CHALMERS
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Potential barriers to a resource efficient and service oriented hub for a new development in Frihamnen

Master of Science thesis in the master's programme infrastructure and environmental engineering

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Cover: Model of future Frihamnen[1]

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[1] Image source: http://alvstaden.goteborg.se/wp-content/uploads/2015/02/Program-f%C3%B6r-Frihamnen-och-del-av-Ring%C3%B6n.pdf

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ABSTRACT

Global trends of e-commerce will significantly affect the future of transport as coordinated transport substitutes private transport. Furthermore, the pressure on citizens to adapt to a more sustainable lifestyle creates a demand for sustainable waste management, recycling and consumption. Many people also argue that our consumption should move from new products to used products. City planners in Gothenburg are now aiming to consider these factors and trends when planning a new city district in Frihamnen. There is a city vision that looks to limit private transport, create an attractive urban environment and facilitate a sustainable lifestyle; therefore, strict traffic regulations will be introduced in this new development. To be able to provide the services that the citizens and businesses require, there are plans to introduce a service hub. This solution will deal with handling of goods (including groceries) and waste flows in Frihamnen, as well as provide a facility for reuse and upcycling. The concept is adopted from that of urban consolidation centers, UCCs, where last mile transport is coordinated through a redistribution central.

The aim of this study is to identify barriers connected to the planning, implementation and operation of the service hub. The means of doing this was to arrange a focus group consisting of project stakeholders and future practitioners. The identified barriers were analyzed from the perspective of two theories: Path dependence and socio-technical transition theory. The study resulted in 15 barriers and a list of recommendations for the planners of the solution.

A general conclusion is that while barriers are important and require attention, none of them seems to be severe enough to hinder the entire project. Most of the barriers relate to economics, organization and/or uncertainty about the future; very few are of a technical nature. The first recommendation to planners is to appoint a responsible authority for handling the organizational matters. The second recommendation is to make the citizens cover the majority of the operational cost. These payments should be collected via apartment fees. It is also recommended to use a problem-based approach when designing the hub – it should not be designed before the traffic regulations are set. The implementation will imply several risks, but also potential benefits. Therefore, a recommendation would be that municipal authorities take a stand on what level of risk to accept in order to gain the advantages. Furthermore, if the solution is designed with regard to flexibility, it will be more adaptable to future changes in trends and consumer behavior. The final recommendations are to carefully investigate how different standards should be integrated to accomplish an efficient operation of the hub and also to consider excluding some of the services discussed in the initial planning phase.

Key Words: Urban consolidation center, service hub, last mile, city logistics, urban planning, reuse, upcycling, waste management, goods management, transition theory, path dependence, integrated infrastructure, sustainability

Potentiella barriärer för en resurseffektiv och serviceinriktad hubb för en nybyggnation i Frihamnen
Examensarbete på masterprogrammet Infrastructure and Environmental Engineering

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SAMMANFATTNING

Globala e-handelstrender kommer att påverka framtidens transportermönster märkbart – samlastade transporter kommer att ersätta privata transporter. Dessutom väntas kraven på att anpassa sig till en mer hållbar livsstil öka hos människor. Detta gör att efterfrågan på hållbar avfallshantering, återvinning och konsumtion ökar. Många påstår också att handeln med begagnade varor bör växa sig starkare och utmana konsumtionen av nyproducerade produkter. Göteborgs stadsplanerare försöker nu ha dessa faktorer i åtanke när de ska planera en ny stadsdel i Frihamnen. Det finns en stadsvision som uttrycker en strävan efter att begränsa privata transporter, skapa en attraktiv stadsmiljö samt underlätta för en hållbar livsstil; därför kommer trafikrestriktioner att användas i denna nya stadsdel. För att kunna leverera de tjänster som invånarna och företagen i Frihamnen kräver planeras en servicehubb. Syftet med denna lösning är att effektivisera gods- och avfallsflöden (inkl. matleveranser) samt att tillhandahålla en återbruksverksamhet. Lösningen baserar sig på konceptet bakom urban consolidation centers, där man ämnar samordna transporter den sista kilometern genom att införa en omlastningsterminal.

Syftet med denna studie är att identifiera barriärer kopplade till planering, byggnation och drift av servicehubben. Detta gjordes genom att anordna en fokusgrupp med deltagare från aktörer och intressenter. De identifierade barriärerna analyserades utifrån teorierna ”path dependence” och ”sociotechnical transition theory”. Studien resulterade i 15 barriärer samt ett antal rekommendationer riktade till de som planerar lösningen.

Trots att barriärerna är viktiga och bör uppmärksammas kan slutsatsen dras att ingen av dem bör stoppa projektets framfart. De flesta barriärerna kan kopplas till ekonomi, organisation och/eller osäkerhet över framtiden; väldigt få är av teknisk karaktär. Den första rekommendationen till planerarna är att tillsätta en huvudman med uppgiften att samordna de organisatoriska frågorna. Nästa rekommendation är att driftskostnaden för hubben slutligen bör läggas på de boende i området, förslagsvis bör den adresseras via lägenhetsavgifterna. När hubben planeras bör man ha ett problembaserat tillvägagångssätt och planeringen bör inte starta förrän trafikrestriktionerna har fastslagits. Det finns många potentiella risker och nyttor med hubben och i många fall är dessa tätt kopplade. Kommunala myndigheter bör därför ta ställning till hur mycket risk man är villig att acceptera för att ta del av dessa nyttor. Vidare bör man utforma hubben så att den går att anpassa efter framtida förändringar kopplade till trender och konsumtionsvanor. De sista rekommendationerna är att noga undersöka hur olika standarder kan integreras för att uppnå en hög effektivitet i lösningen, samt att överväga att exkludera vissa tjänster som diskuterats i planeringsfasen.

Nyckelord: Urban consolidation center, servicehubb, sista kilometern, citylogistik, stadsplanering, återbruk, upcycling, avfallshantering, godshantering, transitionteori, path dependence, integrerad infrastruktur, hållbarhet

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VOCABULARY

E-commerce – Online shopping, including delivery of the goods.

E-vehicle – Electrical vehicle, classified as a low emission vehicle.

Focus group – Qualitative research method for data collection where a group of people is set to discuss a certain topic. Beyond the participating discussing persons, there is a moderator (often the researcher) controlling where the discussion is headed.

Household waste – In this report: combustible and biodegradable waste.

Increasing returns – "Increasing returns mean lower costs per unit […] As more and more units of the commodity are produced, the cost per unit goes on steadily falling." (Seth, 2015)

Lock-in mechanisms/Lock-ins – Mechanisms that hinder a change from the current practice in a system. Examples are investments, industry standards and legislation.

Low-emission vehicle – A vehicle emitting little or no greenhouse gases and that does not pollute the nearby environment with noise.

Practitioners – In this thesis: All those who utilize the service hub. Companies as well as citizens.

Probes – Follow-up questions used in the focus group and semi-structured interviews.

Rebound effect – "Rebound effects refer to increased consumption that often occurs when efficiency improvements reduce user costs." (Victoria Transport Policy Institute, 2014)

Reuse – Consumption of used goods, often referred to as second-hand usage. The concept is used primarily when the item switches owner.

Separate collection (facility) – A facility for collecting waste, recyclable, reusable and upcyclable material. The facility is located in the building where the material originated from, for example an apartment building. There are different containers, allowing the user to separate different fractions.

Service hub (SH) – A multi-purpose facility that will encompass services such as goods deliveries, collection of waste, recyclable, reusable and upcyclable material, storage and pick-up point for cold goods (groceries ordered online) as well as an upcycling facility. Also referred to as "the hub solution" or "the hub" in the text.

Stakeholder – People or organizations that have either interest in, or the power to influence a specific project.

Throwaway society – A society in which people do not keep things for very long, even if those things still work or are still useful.

Upcycling – The highest form of reuse. It is the process of making something more valuable than it was before. Often used in the context of taking something that someone wants to get rid of, and renovate it so that it becomes desirable for someone else.

ABBREVIATIONS

MLP – Multi-level perspective

TIS – Technological innovation system

ICT – Information and communications technology

NGO – Non-governmental organization

SH – Service hub

UCC – Urban consolidation center

1. INTRODUCTION

Infrastructure decisions have affected society throughout history (Roelich, et al., 2015). The purpose of infrastructure is, according to the Oxford Dictionary (2015), to ensure the proper functioning of society through providing physical and organizational structures. However, beyond this primary function, infrastructure also serves as an indicator of the advancements of a civilization or society (Tomazinis, 2003; ARCADIS, 2014). Construction of infrastructure involves vast investments, and consequently, substantial lock-ins are created (Roelich, et al., 2015). Furthermore, the replacement rate is generally low and thus decisions affect society for a long time – often several decades (Roelich, et al., 2015). Society co-evolves with the present infrastructure; making reforms not only a technical issue, but also a social issue (Roelich, et al., 2015). Not only does infrastructure provide ways to make sure daily life progress, it also contributes to developing industry as well as urbanization (ARCADIS, 2014).

Urbanization is one of the major global megatrends together with globalization and digitalization (Citibank, 2012). This trend is co-evolving with the building and development of infrastructure to allow transport within cities as well as outside of cities (ARCADIS, 2014; Citibank, 2012). In a 2009 article (Allen) states that "by definition, cities are not sustainable, urban dwellers and economic activities inevitably depend on environmental resources and services from outside their built-up area". As urbanization leads to cities with higher population, the flow of resources into the cities will increase, leading to more transport and a larger ecological footprint (Grimm, et al., 2008; Allen, 2009). Thus, achieving urban sustainability clearly becomes even more challenging as urbanization increases.

The sustainable city is a vision that entices both decision-makers and other members of society. Efforts are made from the public sector to promote a more sustainable lifestyle among citizens; an example is to encourage people to consume more organic food (Naturvårdsverket, 2012). People that want to devote themselves to a sustainable lifestyle need to replace their old habits. This could involve using shared cars (Shaheen & Cohen, 2007) or public transport (Patterson, 2015) instead of a private car. Other examples are upcycling and reuse instead of abiding to the "throwaway society" (Cambridge news , 2014), and replacing meat dishes with vegetarian or vegan alternatives (Barford, 2014; Vegetarian times, 2008). Many companies take advantage of these new circumstances to adapt and further push the movement forward. An example can be IKEA's new city center stores that have been developed because the company is aware of people's choice not to own a car anymore (Thomasson, 2014). Another project is Riksbyggen Positive Footprint Housing, where, as the name indicates, the aim is to leave a positive ecological footprint. Three of the main areas of consideration to reach this goal are energy consumption, waste management and transport connected to the home (Riksbyggen, 2015). To further increase the environmental consideration, dedicated spaces for second-hand exchange of goods are planned in the housing complex (Riksbyggen, 2015).

Vehicle ownership is steadily increasing worldwide, and it has a strong relationship to economic growth (Dargay, et al., 2007). This trend is particularly noticeable in developing countries; China, for example is projected to increase its vehicle stock from 20.5 million to 390 million between the years 2002 and 2030 (Dargay, et al., 2007). At the same time, many countries are working hard to limit the use of private vehicles for transport, especially in urban areas. Promoting use of public transport, introducing congestion charges and low emission zones, as well as limiting urban parking spaces are some of the measures taken to do so (France 24, 2014; Zeng, 2013).

Another challenge when it comes to limiting transport is connected to online shopping. Shopping for goods and groceries online is an increasing trend; the European countries purchased wares for 18,4 % more money in 2014 than the year before, and this pattern is expected to grow by the same number for 2015 (Ecommerce News, 2015). Since e-commerce implies a need for transport of the ordered goods, deliveries are likely to increase as well (U.S. Department of Transportation, 2015). Consequently, there will be an increase of greenhouse gas emissions from these transports if the emissions from vehicles are not reduced compared to today. However, these transports are often replacing the private vehicle trips that otherwise would have been done by the consumers (Rayner, 2008). To be able to analyze the total effects of e-commerce, one has to consider a wide range of factors. However, research indicates that the total energy consumption from transport will decrease because of e-commerce (Johnsson & Jönsson, 2006; Rayner, 2008)

A substantial part of the greenhouse gas emissions are caused by the human demand for transport (U.S. Environmental Protection Agency, 2013). To make the transports more efficient and sustainable, new infrastructure concepts need to be introduced. Making last mile transport more efficient is believed to have particularly great potential when it comes to reducing emissions (Allen & Browne, 2012). Over the last decades city logistics has been supplemented by the use of urban consolidation centers, UCCs (Dablanc, 2009). These centers acts as transshipment hubs where incoming goods will be unloaded, sorted and then reloaded onto smaller low-emission vehicles that will take the goods to the end-user (Dablanc, 2009; Allen & Browne, 2012).

There is a general opinion among people in the city logistics field that the subject is somewhat neglected in politics in Sweden (Lindholm & Blinge, 2014; Hammarberg, 2015). In politics, transport issues are mainly focused on passenger transport rather than goods transport. Researchers and enterprises are now gathering in initiatives (*e.g.* CLOSER) aiming to introduce this field to the political agenda. Samcity, BESTUFS, Sendsmart and DenCity are just a few projects that are aimed at developing and analyzing sustainable freight solutions in urban environments (Lindholm, et al., 2014; BESTUFS, 2015; CLOSER, 2015; Gatukontoret Malmö, 2014). These projects are mainly concerned with goods deliveries, but also transport of waste.

A new city district is currently under development in Frihamnen, Gothenburg. When planning this district, city planners are looking to introduce new sustainable infrastructure solutions for the area to be well functioning without private vehicles (Göteborg Stad Stadsbyggnadskontoret, 2014). There are plans to extend the concept of UCCs, by incorporating additional services, primarily waste management and reuse facilities. This new concept constitutes the foundation for this thesis.

1.1 Urban consolidation centers

An urban consolidation center (UCC) is a solution for city logistics where goods deliveries from different sources are consolidated and forwarded to the receivers in the concerned area (Browne, et al., 2005). A UCC is normally used in a city district or at specific sites (such as construction sites or airports), but can also be used for an entire town (Browne, et al., 2005). A main reason for implementing the solution is that it reduces the number of vehicle trips with low load factor (Behrends, 2015). The concept is founded on the principle that all incoming goods to an area is unloaded at the UCC facility, from which it is delivered by fully loaded vehicles (often smaller and with lower emissions) serving the area. Normally it is

introduced as a means of reducing congestion through coordinating goods transports from different logistics companies (Browne, et al., 2005). Other terms referring to the same or similar concepts are “shared-user urban transshipment depot”, “cooperative delivery system” and “urban distribution center” (Browne, et al., 2005).

UCCs are a way to coordinate and consolidate transports from different suppliers and warehouses to the end-customers. Figure 1 shows a representation of the driven routes for delivery of goods from warehouses to the end-consumers. For a case with conventional logistics, the total driven distance is generally longer than for that with a UCC; however, the reduction in total driven distance is naturally dependent on how close the UCC is located to the serviced area. Related to this, Table 1 lists a number of frequently discussed potential advantages and disadvantages for UCCs.

