station works badly. Other people, not from Hässleholmen, come here and dump waste at the recycling station."

The waste collection bins for the white- and black bags received many complaints – they were often too full. People also asked for collection of bulky waste more often. "I wish for bigger space at home for waste, increased collection frequency of white- and black bags and more frequent pick-up of bulky waste in this area"

There were also many complaints regarding littering and dumping of waste in the area. Littering was a general problem in the area, especially around the waste collection bins and at the recycling stations: "There is waste everywhere!" one inhabitant said.

4.2.3.2.4 Economic improvements
A comment regarding the economic aspect of waste handling was that inhabitants had got punished by receiving a fine from the property owner. This was due to that waste had been thrown outside the waste bins and that it had been a lot of dumping in the area. "I'm upset, since me and my family have received a fine from the property owner, even though we sort our waste correctly. It is unfair that everyone is punished and not only those who behave incorrectly. "

4.2.3.2.5 Solutions suggested by the inhabitants

Some of the inhabitants had learnt about the sorting- and collection system through their education at SFI (Swedish for immigrants), which they considered important to keep. Education at SFI could be a good channel to teach newly arrived about the waste sorting and collection system in Borås: "It is good with black- and white bags – there are many advantages, for example to save energy. I think it is easy to sort at home. I learned at SFI, which is a good channel because newcomers may find it difficult to know how to sort."

Also, the collection of bulky waste that AB Bostäder arranges twice per year was appreciated, though it was suggested to have this collection more often. Another suggestion to AB Bostäder was that they could install sorting bins under the sinks in the apartments. That could improve the sorting of waste since it would help and encourage people to start sorting: "It would be good if AB Bostäder installed bins for source sorting in the apartments already before people move in. Then it would be easier for people to get going and sort right."

4.2.3.3 Waste composition

The results from the waste composition analysis are presented through the indicator MR (Ratio of materials in residual waste). The indicator shows that the inhabitants are good at sorting food waste into the black bags, though there is a large potential for improvements regarding the white bag. The white bags contain approximately as much packages as combustible waste, about 35 %, see Diagram 5. It can also be pointed out that about 30 % of the contents in the white bags should have been thrown in the black bag.
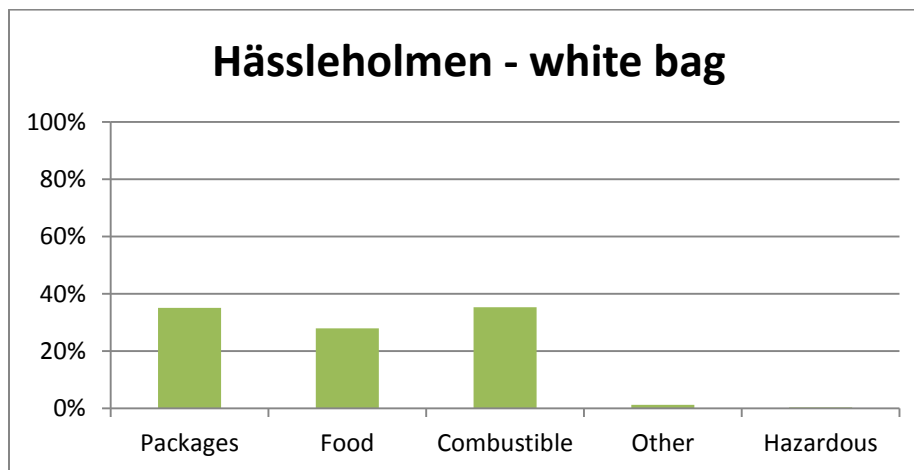
Diagram 5. Waste composition results from the white bags in Hässleholmen. Source: Based on Rousta (2015)

As seen in Diagram 6, Hässleholmen is quite good at throwing food waste into the black bags. However, about 10 % of the content was combustibles and 8 % was packages.
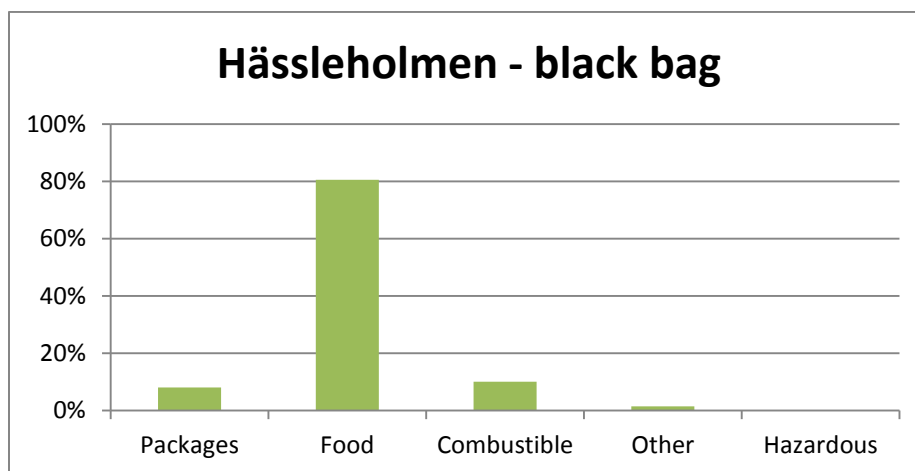
Diagram 6. Waste composition results from the black bags in Hässleholmen. Source: Based on Rousta (2015)

4.2.3.4 Area demographics

Some of the area demographics from 2013 have been summarized and can be seen in Table 27 below. It shows that the largest share of the population is between 25-64 years. It further shows that the second and third largest groups are people between 16-24 years and 0-5years. There are about 32% of the inhabitants that have moved in that have not used the waste system and the white-and black bags before.

Table 27. The table shows the age distribution of the inhabitants, the average income per family and "new to the system with white-and black bags". The later means the share of the new inhabitants that have moved to Hässleholmen from other municipalities and from abroad. It is assumed that they therefore have not used the waste system before. The statistics were retrieved from Lindqvist (2015).

Age distribution	Share of population
0-5	14,8%
6-15	8,1%
16-24	15,3%
25-64	50,7%
65-w	11,2%
Average income per family	195 700 SEK
New to the system with white- and black bags	32,5%

4.2.3.5 Summary of findings in Hässleholmen

A short summary of the findings is presented below:

- The inhabitants in the area were satisfied with the current system with the white- and black bags.
- None of the registered participants showed up at the focus group.
- The inhabitants asked for help to understand how to sort and to get information about sorting.
- Littering and dumping in the area and at the recycling stations were very common.
- Some inhabitants were afraid to go outside due to multiple criminal actions in the area. This made it hard to motivate the inhabitants to care about waste handling.
- Many inhabitants thought the closest recycling station was badly cleaned.
- There were large shares of miss-sorted package materials and food waste in the white bags.
- There were many young inhabitants and children in this area. Many of the newly moved in inhabitants are new to the system.

Reflections – Hässleholmen

Several reflections on the experience of trying to collect data in the area occurred. To be able to revise the data collection, it was needed to come up with an interview guide. It was time- and energy consuming to revise the method. However, it seemed to be worth it, since many interviews could be held in the streets and it was easier to engage people in that way.

Another interesting finding is the factor of safety that seemed to make it difficult to engage people in this area. Many inhabitants were worried about going outside and felt unsafe in the area. This could generate that people were less interested in this topic and said that they had other things to worry about.

Also the attitudes in the area varied and could be better. Some inhabitants commented that they thought it would be difficult for us to engage people in this area and that people did not have any interests in this topic.

4.2.4 Brämhult

In this section follows the results from observations, focus groups and comments from the inhabitants in Brämhult. The section ends with results from the waste composition analysis by Rousta and demographics retrieved from the statistician.

4.2.4.1 Observations

The neighborhood was characterized by single family houses and it felt safe and well maintained. The surrounding area was clean and no distinctive observations were made, see Figure 34.

Figure 34. The neighborhood in Brämhult is shown in the picture. Image source: Blomér & Jansson

People living within this area showed an interest in the field of waste handling and the attitude toward the project was positive in general. For people living in Brämhult, the closest recycling station is located on Dammkullevägen/Trastvägen, see Figure 35. The station seemed relatively clean during the visit. However it looked like the container had been burnt and needed some maintenance.

Figure 35. The figure shows a picture of the recycling station at Dammkullevägen/ Trastvägen that provides collection of newspaper, glass and batteries. Image source: Blomér & Jansson

4.2.4.2 Focus groups

The focus groups with the inhabitants from Brämhult were held in two different ways.

As earlier described in the method Section 3.2.4.1.2, the first group listed factors, importance and grading based on a question, while the second group was a regular focus group. Results from the first group are presented first and thereafter comes the results from the second group. Photos from the first focus group can be seen in Figure 36.
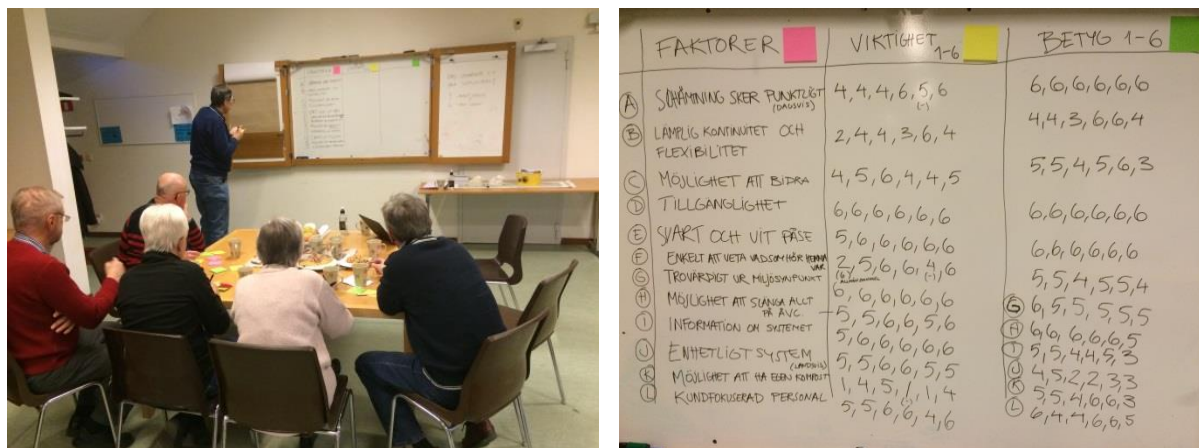
Figure 36. To the left: The focus group in Brämhult. To the right: The results from the focus group. Image source: Blomér & Jansson

The right figure above, Figure 36, shows factors listed by the participants at the first focus group in Brämhult. They were asked:

- From your perspective, what characterize a good waste system?

In Table 28 the factors from the right picture in Figure 36 are presented. They are further developed below.

Table 28. The table shows a list of factors from the first focus group in Brämhult. The participants listed factors that they thought answered the question: "From your perspective, what characterize a good waste system?" The letters in the left column were set to able to keep track of the factors.