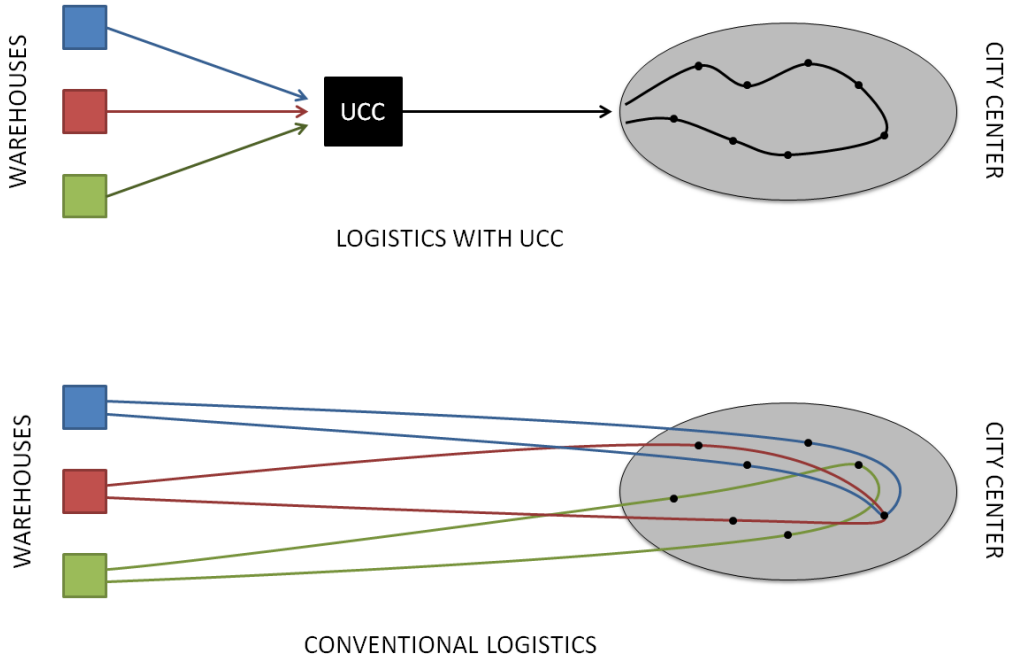

Figure 1. Representation of transport routes between warehouses and recipients (black dots) with and without an urban consolidation center.

Table 1. Potential advantages and disadvantages with UCCs, adopted from (CoE-SUFS, 2015; Browne, et al., 2005; Widegren, 2015; Hammarberg, 2015).

Potential advantages	**Potential disadvantages**
Higher load factor	High cost
Reduced congestion	Requires large space
Reduced total travelled distance	Inefficiency due to already optimized transports
Lower emissions	Longer transport times
Reduced curbside occupation time	Can induce monopolistic situation
Creates opportunities for value-added services	Eliminates interface between suppliers and customers
Reduced noise and visual pollution	Difficulties with different standards (*e.g.* IT, service, pricing)
Lower cost for last mile transport	
Reduced time window problems	

Table 1 shows that UCCs seem more natural under some circumstances than under others. For example, in order to reduce congestion, the UCC must be introduced in an area that is already congested.

Using one fully loaded larger vehicle will yield higher cost efficiency as well as environmental benefits compared to several fully loaded smaller vehicles (Browne, et al., 2005). Hence, UCCs should normally only be used as a replacement for inefficient transport, *i.e.* transports with a low load factor (Lindholm, 2015).

There have been many urban consolidation centers in use throughout Europe in the last decades; however, most of them are now shut down (Giuliano, et al., 2013; Browne, et al., 2005). The main reason seems to be lack of sustainable financing; many were dependent on municipal funding (Giuliano, et al., 2013). There are still some UCCs in operation today, though. Notable examples include Binnenstadservice in the Netherlands (Binnenstadservice, 2015), O-centralen in Stockholm (Home 2 You, 2015) and the UCC in La Rochelle (France) (Browne, et al., 2014).

1.2 Local context

Gothenburg has developed a climate programme that assembles strategic objectives and strategies for "achieving an equitable and sustainable level of greenhouse gas emissions by 2050". The programme also intends to create and develop a climate smart and attractive city center (City of Gothenburg, 2014). Furthermore, the city has an outspoken aim to become one of the leading cities in the world when it comes to climate smart goods management

(Hellberg, et al., 2014). One of the approaches for achieving this is to make sure that city logistics is considered when the city areas are being developed. Thus, when developing the new city district in Frihamnen, the city is keen to plan the district according to the climate programme and with efficient urban logistics (Bengtsson, 2015; Svensson, 2015). Therefore, the city authorities are looking to introduce a solution for waste and goods management based on the UCC idea. Another desire is to make it contribute to a social and attractive city district (Bengtsson, 2015).

All of the strategies and strategic objectives that the city has developed are provided in Appendix A – Climate strategy of Gothenburg. The seven climate strategies (City of Gothenburg, 2014) quoted below are the most relevant for city logistics Frihamnen:

- Strategy #2: "Support citizens to reduce their climate impact"
- Strategy #4: "Plan for an energy and transport efficient society"
- Strategy #14: "Prioritize and invest in the travel modes walking, cycling and public transport"
- Strategy #15: "Work towards a more energy efficient vehicle fleet and promote the use of fuels with low climate impact"
- Strategy #16: "Use and develop policy instruments to reduce car traffic"
- Strategy #17: "Become a world leader in climate smart cargo handling"
- Strategy #22: "Prevent waste and promote recycling"

During the period 2008 to 2012, two projects started in Gothenburg as a way to improve city logistics, but also working towards a safer and more attractive environment for central parts of the city (Sörling, 2015; Thorén, 2014). First out was Lindholmsleveransen, which delivers goods and collects waste in the area Lindholmen and second was Stadsleveransen, which delivers goods to stores inside the city core (Widegren, 2015). The following sections will contain two case studies of these projects and some background information regarding the development of Frihamnen.

1.2.1 Case study: Stadsleveransen

Stadsleveransen is a goods delivery project that operates in the city core in Gothenburg, and is an example of a UCC (Innerstaden Göteborg, 2015). Its main purpose is to create a safe, accessible and attractive city center by consolidating goods and delivering it to companies using low-emission vehicles, see Figure 2 (Innerstaden Göteborg, 2015). This is done by reducing the number of heavy transport after 10 *a.m.* (Lindholm, et al., 2014). The connected transport companies deliver the incoming goods to a redistribution central where it is unloaded and sorted. Once reloaded onto electric vehicles the parcels are delivered in optimized rounds (Sörling, 2015). No collection of waste or recyclable material is done, only goods deliveries (Sörling, 2015).

Figure 2. The low-emission vehicle used for deliveries in Stadsleveransen.[2]

Currently, around 450 recipients are connected to the services that Stadsleveransen offers (Sörling, 2015). A relatively new feature of the delivery service is that people living in the area that Stadsleveransen operates in can get goods delivered home for an added charge. (Sörling, 2015). According to Sörling (2015) the project was met by some skepticism by the potential clients (*e.g.* shop owners and restaurants) in the early stage. However, most clients are now positively inclined.

Stadsleveransen is supported financially by advertising spaces on the delivery vehicles as well as from fees taken from transport companies. The transport companies are currently paying 10 SEK per parcel, which covers a significant part of the financing (Rendahl, 2015). The intention is to make the last mile deliveries more efficient by unloading the goods at a terminal located outside of the supplied area instead of inside of it and thereby saving time (Sörling, 2015). The savings made by the transport companies will equal the fees taken to support the operation of Stadsleveransen. There is no intention to make the transport companies benefit from this solution financially (Rendahl, 2015).

The services provided by Stadsleveransen is not used by all of the companies within the serviced area, but the number of companies that uses it continues to grow and the intention is that the whole city center (the area within the moat) will be connected to its services (Sörling, 2015; Hjertberg, 2014). The current transport partners in the Stadsleveransen-project are DHL and Postnord (Thorén, 2014) and there are plans to include more companies (Sörling, 2015).

1.2.2 Case study: Lindholmsleveransen

Lindholmsleveransen is a solution where goods deliveries and collection of recyclables are operated through a consolidation terminal on the fringe of the supplied area (Widegren, 2015; Lindholm, et al., 2014). It has been up and running since 2008 and the daily operations are

[2] Image source: http://www.k-vagnen.com/pictures/produktbilder/Stadsleverans3.jpg

run by a third party contractor (Lindholm, et al., 2014). The supplied area houses a mixture of academic facilities and businesses (Lindholmen Science Park, 2015), and is located in Lindholmen in Gothenburg. This facility, often referred to as "mikroterminalen" (Figure 3), features a combination of goods management and collection of recyclables (Widegren, 2015). The financing for the project comes from fees taken from the businesses that are connected to its services (Widegren, 2015).

The general aim with the terminal is to limit heavy traffic in order to create a safer, less noisy and cleaner environment in the business park. By the use of a facility for reloading, heavy transports can be replaced by smaller low-emission vehicles (Widegren, 2015).

Widegren (2015) describes collection of recyclables as the backbone of the concept − financially as well as operationally. It accounts for a majority of the transports as well as space allocation at the terminal. The different recyclable fractions are collected using an electric vehicle with trailers. It is transported to the terminal, where it is consolidated in larger containers and stored temporarily. The containers (sorted by fraction) are then carried away from the terminal by larger vehicles to the recycling companies (Widegren, 2015).

All goods deliveries with a maximum quantity of two pallets are unloaded at the terminal and the consignment note is signed by the terminal staff (Widegren, 2015). This requires the driver to know that the goods are to be delivered to the terminal even though this is not the final shipping address. The goods are then carried to its final destination by the terminal staff (Widegren, 2015). Thus, this solution adds an additional step to the supply chain. The e-vehicle commonly delivers goods in rounds twice daily, however the delivery schedule is flexible and extra rounds are added if required. The goods are temporarily stored indoors in the terminal building before being forwarded (Widegren, 2015).

Figure 3. The facility at Lindholmsleveransen.[3]

[3] Image source: http://goo.gl/xVy2uq

1.2.3 Frihamnen development plan

Frihamnen is an area located in the central part of Gothenburg. Historically, the site has been occupied by seaport activity, which is now disused (Älvstranden Utveckling, 2015). In recent years the site has been rather unused apart from occasional events such as music festivals and touring car racing (Älvstranden Utveckling, 2015). The area is now about to be rebuilt with the aim of expanding the city center across the river. Future Frihamnen will be a densely populated mixed-use waterfront development comprising a large number of residential buildings in combination with businesses, schools, parks *etc*. (Göteborg Stad Stadsbyggnadskontoret, 2014). Figure 4 shows a model of the future city district.

Figure 4. Overview of the new development in Frihamnen[4].

A main concern in the planning process is to design the city district in a way that facilitates a car-independent lifestyle. One of the reasons for limiting car traffic is due to the climate strategy; another reason is that the area is supposed to be a dense mixed-use district and therefore there will be limited space for private vehicles (Bengtsson, 2015). Therefore, there are plans to introduce legal restrictions to limit accessibility with motorized vehicles in the area in order to create a more attractive urban environment. (Göteborg Stad Stadsbyggnadskontoret, 2014).

The Frihamnen area will, when completed in 2040, be home to 18 000 people and have approximately 15 000 workplaces (Göteborg Stad Stadsbyggnadskontoret, 2014). The development of the area is driven primarily by the municipal development company Älvstranden Utveckling AB. The vision for Frihamnen is shared with other city districts along the river, collectively known as Älvstaden (River city), and is focused on making the district a part of the city center, "heal the city" as well as integrating the river with the city (Göteborg Stad Stadsbyggnadskontoret, 2014).

[4] Image source: (Göteborg Stad Stadsbyggnadskontoret, 2014)

In order to fulfil these parts of the vision, the planners will aim to create an area free from barriers by linking different parts with bicycle and walking paths, avoid having areas that feels disconnected and incorporate parks and places to live and work (Göteborg Stad Stadsbyggnadskontoret, 2014).

1.3 The service hub concept

The concept of urban consolidation centers will partly be used in Frihamnen to serve citizens as well as businesses (Bengtsson, 2015). Although nothing is decided yet, the solution will be based on ideas from Lindholmsleveransen. It will be an enhanced and adjusted version to fit the environment in Frihamnen. A major difference is that the planners intend to incorporate private households. Based on these ideas, the authors have developed a concept for this report, which will be referred to as the "service hub". The service hub will not be used as a complement to conventional solutions, but rather as the main – and only – solution. The reasons behind the plans for a service hub are many, but some of the more important ones are (Bengtsson, 2015):

- Create an attractive urban environment
- Streamline last mile transport
- Ensure traffic safety
- Reduce emissions of pollutants
- Reduce traffic noise
- Increase convenience (primarily for citizens)
- Create a sustainable city district in terms of resource use

In Frihamnen, the city authorities seek to include more services and functions than in Lindholmsleveransen (Bengtsson, 2015). The service hub is intended to act as a meeting place connecting services such as goods deliveries, waste collection, upcycling and reuse as well as public transport and small shops (Svensson, 2015). Based on meetings and interviews with stakeholders and practitioners more detailed suggestions of how these functions can work in practice will be suggested. These functions will be presented in chapter 1.3.2 Features of the hub.

Since Frihamnen will have limited access for motorized vehicles, the vehicles operating between the service hub and the households will have to adjust to certain conditions (Widegren, 2015). The service hub solution is intended to replace conventional last mile transport by incorporating vehicles operating the transports between the hub and the users. This is done because of the environmental benefits connected to freight consolidation (Allen & Browne, 2012). These vehicles should emit less greenhouse gases in order to reach the desired outcomes (Svensson, 2015).

Although business models are being discussed among the stakeholders, the financing of the hub is not yet decided. Even though sustainable financing is a well-known difficulty in such projects, it is a necessary criterion to fulfill; lack of it is the main reason why they fail (Widegren, 2015; van Dam, 2014). Interpreting the thoughts presented by the authorities, the cost will be distributed mainly on logistics companies and real estate owners, and thus, ultimately end up being paid by the inhabitants in the district.

1.3.1 Stakeholders and practitioners

There is a large spread among the different parties and their interest and responsibilities in the project. The municipal stakeholders, who are responsible for planning, seek to create a sustainable and attractive city (Göteborg Stad Stadsbyggnadskontoret, 2014). The real estate companies will have to follow the standards of the hub solution in order for it to function properly. At the same time, they seek to maximize their profit, and therefore might prefer a low-cost solution. However, restrictions in Frihamnen limit the available choices of solutions concerning waste management and goods deliveries (Bengtsson, 2015). Furthermore, the logistics companies are faced with the same situation, trying to profit from the solution, although they might be required to finance it (Hammarberg, 2015; Widegren, 2015). Thus, such private companies are probably keen to participate in the planning process and sway it in a direction that they would benefit from.

Inhabitants in Frihamnen will also represent a strong interest in the solution in the form of practitioners. Their key interest is convenience, and the most important part regarding this aspect is that the solution is equally good or better than conventional solutions (Bengtsson, 2015). Furthermore, there are NGOs, recycling companies, upcycling companies, politicians, retail businesses, hub operators, restaurants and public facilities, all of whom are interested in benefitting from the solution. The service hub project involves many stakeholders and practitioners, making the planning process a complex organizational task. Adding another dimension to this complexity is that the role of project coordinator has yet to be decided (Svensson, 2015).

1.3.2 Features of the hub

It should be emphasized that the following chapter contains ideas that are not produced by the authors; rather, it is a collection of the most discussed features among stakeholders. However, some parts of the solution have been invented to make the main parts fit well together. A selection process by the authors has led up to this collection of features, which will hereafter be used as a foundation for further analysis and discussion in this thesis.

As Figure 5 indicates, the hub will consist of several facilities merged into one building. There will be a part of the hub that is concerned with handling of goods. A desirable solution would be to lead the arriving goods transports as well as the departing waste transports from the main road to an underground level of the terminal. This would separate the heavy traffic from public transport, private cars, bikes and pedestrians. This underground level will function as loading and unloading dock as well as a facility for consolidation and redistribution of goods and waste. The incoming goods will be transferred to the ground level, where they will be sorted, stored and reloaded onto distribution vehicles. The vehicles will deliver packages to coded boxes situated in the recipient's staircase, as for example the solution provided by Combiplate (2015). When the package has been delivered, a text message is sent to the recipient with a one-time code that can be used to access the content of the box. The hub will feature a manned refrigerated room where online grocery orders can be stored. The customers are free to pick up their orders at any time during the hub's opening hours. When transporting parcels to businesses in the area, the procedure will be similar to that of Lindholmsleveransen and Stadsleveransen. The parcels are delivered in fixed daily rounds. There will be no need for package boxes located at the businesses since the deliveries are carried out during daytime when there are personnel present to accept the deliveries.

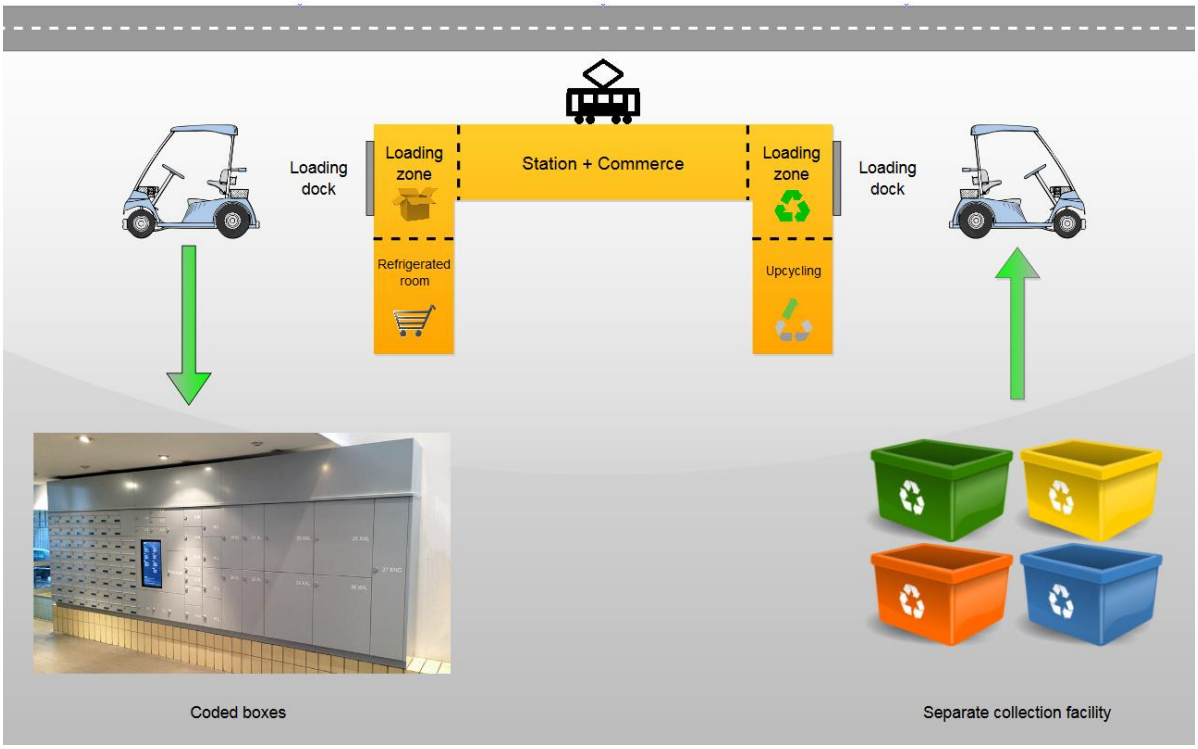

Figure 5. Schematic sketch of the service hub[5].

The hub will also be a consolidation center for household waste as well as for most of the recyclable fractions that can be expected to originate in this type of mixed-use area. There is also an issue concerning where to collect and drop off the different waste fractions. Table 2 shows the collected fractions along with their collection points. The same vehicles that deliver packages from the hub will also be responsible for collecting the waste and recyclable material from the residential buildings as well as from companies in the area. Optimally, these transports will be fully utilized in both directions, *i.e.* they collect waste in the same rounds as they have delivered goods. The waste is collected through separate collection facilities that are connected to the buildings where the waste originated.

[5] Part of the image is taken from: http://combiplate.com/wp-content/uploads/2015/01/laposte.png

Table 2. List of fraction and collection points

Waste fraction	Collection point
Landfill materials[6]	Service Hub
Hazardous waste	Service Hub
Plastic packaging	Separate collection facility
Paper packaging	Separate collection facility
Cardboard	Separate collection facility
Glass containers (colorless)	Separate collection facility
Glass containers (colored)	Separate collection facility
Light bulbs/fluorescent lights	Separate collection facility
Metal containers	Separate collection facility
Paper	Separate collection facility
Reuse/upcycling products	Separate collection facility and service hub
Electronic waste	Separate collection facility
Biodegradable waste	Separate collection facility
Combustible waste	Separate collection facility
Batteries	Separate collection facility
Textiles	Separate collection facility

Along with household waste and traditional recyclable material (paper, plastic and metal containers), a new type of container will be introduced in the recycling collection facilities that is intended to collect products that can be reused or upcycled. This material will be brought back to the hub where it will be sorted with regard to quality. Some of the goods will be sold directly through traditional second-hand trade whereas other goods may be upcycled, meaning that the value of the product is increased by any means. Examples include refurbishing or rebuilding furniture, making a table from a barrel or making lamps out of old glassware. These goods can then be sold to the citizens of the area. This reuse and upcycling facility is believed to increase the social attractiveness by contributing to ground floor activity, which is also requested from politicians (Bengtsson, 2015). The reuse and upcycling could be organized and run by for example NGOs, designers and commercial firms. Material and goods that will not be applicable for neither reuse nor upcycling will be sorted out for recycling.

1.3.3 Physical design

The physical design of the hub will only be briefly described. However, what can be said about the physical features of the hub is that there needs to be a specific part of the building dedicated to recyclable material and waste, where the collected materials can be consolidated and stored until larger vehicles arrive for taking the material to recycling stations. There will also have to be a specific part fitted for goods acceptance, unloading and sorting. This part will also be used for reloading the goods onto the small low-emission vehicles used for delivery to the end consumer.

[6] Landfill materials include ceramics, porcelain, tiles, sand, gravel, bricks, windowpanes, concrete *etc*.

The storage room for cold goods will need to be located in close proximity to the loading bay in order to keep the cold chain intact when refrigerated goods are delivered. The last part of the facility will be a workshop and sorting area for goods that can be reused or upcycled. The idea is to keep this part close to the recycling and waste section of the building since some of the materials that have been sorted as reusable or upcyclable might have to be discarded as waste or recyclable material instead.

The hub should be located in the outskirts of the area for the sake of reducing heavy transport in the area itself. Since this is one of the main points with the hub, this criterion will have to be fulfilled. The hub must, however, be placed strategically, since the aim is to make it an attractive facility where people will want to go. These two factors make the placement options for the hub limited to a few places. Additionally, the ideal location of the hub cannot be found without proper data on the flow of waste and goods (Panero, et al., 2011), which is unavailable at the present.

1.4 Aims and objectives

The aim of this master's thesis is to contribute to the planning process of a service-oriented hub in the new development in Frihamnen.

The objective of this study is to identify barriers connected to planning, implementation and operation of the service hub, as well as present possible ways to overcome these. Furthermore, the thesis intends to highlight the key questions that need to be answered in order for the planning to proceed. The result will be presented in the form of a list of recommendations to the stakeholders in the project.

1.5 Scope

The report will consider a service hub encompassing services for domestic and commercial purposes. The geographical setting for the hub is a new development in Frihamnen in central Göteborg. It will be a mixed-use city district comprising a combination of housing, businesses and public facilities. Barriers connected to the hub will be examined from the perspectives of sustainability, economy, city logistics, social influence and organizational matters. Barriers are, in this report, defined as major difficulties that could hinder or complicate the development of the hub. The discussion will be based on the present situation in the city of Gothenburg.

2. THEORETICAL

The theoretical framework used in this thesis involves two main theories: Path dependence theory and sociotechnical transition theory. The authors believe that the theories complement each other well when it comes to analyzing changes in the interrelationship between society and technology. Path dependence theory analyzes the consequences of making a choice (Malm, et al., 2012), whereas sociotechnical transition theory explores the relationship between different structures in society (Geels, 2005). Both theories have developed over several years and are now widely accepted and used.

2.1 Path dependence theory

The term path dependence has its roots in microeconomics, where path dependent processes are characterized by the property of increasing returns. (Pierson, 2000) In other contexts, *e.g.* social science, the term usually refers to the statement that history matters, *i.e.* current and future situation is affected by historical events (Liebowitz & Margolis, 1995). David (2000) also presents a negative definition of path dependent processes: *"Processes that are non-ergodic, and thus unable to shake free of their history, are said to yield path dependent outcomes"*. However, some researchers have argued that defining path dependence as 'history matters' is trivial and narrow; Levi (1997) claims that the meaning of path dependence is *"that once a country or region has started down a track, the costs of reversal are very high."* Furthermore, Levi (1997) suggests that a more appropriate metaphor for describing it would be a tree instead of a path: Walking a path would then correspond to climbing a branch; the climber tends to stay on the branch it began to climb even though it would be possible (but less convenient) to switch to another branch. In summary, path dependence theory comprises the relationship between future and present activities, and historical decisions.

Decisions made in the past will often have a strong influence on people's way of acting and thinking, but also their way of making future decisions (Malm, et al., 2012). Therefore, decision-making also provides limitations for further events − a mechanism known as lock-in (Liebowitz & Margolis, 1995). An example of such lock-in is the standardization of railway track gauge, where the decided-upon gauge creates a lock-in in terms of compatibility with trains and other railway networks (Puffert, 2002). Often, decision-makers have options considered equally beneficial, and decision-making is just a question of an arbitrary choice of a path (Liebowitz & Margolis, 1995). Just by choosing a path, one often creates a dependence to proceed with activities that is in line with that initial decision (Liebowitz & Margolis, 1995). Establishing a certain railway track gauge will limit the possibilities for further decisions and activities, even though this is not necessarily a disadvantage (Puffert, 2002; Liebowitz & Margolis, 1995).

Liebowitz & Margolis (1995) suggest there are three degrees of path dependence. The first degree is reached just by making a binding decision, with no obvious inefficiency. At some point, one may recognize historical decisions as barriers for further development. The path chosen might appear to be inferior or erroneous in some way − something characterized as second-degree path dependence. Furthermore, if the inefficiency of a decision could have been identified beforehand and thereby avoided, the path dependence is said to be of a third degree. (Liebowitz & Margolis, 1995)

2.2 Sociotechnical transition theory

There are different theories in the field of sociotechnical transitions. Two of these are the multi-level perspective and the technological innovation system theory. These have in common that they are used to analyze entire systems where continuous changes of social and technological parameters take place.

2.2.1 The multi-level perspective

The multi-level perspective (MLP) is a method for analyzing sociotechnical transitions (Markard, et al., 2012). It has been developed by several researchers over a number of years, but Geels (2002) played a large role when moving from describing only technological regimes to sociotechnical regimes, meaning that sociological perspectives would be included as well (Genus & Coles, 2008; Markard, et al., 2012). There are three levels to be considered when using this method: Landscape, regime and niche. A sociotechnical transition is defined as "shifts from one regime to another regime" when utilizing the MLP theory (Geels, 2011). Analyzing sociotechnical transitions can provide knowledge about how and why these changes occur (Genus & Coles, 2008).

The landscape level in the MLP framework is a representation of exogenous factors that constitute the environment for sociotechnical development (Geels, 2005). The sociotechnical landscape includes values, conditions and trends that relate to culture, demography and long-term politics. Such factors could be for example globalization, economic growth, spatial structures, societal values, oil prices and environmental problems (Geels, 2002; 2005; 2012). On this macro level, changes are characterized by slow pace (Geels, 2002) and cannot be triggered by any single actor (Geels, 2005). Although changes take place at a slow pace and the impact of individual actors is practically insignificant, it is continuously under influence of the sociotechnical regime (Geels, 2005; 2012).

The middle (meso) level in the multi-level perspective is termed (sociotechnical) regime (Geels, 2002). This level is made up of the network of currently dominating sociotechnical configurations on the market. The regime is the current sociotechnical system and because it has been chosen at some point it can be concluded that it has been preferable compared to other solutions. The regime therefore acts as the stabilizing factor (level) in the sociotechnical system (Geels, 2005). However, tensions can emerge within the different dimensions of the regime, which can lead to windows of opportunity for niche innovations to enter (Geels, 2005). The different "dimensions" of the sociotechnical regime that were identified by Geels in (2002) are technology, user practices and application domains (markets), symbolic meaning of technology, infrastructure, industry structure, policy and techno-scientific knowledge.

The regime changes slowly and primarily in an incremental way, where the current solutions and processes are refined and improved rather than being exchanged for something completely new (Geels, 2011). A reason for this behavior is lock-in mechanisms. Lock-in implies that the actors in the existing regime oppose new sociotechnical ideas because they benefit more from keeping the existing regime (Geels, 2011). These benefits can for example originate in that the experience gained from having used the current solution is considered too valuable to disband (Liebowitz & Margolis, 1995). It can also be that investors have spent large amounts of money on equipment and infrastructure and that changing technology means giving up on the current economies of scale (Geels, 2011).

The third level in the MLP is niches. This level is characterized by breeding new sociotechnical ideas in enclosed (safe) spaces. On the niche level, innovations can be researched and developed without having to consider the world outside since its research environment acts as an incubator (Geels, 2002). The developed niche innovations are likely to be radical, in comparison to the incremental improvements that can be observed on the regime level. Not only are ideas developed on the niche level, but also networks are created and strengthened, such as between producers and customers (Geels, 2002).

Innovations on the niche level can contribute to a socio-technical transition. Although far from every innovation developed in niches make their way to the regime level, some do, and this is what characterizes a regime shift (Geels, 2011). Even if a niche innovation will not reach the regime level by itself several niches can be merged in order to create a successor for the current regime (Geels, 2005), this process is referred to as niche accumulation. This is illustrated in Figure 6.

The landscape puts pressure on the regime and influences the interactions between the niche level and the regime level (Geels, 2011). A contemporary example of such interactions is the increasing demand for green transport. Global trends such as raised oil prices and environmental change put pressure on, and demand a change of, the current regime of transport. The pressure generated on the landscape level creates windows of opportunity on the regime level. This development paves the way for new niches to emerge, break through and induce changes of the current regime (Geels, 2012). Alternative means of transport and new fuel technology is being developed, taking advantage of the windows of opportunity to enter the regime. Figure 6 illustrates the different levels in the multi-level perspective along with the mechanisms that causes regimes to shift and new niches to arise at the regime level.