Factor	
A	Waste collection occurs on time (on the expected day)
B	Suitability, continuity and flexibility
C	Possibility to contribute
D	Accessibility
E	White- and black bag
F	Easy to know what belongs where
G	Trustworthy from an environmental point of view
H	Possibility to throw everything at a recycling center (all types of waste)
I	Information about the system. It is important to get information about the system

J	Identical system everywhere (in Sweden)
K	Possibility to have my own compost
L	Customer focused staff

The participants were asked to grade the factors listed in Table 28 above, on a scale from 1-6, on how important they were and how good they thought they work in the current system. In order to analyze and understand the values and relation of the factors discussed, they were reviewed in a diagram of importance and grade, as seen in Diagram 7. It showed a lot of factors are placed in the upper right corner with high importance and high grades. This means that the factors of high importance also work well in the current system.
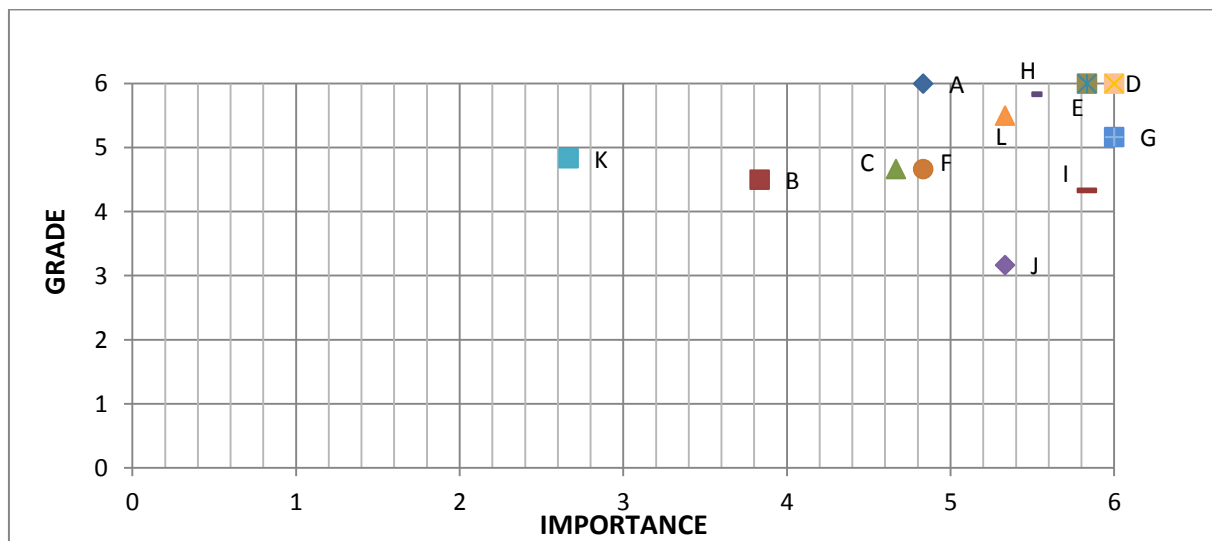
Diagram 7. The diagram shows results from the first focus group in Brämhult. The participants got to grade the factors listed in Table 28 with regards to importance and "how well the factor is working in the current system" on a scale 1-6. If a factor is considered very important but gets a low grade – it should be in focus when trying to improve the system. However, as can be seen in the diagram almost all factors seemed to work very well.

The two factors that are of highest importance are factor D and factor G; to have accessibility to the waste system and to have a trustworthy waste system from an environmental point of view.

Two other factors, factor J and factor K, are discussed below.

Factor J – Identical system everywhere in Sweden, has quite high importance but has the lowest grade. This shows that the inhabitants in Brämhult think that it would be better to have an identical waste sorting- and collection system on a national level and that they do not think it is working well today.

Factor K – Possibility to have my own compost has quite low importance but a high grade. This is an indication that resources should not be put on making it possible for people to have their own compost.

Below follows the results from the second focus group together with additional comments.

4.2.4.2.1 Important aspects to keep
The inhabitants in Brämhult were in general satisfied with the system with white- and black bags, and further with the pick-up service of the bins. They were also satisfied with the recycling center Boda: "Boda works well. The recycling station is close enough and the system is easy to understand".

4.2.4.2.2 Social improvements
The information and education requested in this area were mainly regarding getting information to make the inhabitants more motivated to sort and to better understand why sorting is important. One part of the requested information was to get feedback on how well the neighborhood is sorting: "Imagine if information about stoppages caused by miss-sorted materials was spread to the customers. I think that would motivate people to become better at sorting glass and metal packages." This was said by a participant after receiving information about stoppages in the incineration process caused by miss-sorted materials in the white bags at a focus group.

The attitudes toward waste sorting could be improved in the area. It was suggested to inspire the inhabitants to sort through visits at Sobacken: "I think an open house at Sobacken could inspire people to become better at sorting." Also the attitude to others and waste sorting was discussed at one of the focus group: "I don't think young men are so good at sorting".

4.2.4.2.3 Technical improvements
The inhabitants pointed out that the recycling station at Dammkullevägen/Trastvägen could be removed, or improved and better maintained. They also commented on that some improvements were needed with regards to the logistics and the traffic flow at Boda, for example by moving the collection of newspapers: "At the recycling centers, especially at Boda, it is bad that the collection of newspaper comes first. All people who throw newspaper stop the flow and it gets very crowded."

4.2.4.2.4 Economic improvements
There was none of the inhabitants that requested any economic improvements.

4.2.4.2.5 Solutions suggested by the inhabitants
It was suggested to improve the information on the white- and black bags and to have the text on both sides of the bags. The information at the current bags can be seen in Figure 37 below.

Figure 37. The information on the white- and black bags is showed in the figures.
Image source: Blomér & Jansson

Some of the inhabitants suggested having property close collection to improve the sorting and minimize car dependency: "Getting my recyclables picked up would be worth paying for. It would be okay if that means that I get another bin outside my house."

It was also suggested that a variety in size of the bin could encourage people to sort correctly: "It could be good to have limiting bin sizes since one is adjusting to the amount of space."

Otherwise, it was suggested to improve the recycling station at Dammkullevägen/Trastvägen. Another comment was that it is too anonymous in multiple apartment houses and they thought that this could be a reason to why the single family houses are better at sorting. However, this is not really true as described in Section 4.2.7 below.

4.2.4.3 Waste composition
The results from the waste composition analysis are presented through the indicator MR (Ratio of materials in residual waste). It shows that people in the area are good at sorting food waste into the black bags. Just like the other three areas, there is a large potential for improvements regarding the white bag. The white bags consisted of most combustibles, but the shares of packages and food waste were also quite large, as shown in Diagram 8.
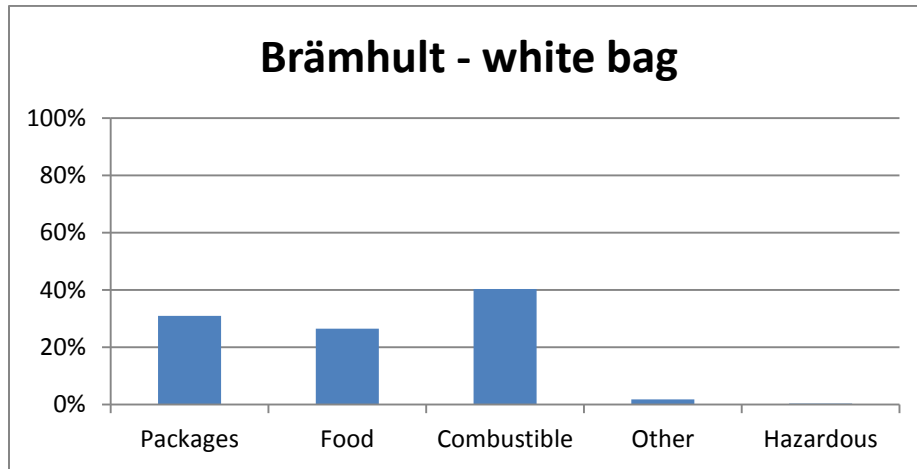
Diagram 8. Waste composition results from the white bags in Brämhult. Source: Based on Rousta (2015)

As earlier mentioned, the black bags in Brämhult consisted of a large share correctly sorted food waste, as shown in Diagram 9 below.
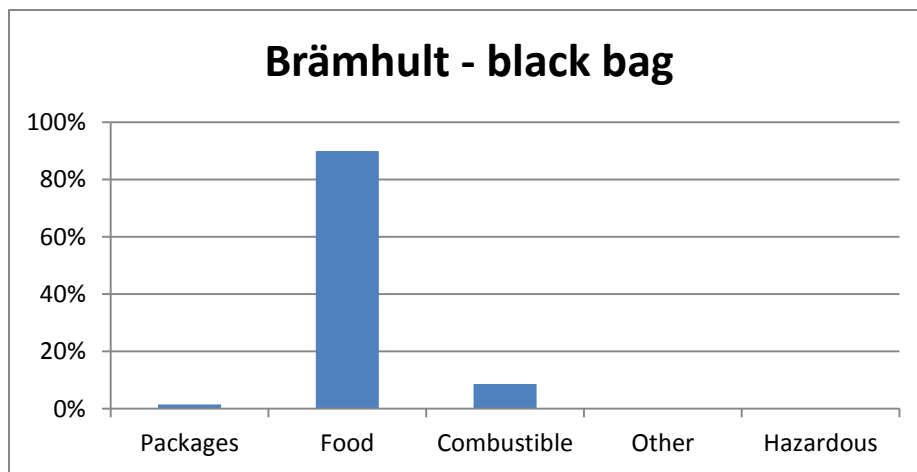
Diagram 9. Waste composition results from the black bags in Brämhult. Source: Based on Rousta (2015)

4.2.4.4 Area demographics

Some of the area demographics from 2013 have been summarized and can be seen in Table 29 below. It shows that the largest share of the population is between 25-64 years. About 27% of the inhabitants who have moved in have not used the waste system and the white-and black bags before.

Table 29. The table shows the age distribution of the inhabitants, the average income per family and "new to the system with white-and black bags". The later means the share of the new inhabitants that have moved to Brämhult from other municipalities and from abroad. It is assumed that they therefore have not used the waste system before. The statistics were retrieved from Lindqvist (2015).

Age distribution	Share of population
0-5	5,3%
6-15	10,5%
16-24	7,5%
25-64	45,1%
65-w	31,6%
Average income per family	603 500 SEK
New to the system with white- and black bags	27,1%

4.2.4.5   Summary of findings in Brämhult
A short summary of the findings are presented below:

- The inhabitants in the area were satisfied with the current system with the white- and black bags and with the recycling center Boda.
- The inhabitants requested more motivating information about why it is important to sort correctly.
- Many inhabitants thought they were very good at sorting correctly.
- There were quite large shares of miss-sorted package materials and food waste in the white bags.
- There are many inhabitants older than 65 years living in the area.

Reflections – Brämhult

It was very fun and exciting to lead two different types of focus groups. Great learnings came out during the two sessions. It was fun that this area had a couple of more participants. It would have been interesting to have conducted the first type of focus group also in another area, so the results from the first focus group in Brämhult could have been compared to another area.

Furthermore, it was interesting to see that the motivation and awareness seemed to exist on higher level than in other areas. But even so, people living in Brämhult sorted as bad and incorrectly as the other areas. Many of the inhabitants seemed to learn new aspects of sorting and seemed eager and interested to learn new things.

It was also interesting to hear that people thought that they were better than other neighborhoods and that they thought anonymity in multiple apartment houses was one reason for people living in those areas to not recycle or sort their waste.