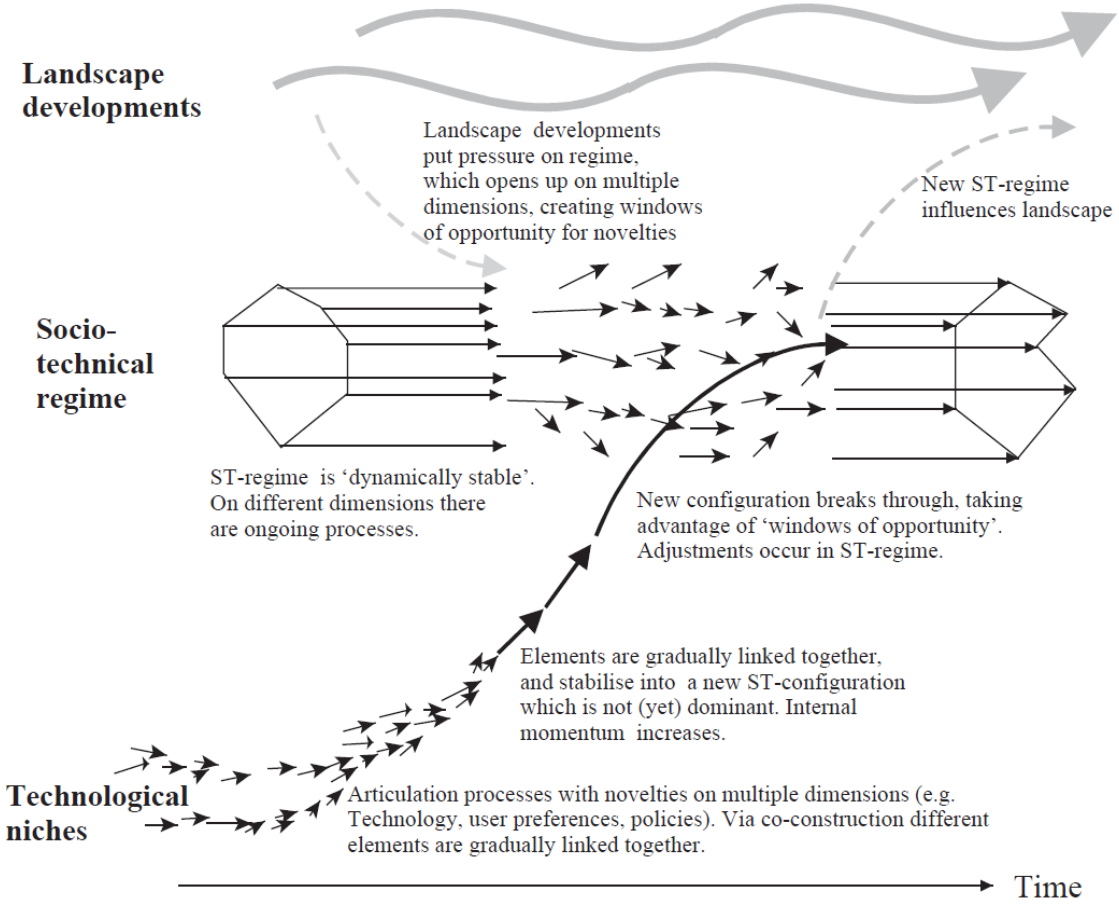

Figure 6. Illustration of how the sociotechnical regime is influenced by, and influences, the landscape and niche levels.[7]

2.2.2 Technological innovation system

Analyzing technological innovation systems (TIS) is a method for studying the processes that give rise to innovations (Bergek, et al., 2008a). A main advantage with the method is that it allows stakeholders to speed up diffusion of desirable innovations (Bergek, et al., 2008b). The method is based upon the assumption that a technical innovation is formed within a system with clearly defined boundaries. This system can be theoretical or exist partly or in its entirety in reality (Bergek, et al., 2008a). An innovation system must first be chosen in order to use this method for analysis. Once it has been found, the different structures of the system can be identified. There are four structures in a TIS: Actors, institutions, networks and technology (Hellsmark & Jacobsson, 2009). A summary of what is included in the different structures can be found in Table 3.

[7] Image source: (Geels, 2005)

Table 3. Summary of what is included in the different TIS structures. Adopted from Hellsmark & Jacobsson (2009).

Structure	What is included	Examples
Actors	Companies and organizations as well as persons involved in development processes in the innovation system.	Municipal authorities, freight companies, recycling companies
Institutions	Norms, rules, standards, routines and laws that affect the relationships between the parties in the innovation system.	Environmental laws, traffic regulations, climate strategies
Networks	Both official and unofficial networks between the involved parties in the innovation system. Can involve networks for learning as well as politics.	Academy-industry relations, EU-projects
Technology	Artifacts as well as coded or embodied knowledge	Electric vehicles, engineers, package boxes

Only after the structures have been identified, the functioning of the innovation system can be analyzed. The analysis is traditionally based upon key processes that can help to establish how the system is functioning (Bergek, et al., 2008a). Following this step, further evaluation of how well each function work should be performed (Bergek, et al., 2008a). The key functions in a TIS are knowledge development and diffusion, entrepreneurial experimentation, influence on the direction of search, market formation, resource mobilization, legitimation and development of positive externalities (Bergek, et al., 2008a; Markard & Truffer, 2008; Hellsmark & Jacobsson, 2009). These functions together with the structural components illustrate the entire TIS. As is shown by Figure 7, there are relationships to consider within the TIS that affect the internal dynamics (represented by arrows) (Hellsmark & Jacobsson, 2009).

The TIS approach is a tool for policy makers to identify which barriers that needs to be dealt with in order to implement and spread the innovation in question (Bergek, et al., 2008b). The barriers are identified via the functions (key innovation processes, Figure 7) – they are essentially the reason why some functions are considered weak (Bergek, et al., 2008b).

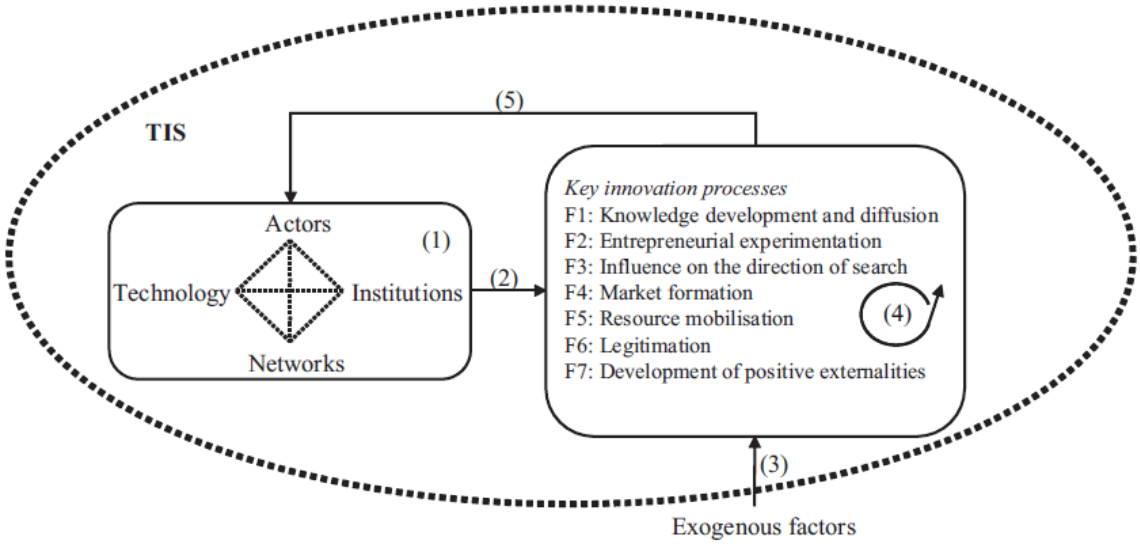

Figure 7. Illustration of the technological innovation system and its components.[8]

[8] Image source: (Hellsmark & Jacobsson, 2009)

3. METHODOLOGY

The research methodology followed a six-step process, which was believed to lead the researchers to the desired outcome of the study. The main method for data collection was to arrange a focus group, which is a qualitative method. This focus group consisted of a mix of participants from local authorities and companies with the aim of identifying barriers connected to the service hub through discussion. The early steps were intended to provide background data for the focus group discussion and analysis. Figure 8 illustrates the whole work process.

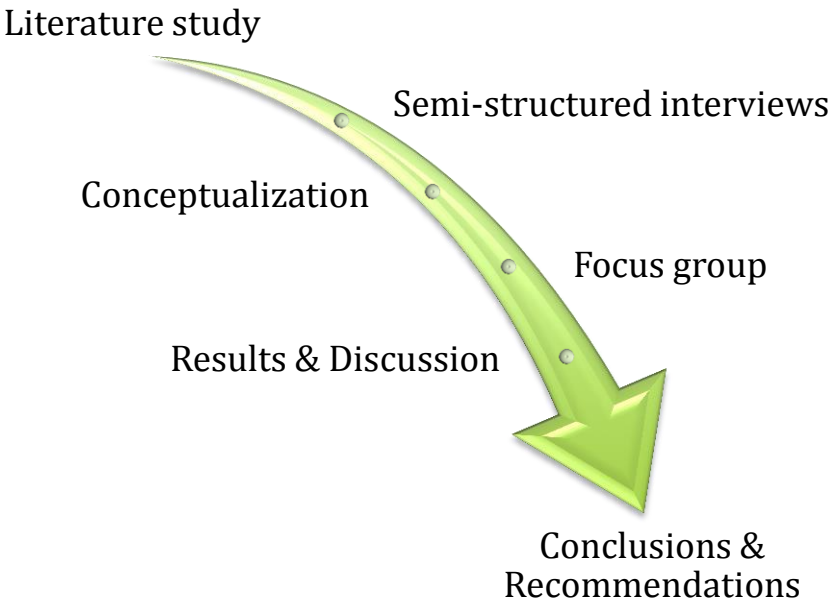

Figure 8. Flow chart describing the work process.

3.1 Literature study

The initial part of the project was focused on data gathering in different forms. The literature study began with creating a brief overview of the Frihamnen project and previous projects of similar characteristics. This step was essential in order to create a context for the authors. Parallel to this step, preliminary meetings were attended to further assist the orientation (see chapter 3.2).

The following part of the literature study was focused on studying scientific articles connected to the theoretical framework used in this thesis. The data was gathered using multiple scientific databases, such as Scopus and Sciencedirect. A wide range of articles was studied in this phase in order to gain understanding of the development and application of the theories. Simultaneously, articles and reports on city logistics and last mile transport were studied more thoroughly from the perspective of the theoretical framework.

Literature on interview techniques and focus groups was studied through books, presentations and scientific articles. This was done continuously until the focus group was held.

3.2 Preliminary meetings and project orientation

To complement the literature study meetings were attended at the municipal authorities Stadsbyggnadskontoret and Älvstranden utveckling. This provided understanding about the project, as well as unravelling the key questions among the stakeholders. The subjects discussed at the meetings were the development of Frihamnen in general, but also specifically about how the concept from Lindholmsleveransen could be applied in Frihamnen. These meetings provided valuable relations for further interviews and the focus group.

3.3 Semi-structured interviews

A semi-structured interview is a method of gathering data that combines the features of structured and unstructured interviews, meaning that it provides possibilities to get in-depth qualitative and quantitative answers while still focusing on the predefined questions (May, 2001; Harrell & Bradley, 2009). Furthermore, the semi-structured interview has a more conversational approach than the structured interview; questions are asked in a manner that allows for a more comprehensive reasoning from the interviewee, rather than short and simple answers (Harrell & Bradley, 2009). Initially a broader type of question is asked, and, when needed, probes (follow-up questions) can be used to directly search for desired information (Harrell & Bradley, 2009). The method is flexible in the sense that it allows the interviewer to reroute the interview to emergent issues that arise during the interview (UK Data Service, 2015). In summary, the interviewer has a desired outcome planned for the interview, but no clearly defined questioning route.

Since the service hub project combines features in non-conventional way, specific written information is rather limited; the only available information originates from projects with partially the same characteristics. Therefore, interviewing experts and stakeholders within relevant fields was expected to provide a more specific source of information since interview questions could be related directly to this project in particular. The interviews were performed in a semi-structured manner to best comply with the needs in the data gathering process. A majority of the semi-structured interviews were intended to provide background data, which subsequently would be used for the conceptualization.

3.4 Conceptualization

Although the service hub solution is discussed among the stakeholders, there is not yet a decided complete concept. By merging the thoughts of the different stakeholders and experts, a preliminary concept of a service hub solution was developed. The aim was to assemble a concept that reflected the main ideas discussed among the municipal authorities as accurately as possible. To complete the conceptualization, information from literature, previous UCC cases, interviews and meetings were used. However, the concept is partly based on approximations and assumptions, and is not described in detail. Its purpose is to be a foundation for the focus group discussion and further analysis and discussion in this report.

3.5 Focus group

A focus group is a qualitative scientific data collection method that helps the researcher gain understanding in a certain topic (Krueger & Casey, 2009). It is primarily a method where the

participants are encouraged to express their feelings, thoughts and opinions about the discussed topic (Krueger & Casey, 2009). The main questions concerning the service hub are of a qualitative nature; hence, the choice of using a qualitative research method in this thesis was natural. A clear advantage with the method is that it provides data on both individual thoughts and a group perspective (Massey, 2011). Thus, a particularly valuable feature is the data produced through the interplay between the participants (Gibbs, 1997). This makes focus groups a well-suited method in this case, since it will emphasize the difficulties in collaboration – which is believed to be the root of some barriers. Moreover, it is a good way to introduce new perspectives into an existing discussion (Gibbs, 1997) – another feature that is believed to benefit this study.

The participants are typically a homogenous group of five to twelve people (Massey, 2011; Krueger & Casey, 2009). There are advantages and disadvantages to both small and large groups. A small group will not offer the same diversity of opinions as a large group; however, expressing one's insights tends to be easier in smaller groups (Krueger & Casey, 2009).

The focus group serves as the primary source of data for this thesis. It consisted of six people from different companies and authorities that had different backgrounds and perspectives. The objective was to identify the main barriers connected to planning, implementing and operating a service hub. Audio-recorders were used during the focus group to capture the conversation, and the recordings were later transcribed. After the transcription, an analysis from the perspective of the studied theories (presented in chapter 0) could begin. Once finished, this analyzed data was used as the basis for the discussion and conclusions as well as suggestions for further research.

For the focus group to give the best results, books and reports on the subject were studied. The literature assisted in creating an overall picture of what types of questions a focus group could be used to answer and how this would be accomplished. The first step was to determine the questions that the focus group would discuss. Once these questions were determined, the questioning route was decided, *i.e.* the order of the questions and probes. The second step was to select potential participants for the group as well as sending out invites. The third step was to choose what roles the authors would have in the focus group, and to study moderating techniques. The last step was to analyze and interpret the results of the discussion. The following sections will explain these steps more thoroughly.

3.5.1 Questioning route

The questioning route has to be planned carefully to get the most out of the focus group (Krueger & Casey, 2009). A common way to line up the questions is to start with some introductory questions to make the group feel comfortable (Krueger & Casey, 2009). However, the invited focus group participants were considered to have some routine in the area; thus, there was no apparent need for warm up questions. Instead, the attendees were asked to state their names and describe shortly what they work with. The purpose of this was to make everyone talk as early as possible, as this is recognized as an important step to make everyone feel comfortable speaking (Krueger & Casey, 2009). It was also an important step since not all the attendees knew each other beforehand.

Five main questions composed the core of the focus group structure. These were formulated in an open-ended way to make the participants share their personal thoughts. To get the most out of these questions, probes were prepared. These probes were designed to lead the

discussion back to the desired topic in case it would take any unanticipated turns. They were also meant to support the main questions, making the discussions more comprehensive. Behind each main question was a specific purpose; something that the authors wanted to know or even expected, but could not ask directly because of the risk of biasing the participants.

Before the discussion started, the group members were introduced to each other and were offered some refreshments. The focus group moderators (the authors) then started the meeting by giving a presentation of the service hub concept. The presentation included the background to the service hub project (the development of Frihamnen), what the authors were trying to achieve with their master's thesis (and the focus group), a presentation of all the features of the service hub and how the focus group discussion was going to be carried out.

The five main questions, together with their intended purpose, are presented in Table 4. The purposes of the questions are connected to the full question, *i.e.* the main question plus its probes. Therefore, the purposes might seem incoherent without the probes. The full questioning route, including probes, can be found in Appendix B – Questioning route. All probes were not used – either because the discussion covered these topics anyway, or because time dictated that the next question was due.

Table 4. The questioning route together with the purpose of each question

Question number	Question	Purpose
1a	What are your initial thoughts and impressions?	To examine how to design a working business model. • Are there some stakeholders or practitioners that will benefit more or less than others? • How should costs be distributed?
1b	Who would benefit from the service hub, and in what way?	
2	Should the service hub be used as a complement to existing, conventional solutions, or should it be used as a primary, standalone solution?	To examine if the there is a need for all affected parties to use the solution for it to work properly. • Will those affected by the service hub embrace and accept the solution to a high degree? • Should the service hub be used as a standalone solution or rather as a complement to another solution? • Is there a risk of forcing stakeholders and practitioners to cooperate even if it is not beneficial?
3	Three different phases can be identified in the service hub project: the planning phase, the implementation phase and the operational phase. Which problems could be expected in each phase?	To examine if there are barriers that can be related to acceptance as well as the transition from a conventional solution to a service hub. • If the service hub was the mainstream solution today, would we want to switch to our present solution; *i.e.* is the transition itself the main barrier? • Frihamnen is a new development – how does this affect the planning and implementing?
4	What arguments can be found, for and against, for combining goods management, waste management and reuse/upcycling?	To examine if there is a risk that an unnatural cooperation between different parties is induced. • Are there natural advantages to combining these services? • Identify barriers connected to cooperation and recognize if and how rival companies can cooperate. • Will the practitioners benefit from combining the services?
5	How do you think citizens within the covered area will be affected with regard to habits and consumption patterns?	To examine if there are any side effects on environmental and resource sustainability. • Will rebound effects of some kind emerge? • Is there a risk for increased total transport globally? • Is the solution sustainable – can it survive?

3.5.2 Participants

In order for the focus group to represent a wide range of perspectives, the attendees in the group needed to be selected carefully. There was a lower, as well as an upper limit to consider to the number of attendees, which gave a sense of direction for how many should be invited. The participants needed to represent the planning stakeholders, the practitioners from all service areas of the hub, researchers and citizens. Since no one knows who is going to live in the area, all participants would have to constitute a voice from the future citizens as well.

The participating institutions in the discussion were:

- Swedish Red Cross
- Traffic and Public Transport Authority of Gothenburg
- Department of Sustainable Water and Waste Management of Gothenburg
- Mat.se (online grocery store)
- SP Technical Research Institute of Sweden
- DHL Freight (Sweden) AB

With the composition of stakeholders listed above, the focus group possessed knowledge from the following fields: freight transport, reuse, recycling, waste collection, city logistics, e-commerce and urban planning.

3.5.3 Moderating technique

A focus group discussion is led by a moderator, whose role is to make the participants engage in a discussion that complies with the research topic. Using open-ended questions is an effective way to receive answers that reflect the respondent's thoughts rather than the moderator's thoughts. (Krueger & Casey, 2009). Furthermore, the moderator ensures that every member of the group share their thoughts during the whole session (Krueger & Casey, 2009). Krueger & Casey (2009) states that "the researcher creates a permissive environment in the focus group that encourages participants to share perceptions and points of view without pressuring participants to vote or reach consensus".

It was decided that only one of the authors would have the role as the main moderator, and that the other would be a supportive moderator. The tasks of the main moderator were to ask the questions, make sure that the discussion headed in a desired direction and make sure all of the participants could share their opinions. The supporting moderator's role was to assist the main moderator with what questions should be asked, make notes of important statements and the time these were said, and observe and take notes on non-verbal communication. The moderator of the focus group discussion was Alexander Spånglund (author). Adam Carlsson (author) was the assistant moderator.

3.5.4 Analyzing the discussion

After completing the focus group discussion, the audio recording was transcribed. Sorting the data was necessary in order to ease the navigation in the transcript. Since a considerable amount of information stated by the focus group was unnecessary (off-topic or repeated information) for further analysis, such data was removed in the sorted version of the

transcript. Furthermore, color-coding provided a useful tool in the sorting process, where the data was marked based on discussion topic. Using the purposes of the main questions as a foundation, the focus group discussion was analyzed by identifying barriers and important reasoning from the discussion (see chapter 4). This method was partly adapted from the TIS theoretic framework. Generally, TIS is used for analyzing technical innovations on a smaller scale, which is why the technique has been modified to fit the characteristics of this study.

3.6 Criticism and questions concerning the methodology

Focus groups are usually conducted several times, instead of only once, as done in this thesis. It could be argued that more details and opinions could be received if the focus group was repeated one or two times more. Another focus group discussion with other participants could have been held, where the same questions could have been discussed. There could also have been another session with the same participants, potentially yielding more in-depth discussion outcomes. However, there was no time for an extra discussion since planning the study, inviting people, transcribing and analyzing the results were time-consuming activities. Thus, arranging another focus group could have been beneficial, but was not reasonable within the set time frame.

Furthermore, not all the invited institutions accepted the invitation. Naturally, with another composition of the focus group, the result would have looked different. Even though several representatives from real-estate companies and academic institutions were invited, no one could attend the discussion. This surely affected the discussion, although in what way is uncertain. Also connected to the composition of the group is that there is a risk that participants do not answer the questions honestly because they want to keep a friendly atmosphere during the discussion. However, it should be noted that the authors are satisfied with the composition of the focus group since most of the important stakeholders were represented.

As with all types of quantitative research methods, there is a risk for bias caused by the analyzers when the focus group discussion is interpreted. Furthermore, the discussion was held in Swedish, meaning that the results have been translated to English by the authors. This translation is also a potential source of errors. These two risks are also valid for the semi-structured interviews.

4. RESULTS AND DISCUSSION

In the following chapter the findings from the focus group discussion will be presented. The barriers identified by the group will be presented one by one followed by the reasoning of the group. Not only barriers will be presented, but also arguments for why these could be considered more or less of a problem. Furthermore, the authors will critically discuss the findings from the focus group. The 15 identified barriers are listed below.

Barrier 1. Creating a sustainable business model

Barrier 2. Make the reuse commercially viable

Barrier 3. Make the goods management commercially viable

Barrier 4. Create a solution that satisfies all users

Barrier 5. Lack of responsible authority

Barrier 6. Organizing the collaboration between stakeholders

Barrier 7. Difficulty in designing viable rule-sets for hub operation

Barrier 8. Legislation

Barrier 9. Integrating different standards

Barrier 10. Lack of apparent reasons for combining services and functions

Barrier 11. Limited previous experience

Barrier 12. Lack of knowledge diffusion in city logistics

Barrier 13. Uncertainty about the hub's effect on transport demand

Barrier 14. Uncertainty about how to handle bulky goods

Barrier 15. Uncertainty about future trends, behavior and effects

4.1 Barrier 1: Creating a sustainable business model

One of the reasons why many previous UCC projects have failed is, according to the focus group (and research), the fact that sustainable financing has not been achieved. This could be a challenge for this project as well since many of the features of a "standard" UCC is included in the service hub concept. If sustainable financing is not achieved, the municipality might have to contribute with financial support, which is not a desirable situation. A problem when trying to create a business model that suits all users of the hub are the many qualitative effects. Examples include increased convenience, a car free environment, increased recycling and an attractive city district. The qualitative effects are difficult to quantify and therefore the costs and benefits in monetary terms are difficult to analyze and compare. Furthermore, even if they are quantified, the question of distributing the costs among the financiers remains. The focus group attendees agreed that the cost (if not all, then some of it) should be put on the inhabitants in Frihamnen. However, this also raises some problems; how is this arranged in a fair way, and who is responsible for collecting the payments? An idea for collecting the service hub fee could be to include it in the apartment fees.

Since the service hub is a part of a greater plan (to make Frihamnen a desirable area to live with strictly limited traffic), the case might be that it should be allowed to cost a little extra to stick to this vision. This extra cost must be covered from some source of financing though,

and the question is from whom? Another opinion is that the service hub is allowed to cost more than a conventional solution, as long as it results in more benefits. These benefits could come in the form of value added services, such as repacking and storage of goods. The hub could potentially offer services that a standard solution could not, and thereby generate extra income from these services. Hence, another approach when designing the business model is to let some of the companies that benefit from the solution pay for some of the costs. Companies that save time and money by, for example, reducing their last mile transports might be willing to share their profits to support the hub. It is important to try to create incentives for practitioners without creating an unfavorable situation for others. If, for example, the price of using the service hub would be too high, only larger companies might be able to use it, leading to an oligopolistic (or potentially monopolistic) market situation.

The costs and benefits of the service hub must be compared to those of a conventional solution. Even though many costs can be avoided by choosing to use a service hub instead of the conventional solution, it is easy to get distracted by the costs. There are many potential services that could be included in the service hub and that therefore should be included when mapping different benefits in order to make a comparison. Therefore, one must remember to compare the alternative costs of the service hub and not just look at the price tag of the hub alone.

Critical discussion

The focus group's views regarding the financing of the hub seem reasonable; finding a sustainable business model is evidently of great importance. A key to accelerate a transition towards a more sustainable infrastructure operation is believed to be the development of innovative and more service-oriented business models (Hannon, 2012; Roelich, et al., 2015). The main difficulty lies in deciding who should pay for what, rather than designing a system for collecting the payments. A reasonable and fair business model would mean that the cost for each practitioner would correspond to the utility, qualitative as well as quantitative. Utility is always a matter of subjective valuation, and can therefore not be accurately determined; additionally, qualitative benefits would have to be accurately quantified to monetary terms, which is practically impossible. Another important question is how the utility connects to the willingness to pay among practitioners. It is challenging to weigh positive utility against negative – how will the willingness to pay relate to either an increase or a decrease in utility?

Limiting car traffic – and particularly parking spaces – in Frihamnen will enable the developers to use more of the land for dwellings and commercial activities. Therefore, it could be argued that the increased revenues from apartment fees could compensate for the added costs for the service hub. Moreover, the willingness to pay generally increases when a dwelling area has a climate smart profile and takes social responsibility (Nielsen, 2014; Mandell & Wilhelmsson, 2011). A conclusion based on these facts would be that it should be possible to charge higher apartment fees in order to cover some or all of the operating costs for the service hub.

Predicting the utility for the different practitioners would give information about how to distribute the costs. By dividing the practitioners into categories (such as citizens, private companies, public facilities), one could create a general scheme for cost distribution. Such generalizations can be perceived as inaccurate and unfair, especially when studied on the level of individuals, but it might be necessary in order to create an initial business model. What must not be forgotten is that even though the physical service hub is difficult to change once built, *i.e.* it is path dependent, the business model is more flexible. If an existing business

model should prove inefficient and noticeably unfair it would be possible to change. In a project of this extent, it is inevitable that some unfairness will occur, and some of it will have to be accepted. Since the service hub (including its business model) has to be considered a niche, one might view Frihamnen as its incubator. In this incubator there is a great opportunity to reach a sustainable business model through continuous refinement; an initial model can be subject to adjustments in order to improve its weaknesses. This exemplifies niche accumulation in the MLP, which is a typical step in the process of shifting regime. Whether this niche will reach regime level or not is for the future to decide; furthermore, it is dependent on the level on which the regime is defined (*e.g.* areas of similar conditions or in global terms).

Clearly, barrier 2 and 3 are connected to barrier 1, but due to their importance, the authors wanted to separate them in order to study them more extensively. The reason why there is no barrier concerning making the waste management commercially viable is that this activity is not expected to be commercially viable (since it does not generate any revenues for the hub operator). Paying for a solution for waste management is unavoidable for the real-estate companies and is required by law. This topic is discussed in barrier 8.

4.2 Barrier 2: Make the reuse commercially viable

A problem with running second-hand shops is the high rents in central city districts. Often, these stores have to be located in non-central parts of town where rents are cheaper. Because of the central position of Frihamnen and, consequently, the service hub, the rents could reach a level where it is difficult to maintain this type of business. On the contrary, the central location might contribute to increased revenues. The area of Frihamnen will, when fully developed, house approximately 18 000 inhabitants and 15 000 workplaces. There will, however, be even more people in close proximity to the hub that will be able to take advantage of the reuse facility. This will further increase its potential to be self-sustaining.

The reuse facility that will be housed in the service hub will encompass both reuse (second-hand) and upcycling of goods, something that the group considers beneficial. These two services will likely complement each other since the supply of wares will be higher and there will be a selection of both cheaper and more expensive objects to purchase. The largest profit will probably come from the more expensive goods; however, of the total number of goods donated for reuse and upcycling only a small fraction will be subject to upcycling that leads to high value goods.

To make the reuse and upcycling facility economically viable, the focus group mentioned that the quality of the facility and its services should be increased compared to traditional reuse shops. The hub's reuse facility should feel organized, clean and have goods of a certain quality, instead of being perceived as a flea market. To be able to get a good economic result from this type of business, the focus should be on the upcycling service, as this is believed to be more profitable than ordinary reuse. More types of goods should be upcycled and to a higher degree, demanding more and better designers.

Critical discussion

The second-hand business in Sweden is normally based on people making donations and the shops reselling these items or that people sell their old items themselves. So far, the plans for the reuse facility in the service hub will be based on the same premise, which means that the

potential for creating a facility with higher quality goods is probably limited. The upcycling part of the facility can surely add value to many types of goods, but as stated in the focus group discussion, these goods are most likely just a small percentage of the total stock. It is therefore contradictory to claim that the quality of the average accepted goods should be increased, when it is the residents in Frihamnen, rather than the upcyclers themselves, that provide the goods.

The focus group pointed out the importance of enhancing the image of reuse in terms of quality and cleanliness. This is clearly a situation that demands a transition in consumption habits and social behavior; the consumption of new goods needs to be replaced by consumption of used goods. At the present, some people are not inclined to buy used goods for such reasons; thus, changing the mentality among the citizens could facilitate an increased consumption of reusables. Upcycling might be a way to improve the reputation of reuse, and simultaneously catalyze a transition. However, the traditional second-hand business might be harder to rebrand, but then, global trends in upcycling might open windows of opportunity for this activity as well.

Moreover, if the upcycling business turns old goods into high fashion goods with prices matching those of new wares, or possibly even higher, it might be increasingly difficult to motivate why people should buy these improved old goods instead of new similar ones. The higher the price of the upcycled goods the lower the demand will be, unless some kind of exclusivity is added to the product. However, the profit will, also probably increase with a higher price. Thus, the barrier is found in the need to make upcycling profitable, while trying to maintain a large customer base. On the other hand, since Frihamnen will be an area developed with climate smart solutions in mind, one can expect the inhabitants to share this mentality. Therefore, the willingness to pay for second hand and upcycled goods could potentially be higher here than in other city districts.