4.2.5 Summary of key findings

This section presents a summary of key findings from the four areas, see Table 30. It is key findings from focus groups, interviews and the waste composition analysis. The considered aspects are:

1. Opinions about the current system
2. Focus group participation
3. Recycling station
4. Waste composition results
5. Demographics
6. Other interesting comments

Table 30. The table shows key findings from the four areas based on six aspects.

Sjöbo	City center
1. The inhabitants in the area were satisfied with the current system with white- and black bags. 2. Several registered inhabitants did not show up to the focus groups. 3. Many inhabitants thought the recycling station at Sjöbo torg needed to be better maintained – today it is too messy. They suggested social improvements such as decreased dependency on others – everyone should be able to get rid of waste without help from others. 4. There is a large share of miss-sorted combustible waste in the black bags – a lot of it is miss-sorted diapers, even though there are quite few children in the area. 5. There are quite few children in the area, otherwise, nothing in particular can be highlighted. 6. -	1. The inhabitants in the area were satisfied with the current system with white- and black bags. 2. It was difficult to get participants to the focus groups. 3. The inhabitants suggested having property close collection, since the location of the recycling station was not so good. Many inhabitants thought that the closest recycling station needed to be better cleaned. Also more fractions, such as light bulbs, were asked for. Information notes at the recycling station need to be changed since they show wrong instructions. 4. There is a large share of miss-sorted package materials in the white bags. 5. The inhabitants in the City center were of mixed ages. 6. The property owner had put up incorrect sorting instructions in the building at Skolgatan.
Hässleholmen	**Brämhult**
1. The inhabitants in the area were satisfied with the current system with white- and black bags. 2. None of the registered participants showed up at the focus group. 3. The inhabitants asked for help to understand how to sort and to get information about sorting. Many inhabitants thought the closest recycling station was badly cleaned. 4. There were large shares of miss-sorted package materials and food waste in the white bags. 5. There were many young inhabitants and children in this area. Many of the newly moved in inhabitants are new to the system. 6. Some inhabitants were afraid to go outside due to multiple criminal act-	1. The inhabitants in the area were satisfied with the current system with white- and black bags and with the recycling center Boda. 2. It was difficult to get participants to the focus groups, even if the groups in this area had the largest number of participants. 3. The inhabitants requested more motivating information about why it is important to sort correctly. 4. There were quite large shares of miss-sorted package materials and food waste in the white bags. 5. There are many inhabitants older than 65 years living in the area. 6. Many inhabitants thought they were very good at sorting correctly.

	ions in the area. This made it hard to motivate the inhabitants to care about waste handling. Littering and dumping in the area and at the recycling stations were very common.	

General key findings from focus groups, interviews and waste composition analysis can be seen in Table 31 below.

Table 31. The table shows key findings from focus groups, interviews, observations, waste composition analysis and survey.

Sorting in white- and black bags	Everyone was very satisfied with the waste sorting- and collection system with white- and the black bags. It seems to be quite clear how to sort food waste in the black bag, but less certain what to sort into the white bag.
	The waste composition analysis showed that inhabitants in all areas are quite good at sorting correctly in the black bags but that people miss-sort a lot of materials into the white bag.
Safety	People at Hässleholmen were afraid to go outside due to multiple criminal actions in the area. This made it hard to motivate the inhabitants to care about waste handling.
Information and education	People in all areas wished for better information and education. They wanted better information on containers at recycling stations and centers, and also information and education about what happens with the waste after collection.
	Borås inhabitants wished for more information about how to sort in the white- and black bags. An important distributer of information seemed to be SFI, where newly arrived people are taught how to sort.
Attitudes	There were many different reasons for not participating in the waste sorting scheme. There were also many prejudices about what kind of people that are the worst at sorting – people thought others are worse "I think people born in the 40's are the worst". Reasons such as "it is too time-consuming" and "people are too lazy to sort" were common.
Recycling stations	People from all areas thought the recycling stations were messy, and asked for improvements. They wanted decreased distance from home to a station, better maintenance and more frequent collection of the

	material.
	From the observations, it was concluded that the signs at the containers need to be updated and clearer. Today, the recycling stations and signs look differently from one another – some signs even inform inhabitants to sort incorrectly, see Figure 27 above.
Collection frequency	The collection frequency of the white- and black bags needs to be investigated and improved in many areas with multiple apartment houses since the bins get overfull.
Dependency on others and physical health	People thought the dependency on others is too high in the current system. Old or sick people rely on family and friends to get rid of waste. Also the car dependency should be minimized so that everyone has the possibility to dispose waste the "correct way".
Economic factors	Very few of the focus group participants or interviewed inhabitants mentioned any economic factors with the waste sorting and collection system.

Reflections – key findings

The waste sorting and collection was in general a topic that many people had opinions about. It felt quite clear that people in general were satisfied with the white- and black bags. However, many aspects on how to improve the sorting have been mentioned and found.

It is interesting that so few inhabitants relate waste to economic factors and costs. This would be interesting to investigate and discuss further.

Some of the improvement possibilities relate to other stakeholders than BEM, such as property owners and FTI and for example how to improve the recycling stations. It shows that it is important to have good collaboration with the stakeholders.

Along the work process it was realized that the thesis could not only investigate if a waste sorting- and collection system could be adjusted depending on house types, but had to consider the inhabitants demographics as well. The inhabitants play a big part in the waste sorting- and collection system. It feels like this collaboration and the communication should have a lot of focus and could be improved.

4.2.6 Survey results

This section presents secondary data that was collected from the survey conducted by Tradewell AB for Borås in general. The survey concluded that BEM has a customer satisfaction of 82 %. The most interesting aspects are further developed into different categories below in Table 32. As described in the Method Chapter, Tradewell AB had to make 3 878 phone calls to 1 967 people, in order to get 300 responses.

Table 32. The table is a summary of aspects that were achieved in the survey. The category "Recycling in general" included comments about how the household recycle waste today and why/why not people sort waste. "Satisfaction with the recycling stations" included comments about the proximity of the closest recycling station, pick-up frequency and total satisfaction with the recycling stations. The category "Overall satisfaction" included comments about how satisfied the inhabitants are today with the waste sorting and collection system in Borås.

Category	Social aspects	Technical aspects	Economic aspects
Recycling in general	• Attitudes (Laziness, interest and time-consuming) • Information and education	• Distance and accessibility to recycling stations • Space at home • More fractions • Pick-up frequency	• Lower fees • Motivation through lower tax if you behave correctly
Recycling stations	• Information and education • Attitudes	• Dumping & littering • Distance • Pick-up frequency • Fractions for e.g. light bulbs • Maintenance	•
Overall satisfaction	• Information and education • Feedback • Overall perspective needed	• Want PCC • Distance • Maintenance	• Price

People thought there is a need for more fractions at the recycling stations, not only newspaper and glass. For example a fraction for textile was wished. One question regarded economic aspects. The survey showed that people in general are willing to pay for the possibility to sort recyclables at home. People also thought it was problematic that the waste sorting- and collection

system requires that everyone has a car. They also mentioned that they wanted motivation to sort, through for example payment or vouchers. A need for more information was also requested.

> **Reflections – survey**
>
> *The results from the survey strengthened the results from the interviews and focus groups with the inhabitants. Although, one difference was that more inhabitants gave general comments on economic aspects of waste handling in the survey than in the interviews and focus groups. This was done even though the questions regarding "recycling in general" were asked before a section of questions about "bills", so the economic aspect had not been introduced by the interviewer. The questions about "overall satisfaction" came after the bill-section, which could have generated that people started thinking about costs and thereby gave more feedback on economic aspects.*

4.2.7 Comparison of waste composition results

The results from each of the areas have been presented earlier. Below follows a comparison of the contents in the white- and black bags, see Diagram 10 and Diagram 11.

The analysis showed similar results for all areas regarding the contents in the white bag, see Diagram 10. All areas throw large shares of both food and package materials into the white bag.

Fractions in the white bags

	Packages	Food	Combustible	Other	Hazardous
Brämhult	31%	27%	40%	2%	0%
Sjöbo	33%	24%	41%	2%	1%
Hässleholmen	35%	28%	35%	1%	0%
City center	39%	26%	33%	2%	0%
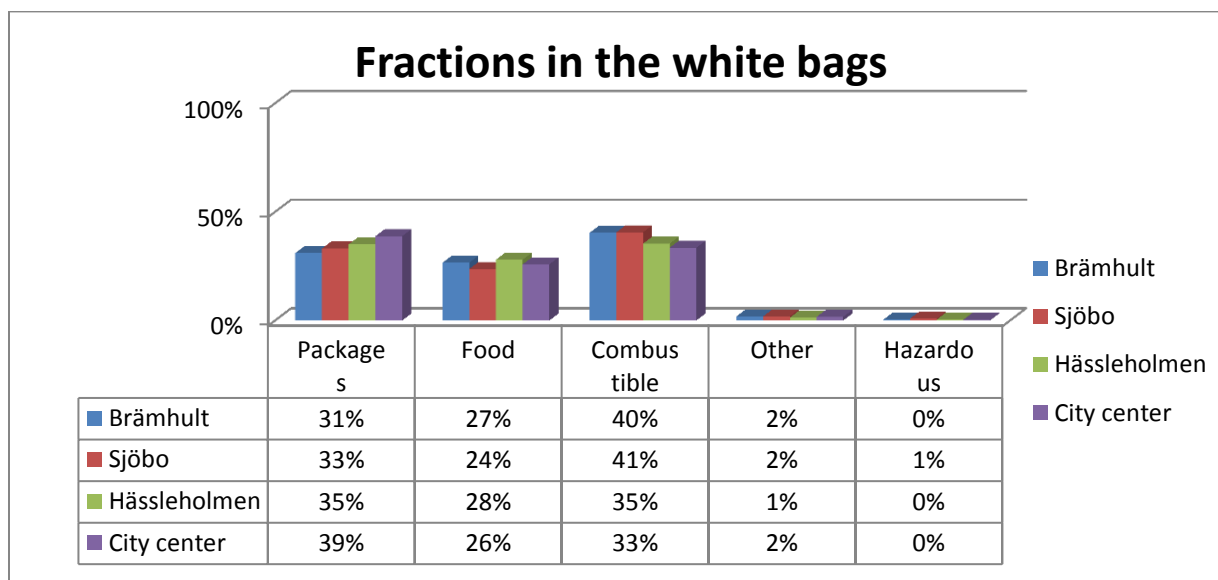
Diagram 10. Comparison of the results from the waste composition analysis in the white bags from the four areas is showed. Source: Rousta (2015)