4.3 Barrier 3: Make the goods management commercially viable

The goods management part of the service hub will lead to extra handling of all incoming goods. All extra handling is synonymous with extra costs compared to if the hub was not utilized. Thus, this adds to the problem of paying for the hub – who should cover this added cost? Businesses that get their parcels delivered once a day may not experience much of a difference compared to a conventional solution, and it can therefore be difficult to motivate a high usage fee. The focus group also recognizes that those who purchase goods are not interested in paying more than they have to for the freight of the goods. This leaves the logistics companies with limited profit margin for each delivery, meaning that they do not want to cover the added cost either. Since the hub shall not be financially supported through research projects or the municipality, this leaves the citizens to carry the weight of payment. The focus group does, however, argue that the citizens should not be responsible for all of the costs. Thus, the challenge is to decide what part they should cover and who will cover the rest.

Other problems are that the companies that deliver goods cannot enter the area and deliver directly to the customer as they are used to. This could mean lost branding and publicity for the companies, and in turn, reduced willingness to pay for the service hub. Another effect is that some companies cannot offer the same services in the area. For example, food delivery

businesses will not be able to carry the food all the way home to the customer and electronics companies cannot offer home delivery and installation of products. On the other hand, these companies might see other values in the service hub solution. Firstly, customers that order goods and get it delivered to the package boxes in their own staircases will experience an increased flexibility since they can retrieve their parcels at any desired time. Secondly, delivering goods to a single hub instead of several individual apartments and businesses is seen as an advantage because it leads to more effective last mile transports, which means reduced costs for deliveries. It is unclear at this early stage of the project how much money can be saved by streamlining deliveries and how high costs the extra goods handling will be. Hence, the net cost difference compared to conventional solutions is unknown. This uncertainty is also seen as a part of the problem, since practitioners want to know the price and potential profit of using the hub before embracing it.

Critical discussion

The authors agree with the focus group's thoughts about letting the citizens pay for the larger part of the goods management costs. Still, the question remains about how much they should cover, and how much they are willing to pay for a higher level of service. No exact measure of the utility for each involved part can be done and therefore appreciations will be what ultimately decide the cost distribution. This type of problem has already been solved in previous cases of urban consolidation centers though, such as for Lindholmsleveransen and Stadsleveransen. These cases are not identical with the one in Frihamnen, but the principle can still be valuable, as the essence in those cases is that both the logistics companies and the goods recipients pay for the service provided. Even though there is a new type of recipient in Frihamnen, the citizen, the costs can be distributed in the same way – both to the logistics companies and to the goods recipients (citizens and businesses).

Regarding the limitation of the services that companies can offer when the hub has been implemented, a contradiction appears since the service hub is meant to increase the service level and flexibility for the practitioners in Frihamnen, but at the same time, it decreases it. It can be stated though, that it is not the hub itself that will restrain the types of services in the area, but rather the traffic regulations that will be implemented along with it. Solving this complication might prove difficult since it would involve either making the operator of the hub provide the "missing/lost" services or providing exceptions to the traffic regulations for those who want to supply the services. No matter which one of these alternatives are chosen, or if none of them are, some practitioners are going to be left with a scenario that inhibits them from getting what they want. If no one can offer the services, the citizens will suffer, if the hub operator provides some services, the outside companies will suffer, and if exceptions are instated, the city and its citizens will suffer. This situation is very delicate during the planning phase since it involves choosing which party will be better or worse off than in any other city district. One must remember though, that there are also upsides that must be considered, which makes the problem even more complex. All these positive and negative effects influence the parties' willingness to pay for the solution. This topic is further covered in Barrier 4.

4.4 Barrier 4: Create a solution that satisfies all users

The focus group attendees agreed that the service hub should provide equally good or better solutions for all users compared to a standard solution to be seen as an attractive alternative. The barrier lies in organizing this since all the parts of the hub should be considered: reuse,

upcycling, goods management and waste management. Because of the many involved practitioners in the project, however, a seemingly inferior solution for some companies might have to be accepted for the hub to be feasible. What is most important is that no companies are deprived of their possibilities to conduct their business properly. As stated in Barrier 3: Make the goods management commercially viable, some companies might have trouble with providing their standard selection of services if the service hub is introduced. Avoiding this to the largest extent possible should be prioritized.

Some features of the hub will undoubtedly lead to improvements for users, such as increased flexibility and convenience. However, those who experience the improvements might not be the same users as those who experience reduction in quality (if there is any), which will lead to an unfair situation.

Critical discussion

What constitutes a good solution for goods management, reuse and waste management is a matter of opinion. There are some features regarding all these services that can be deemed better than other solutions from an objective perspective, such as fully loaded e-vehicles without greenhouse gas emissions compared to petrol driven trucks with a low load factor. However, many other parts of the service hub solution must be judged based on subjective premises. This implies that there will be 18 000 opinions in Frihamnen from the citizens alone. Thus, if one considers companies and municipal authorities as well, creating a solution that satisfies all users seems like a problematic task indeed.

With all these opinions, it seems impossible to convince all involved parties that the new solution will be better than a conventional one. What seems to be more important is to make everybody accept the solution by making it fair. If the future practitioners do not feel that the solution in Frihamnen is fair, they might oppose it by not moving there (citizens or businesses) or not providing their services there (businesses). If this is the case, the area might get a reputation for discrimination towards some practitioners. It is therefore important to make prominent practitioners involved in the new solution early, to send the message that there are parties that are positively inclined to the solution. Achieving this could make other practitioners might be more easily convinced of the solution's upsides.

The authors theorize that the transition to the hub solution is the main problem rather than the solution itself. This would mean that once the solution is in place, most problems would be gone, considering they originate in uncertainty and lack of knowledge about the hub. In terms connected to transition theory (MLP), the hub would be a niche, and the regime would be the conventional solutions with decentralized goods deliveries and waste management as well as traditional reuse alternatives. Depending on how the regime is defined, there is a chance that the service hub, as a niche, could challenge the current regime. If one defines the regime as the current infrastructure solutions in operation in newly developed densely populated mixed-used city districts, the service hub solution could be seen as a challenger to it. On the other hand, defining the regime as the distribution systems of waste and goods in an entire city makes it more difficult for the hub to challenge the regime. The reason is that the hub is designed to function in a densely populated area where its services benefit from the proximity of its practitioners. The fact that Frihamnen will be designed partly with the hub in mind makes its suitability even better. Thus, areas that are not developed together with the solution for waste and goods management are not as effective.

4.5 Barrier 5: Lack of responsible authority

One of the primary barriers for instating the service hub is the lack of a responsible authority. The role of this authority would be to coordinate and organize the features of the hub and be responsible for procurement of services from the desired sectors. What authority that should be responsible for this, who should decide it and who it should be are questions that need to be answered. Without this responsible authority, there will be difficulties in setting up the necessary relations between the hub's practitioners. This responsible authority also needs to create a legal framework (see barrier 7) to make sure all parties involved in the hub have the same opportunities for doing business.

Critical discussion

This barrier was repeatedly mentioned during the focus group discussion; however, the group never came to any in-depth discussions on this topic. A responsible and coordinating authority is, indeed, a vital role that is currently missing. Failing to appoint one soon enough, the project might be delayed or even cancelled since no one will take the leading role. There are numerous complex decisions that have to be made that involve several disciplines. Such decisions are likely to be perceived as controversial since it doubtlessly will benefit some and disfavor others. Hence, no one is likely to make these decisions without being given the power to do so; besides, there is a risk that other stakeholders will invalidate the decisions. Furthermore, if all decisions were to be made by a consortium, the process would be slower.

Roelich et al. (2015) argue that we need to re-evaluate the way we look upon infrastructure; we should, by restructuring governance and incorporating ICT, integrate different infrastructure elements and go from a consumption based approach to an end-user demand based approach. Furthermore, they suggest that the interrelations between different infrastructure streams should be facilitated by innovative governance (Roelich, et al., 2015). A potential way of doing this in the service hub case would be to appoint a new municipal authority responsible for coordinating integration of different infrastructure elements, *i.e.* connecting the different disciplines. This would not only facilitate the implementation of the hub, but also future infrastructure projects.

4.6 Barrier 6: Organizing the collaboration between stakeholders

There are, as stated in barrier 5, problems connected to the organization and cooperation between stakeholders when planning the hub. Cooperation must be achieved between a number of different private companies, but also between private companies and municipal stakeholders. A barrier lies in the lack of standard procedure for accomplishing this type of relationships. The planning process should involve as many practitioners as possible; if only a few are involved there is a risk that the rest of them will feel excluded and therefore not fully support the initiative. The more transparent the planning process is, the higher the acceptance will be. Planning for well-functioning collaborations within the project is vital; in spite of this, there is no national authority coordinating city logistics.

Another problem connected to collaborations between companies is that the Swedish competition authority might put a stop to some sorts of cooperation. A sector that could experience trouble with this is the transport and logistics sector. Although this is often not a

problem, there are still rules to obey when planning the hub. Other businesses, that can and are interested in cooperating, are the charity organizations that potentially will handle the reuse and upcycling facility. There is a strong will to collaborate between these organizations because they have much experience to share.

There is plenty of knowledge about how to run the different functions of the hub separately, but not much experience concerning coordinating them. Even though the features of the hub may be coordinated, there are also external effects that need to be considered. Many of the incoming transports to the hub will depart from foreign countries and from a great number of companies. This might constitute a problem because of communication difficulties. When the transports come to Frihamnen, they might try to enter the area as per usual, not knowing that all packages directed to that area are supposed to go through the hub. Getting these transports to go to the right place and to deliver their parcels to someone other than the customer is something the planners must have in mind.

To avoid any misunderstandings during the operation of the service hub, the solution should be planned and constructed in a way that does not allow any confusion. Furthermore, it is important for the planners to think of the area as a new area with new circumstances. Thus, the solution needs to be customized for this particular case rather than a combination of old types of features.

Critical discussion

The reasoning presented in barrier 5 regarding the integration of different infrastructural elements is highly relevant for this barrier as well. Roelich *et al*. (2015) state that in order to achieve long-term sustainable infrastructure operation, different infrastructure systems have to be integrated. This is where the necessity of a responsible authority becomes obvious; the integration would require a large network of stakeholders, putting high pressure on collaboration and governance.

The focus group attendees argue that the planning process should involve as many parties as possible. Although it seems like a good point, it also brings further complications when it comes to collaboration. The project is likely to be rather unwieldy if an excessive number of parties are involved, making the planning process inefficient. Besides, it might generate an inferior outcome compared to a case with a limited number of parties. However, the focus group points out good reasons why to include a larger number of parties.

A further difficulty when it comes to collaboration in the project seems to be a lack of a common idea of what to achieve with the hub. Different stakeholders see the hub in different ways, making the collaboration difficult since people are talking about different things. Furthermore, it could be difficult to grasp the whole solution since it is encompasses a wide range of features; people tend to stick to their specific area of interest when discussing the hub. Hence, describing the hub in a unified and holistic way would probably simplify the collaboration by reducing misinterpretations – and therefore improve the efficiency of the planning process. Furthermore, as the focus group expressed, it should be clarified for all involved parties that the hub is a matter of introducing a new solution rather that combining old ones. Failing to do so might result in them running their business by common practice and essentially working against the hub solution.

4.7 Barrier 7: Difficulty in designing viable rule-sets for hub operation

Rule-sets will help make the service hub easy to plan and operate and are, by the focus group, seen as one of the keys in making the hub successful. It should be noted that these rules are not necessarily laws. Without them, there will be no standardization of functions and thereby the practitioners will have no guidelines in their work process. An example is goods deliveries: what size should be the maximum size for delivery with the electric vehicles? What happens to goods that are too large to be transported with these vehicles (as discussed in Barrier 14: Uncertainty about how to handle bulky goods)? How should the goods be addressed? These types of questions could be answered with a proper rule-set. It is problematic to create a rule-set though; the rules must treat all parties fair and equal in a non-discriminative way. Another problem arises from the fact that what is considered fair is always a matter of opinion.

Since Frihamnen is built from scratch, there are no previous structures, inhabitants, rules or businesses to consider in the creation of the rule-sets. The focus group repeatedly articulated these circumstances as an advantage. Moreover, when the rule-sets are defined, citizens and businesses can review these conditions before moving into the area. This means that they actively accept the conditions by moving there. It is not only inhabitants and businesses inside of the area that will have to adjust to the rules, but also external businesses. The same conditions apply to them – if the rules for the area are clear, there will be fewer problems.

Critical discussion

For Frihamnen to be able to function the way that urban planners want, it is important that the rule-sets are carefully designed. If waste or goods management companies are able to carry on with their business as usual in Frihamnen, the rule-sets are not effective. The services that the hub is designed to perform must be carried out from the hub operators only; otherwise the hub might become obsolete. Since the point of consolidating deliveries is to take advantage of the economies of scale by including as many clients as possible, it would be undesirable if some of these used other companies than the hub operator for the main services.

The fairness in making the rule-sets strict can be discussed, but when it comes down to having clearly defined rule-sets and a well-functioning hub instead of unclear rule-sets and a hub without effective operation the choice seems less difficult. Accepting that some practitioners will have to adapt to the new solution is a price worth paying if the solution works as initially intended. Furthermore, moving to the Frihamnen, either as a citizen or with a company, means accepting the current rule-set.

Rule-sets are definitely needed when it comes to management of goods and waste, however, regarding reuse it is unclear if, and in that case, what type of rules should be implemented. There might be a need for such rule-sets even for the reuse function and therefore it should not be neglected in the planning process.

The landowner in Frihamnen, Älvstranden utveckling, has a great opportunity to make decisions for systems for the waste and goods management in the area. As the landowner, they can demand that the developers include specific solutions when building the area as criteria. This makes it possible to adjust the rule-sets and details of the service hub simultaneously since Älvstranden utveckling is a municipal authority and can thereby

cooperate with the other involved municipal parties. The focus group clearly stated that it is an advantage to build the service hub in a newly developed area. The question is how much of this advantage is reflected in the making of the rule-sets. If the rule-sets can be given new dimensions because of the area being a new development, this should absolutely be utilized.

To some extent, experiences from Stadsleveransen and Lindholmsleveransen can provide useful knowledge when designing the rule-sets for the hub in Frihamnen. This is an example of niche accumulation as described in the MLP theory, and is an important step in the niche development process. The current regime does not include this type of hub solution for neither goods management nor waste management; however, when studying a regime shift, well-developed niches play important roles as potential candidates. Just as the regime is under the influence of landscape changes, it is also affected by niches, particularly the most prominent ones. The success of the service hub (in this case the niche) is largely determined by how well it functions operationally; thus, the rule-sets play a major role in the hub's ability to challenge the current regime.

4.8 Barrier 8: Legislation

Sorting domestic and commercial waste is enforced by Swedish law; however, there is no imposed penalty for violating this law. In a worst-case scenario, this might cause the businesses and housing cooperatives to work against the hub solution with the purpose of finding a less expensive, non-legitimate solution for waste management.

Since the service hub will deal with food deliveries, there is a risk that it will be classified as a food facility. This would bring high costs since it requires certain levels of cleanliness and hygiene. Furthermore, it will be subject to periodic inspections by the Swedish national food agency. These hygiene requirements might be harder to fulfill due to the close proximity of the waste management facility. Conclusively the focus group states that these requirements should not be too difficult to satisfy since the food is securely sealed, although it would imply a relatively high cost.