Fractions in the black bags

	Packages	Food	Combustible	Other	Hazardous
■ Brämhult	1%	90%	9%	0%	0%
■ Sjöbo	8%	73%	18%	1%	0%
■ Hässleholmen	8%	80%	10%	1%	0%
■ City center	4%	88%	8%	0%	0%
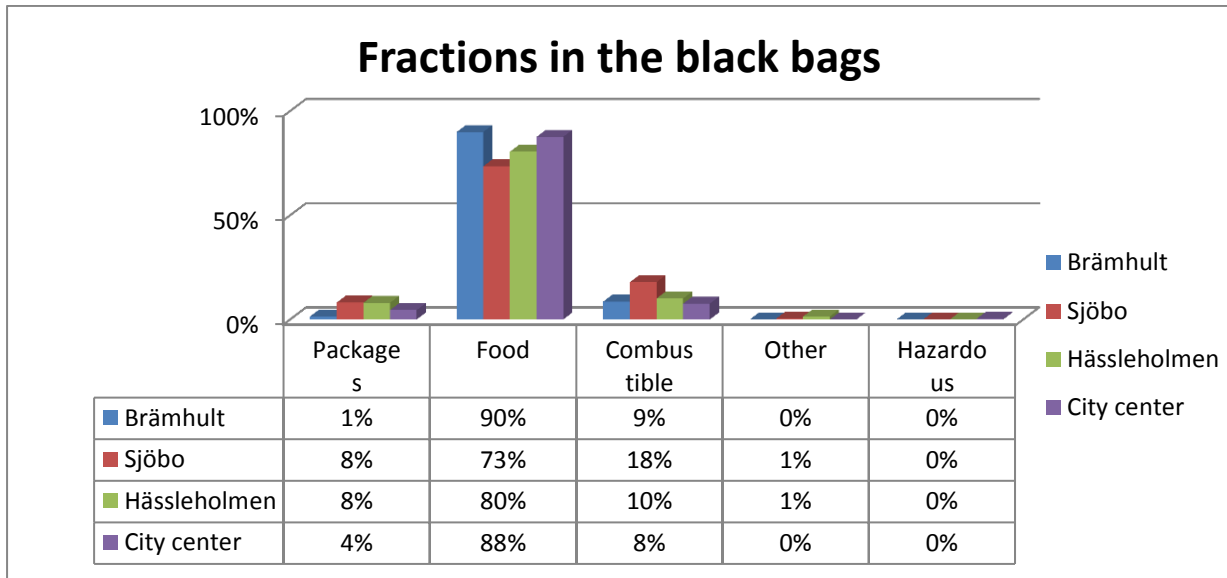
Diagram 11. Comparison of the results from the waste composition in the black bags from the four areas is showed. Source: Rousta (2015)

In general, the materials in the black bags were well sorted with a high share of food waste and a low share of miss-sorted materials. The largest share of miss-sorted materials was combustible waste that should have been thrown in the white bag. The second largest share was package materials that should have been sorted at a recycling station or center.

Reflections – comparison of areas

It is interesting to see that the results did not vary that much between the areas and it is also interesting that the area with single family houses is about as bad at sorting as the areas with multiple family houses.

It seems quite clear that BEM needs to work with how to improve the sorting quality in both the white- and black bags. It seems like that the inhabitants are more aware of how to sort in the black bags, than in the white bags.

4.2.8 Feedback workshop

The feedback workshop was held for inhabitants from all four areas. The purpose for leading this workshop was to: 1) get feedback from the inhabitants to be sure their views were presented clearly and correctly. It was done in order to validate the 'trustworthiness' of the collected data from the focus groups and interviews, 2) give back the findings and learnings – in order to share knowledge and enhance a feeling of mutual learning and cooperation regarding waste management in Borås. Finally, the feedback workshop was an important step in supporting a more active participation of inhabitants in the waste management process.

Based on the findings from the analysis of the four geographic areas, a number of key findings were selected to be presented in the Feedback workshop. The findings were categorized into five themes that were discussed along the presentation. The categories were based on the findings mentioned above in Section 4.2.5 and were the following:

- Sorting in white- and black bags
- Information and education
- Attitudes
- Recycling stations, collection frequency and dependency
- Economic factors

Seven inhabitants and one representative from BEM participated in the workshop; four of the participants were older and lived in single family houses while the other three were younger and lived in multiple apartment houses. The workshop had an open and honest atmosphere where everyone seemed to feel confident in sharing their experiences and thoughts. The feedback workshop was recorded and notes were taken. These can be found in Appendix XXV. The documentation was analyzed the same way as data from focus groups and interviews, as can be seen in section 3.5.4 and Appendix XXVI. The discussed themes and the received feedback are presented below.

4.2.8.1 Sorting into white- and black bags

The main findings and the feedback received regarding sorting into white- and black bags are presented below.

Main findings

The waste composition results showed that the inhabitants from all areas are quite good at sorting correctly in the black bags, but that a lot of materials are miss-sorted in the white bags.

Feedback

The workshop started with a discussion about why the waste composition results are better in the black bags than in the white bags. The group concluded that: "it feels natural to sort out food waste" and that: "there is an awareness of what to throw in the black bags". The discussion continued about why the waste composition results for the white bags are worse than the black. The answers considered that: "it is difficult to know what to throw in the white bag". Some of the participants had realized they sorted incorrectly in the white bag after receiving BEM's sorting guide at the focus group session. It was further concluded that it is quite complex to sort everything, due to different types of materials in different products. The group also thought that: "the black bags are probably only used by those who care enough to sort".

The participants also commented that it can be difficult to know what to classify as package materials. Sometimes package materials are considered to be only the hard packages and not the soft ones, such as plastic bags. The group further concluded that: "the messy packages are often sorted into the white bags, since it feels unhygienic to store them a longer time."

4.2.8.2 Information and education

This section presents main findings and feedback regarding information and education about waste sorting.

Main findings

The presented findings regarded information and education about:

- Information at recycling stations and centers
- Information and education about how to sort correctly in the white- and black bags
- Information and education about how to sort bulky waste

Feedback

A general idea mentioned, was that it is difficult to get a lot of information at once. Regarding recycling stations and centers, it was concluded that: "the signs often look different and sometimes give misleading information". The signs should be clear, accurate and concrete. If the sign on a container for plastic packages says "hard plastic packages", it could generate that soft plastic packages are thrown outside the containers.

It was also mentioned that more information is needed about how to sort correctly, especially in the white bag. It was recommended to: "try to use as many different ways of spreading information as possible". Some suggestions were through waste bills to the single family houses, at the waste bins, in schools, with campaigns and at buses. Another suggestion was to send the sorting guide to all inhabitants in Borås, though it was noted that the guide consists of too much information. Also a suggestion of promoting the app "sortera smart", the digital version of the sorting guide, was proposed.

Another discussed topic was information about how to sort bulky waste. The participants thought that: "people in general think that bulky waste can be put at the recycling station or at the waste collection bins, since it sooner or later disappears." The participants thought people are misinformed. They suggested BEM to encourage the correct behavior.

Another mentioned aspect was how important it was to make people aware of sorting at an early age. It was commented that: "it is important to make sure that children do not "forget" this behavior during the teenage years since it is not brought up in the higher education that much. Then the recycling behavior depends a lot on the parents."

4.2.8.3 Attitudes

This section presents main findings and feedback on attitudes towards waste sorting.

> **Main findings**
>
> There are many different reasons for not participating in waste sorting schemes. There are also many prejudices about what kind of people who are worst at sorting. Lack of time, space and interest were the main reasons for not participating.
>
> **Feedback**
>
> The discussion was regarding what the participants thought was necessary to improve or change to get everyone to participate. It was also discussed that it is important to have the right prerequisites in order to sort and behave correctly. As mentioned in "information and education" regarding attitudes, it was discussed how important it is to educate children about how to sort at early ages and to make sure that the behavior lasts throughout the teenage years. It was concluded that: "when you get older, it is just assumed and taken for granted that everyone knows about how to sort."

4.2.8.4 Recycling stations, collection frequency and dependency

In this section main findings and feedback regarding recycling stations, collection frequency and dependency on others and physical health are presented.

Main findings

The findings regarded:

- Recycling stations need improvements through closer distance, better maintenance, better signs and pick-up frequency
- The collection frequency of the white- and black bags needs to be investigated and improved in some areas with multiple apartment houses
- The dependency on cars and others is too high in the current system

Feedback

The discussion confirmed the above described improvements of the recycling stations in Borås are needed. However, the collection frequency at multiple apartment houses did not generate that much of discussion since none of the participants had experienced any troubles with it.

Regarding dependency on others, the group suggested that: "the pick-up of bulky waste need to occur more often than once or twice per year, since it is difficult to store bulky waste during longer periods at home." Another interesting aspect mentioned was the waste sorting system in Eskilstuna where waste and recyclables are sorted in six bags with different colors. This type of system requires less transports and walks to the recycling

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4.2.8.5 Economic factors

Main findings together with the feedback regarding the economic factors are presented below.

Main findings

Very few of the focus group participants or interviewed inhabitants mentioned the economic factors as important.

Feedback

The discussion regarded why this "lack of finding" had occurred. The group thought inhabitants in multiple apartments did not think about the economic aspect with waste since the price is included in the rent. They thought it would be different for inhabitants in single family houses since they pay for waste collection through bills. However, it was concluded that: "does anyone know how much you pay for the waste collection? No. You see, we do not really reflect upon this."

Reflections – feedback workshop

The participants seemed to appreciate that the meeting was held at BEMs office – none of them had been there before. From BEMs point of view it could be seen as great opportunity for marketing. It felt good to have a representative from BEM in the workshop. Also that seemed to be appreciated by the participants.

The feedback workshop was the last point of contact with the inhabitants, so it was very important to "end the relationship" in a good way. In the end of the feedback workshop, the authors explained the next steps in the process and that it from now on was BEM's responsibility to follow up this work and contact. It was important to leave the inhabitants with the understanding that this work has been important, that their participation is important and that it also will continue in the future.

The discussions were very interesting and generated reflections and great feedback to the study. It also generated a deeper learning both for BEM, the authors and the participants. The inhabitants seemed to agree that main aspects that need improvements are:

- *how to sort correctly in the white bag*
- *information and education*

Some of the participants asked for the final report of the thesis, since they were curious about the final results. That felt good.

5 Discussion

In the previous chapter, many interesting findings were presented. As there are so many findings on so many various aspects of waste management – it is necessary to deepen the understanding, the meaning and the relevance of the results. This chapter starts to further explore and discuss the findings following the research questions in the study. It further discusses cooperation with stakeholders, the methods and presents a summarized discussion about the findings linked to the four geographical areas. The chapter ends with a discussion on weaknesses and uncertainties and some general reflections.

5.1 Findings linked to the theories and previous studies

As mentioned above, it was necessary to deepen the understanding, the meaning and the relevance of the results. One way of doing this is by linking the findings to important theories and previous studies that were presented in theory Chapter 2. This section aims to explore and discuss these parts and follows the research questions in the study: waste hierarchy, indicators to measure and improve waste quality, factors influencing the waste management systems and waste composition analysis in the four areas.

5.1.1 Waste hierarchy (RQ 1)

In Borås, the waste hierarchy is applied in the waste management plan with three goals to fulfil. As a reminder, the goals are:

- To reduce the amount of waste.
- To regard waste as a resource.
- To make the inhabitants satisfied with the sorting- and collection system.

In general, using the waste hierarchy in the waste management plan seems to be one way to apply and work with it. Furthermore, it seems good to have some main goals to work towards – of which Borås has three. An important focus of the thesis has been to understand what it takes to fulfil the goal of satisfied customers. It has been shown that many different factors are necessary to consider to increase customer satisfaction. These factors are further developed in Section 5.1.3 below.

The two other goals in Borås' waste management plan are to reduce the amount of waste and to regard waste as a resource. As an example of how to encourage waste reduction, the single family houses have the possibility to choose size of the waste collection bins while the multiple family houses do not have the same opportunity. Single family houses can choose smaller bins to reduce the costs, which could motivate to generate less waste. It can thereby be linked to economic incitements. The question is how to encourage and motivate the inhabitants in multiple apartment houses in a similar way. Some inhabitants mentioned that they already think of unnecessary package materials and the waste it generates when they purchase products, while others did not seem to consider this at all. BEM regards waste as a resource through using the white- and black bags for energy and biogas production. However, it is unsure if all inhabitants

are aware of this. The application of the waste hierarchy is on an overall and general level in the case of BEM and their waste management plan. However, it could be beneficial for BEM to spread the knowledge of the waste hierarchy among the inhabitants. This could make people more proactive in their waste handling on a daily basis and could encourage people in all areas to generate less waste.

5.1.2 Indicators to measure and improve waste quality (RQ 2 & 4)

The indicator MR (ratio of materials in residual waste) defined by Dahlén & Lagerkvist (2010), was used in the waste composition analysis and has shown the ratio of materials in the residual waste. This data contributed to valuable input as further discussed below. The article by Elander et al. (2013) stated that the indicator also can help to show how efficient a waste sorting- and collection system is.

The waste composition analysis showed that the quality in the white- and black bags can be improved – but that the quality in black bags was better than the quality in the white bags. In general, the white bags contained 35-40 % correctly sorted combustible waste. The remaining parts were 30-40 % package materials and 25-30 % food waste. The black bags contained in general 75-90 % of correctly sorted food waste, and further a small share of package materials and 10-20 % combustible waste. The analysis showed that the inhabitants in all areas are about equally good/bad at sorting in both white- and black bag. The area with single family houses was slightly better at sorting in the black bags than the areas with multiple apartment houses.

The article by Elander et al. (2013) further stated that indicators can be used as a tool for communication. The thesis showed that it was useful to show the results from the waste composition analysis to the inhabitants who participated in the feedback workshop. Many of the participants thought that their area sorted quite well. They were surprised when they saw that they sorted equally bad as other neighborhoods in Borås. An explanation to this could be that they sort according to old instructions by habit, or simply that they have prejudices about other neighborhoods. Many inhabitants did have attitudes about that others are worse at sorting, which is further discussed in Section 5.1.3.1.2 below.

An idea for the future could be to use the indicator MR after implementing changes in the system or in specific areas. The article by Bernstad (2014) saw that installing sorting equipment in kitchens directly improved the recycling behavior. This theory can be linked to a proposed solution in Hässleholmen, where an inhabitant suggested AB Bostäder to install sorting equipment in the apartments to improve the sorting. This could be a suggestion for AB Bostäder, and also for BEM to further promote the idea for other property companies. If AB Bostäder or BEM would test this way of sorting, the MR could be used to measure waste quality before and after the change. They would thereby get an indication of how much this change directly affected the waste quality.

5.1.3 Factors influencing waste management systems (RQ 3, 3a-b, 4)

Several factors that influence waste management systems have earlier been investigated by other studies. Some factors presented in 2.2.1 are confirmed by the thesis – while others seem not to be of weight in Borås. Even if both bags contained miss-sorted materials, many inhabitants seemed satisfied with the current waste sorting- and collection system. It is thereby rather difficult to draw any conclusions about how customer satisfaction is linked to waste quality, which would be interesting to see. This type of investigation seems rather new and rare, since other theories or studies about the link between customer satisfaction and waste quality have not been found.

It is important to remember that BEM already has quite high customer satisfaction (82%) and that they do not want to risk decreasing it. It is therefore suggested that the current system with white- and black bags should be kept and improved. This instead of changing to a totally new waste management system, since changing the system might risk the satisfaction. From BEM's point of view, proposing a completely new system might not have been preferable from an economic point of view. This since a new waste management system most likely requires a lot of investments. Economic factors are further discussed in Section 5.1.3.3 below, however social- and technical factors are first discussed in the following sections.

5.1.3.1 Social factors

The study showed that several social factors are important to include when developing a waste management system. The article by Rousta & Dahlén (2015) states that social factors should be included when developing a source separation system. The article concludes that factors vary from case to case. They mean that internal factors influencing the success of a source separation system are for example; attitudes, information, awareness, responsibility and environmental knowledge. The factors can also be external, such as convenience, cultural norms, economic, storage space at home and type of household. The last category of factors is the socio-demographics, such as gender and income. The thesis can confirm that several of the factors listed above are of importance. It has though been difficult to measure how much they actually influence the participation in sorting of waste. That could be a suggestion for further investigation. Below follows separate discussions of social factors that have been found in the thesis.

5.1.3.1.1 Safety

The investigation shows that the factor of safety is important in order to get inhabitants to sort waste. This factor has not been found in previous studies, though it might have been considered in articles that were not found in the literature searches. The factor, safety, was especially obvious in one of the areas, Hässleholmen, where several criminal incidents made the inhabitants feel unsafe and not wanting to go outside. It felt natural that they thought safety was a prior issue to deal with than waste sorting. The safety issues might have made people care less about how to sort waste in general. That could be an indication that the municipality must consider the safety factor when improving and developing the waste management system.

5.1.3.1.2 Attitudes

The thesis has shown that attitudes toward waste sorting are important to consider in a waste management system. The thesis confirms the studies by Rousta & Dahlén (2015) and Finnveden et al. (2007), who mean that attitudes influences people's participation in waste sorting schemes.

This study shows that many inhabitants think that others are worse at sorting – and that there are many prejudices about what kind of people who are the worst at sorting. This is an interesting aspect since it did not matter in what area the inhabitants lived – or what age they were – there was always someone worse than themselves. The inhabitants in one area said that another area probably was worse – while women thought that men are worse and the opposite. There could be many reasons to this behavior. One suggestion is that people knew they do not always sort correctly – and to defend themselves they say that others are worse. Blaming others could thereby be a way of decreasing bad conscience. Another reason could be that people have prejudices against other cultures, genders, ages, etc. and just added waste sorting into their narrow mind of thinking.

The reasons for not participating in the sorting scheme varied – from the time issue, to "I do not care". The thesis confirms the study by Borås Renhållning (2004), that laziness and lack of interests are common reasons for not participating in the recycling scheme. However, they say that information is not as important as peoples' will and interest. The thesis however shows lacking information also is a common reason for not participating. Information is thereby an important factor to consider; it is further elaborated and discussed in Section 5.1.3.1.3 below.

It has been shown that more motivating information is requested in some of the areas. As mentioned by Borås Renhållning (2004) information about what happens with collected waste and environmental benefits related to recycling could trigger the inhabitants' values and attitudes.

The thesis indicates that the inhabitants would like to get continuous feedback. It has also been shown that it is important to include the inhabitants in the process. It is further important to reinforce and encourage good and correct behavior. This can be said in addition to the theory by John et al. (2011), where they state that it is more effective to "nudge" where there is a need for behavioral change. BEM's process of involving and having continuous contact with inhabitants is not as developed as it could be. Involving inhabitants can be suggested for BEM to work with and improve in the future. A deeper co-operation with the inhabitants could bring a better understanding for BEM's work – and the other way around – which could affect the waste quality and customer satisfaction in a positive way.

5.1.3.1.3 Information and education

The type of information requested in the areas has been shown to vary. The inhabitants wanted better information and education regarding three main-aspects:

- at recycling stations and centers
- about how to sort in the white- and black bags

- about how to sort bulky waste

Information seems to be a key to successful sorting. Encouraging the correct behavior and teaching everyone in Borås how to sort, need to be improved through information and education. Later in this section, information is linked to how important it is to include schools and encourage education about waste sorting.

The thesis has shown that two factors of importance are distance to collection and better accessibility of information about how to sort waste correctly. These factors were also discussed by Rousta et al. (2015). The article showed that new and correct information generated 70 % less miss-sorted materials in the black bags. The thesis has shown that the inhabitants are unsure about how to sort into the white bags. That was shown both through worse results in the waste composition analysis and through the interviews and focus groups with the inhabitants. It seems like BEM was good at distributing sorting information when the system with white- and black bags was launched in the 1991. However, after 25 years people have gotten into habits – both correct and incorrect – regarding what should be sorted as combustibles or food waste. Thereby a lot of waste could be sorted wrongly by people who think they sort correctly. Organizing a campaign to remind and enlighten people of the sorting scheme could have great benefits for the waste quality.

It was shown that another channel to education is SFI (Swedish for immigrants) that educates newcomers in Swedish and informs inhabitants who have moved to Sweden from abroad. It seems to be an important channel to keep since some inhabitants mentioned they had learnt how to sort in white- and black bags at SFI. It was not further investigated if they actually did sort correctly. Though if the waste management system should be successful, it is of great importance to include and give the possibility to participate to all people in society.

Another finding linked to education and information was that it is important to use schools as a source to teach children about waste sorting. This aspect was especially addressed at the feedback workshop. As discussed in the previous section, it is central to include all groups in society, thus also the children. They should be seen as a great resource regarding distribution of information. If a child learns how to use the white- and black bag at school – it is likely that he/she will bring the information home and affect the parents. It should also be stressed that it is important to have continuous education about waste sorting at the schools, so that the students get a constant reminder and do not forget as they grow up.

Statistics from the areas showed that approximately 30 % of the people moving to the neighborhoods during a year, moved in from abroad or from other municipalities. It could mean that these people probably are new to the sorting system with white- and black bags – which takes time to learn. This can be linked to the theory by Timlett & Williams (2009) who mean that it takes approximately three years for people to get used to the waste collection system and to make recycling a regular behavior. It is therefore important to distribute suitable information to these newcomers. The thesis has shown that information about how to sort was requested by both the

inhabitants who had lived in Borås for a long time and by those who are newer to the system. The information could include the sorting guide that was introduced in Section 3.2.4.1.2. It should also stress why it is important to use both the white- and black bag together with sorting package materials at a recycling station. This can be further linked to how information about waste sorting is spread and communicated to inhabitants who have moved to Borås. Some inhabitants said they had gotten information and instructions from the property owners, which shows how important the cooperation between BEM and the property owners is.

It would also be interesting to further investigate how people who move to Borås from abroad receive information. Do they receive information in different languages or only in Swedish? This is not known, and could thus be a field for future research. In areas like Hässleholmen, where people to a large extent have different backgrounds and cultures, it could also be beneficial to spread information about waste handling face-to-face. This, since some of the new-comers might not be able to read – even if the information is provided in their language. In addition, it would be interesting to further investigate and see how those people adapt and learn the system. Seeing the system through new eyes could also be a source for new ideas.

A suggestion is to use the media channels in Borås to spread information about the waste sorting- and collection system. The newspaper Borås Tidning could be used to encourage the inhabitants to sort better. As an example, the inhabitants at the feedback workshop thought it was interesting to see the results from the waste composition analysis. These results could perhaps be presented either in the newspaper or in social media to encourage better sorting behavior. It is though important to also explain *why* it is important to sort and not just show the results, this in order to increase the understanding for waste handling.

Communication can also be done through other ways, such as a neighborhood competition where different areas compete in how good they are at sorting. That could encourage both correct and improved behavior and also improve attitudes. It could be useful for people to see their own results in order to not blame others for being bad at sorting. It could also be a wake-up call for the inhabitants in a neighborhood that their area might not be as good as they thought.