Another issue that the focus group discussed is that the hub is responsible for accepting and signing goods deliveries as a delegate of the inhabitants and businesses in the area. This may cause legal problems in terms of liability and insurance-related issues. Therefore, the hub's responsibility should be clearly defined and articulated in order to avoid legal procedures. There is a risk that the hub might end up in a legal grey zone otherwise.

A general risk with the legislation and rule-sets concerning the hub is the risk of loopholes. If people or institutions start discovering loopholes, there is a risk that the functioning of the hub is undermined, as is discussed in Barrier 15: Uncertainty about future trends, behavior and effects.

Critical discussion

There are several laws that to some extent hinder the development of the service hub. Although the focus group does not consider this a major problem, it may complicate the process and add extra costs. Furthermore, regardless of which solutions are chosen, there will be similar problems; the law-related challenges will not apply to the service hub solution exclusively. The focus group also mentions experiences where these problems have been

solved before. Conclusively, legislation seems to be a barrier, but not something that cannot be solved.

In some cases it might be worth reviewing some of the parts of the hub with regard to legislation. If some legal barrier risks complicating the process excessively it might be more beneficial to modify the solution. For example, if combining food handling and waste management generates considerable extra costs, not combining these services should be considered, especially if there is no clear benefit from doing it (see Barrier 10: Lack of apparent reasons for combining services and functions).

Legislation is path dependent due to its nature (Pettersson, 2011); it is based on experiences from the past rather than on predictions about the future. Thus, legislation is largely based on a previous state of society and its characteristics at that time. Although legislation co-evolves with society, it is often one step behind the development of society. There are no experiences from the hub solution, and therefore the legislative system might not be adapted to fit such a solution. Initially, some features of the hub might be in a legal grey zone due to the lack of experience, wherefore either the hub or the legal system will have to adapt. The theory of path dependence is applicable on the development of legislation and society because introducing limitations are inevitable when it comes to forming laws. Moreover, it seems impossible to legislate without creating a path dependent situation of some degree. That means that what should be avoided is the higher degrees of path dependence, not path dependence itself.

It is important to make a distinction between the traffic regulations and the service hub, even though they are closely related. The regulations will be beneficial in many ways but they will also result in some new problems, and the hub is a solution intended to solve these. Hence, the first step of planning should be to design the traffic regulations to work towards the city vision. The second step should then be to identify the shortcomings that the new regulations imply. Once this is done, the hub can be planned accordingly. When following these distinct steps, it is important to keep in mind that the best result for the final solution will surely be achieved by integrating the planning steps; meaning that the planners should consider all of the parts in Frihamnen in each step of the planning process. Thus, even though it is a generalization, this 3-step workflow should be the basis for planning the hub and traffic regulations in Frihamnen.

4.9 Barrier 9: Integrating different standards

Different companies use different systems in their business. For example, some logistics companies provide a service that allows the customers to track parcel deliveries. As the hub solution encompasses an abundance of different companies, there will be a challenge in merging such standards of the different companies. It is desired that the service hub does not interrupt or disturb the services provided by the involved companies; thus, the hub has to be compatible with different systems. This barrier mainly involves the private companies in the businesses of freight and recycling. Examples of processes that need to be considered from the compatibility perspective are company standards in consignment documents, loading units, pricing, payment, customer interface, service and ICT. Otherwise complications related to these standards, when adding another step in the distribution chain, might occur.

Critical discussion

The focus group seems to be determined that the hub should be compatible with services such as parcel tracking. However, there will be a challenge in deciding where to draw the line when it comes to the hubs' compatibility. Some services might not be suitable for the hub, and some services might not go in line with the sustainability vision for the city. Door-to-door delivery is one of those debated services; it might be difficult for the hub to provide this service in a way that satisfies the freight companies, since they intend to have a characteristic service. Hence, running this service through the hub eliminates the possibility for logistics companies to differentiate their service.

Another thing to consider is whether the hub should adapt to company standards or *vice versa*. Numerous different companies will utilize the hub, and therefore a large number of different standards for the hub to consider. It might not be reasonable for the hub to adapt to all of these. Doing it the opposite way, *i.e.* force the companies to adapt to predefined hub standards, might on the other hand bring some disadvantages – economically as well as organizationally. Recycling companies might have to reload their cargo to other loading units; seamless parcel tracking might not be available and other additional services might be difficult to supply. Also relating to different standards is the complication of pricing the services running through the hub. For example, some freight companies might charge its customers per loading unit, others per weight and others per delivery. If these companies are expected to pay for the operation of the hub, how can a payment model be designed in a fair and nondiscriminatory way?

4.10 Barrier 10: Lack of apparent reasons for combining services and functions

Unless there is a clear advantage of combining services in a hub, there is no reason for doing it. There is a risk that this is disregarded when planning this all-in-one solution. Some features of the hub might not benefit from being combined, or it might even be unfavorable in some cases. Food deliveries are, for example, difficult to combine with waste handling for hygiene reasons (see Barrier 8: Legislation); although it would be possible, it might not be beneficial. Furthermore, consolidation of waste requires a lot of space, which some of the other processes does not; this might make it difficult to keep the services tight and accessible. Another concern is that it might not be economically favorable to allocate attractive urban land for such space demanding activities. Due to this, the group concludes that it might not be reasonable to include all waste fractions in the hub, particularly not the vast volumes of domestic combustible and biodegradable waste.

No real advantage of placing the three activities (goods deliveries, waste collection and reuse) together can be identified. However, the group attendees see some benefit in combining waste collection with reuse. They also see a certain potential in combining goods deliveries and waste management if it is possible to coordinate the transports between the two processes. However, they do not see a natural reason why the three of them should be interlinked.

The hub is likely to involve many heavy transports; this does not fit very well with a social and attractive urban environment. The focus group members state the importance of making these transports invisible in order to fulfill this vision. They see the suggested underground entrance for heavy transports as a possible solution to this, but also as a means of increasing

traffic safety. Furthermore, they express a desire of reducing transport in the area through repositioning the activities that does not necessarily need to be incorporated in the hub.

Critical discussion

Although the authors recognize that combining functions in the hub is advantageous in some cases, it seems more doubtful in others. A benefit of having the different services close to each other is that all transports coming from outside the area will be able to use the underground loading docks. This includes parcel and food delivery vehicles as well as waste collection vehicles. The purpose of it is to increase safety and to make the area around the hub more attractive from a social perspective. If the services of the hub should be separated, the vehicles arriving at the other location would not be able to take advantage of this feature, meaning a higher security risk. Another reason for keeping the functions together is that the personnel and buildings can be shared.

There are links between goods and waste handling as well as between waste management and recycling; therefore, an alternative solution might be to consider keeping the services that do fit well together in close proximity and relocate some of the features that do not. This way, the household garbage might not end up in the same building as the good management facility or social workshops (for example upcycling facilities). It could be a good idea to transport all waste fractions to a separate station where consolidation of waste occurs and only bring the reuse fraction to the service hub, where these goods will be used. All of the reusable goods may not be in a condition that allows them to be either reused or upcycled, and thus need to be thrown away. In that scenario, there would be benefits in having the waste facility nearby to get rid of the excess goods in a convenient way.

Yet, there is a risk that the initial plan for the service hub solution has been proceeded with without critically reviewing it from a holistic perspective. Some of the services have been combined and put closely together without apparent reasons for doing so. Hence, the planning process itself seems path dependent, and there is a risk of ending up in second or third degree path dependence if the plans are not thoroughly reviewed beforehand. As the focus groups stated, if integrating the functions does not yield any benefits, there are no reasons for doing it. Although there are benefits with pairing some of the services together, such as waste collection and reuse (due to the proximity), as well as goods deliveries and waste collection (if the transport can be shared); the advantages of keeping all services close are not obvious. Furthermore, it is highly uncertain if combining collection of waste and delivery of goods is even viable. Forcing this routine might bring additional costs, and thereby raise the question how much the project should be allowed to cost in order to stick to the initial plans. Will the goal of achieving an attractive and vehicle independent city district be enough to keep the service hub plans, or will another solution take its place due to complications with the combination of services?

4.11 Barrier 11: Limited previous experience

The previous experiences from this type of solutions are limited to the experiences of UCCs (particularly Lindholmsleveransen and Stadsleveransen), and not everything is straightly applicable to the hub solution. The planning and implementation of the hub therefore involves a number of uncertainties about the outcome. It also implies a transition from the common practice of some processes, which might face some criticism among practitioners – companies as well as individuals. In order to limit such criticism, the solution needs to be seen as an

improvement for most involved parties. The focus group states that the risk for any distrust or skepticism needs to be minimized in an early phase through complete transparency when it comes to information. They believe that keeping the inhabitants satisfied is a key concern; this would require proper service and clear communication.

The fact that the hub is to be implemented in a new development is believed to simplify the transition. Keeping the inhabitants carefully informed about the system before moving in should, according to the group, limit their skepticism since they have agreed on it. Still remaining is the challenge of meeting the needs of the practitioners once the hub is in operation, making the planning process critical.

Critical discussion

The fact that no one knows the effects of introducing the service hub seems to be the source of many of the barriers identified by the focus group. This, in turn, generates uncertainty and skepticism among decision-makers and stakeholders. When comparing a conventional solution with the service hub there is no objective and unambiguous answer to which one is superior. Hence, a choice of solution at this stage, when data on expected outcome is very limited, would be arbitrary rather than fact-based. Such a choice could lead to second-degree path dependence, which would mean that the solution proves inferior to other alternatives in a later stage. Even third degree path dependence could appear in the future if potential effects are not thoroughly researched at the present stage. Thus, it could turn out in the future that the solution should have been discarded from the beginning. It is therefore essential to map and predict the effects of the solution thoroughly beforehand to minimize the risk of ending up with unpleasant surprises in the future.

Due to the aforementioned uncertainty, it might be difficult to persuade decision-makers to go through with the hub. Undoubtedly, implementation of the hub is connected to both a number of risks and potential winnings. As stated by the focus group, there is some experience available from the previous projects in Gothenburg. The implications of this were discussed in barrier 7, where parallels were drawn between gaining experience and niche accumulation in the MLP theory. This reasoning is also applicable for future practice, wherefore the service hub can be considered a part of a niche accumulation process, and introducing the hub could therefore be partly justified for the sake of gaining and spreading experience.

4.12 Barrier 12: Lack of knowledge diffusion in city logistics

City logistics is, according to the focus group, a subject that is often forgotten or neglected in urban planning; Lindholm & Blinge also emphasize this in their (2014) report. Planning for efficient city logistics has often been somewhat disregarded historically among decision-makers and stakeholders in politics, municipal authorities, construction industry *etcetera*. The focus group states that the architects should consider city logistics already in the initial design. They mention several examples of bad experiences connected to this. For example, an urban shopping mall was built in Stockholm lacking a proper goods reception; the effect of this was that the goods were being unloaded on the sidewalk. Even though the service hub is a solution for efficient city logistics in itself, the group emphasizes the importance of keeping the logistics in mind when designing all the other components of the city. For example, private housing, business buildings, schools and streets all need to be compatible with the hub solution.

Critical discussion

When using the TIS-framework, "knowledge development and diffusion" is one of the main functions to examine in order to analyze changes in a technological system. If this function should be considered weak due to the lack of previous experiences (*i.e.* diffused knowledge), difficulties could arise when planning the hub. Since city logistics is a central part of this project it is important to share the knowledge in the subject among stakeholders and practitioners. Doing so would facilitate the implementation and operation of the hub. Furthermore, sharing this knowledge would also help future projects of similar characteristics.

This barrier is not connected to the service hub *per se*, but rather the complementary logistics solutions for the rest of the city district. For the hub to be able to function optimally, the places where goods will be delivered and waste collected must be planned in accordance with the hub's mode of procedure. A high ambition from the planners of the service hub might be partially undone if the planners of the rest of the district is unaware of the demands that the hub will entail. The risk for that type of scenario is probably limited, mainly because several stakeholders are co-developing Frihamnen and the landowner (Älvstranden utveckling) has the authority to demand certain solutions from the developers.

4.13 Barrier 13: Uncertainty about the hub's effect on transport demand

It is difficult to assess the total change in transport (miles travelled) that the implementation of the hub would result in. In many cases, the solution leads to transports being replaced by other transports. For example, private transport to the grocery store may be replaced by home delivery transports of groceries; and private transports to a conventional recycling facility is replaced by transport for recyclables collected close to the dwellings. Thus, private transport is substituted by new coordinated transport. Although the new transport is believed to be more efficient in terms of load factor and emissions, the effects on total travelled distance are not yet calculated and therefore uncertain.

Concerning collection of recyclables, previous experiences show that more material is recycled if the collection is in close proximity to the dwelling. This is considered a strong advantage, and therefore, more transports might be justified.

Critical discussion

The service hub in Frihamnen will not result in any significant global changes on the emissions of greenhouse gases because of its limited service area. However, by introducing this solution in a majority of similar looking city districts around the world, it might contribute. At this stage, no one knows what effects the hub will have on the total number of vehicle trips or emission of greenhouse gases, but considering that it is introduced as a means of improving city logistics, and the effects of previous UCCs, it could prove beneficial. What must not be overlooked are the potential rebound effects that the added comfort will bring. Increased convenience in receiving online purchased goods may increase the number of bought items, in turn increasing the number of vehicle trips.

If e-commerce increases due to the situation in Frihamnen, this could lead to goods being ordered from places further away than before. This is especially likely if the freight is free or very cheap. A potential rebound effect could therefore appear when there is a transition from

traditional shopping to online shopping. It would be interesting to see measured quantities of the total number of online orders for Frihamnen compared to other similar areas without the service hub. This could provide useful information of the real effects.

If the total driven distance would increase because of an increased sorting of waste, the negative effects must be compared to the positive effects that more recycling and reuse means. Conversely, fewer trips will have to be made from people's homes to recycling stations, which will counteract this effect to some extent. Increased reuse will decrease the amount of waste produced and goods ordered in the area, which will further reduce the need for transport outside of the area.

Overall, the total effect on the number of transports depends on a vast number of parameters. These parameters include, but are not limited to, where the goods are ordered from (both for private orders and for company orders), what change in total ordered volume can be expected, change in trips to local stores, how much material is reused, upcycled and recycled as well as preferences regarding where to buy goods. Although the uncertainty is high, the hub should be able to function anyway. Assuming this is the first time these services have been combined in this way (the "service hub" concept) it serves as a pilot project, meaning that it is a great opportunity to analyze the effects and gain understanding about some of the presently uncertain factors.

No matter if the number of transports changes, the quality of the transport must also be considered. Environmental loads such as noise, emissions, congestion and visual pollution are likely to decrease as other vehicles replace the traditional transports.

4.14 Barrier 14: Uncertainty about how to handle bulky goods

A shop is likely to get deliveries on pallets and citizens are likely to order furniture and kitchen appliances for home delivery. Such deliveries will not be able to be handled by the same procedure as the parcel deliveries; and there is not yet a plan for how to handle bulky goods to the area. If the traffic regulations are as strict as intended, it will not be possible to drive a vehicle to the entrance of the dwelling or business to unload the items. Potential ways of overcoming this are to introduce some system of exceptions for such transports, or the bulky deliveries will have to be reloaded onto electric vehicles through the hub. In order not to risk the convenience for the inhabitants and shopkeepers, a good system for solving this issue needs to be developed.