5.1.3.1.4 Recycling stations
It has been shown that people wish for technical improvements of the recycling stations, see Section 5.1.3.2. The comments were mostly on maintenance, distance to the closest recycling station, information signs and pick-up frequency. Also own observations confirm that improvements are needed. Today, the recycling stations and signs look differently from one another – some signs even inform the inhabitants to sort incorrectly. Arranging clean-up more often could be one way of improving the messiness at the recycling stations. But maybe other solutions, than cleaning, could be used to prevent messiness. At Hässleholmen an example could be to investigate the possibility of arranging a room for bulky waste, since a lot of the messiness at the recycling station is caused by dumped furniture, TVs, etc. Improving signs and information

at the recycling stations could be another rather easy way to achieve better order. A technical fix could be to put up surveillance cameras to monitor the stations.

According to Dahlén et al. (2009) and Borås Renhållning (2004), the longer distance to the recycling station, the less materials is recycled. The thesis shows that several inhabitants complained about the distance to the closest recycling station. However, it can be discussed how close the station must be. It can depend on age, physical health and other factors – what is close enough for one person does not have to be close enough for somebody else. It can still be concluded that both distance and location of recycling stations are important factors to take into account when developing the waste collection system.

5.1.3.1.5   Dependency on others
It has been shown that many of the inhabitants would like to decrease dependency on others and physical health regarding waste disposal. This could be seen as an indication that the current waste management system is not adjusted to all groups in society, as the article by Villaägarnas riksförbund (2010) stresses. The current waste system requires inhabitants to walk to a waste collection bin, to transport package materials to the recycling stations and to transport bulky waste to a recycling center. The system is not adjusted to people without a car, or to people who have trouble carrying materials. A solution for decreasing the dependency could be to have property close collection of recyclables, and that property managers arrange collection of bulky waste to larger extent than they do today. A solution, linked to property close collection, could be if all recyclables were disposed in the same bag, picked up by a truck and later sorted at a sorting factory; Mixed fractions, described in Section 2.3.1. That system could thus bring other issues, such as purity of the collected material and ethical perspectives due to manual sorting. However those concerns are outside the system boundary of this study and are therefore not further discussed.

The dependency on others and having a car could be linked to the idea of a convenient waste sorting- and collection system. The problem is that the idea of a convenient system varies, depending who is asked. In Brämhult, it seemed okay to be car dependent and go to Boda to sort waste, while in Sjöbo it seemed necessary and important to have recycling stations close to the apartments, especially for the older inhabitants. The issues with distances to recycling stations will be further discussed below in Section 5.1.3.1.4. It can also be discussed how much of the responsibility for disposing waste the society should take – and what should be left to the individual. How much effort can society request from people? Especially with regards to that waste collection is a service that people pay for. This issue was addressed during the interviews where a person thought "the system" got paid for the work the inhabitants do. Economic factors are further described in Section 5.1.3.3 below.

5.1.3.2   Technical factors
The study shows that several technical factors are important to include when developing a waste management system. They are further developed below.

5.1.3.2.1 Collection frequency of white- and black bags

The study shows that there are problems with full waste collection bins in some of the areas with multiple apartment houses. This indicates that the collection frequency should be investigated and improved.

In Hässleholmen, it was shown that people put white- and black bags outside the collection bins if it is full. As a direct result from this behavior, the area gets messy and gives a disordered impression. The big amount of waste produced in Hässleholmen could be connected to the many children in diaper-age living in the area. This kind of area statistics/information is thereby strongly recommended to take into account when adjusting the pick-up frequency. People in the area also claimed that other people come to Hässleholmen and dump white- and black bags in the collection bins. A solution to that could be through collecting waste inside the buildings – through for example waste chutes or environmental rooms. That could also help removing the number of "dump sites" that is created next to every collection bin in the yards between the houses.

Also in Sjöbo, there were overfull collection bins. When looking at inhabitant statistics, there is no remarkable amount of kids living in the area. However, there are many older people – who also could be using diapers, though that notion seems rather unlikely to cause overfull collection bins. The income level in the area is low, which could be an indication that the inhabitants do not consume that much. The reasons for overfull bins are thereby not known – perhaps is the collection just not sufficient for the number of people living in the area. Just like the other areas, Sjöbo had big amounts of package material in the white bags. If that material was sorted at the recycling station, the collection frequency and size of bins would most likely be enough.

5.1.3.2.2 Collection of bulky waste

In the thesis, it has been shown that there are problems with bulky waste being dumped at both recycling stations and at the waste collection bins in certain areas. Today, there is a bulky waste collection day twice per year arranged by the property owner AB Bostäder. However, the dumping indicates that there is a need for redesigning the collection of bulky waste. It could perhaps be through arranging collection of bulky waste more often, for which both AB Bostäder and BEM could take responsibility. Another option, proposed in Sjöbo, was to encourage charity organization to arrange frequent pick-up of furniture. Setting up a room for bulky waste could be a more costly solution. In the long term it could however be more cost efficient due to savings on staff and care-takers that today clean up and remove the dumped waste.

5.1.3.3 Economic factors

The inhabitants did in general not have many opinions about the economic factors. A few mentioned costs of waste handling and punishments through fines. For people living in multiple apartment houses the cost for waste handling is included in the rent. That could be a reason why people in general did not think about the economic factors. It was however interesting that neither people living in single family houses could tell how much they paid for waste handling.

According to Rousta and Ekström (2013) the miss-sorted materials costs Borås approximately 13 million SEK every year. Improving the communication, between BEM and the inhabitants, about these and other costs connected to waste could be a way to improve the economic incitements. Thereby a better public understanding for the waste service could be created and it would be easier for BEM to implement economic motivators.

5.1.4 Waste composition analysis in the four areas (RQ 5, 5 a-d)

Findings linked to the different areas and different types of houses were presented in Chapter 4.2. As Christensen (2010) suggest, it could be beneficial to research waste collection systems suitable for a variety of housings, which has been one of the focuses in the thesis. Improvements, linked to the results from the waste composition analysis, are further discussed below.

The inhabitants in Sjöbo were worst at sorting in the black bags compared to the other areas. On the other hand they were one of the best at sorting in the white bags. The black bags contained of 18 % miss-sorted combustible waste, of which 60 % was diapers. According to the demographics, the number of children between 0-5 years is quite low and only represents 7 % of the inhabitants. This indicates that a big share of inhabitants who throw diapers, sort them into the wrong bag. Arranging a campaign to address this problem could thereby have a great impact on the waste quality.

For the City center, one of the biggest issues was the high amount of package material in the white bag – almost 40 %. This could be explained by the incorrect sorting instruction put up by Willhem Fastigheter, shown in Figure 25. Another reason could be the distance to, and location of, the closest recycling station – which according to some of the inhabitants was too long and inaccessible. Solutions to these aspects could be for BEM to have a dialogue with the property owner about the incorrect signs, but also to encourage setting up an environmental room for recyclables in the building.

Even though Hässleholmen has a large share of inhabitants new to the system every year, and many children, the waste composition analysis showed that the area is quite good at sorting in the black bags. People living in Hässleholmen are better at sorting diapers correctly than Sjöbo, which actually has a smaller share of young children. There could be many reasons to this result. It could be a result from that more people in Hässleholmen only use the white back, which would mean that the diapers end up in the white bag unconsciously – together with food waste. Or it could be seen as an indication that people got correct information and thus know how to sort diapers. It could be an idea for further research to see if the correctly sorted diapers lay in white bags that also contain food waste. In the white bags, there is approximately 35 % of correctly sorted combustible waste, and approximately 35 % miss-sorted package materials. This shows that the sorting of package materials need to be improved. People in the area asked for sorting instructions to a large extent. Perhaps could an information campaign, including the schools and associations in the area, be a good way to spread instructions regarding sorting.

As the waste composition showed, the inhabitants in Brämhult were very good at sorting into the black bags with almost 90 % food waste. The white bags contained about 40 % correctly sorted combustible waste, while 31 % was package materials and 26 % food waste. It was a bit surprising that the inhabitants seemed quite aware of how to sort but still had so much miss-sorted materials in the white bags. The inhabitants in Brämhult thought they were very good at sorting. However, some of the inhabitants pointed out that they had learnt to sort better after they got the sorting guide at the focus group. This can indicate that all inhabitants in Borås need information and feedback about how good they are at sorting – both to realize if and how they can improve their sorting.

5.2 Cooperation with stakeholders

Many stakeholders are involved in the waste management system in Borås. Some of them have been involved in the thesis but in the larger perspective there are many more that could have been interesting to include. Below follows discussions based on the stakeholders that have come across during the work, seen in Table 33 below.

Table 33. The table shows a list of stakeholders for BEM to cooperate with.

Stakeholders
Inhabitants in Borås
Property owners
FTI (Förpacknings- och tidningsinsamlingen)
Borås Stad
Schools
Production- and manufacturing companies

5.2.1 Inhabitants

It has been shown that it is very difficult to get people to participate in focus groups about waste sorting and collection. On the other hand it has also been proven that the inhabitants in general have opinions and thoughts about it. The cooperation between BEM and the inhabitants seems like it could benefit from further development. The reasons to not participate in the groups have been many. However, this could be an indication that BEM has not included the inhabitants in their work before. It could also be that BEM only has given inhabitants information, but not actually asked for feedback or comments in return. Continuously contact and better interaction between BEM and the inhabitants in a participative way, are thus encouraged to be developed in the future. It is of weight to build the relationship on trust and respect and it is needed to be maintained in a good way.

5.2.2 Property owners

The thesis shows that a good cooperation between BEM and the property owners is important to promote. The property owner's actions could influence both amount of produced waste and waste quality. As an example the property owner Willhem Fastigheter has put up incorrect sorting instructions in the buildings at Skolgatan. It shows that the communication between BEM and property owners have room for improvements. Property owners need information and education about how to sort correctly. It could thus be recommended that BEM investigates this matter further.

The above discussed situation occurred at one property in the City center. It is not known whether these instructions are given on other properties that Willhem Fastigheter owns. That could be a matter for BEM to investigate further.

Another problem was how hard it was to get hold of one property owner. As described in the method, Section 3.1.1.1, four streets had been chosen for the waste composition analysis, though only the property owner at Skolgatan could be reached. This strengthens the idea that improved cooperation between BEM and the property owners is necessary. There could be many reasons to why the property owner could not be reached; wrong contact information, vacations, lack of time and interest, etc. They however never showed any indication that they had gotten the voice mails or calls so the actual reason is not known.

5.2.3 FTI

The thesis shows that it can be difficult to get information from FTI (Förpacknings- och tidningsinsamlingen). However, it is unsure if the cooperation between FTI and the municipality is bad. The difficulties to get hold of them could perhaps be one of the reasons why the cooperation between FTI and the municipalities needs improvements as suggested by Rousta & Ekström (2013). This study has not included any deeper analysis of the relationship between FTI and the municipalities and it is therefore not further evaluated.

5.2.4 Borås Stad

One of the findings shows that the cooperation between BEM and strategic department at Borås Stad works okay most of the times. It seems like BEM and the departments have a working collaboration, where they exchange information about upcoming projects. It is of course important to maintain the collaboration and evaluate how the cooperation can be improved to achieve a better waste handling in the future.

5.2.5 Schools

As earlier stressed, it is of great importance to include children in the waste sorting scheme. The cooperation between BEM and schools has not been specifically investigated in this study, but should be encourage since both schools and children could be used as information distributors, see Section 5.1.3.1.3 above. Of course is also the children's own participation in the sorting scheme of importance.

5.2.6 Production- and manufacturing companies

The thesis shows that some inhabitants consider and think of unnecessary packages when purchasing products. The package materials make unnecessary waste that the customers have to get rid of in some way. Using wrapping materials to a large extent could be seen as beneficial for the producers since that could make it possible to cut down on quality. Making it easier for the producer and transporter could thereby move the problem to the customer – and at a later stage – society. Therefore, an interesting aspect to investigate and evaluate is how production- and manufacturing companies could be included in working with waste generation and prevention of waste. In such investigation, the system boundary should be expanded to include aspects regarding production, transport and problems at the customers'. This could be done in order to address issues that occur on different levels in the chain.

5.3 Summarized discussion regarding the geographical areas

In this section, a summarized discussion regarding the four geographical areas is presented. The focus is on technical sorting- and collection systems suitable for each area.

5.3.1 Sjöbo

An idea for Sjöbo and for similar areas, is to divide the waste collection bins for white- and black bags into two fractions; one for the white bags and one for black bags. The inhabitants in this area are used to bringing their waste outside to the yard and the waste collection bins seems to work okay. This solution could motivate the inhabitants to sort correctly and could also communicate that the white- and black bags are not mixed in a later process.

When the waste collection bins are divided into two fractions, there is a need for information about how it works and why it is done. This could also be an opportunity for BEM to send out updated sorting instructions to the inhabitants in the area. It is also of value to promote BEM's app and sorting instructions online.

In Sjöbo, BEM could investigate the possibility to build an environmental room/house, since there is enough space in the yard between the houses. The location of the environmental room/house should be put on a suitable place between the houses so it is close distance for all inhabitants. In the environmental room/house, it would also possible to have more fractions than on a recycling station, such as light bulbs. An idea is to co-operate with Kamran Rousta, to get inspiration from his work with environmental houses and to apply a similar house.

To be able to build the environmental house, BEM needs to have a dialogue with the property owner. At the same time, BEM could discuss the possibility to collect bulky waste more often. This could decrease the dumping at the recycling stations in the area.

5.3.2 City center

For the City center and similar areas, the suggestion is to keep the waste chutes for white- and lack bags since it is an appreciated service and due to limited space in the apartments. An idea is

to use property close collection and thus to re-open the environmental room in the basement. This was an idea suggested by the inhabitants. Through the property close collection, it would be possible to collect more fractions such as light bulbs.

To be able to create a property close collection in the basement, BEM needs to have a dialogue with the property owner (Willhem Fastigheter). Willhem Fastigheter also needs to communicate with the inhabitants and let them know that they have put up incorrect sorting instructions. The incorrect sorting instruction shows that they, and perhaps also other property owners, need to learn about how to sort and how to communicate this to the inhabitants. BEM further needs to tell the property owners that it is possible to save money on having property close collection. The property owners are important and their participation is very valuable.

When the environmental room is built, it needs to be promoted and the inhabitants need to be informed about it. At the same time, the inhabitants could also get updated sorting instructions. These solutions could hopefully contribute to decrease the miss-sorted package materials in the white bags and to generate better waste composition results in general.

5.3.3 Hässleholmen

In Hässleholmen and in similar areas, a solution could be to remove the waste collection bins in every yard between the houses. The solution could further include investigating the possibility to collect waste inside the property, for example through a waste chute or a waste room with locks. This would remove the possibility to dump the bulky waste at the waste collection bins in the yards; it also decreases the distance and could probably make the inhabitants feel safer. The locks could also help keep track of how often the inhabitants dispose waste.

Also here, BEM need to have a dialogue with the property owner (in this case AB Bostäder). It is further suggested to investigate the possibility to create a room for bulky waste collection, since also this could decrease the dumping of bulky waste in the area.

In Hässleholmen, there is a need to distribute information in multiple languages. The suggested information could be about how to sort in the white- and black bag, what to sort at the recycling station and to give concrete examples of what to sort where. It is also of value to promote BEM's app and sorting instructions online. There is sorting information in multiple languages online on BEM's website, however, it could be an idea to promote and distribute this more actively.

5.3.4 Brämhult

In Brämhult and similar areas with single family houses, a solution could be to investigate the possibility to offer the inhabitants to have collection of recyclables at their property. Another idea could be to investigate if the sanitation staff could report if the inhabitants only use white bags.

It is suggested to give information to the inhabitants to motivate them and to work with attitudes. The information could consider why sorting is important and what happens with the waste after collection. Also in this area, it is of value to promote BEM's app and sorting instructions.

5.4 Method discussion

The methods have earlier been described in Method Chapter 3. However, this section discusses findings linked to the used methods.

5.4.1 Action research

The thesis has shown that an action research study is an effective way of including multiple stakeholders. This was also stated by Zuber-Skerritt (2012) in the Theory Section 2.5.1.2. The focus group method was though not an effective data collection method in this study. That is further discussed below, see Section 5.4.2.

As Herr & Anderson (2005) mean, it is important to keep track of the increased understanding along the way and other reflections that occur. These have therefore been noted along the thesis in the grey reflection boxes. This have generated a deeper understanding and made the researchers more aware of how the thesis has been shaped and why some of the decisions have been made.

The study also showed that action researchers need to be flexible and need social skills, which confirm the theory by Greenwood & Levin (2007). It has sometimes been difficult to be a friendly outsider, since it takes courage and energy to get in contact with new people.

It has also taken time to understand all different aspects of the waste sorting- and collection system and how to change it. These factors – understanding and change of a complex system – are further confirmed to be issues by the article by Schein (1995) as presented in the Theory Chapter, see Section 2.5.1.1. The work has been a learning process that have generated great insights about what is needed to improve the waste sorting- and collection system in Borås.

5.4.2 Focus groups

Some of the issues and thoughts that occurred along the focus group work process were discussed in the grey reflection boxes in the Method, see Chapter 3. These will thus not be further discussed in this section. However, other aspects connected to the focus groups are discussed below.

As Kungsbacka Municipality (2012) states, the participant recruitment to focus groups is time consuming and can be a difficult process. This can be confirmed by the study since it has been very difficult to engage people and to get them to participate. It can be questioned if the use of focus groups is the best method to gather opinions about the waste sorting and collection. In the thesis, the most efficient way to gather data from the inhabitants was through interviews in the streets. That was both a time-efficient and flexible method. This type of qualitative research, has given depth and a lot of valuable input to the thesis.

However, if the study was to be conducted all over again, it would be difficult to decide whether to use focus groups or not. This since the few focus groups that were held gave a deeper understanding and also a better relationship with the inhabitants than the interviews in the streets. At the same time, it was easier to reach out to more inhabitants through the interviews. The

gained knowledge of how difficult it was to get the inhabitants to participate has generated the idea of re-designing the recruitment process, for example through giving it more time and by having more than two persons to recruit. Aspects that have been used, and would be used again are to have the locations for the focus groups close to the neighborhoods and to use existing associations to reach out to the inhabitants in the areas. Existing associations could probably have been used to an even larger extent in this study.

5.4.3 Weaknesses and uncertainties

The thesis has been based on the method of action research, through focus groups and interviews. This has required participation of the inhabitants in Borås. The results have been based on data gathered from the focus groups and interviews, which depended on the sample of participants. This is an uncertainty since another sample might have generated different results. The sample has included participants in all ages (18-99). However, it has been difficult to reach out to younger participants in some of the areas. This could have led to misleading results, for example in Brämhult.

Another uncertainty was that the sample could give socially desirable answers i.e. that the interviewed inhabitants give the answer that they think is "correct" or "wanted". This has been an aspect that have been taken into account and tried to consider. When the focus groups and interviews were conducted and inhabitants said they did sort their waste, they were often asked for concrete examples. Sometimes, it showed that the inhabitants did not sort as well as they had earlier described. This generates uncertainties in the answers, since it sometimes might have been missed to ask follow up questions.

As earlier mentioned, some of the investigations such as the survey or waste composition analysis have not been possible to influence. It could have been interesting to adjust them after the thesis' purpose which could have generated even deeper results.

Another weakness could be that the thesis has had case specific settings. It can be questioned how transparent the results are and if it is directly applicable in other cities with similar areas. As described earlier, the four areas have had inhabitants with different demographics and considered two different types of houses – a lot of parameters have differed between them. By looking at areas in other cities that have similar demographics and house types, the results and suggested solutions could probably be applicable to some extent. However, it must be noted that it can be difficult to directly apply all results without going into detail about the areas. It could have been interesting to compare more similar areas, such as neighborhoods with only single family houses or only multiple family houses, to get an even deeper analysis and focus on area specific solutions. Another idea could have been to not only look at areas in Borås, but to compare one area in Borås with neighborhoods in other cities in Sweden. This could though be difficult since other cities use other waste sorting- and collection systems. Linked to that, the thesis has focused on Borås that already has a waste management system with white- and black bags. It could

perhaps be difficult to directly apply the results from this study to a city where the waste is not sorted into two different fractions without any adjustments.

Reflections – discussion

As earlier mentioned, there are many stakeholders that can be included in a waste management system. To be able to conduct the thesis, there has been many cooperation with mainly three stakeholders; BEM, Sweco and Chalmers University of Technology. It has sometimes been difficult to know what the stakeholders wanted and to know how to adjust the work process so that all three would be satisfied. More than once, they have expected different things that have generated interesting discussions and decisions along the thesis work.

It has been fun and interesting to meet people – in general there are many opinions, reasons and questions about waste handling. It has been interesting to take part of it all and also generated valuable input to the investigation. The findings show how important it is to listen to and include the inhabitants and other stakeholders when developing a waste sorting- and collection system.

6 Conclusions

This chapter presents the conclusions and answers the research questions. It ends with the final recommendations to BEM, inhabitants, property owners and ideas for future research.

6.1 Conclusions from key findings

This section presents the conclusions based on the key findings and answers the research questions.

> *Main RQ) How can an already developed waste management system be improved in order to achieve high customer satisfaction and high sorting quality?*

A general conclusion with regards to the main question, is that it seems quite rare to investigate and link customer satisfaction to waste quality. However, since the main research question is broad, it is answered through answering the five under-questions below.

> *1) How can the waste hierarchy be applied to improve a waste management system?*

The waste hierarchy is applied through the waste management plan on an overall and general level in Borås. Using the waste hierarchy in the waste management plan seems to be a good way for strategic reasons, such as how to regard waste as a resource. It can however be concluded that it could be beneficial for BEM to spread the knowledge of the waste hierarchy among the inhabitants. This to make people proactive in their waste handling, and as an example encourage people to generate less waste.

> *2) How can the quality in the white- and black bags be measured and compared?*

It can be concluded that the indicator MR (the ratio of materials in residual waste) defined by Dahlén & Lagerkvist (2010), was an efficient way to measure and compare waste quality of residual waste in Borås. Another conclusion is that the MR was a good tool for communication. It was a communicative measure that can be used to encourage better sorting and further to change attitudes and prejudices among inhabitants.

Further, it can be concluded that all of the four investigated areas are about equally good or bad at sorting.