Critical discussion

The authors agree that there has to be a solution for door-to-door bulky deliveries (*e.g.* moving trucks and kitchen appliance deliveries). If the hub is unable to supply this service, this problem has to be solved through some kind of exception in the traffic regulations. Potential solutions could be to let the citizens apply for permission for such transports or to charge a fee for entering the area with heavy vehicles. It might not be advantageous to run such services through the hub, since it would imply lots of extra handling of heavy and bulky goods. Furthermore, it might require special vehicles as the low-emission vehicles operating in the area are likely to be rather small. Hence, the most beneficial solution to this problem is believed to be introducing some sort of exceptions in the traffic regulations.

4.15 Barrier 15: Uncertainty about future trends, behavior and effects

According to the focus group, there are numerous uncertainties connected to the future – locally as well as globally. Examples of factors related to the hub solution are consumption patterns, transport habits and dwelling situation. Questions about future trends in such factors are virtually impossible to answer. What would happen if people stopped shopping online? What would happen if the demand for door-to-door services skyrocketed? Although such dramatic changes are unlikely to occur, there are still many uncertainties that might lead to problems unless accounted for. No one knows exactly how many people will live there, nor what their consumption pattern will look like; this implies a risk of dimensioning the service hub erroneously. Furthermore, future service demand is hard to predict; the hub might not be able to provide the services the inhabitants and businesses are demanding.

The focus group identifies a potential rebound effect that the traffic regulations may bring: inhabitants and businesses find loopholes in the regulations and start buying their own electrical vehicles. Loopholes can be seen as ways to evade a responsibility or a regulation but does not necessarily involve anything illegal. The group mentions experiences from the southern archipelago in Gothenburg, where people have bought golf carts to overcome the existing traffic regulations. To some extent, a similar scenario would mean a failure of the hub solution, and in reaching the city vision in terms of visual pollution and traffic safety.

The hub concept relies on a large number of collaborations. However, the focus group argues that unawareness of what parties to expect in the collaboration makes forecasting challenging. The housing cooperatives and developers will play major roles in the collaboration, and should therefore be involved in the planning process as early as possible. In order to get the hub working, they need to adapt to the solution. Since such stakeholders are not yet involved, it is impossible to predict their standpoint in the project. Additionally, some stakeholders and practitioners might be replaced, or change their standpoint in the future. A potential scenario, that the focus group identifies, is that outside investors get involved in the exploitation. With the intention of making profit, such companies might ignore the vision of a sustainable city and therefore complicate the collaboration.

Critical discussion

High degrees of path dependence have a strong correlation with the uncertainty about future needs. With a higher uncertainty comes a higher risk of ending up in the second or third degree. Although the planning process needs to include some predictions about future needs, there are still parts that are left to chance. Since the hub will be constructed based on predictions, it will become path dependent to some degree, just by making a decision. However, if the predictions are not accurate, there is risk for second-degree path dependence to occur. For example if the facility for waste management is dimensioned based on the current situation and the amount of waste increases gradually, the hub will be difficult to modify to meet the new needs. Furthermore, if the facility needs to be expanded, the challenge will be the same as when it was initially constructed, *i.e.* how to predict the future needs.

The focus group does not extensively discuss any potential effects on consumption behavior among the citizens. The coded package boxes will make deliveries of goods of a certain size more convenient to the consumers. A potential effect of this would be that people start

ordering more goods online, and possibly even from further away as mentioned in barrier 13. The convenience of this form of consumption could potentially even spur an increase in consumption. This would mean that even if the service hub is a success from a local perspective, it might generate negative effects globally. However, such effects would most likely be invisible even if they existed since the entire system is too complex to map and the effects are too difficult to trace. If the service hub were to be used more extensively worldwide such effects are likely to be more visible.

On the contrary, if there is an increase in local reuse, increased consumption is not necessarily a negative effect. Hence, what is essential is not the amount of goods that people consume, but rather what they consume – in other words, the sustainability of their consumption. Introducing more options when it comes to reuse is likely to increase the consumption of used goods. Ideally, this consumption replaces the consumption of new goods, and thereby makes the consumption more sustainable. There is, however, an uncertainty in the future demand for reuse. Whether or not reuse still is a prevailing trend will have a large impact on that particular function of the hub. There is no definite way to foresee how this trend will develop and therefore one has to be flexible and able to adjust to changes in demand.

The focus group discussed the possibility of taking advantage of loopholes. This could be avoided by making the service hub comprehensive enough to provide all the desired functions. What seems most likely is that people will look for loopholes mainly when the supplied services are unsatisfactory. Thus, the quality of the provided services should be sufficiently high not to incentivize use of alternative means.

Due to the uncertainties that surround the project, there is a risk for dimensioning the hub erroneously. While planning the hub, being aware of scenarios that seem unlikely is important. To guarantee continuous operation of the hub, the design of it should allow for modifications such as redistribution of space, addition of services or expansion of existing services.

5. CONCLUSIONS AND RECOMMENDATIONS

Most of the barriers relate to economics, organization and/or uncertainty about the future; very few are of a technical nature. They generally have the characteristics of questions that need to be answered and ultimately choices that have to be made. Perhaps the barriers should not be seen as dead ends, but rather as choices of path. These choices can be approached by answering essential overall questions, such as: How much are improvements allowed to cost? How much risk is acceptable? What are the desired achievements and will the hub deliver these? To what extent can the cost be justified not only by direct results, but also by the experience gained?

Although organizing the different features separately is challenging, integrating them with each other seems even more challenging. What would justify an integration of different services in a hub would be if it yields synergetic effects. Hence, if a combination of services lack potential for such effects, or if the organization of them fails to bring forward such effects, the concept of the service hub is undermined. This emphasizes the importance of extensive preliminary research and a thorough organization process to achieve the desired goals.

It seems unclear whether the service hub project began with an idea of how to deal with the future needs in Frihamnen or if it was a way to introduce many different functions packed in one innovative solution. Nevertheless, it is important not to get stuck in brainstorming interesting ideas of features to include in the hub; the planning process should rather be focused on solving the problems that will exist in Frihamnen. Starting with interesting ideas implies a risk of supplying solutions to problems that do not exist. A more problem-based approach is believed to yield a better result since it starts from the root of the problem, after which solutions are designed accordingly. Using this approach would limit the risk of including features that does not benefit from being included.

Even though this study addresses and recognizes many problems connected to the service hub project, one should bear in mind that many of these barriers are not exclusive for this particular project. Alternative solutions would likely face similar challenges. Although some of the barriers seem harder to overcome compared to others, none of them directly threatens the feasibility of the project. There are, however, some critical decisions to be made and aspects to consider before proceeding with the plans. The following recommendations are based on the most important findings from this study; the intention with these is to provide guidance in the forthcoming planning process of the project.

Recommendations:

- **Appoint a responsible authority** (barrier 5) **–** The suggested approach would be to appoint a municipal authority responsible for coordinating integration of different infrastructure elements. Such an institution would be useful in this project as well as in future projects. This authority would also have the ultimate power and responsibility for decision-making.

- **Use a problem-based approach when designing the hub** (barrier 8) – Develop the traffic regulations prior to designing the hub, but with the hub in consideration. Do not just consider the needs of the users, but also the conditions under which the hub will have to work. Also, consider making exceptions in the regulations for vehicles delivering bulky goods, since this seems more feasible than running it through the hub.

- **Collect the hub's operating costs via residents** (barriers 1 & 3) – Including an extra charge in the apartment fee should be viable since the environmental standard and service level will be higher than normal for citizens and businesses in Frihamnen. The citizens are believed to receive the greatest benefit from the hub, and should therefore cover the greatest part of cost. This method for payment collection is also believed to be the most convenient and reliable one. The remaining parts of the business model need to be studied further.

- **Choose your risk level** (barriers 1, 11, 13 & 15) – Implementing the hub is connected to both a number of potential risks and benefits. Each new and untried feature will add another layer of risk. It is crucial to assess the impact of the risks and benefits along with their probability to occur. What should be considered is primarily gained experience, environmental effects, convenience, costs and social factors.

- **Design a flexible solution** (barriers 7 & 15) – Due to the many uncertainties surrounding the project, the hub should be able to adapt to future needs. To guarantee continuous operation of the hub, the design should allow for modifications such as redistribution of space, adjustment of rule-sets, addition of services and expansion of existing services. This is important because radical changes in trends and behavior might occur in the future.

- **Investigate how to effectively integrate different standards** (barrier 9) – Develop a way to take care of different company standards and integrate them into the hub. Adding more functions makes this process even more complex. This is a topic for further research.

- **Re-evaluate what functions to include** (barrier 10) – Unless there is a clear advantage of integrating a specific service in the hub, there is no reason for doing it. Thorough investigations should reveal the suitability for each function. It seems like some of the services would benefit from being separated from the hub; particularly household waste management.

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APPENDICES

Appendix A – Climate strategy of Gothenburg

Appendix B – Questioning route from the focus group

APPENDIX A – CLIMATE STRATEGY OF GOTHENBURG

The following list contains the nine strategic objectives defined by the city of Gothenburg (City of Gothenburg, 2014):

1. By 2030, all district heating derives from renewable energy sources, waste incineration and residual heat from industry
2. By 2030, the total use of primary energy for electricity and heat does not exceed 31 MWh per inhabitant
3. By 2030, the City of Gothenburg produces at least 500 GWh of renewable electricity and 1200 GWh of biogas
4. Carbon dioxide emissions from road transport within the Gothenburg geographical area will decrease by at least 80 percent by 2030 compared to 2010
5. Carbon dioxide emissions from shipping in the Gothenburg geographical area will decrease by at least 20 percent by 2030 compared to 2010
6. The climate impact of citizen's air travel will be reduced by at least 20 percent by 2030 compared to 2012
7. By 2030 the climate impact of food consumed in the City of Gothenburg will be reduced by 40 percent compared to 2010
8. The climate impact from our purchase of goods and materials should decrease. A target for 2030 will be set before 2018
9. The volume of household waste per person in Gothenburg will be reduced by at least 30 percent by 2030 compared to 2010

The following list contains the 24 strategies defined by the city of Gothenburg (City of Gothenburg, 2014):

1. Have knowledge and show decisiveness
2. Support citizens to reduce their climate impact
3. Educate a new generation of climate-smart citizens
4. Plan for an energy- and transport efficient society
5. Contribute to climate-smart regional expansion
6. Increased resource efficiency in district heating
7. Improve energy efficiency in Gothenburg's municipal property holdings
8. Improve energy efficiency in Gothenburg's private property holdings
9. Promote energy efficiency in industry
10. Continue to invest in district cooling
11. Further developed large-scale production of renewable electricity
12. Promote and facilitate small-scale production of renewable electricity
13. Lead biogas development
14. Prioritize and invest in the travel modes walking, cycling and public transport
15. Work towards a more energy-efficient vehicle fleet and promote the use of fuels with low climate impact
16. Use and develop policy instruments to reduce car traffic
17. Become a world leader in climate-smart cargo handling
18. Reduce the climate impact of construction, operation and maintenance of infrastructure
19. Facilitate and encourage shipping that is energy efficient and fossil free
20. Reduce the climate impact of food in our organization

21. Reduce our purchases of resource-intensive goods
22. Prevent waste and promote recycling
23. Promote sustainable activities
24. Promote alternatives to air travel

APPENDIX B – QUESTIONING ROUTE FROM THE FOCUS GROUP

Question 1a: What are your initial thoughts and impressions?
Question 1b: Who would benefit from the service hub, and in what way?

Probes to question 1:

- (When short statements are given from participants): Can you elaborate and give examples?
- Are there companies or other stakeholders or practitioners that will be worse off? In what way?
- Is it acceptable that some parties become worse off?
    - If no – How can incentives be created for these parties in that case?
    - If yes – Who, and why?
- (If someone states that the society is the clear winner) Should the society pay for the solution in that case? Or should someone else pay for it?
- Do you think any involved party will oppose the solution if it turns out that they won't benefit from it?
- Who should be in charge of decision-making? *i.e.* who should decide what distribution of costs is fair and acceptable?

Purpose of question 1: To examine how to design a working business model.

- Are there some stakeholders or practitioners that will benefit more or less than others?
- How should costs be distributed?

Question 2: Should the service hub be used as a complement to existing, conventional solutions, or should it be used as a primary, standalone solution?

Probes to question 2:

- (If someone answers complement): What incentives would practitioners and users have for using the solution in that case?
- (If someone answers main solution): Do you think there will be problems connected to acceptance from inhabitants or businesses in Frihamnen?
- Will the solution require that all involved practitioners and stakeholders accept the concept?

Purpose of question 2: To examine if the there is a need for all affected parties to use the solution for it to work properly.

- Will those affected by the service hub embrace and accept the solution to a high degree?
- Should the service hub be used as a standalone solution or rather as a complement to another solution?

- Is there a risk of forcing stakeholders and practitioners to cooperate – even if it is not beneficial?

Question 3: Three different phases can be identified in the service hub project: the planning phase, the implementation phase and the operational phase. Which problems could be expected in each phase?

Probes to question 3:

- What factors are the most important ones?
- (When relevant in the discussion): How will the concept be affected by the fact that Frihamnen is a new development? Advantages and disadvantages?
- Who should be in charge of solving these problems?
- Which arguments (for and against) for implementing the service hub can be found?
- Which of the phases will bring the most difficult challenges?
- Is it the concept itself that will pose the biggest problem, or is it the transition to this solution?

Purpose of question 3: To examine if there are barriers that can be related to acceptance as well as the transition from a conventional solution to a service hub.

- If the service hub was the mainstream solution today, would we want to switch to our present solution; *i.e.* is the transition itself the main barrier?
- Frihamnen is a new development – how does this affect the planning and implementing?

Question 4 – What arguments can be found, for and against, for combining goods management, waste management and reuse/upcycling?

Probes to question 4:

- Is it desirable to make infrastructure visible (as the service hub is planned to be) and into a meeting place, or should it just work "in the silent"?
- What collaborations could be most difficult to achieve?
- Which collaborations are the easiest to achieve?
- For some of the hub's services, an extra step will be introduced in the logistics chain. What are your opinions on that? Potential problems? Potential positive effects?
- Does the solution require that all practitioners use the same standards within the supplied area?
- Are there any examples of how this has been solved earlier?
    - Could a model from a previous case be applied in this case?
    - Is that a good solution?

Purpose of question 4: To examine if there is a risk that an unnatural cooperation between different parties is induced.

- Are there natural advantages to combining these services?

- Identify barriers connected to cooperation and recognize if and how rival companies can cooperate.
- Will the practitioners benefit from combining the services?

Question 5: How do you think citizens within the covered area will be affected with regard to habits and consumption patterns?

Probes to question 5:

- Will there be an increase or decrease in: consumption, generation of waste, recycling or reuse?
- Will consumption be facilitated by the use of the service hub (since goods will be delivered all the way home to the consumers)? How will reuse be affected?
- (If you think e-commerce will increase): Is there a risk that more transports will be needed outside of Frihamnen because of increased e-commerce?
- What do you think will happen to the total amount of transports? Locally and globally.
- Are there any more rebound effects?
    - Caused by potentially increased reuse?
    - Caused by potentially increased e-commerce?

Purpose of question 5: To examine if there are any side effects on environmental and resource sustainability.

- Will rebound effects of some kinds emerge?
- Is there a risk for increased total transports globally?
- Is the solution sustainable – can it survive?