> *3) What factors regarding sorting- and collection of waste are influencing customer satisfaction?*

It can be concluded that several factors were influencing the customer satisfaction. The factors could be categorized into social, technical and economic factors.

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> *a. What is working well in the current sorting- and collection system in Borås?*

A conclusion that can be drawn is that the inhabitants in general were satisfied with the current waste sorting- and collection system. The inhabitants thought the white- and black bags should be kept but be further improved. That opinion was shared by inhabitants from all four areas.

> *b. What are the most important aspects to improve in the current sorting- and collection system in Borås?*

It can be concluded that several important aspects and factors are needed to improve the current waste sorting- and collection system in Borås.

Social factors

It can be concluded that an important social factor to consider when developing the system is safety. This factor was not mentioned in the studied theories and previous studies. Another factor, proved to be important, is information about *how* and *why* to sort waste. Different information was requested in the four areas. This is further developed under research question 5) below. However, it can be concluded that inhabitants from all areas, both newcomers and inhabitants who had lived in Borås for a long time, needed to update their knowledge about *how* and *why* to sort. It can also be said that education about sorting is important and that this should be done through several channels; such as schools and SFI. Furthermore, the attitudes among the inhabitants need to be improved. The thesis can conclude that inhabitants often think that others are worse than themselves at sorting. These attitudes occurred in all areas. Attitudes, information and education are all factors that were confirmed by theories and previous studies.

Another factor that can be concluded is the dependency on others and on physical health. The current system is not adjusted to all people in society. This factor should thereby be improved in Borås.

Another conclusion to be drawn is that it has been difficult to get the inhabitants engaged in the topic and to participate in the focus groups. The concluded reasons are several; bad attitudes, lacking interest and that the inhabitants have previously not been included in BEMs work, etc.

Technical factors

It can be concluded that the most important technical aspects to improve are the recycling stations. It should be done through better maintenance, shorter distance, information signs and pick-up frequency. A short distance to the recycling stations can be concluded to vary depending on person and age, physical health and other factors. However, it can be further concluded that both distance to and location of the recycling station are important when developing the waste sorting- and collection system.

The pick-up frequency should be adjusted depending on inhabitant demographics in an area. It can also be concluded that dumping of bulky waste could be an indication that the collection of bulky waste needs to be further investigated and redesigned.

The property owners are concluded to be an important stakeholder to consider in developing a waste sorting- and collection system. Their actions could have impact on the waste quality and therefore the relationship between BEM and property owners need to be improved.

Economic factors

The inhabitants in Borås in general do not consider economic factors when they think of waste sorting and collection.

> 4) *What is needed technically, socially and economically to improve the ratio of correctly sorted waste in the white- and black bag?*

It can be concluded that the main focus should be on technical and social improvements.

Social improvements needed are to have a safe environment for the inhabitants. General attitudes towards waste should be improved and further information and education about *how* and *why* to sort is needed. Decreased dependency on others and physical health through adjusting the system could be beneficial. As earlier mentioned, it can be concluded that the property owners are important to include. They need information and education about how to sort in order to provide the inhabitants with the right information.

It can be concluded that technical improvements are needed. For example, arranging clean-up more often at the recycling stations. Also the signs and information at the recycling stations should be adjusted. The signs should give easy and correct information and look similar in all recycling stations. Another technical factor to improve is the collection of bulky waste. The collection should be done more often – or rooms for bulky waste should be set up.

As earlier mentioned, the inhabitants in Borås do not associate the waste sorting and collection with economic factors. However, since the miss-sorted materials costs Borås a lot every year, it can be concluded that the communication about costs connected to waste needs improvements and could be a way to improve the economic incitements.

> 5) *How can the sorting- and collection systems be developed depending on the type of houses and inhabitant demographics in an area?*

It can be concluded that a waste sorting- and collection system can be developed depending on house types and that the demographics of the inhabitants need to be considered. This is further developed in the sections below.

The waste sorting- and collection system recommended for Sjöbo, and similar areas, is to divide the collection of the white- and black bags into two bins; one for white and one for black bags. It is important to spread information about the change and explain why it is done. This should also be seen as an opportunity for BEM to send out updated sorting instructions to the inhabitants.

It can be further concluded that an area like Sjöbo would benefit from decreasing the distance to a recycling station through building an environmental room for recyclables. It is thereby necessary to have a dialog with the property regarding such investment. Also collection of bulky waste should be discussed.

The waste sorting- and collection system recommended for the City center, and similar areas, includes keeping the waste chute for both white- and black bags due to limited space inside and outside the building. It can be further concluded that the area would benefit from having an environmental room in the house – which there seems to be room for. At the same time as promoting and informing about the environmental room, the inhabitants should get updated sorting instructions. This could also be an opportunity for BEM to promote the app and sorting guide online.

It can be concluded that it is necessary to have a dialog with the property owner about the possibility to have an environmental room. The property owners also need to get information and education so they can distribute correct sorting instructions in the property.

The waste sorting- and collection system recommended for Hässleholmen, and similar areas, is to remove the waste collection bins in every yard between the houses. Instead the waste should be collected inside the properties. It could be done through for example waste chutes or waste rooms with locks.

Also in this area, it can be concluded that it is necessary to have a dialog with the property owner. The discussion be about collection of waste inside the buildings and also include investigation of the possibility to create a room for bulky waste collection.

In this area, information is needed in multiple languages. The information should be about how to sort in the white- and black bags, what to sort at the recycling station and also to give concrete

examples of what to sort where. It is also of value to promote BEM's app and sorting guide online.

> *d. What sorting- and collection system is suitable for an area with similar house type and inhabitant demographics as in Brämhult?*

The waste sorting- and collection system recommended for Brämhult, and similar areas, is to offer the inhabitants collection of recyclables at the house. In order to improve the usage of white- and black bags, the waste collection staff could report to a system if for example only the white bag is used. The household should then get informed why it is important to use both bags.

Another conclusion is that more motivating information is needed to improve the sorting and attitudes in the area. The information could consider why sorting is important and what happens with waste after collection. Also in this area, it is also of value to promote BEM's app and sorting guide online.

6.2 Final recommendations

This section presents the final recommendations for BEM, inhabitants, property owners and recommendations for future research.

6.2.1 Recommendations to BEM

The inhabitants are satisfied with the waste sorting- and collection system with white- and black bags. It is therefore recommended to continue using and improving this system:

- Refresh and update the inhabitants' knowledge on how to sort in the white bag. This can be done through promoting the sorting guide and mobile application. Another idea is to arrange a campaign to address the problems in certain areas, such as the miss-sorted diapers in Sjöbo. The information campaign can also include schools and associations in the areas, to spread instructions regarding sorting. Other ideas are to give the inhabitants feedback about how good they are at sorting and to spread the knowledge of the waste hierarchy.
- Included the inhabitants in the development of the system. They have many interesting opinions and ideas. Becoming more involved could also encourage them to improve their sorting and feel more motivated to participate. It is also important to hear the inhabitants' opinions in order to improve the customer satisfaction. An increased interaction with the inhabitants could also generate a better participative relationship between BEM and the inhabitants.
- For newcomers, it can be further investigated how the sorting information is communicated and in what languages. It could be beneficial spreading the information face-to-face, since some of the newcomers might not be able to read.
- Improve the communication about the costs connected to waste to the inhabitants.

- Spend time in the neighborhoods to understand the current situation. Also that could encourage the inhabitants to improve their sorting and feel more motivated.
- Use the media channels in Borås to spread information about the waste sorting- and collection system. For example, show waste composition results to encourage better sorting behavior. Increase the understanding for waste handling, through explaining why it is important to sort. It is also important to encourage the inhabitants to ask questions if they are unsure about sorting or collection of waste.
- Arrange visits for inhabitants to Sobacken, where Borås' waste is processed – it creates understanding for the waste handling process.
- Develop the dialog with property owners. They need information and education about how to sort – make sure they spread correct sorting instructions to the inhabitants. Co-operate with property owners and investigate the possibility to collect bulky waste more often in areas with multiple family houses. Also discuss the possibility to create rooms for bulky waste. Another topic to discuss is the possibility to install sorting equipment in the apartments. According to previous studies, that has been shown to directly improve the recycling behavior. A developed dialog with the property owners can also improve the cooperation and the relationship in general between BEM and them.
- Continue working with SFI and spread information to children.
- Investigate where property close collection can be implemented – it could help decrease dependency on others.
- Use the indicator MR after applying changes in the system to see if the waste quality improved.
- Improve the recycling stations through better maintenance and cleaning, put up surveillance cameras and lights, make signs correct, clear and easy to understand and see if there is a need to collect more fractions (especially light bulbs is an issue for the inhabitants)
- Promote the information that already exists – sorting guide, mobile application, web page etc.
- Keep on working and maintain the cooperation with waste researchers through Kamran Rousta.

6.2.2 Recommendation to inhabitants
The thesis has generated some recommendations to the inhabitants in Borås:

- The inhabitants are recommended to put demands on BEM and to request information. It can also be recommended to take the responsibility to sort and look for already existing information, since a lot of information is available online and is distributed by BEM. Having satisfied customers is important to BEM – they would like to know what would make the inhabitants more satisfied – help them to understand what makes the inhabitants satisfied or not.

6.2.3 Recommendation to property owners

The thesis has generated some recommendations for the property managers:

- Increase the cooperation and have a dialog with BEM. It is important for BEM to understand what the property owners' interests are.
- Investigate the possibility to collect bulky waste more frequent. See if it is possible to create storage rooms for bulky waste where the inhabitants can put their bulky waste when they want to get rid of it until the collection day.
- Investigate the possibility to install environmental rooms or houses where there is space for it.

6.2.4 Future research

It has been difficult to measure how much the different factors actually influence the participation in sorting of waste and this is therefore suggested for further investigation. It is further recommended to continue to investigate the possibility to create area specific solutions for the waste sorting- and collection systems through looking at house types and inhabitant demographics. Another recommendation is to investigate and evaluate how production- and manufacturing companies are working with waste generation and prevention of waste.

A recommendation is to continue using the waste composition analysis as a tool for measuring waste quality and measure improvements of waste management systems. Another recommendation can be to investigate if the white bags with correctly sorted diapers also contain food waste.

An additional recommendation is to further investigate and see how people new to a waste management system adapt and learn how to use the system. Seeing the system through new eyes could also be a source for new ideas.

If a similar study with focus groups with inhabitants will be conducted, it is recommended not to underestimate the amount of resources that the recruitment process requires – it takes a lot of time, energy and engagement to get people to participate.

Finally, it is further recommended to continue to investigate and evaluate if there are correlations between customer satisfaction and waste quality. The thesis has not been able to found any direct correlations, but have found this very interesting and very little investigated in previous studies.

Reflections – conclusions and final recommendations

The thesis has generated many interesting findings. It has been a complex study with many different types of data to match and consider. It has been impossible to follow up everything and therefore there are many suggestions for how to continue the research about waste management systems and BEM's work to improve the waste quality and customer satisfaction.

There has been an interesting process that has led to many new insights, learning, sometimes frustration and surprises. The thesis has required both courage and skills to meet and interact with unknown people. The learning has regarded many aspects, from the researchers' own social skills to the development of knowledge about waste.

The thesis has also showed how important it is to include inhabitants and other stakeholders in the process in order to know how to change the system. Hopefully this work will continue after the thesis work is finished.

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