CHALMERS
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Collaboration in a complex urban freight transport system

A case study in the area Innanför Vallgraven in Gothenburg

Master's thesis at Challenge Lab

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Abstract

Freight transports are an essential part of society as they enable both social and economic value. However, there are challenges connected to freight transports. Especially urban areas, where over 90 per cent of the Swedes will live in 2050, face challenges such as congestion, emissions and noise. The purpose of this report is to explore the opportunities for transitions towards a sustainable development of the urban freight transport system in the area *Innanför Vallgraven* in Gothenburg. Two research questions are supporting the purpose.

1. **What are the main characteristics of the urban freight transport system, in the area IV and what are the barriers against sustainable development of the urban freight transport system in the area IV?**
2. **How can stakeholders in the area organize collaboration towards a more sustainable urban freight transport system?**

The urban freight transport system is complex as it is influenced by different factors such as many stakeholders with sometimes conflicting interests and decisions on infrastructure and city planning. Furthermore, it has impacts on the sustainable development of a city in terms of economic, environmental and social sustainability.

In this thesis the multilevel perspective is used as a theoretical framework to describe the complex urban freight system. In semi-structured expert interviews and Delphi surveys, stakeholders were involved and described their view on characteristics of the urban freight transport system. In follow-up interviews with participants from the Delphi survey it was explored how stakeholders could collaborate towards a more sustainable urban freight transport system. The interviews were based on measures and barriers that the stakeholders had identified in the Delphi study to give them ownership of the problem.

After analyzing the data the desirable future, characteristics of the system and possible ways to use collaboration for transitions were identified. The characteristics of the system were multi-stakeholder environment, fragmented deliveries, an increased use of light trucks, time regulations on vehicle types and collaboration in an FQP. Sustainable development in the system is hindered by low economic profitability of alternative transport modes, regulations, a lack of shared system understanding and goal communication as well as a lack of incentives for more sustainable transports. In the

thesis a high interest for collaboration as a tool for understanding in-between stakeholders and to improve efficiency in the urban freight transport system could be identified. A broad collaboration network is already well functioning in Gothenburg, but there is a need to have a smaller collaboration network where specific problems for the area *Innanför Vallgraven* can be addressed. Thus, it is suggested to involve relevant stakeholders in the area in a group that systematically addresses problems and implements solutions in the area.

Keywords: urban freight transport; complex system; multi-level perspective; collaboration; stakeholder involvement; Delphi method

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Abbreviations

FQP Freight Quality Partnership

IV Innanför Vallgraven (Inside the moat)

JKP Joint Knowledge Production

LFNG Local Freight Network Gothenburg

MLP Multi-Level Perspective

PDCA Plan Do Check Act

SSA Shared Situational Awareness

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Introduction

Within our everyday lives, we use services provided by the society. We have supply of energy to our home and office and we get fresh avocados from the other side of the world at a supermarket just down the street. There are also intangible services in the society that we use or are depended on, such as the economic market, laws, and regulations (Geels, 2005). At the same time, some of the services in society feeding us today will have huge negative effects on how we live tomorrow. Looking at Brundtland´s definition about sustainable development one realizes that some of the services in society today need to change. Because some of the things that we do today, to meet our needs, will compromise or are already compromising the ability for others to meet their needs.

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*
>
> Brundtland's definition of sustainable development (WCED, 1987, p. 17).

Many of the problems that can hinder future generations' ability to fulfil their needs, such as global warming, pollution, humanity´s impact on the environment and diseases, often have their origins in cities (West, 2011). The United Nations (2019) state that 90% of urban dwellers are breathing polluted air which, in 2016, led to 4.2 million deaths. At the same time cities enable people to advance economically and socially. In cities ideas are created, science evolves and productivity increases. The United Nations (2018) have estimated that 60 percent of the world population will live in cities by 2030. In Europe 73 percent of the residents were living in urban areas in 2010 (European Union, 2017). In 2050 the percentage for Europe is expected to be more than 80 percent and over 90 percent in Sweden. The United Nations (2015, p. 9) state in *Transforming our world: the 2030 Agenda for Sustainable Development* that *"We recognize that sustainable urban*

development and management are crucial to the quality of life of our people". Sustainable development in cities is also one of the seventeen sustainable development goals stated by the United Nations. *"Goal 11: make cities inclusive, safe, resilient and sustainable"* (United Nations, 2019).

Figure 1. Illustration of the seventeen goals for sustainable development with extra focus on cities (United Nations, 2019).

1.1. Background, urban freight transport

> *Take a moment to look around the room you are in right now. Whether it's your home, place of work or favourite cafe, every item that you see was brought here from places around the corner or the globe by the goods movement system.*
>
> Barone and Roach (2016, p. 7)

One essential function in society and especially in cities, that leads to congestion, pollution, noise and sets demand on the infrastructure, is freight transport (OECD, 2003). Transports of goods have increased as globalization and new advanced technologies have increased, and the behaviour of consumers has changed. The supply chain between manufacturers, suppliers, and customers has developed to be worldwide, leading to an increased demand for transports. If these demands are not fulfilled, as if the supply chain is disturbed or is, for some reason, paused it will have huge consequences. Within one day, supplies at hospitals will start to run out, within two days many service stations will run out of fuel and grocery stores will run out of perishables within three days (FHWA., 2009).

Lindholm (2012) regards the transportation of goods as a driver of urban economies and remarks that a liveable city with all its offerings such as restaurants, shops, and

employment needs transport of goods. The importance of urban freight transport for the liveability of cities is also emphasized by Barone and Roach (2016) who describe challenges and solutions for efficient urban freight transport. Freight transport does not only provide thousands of jobs but also services that are needed for the urban economy (Dablanc, 2011). It is thus a fundamental component of life in urban areas (OECD, 2003). OECD (2003) states that urban transports provide the everyday needs of goods, e.g. books, food, clothes, cars and computers which are produced in a different place as they are needed or wanted. Other flows of goods in urban areas are transports of waste, transports of bulk materials and service transports (Behrends, Lindholm, & Woxenius, 2008). Service transports are activities that in some way provide a service, e.g. maintenance of products. Different operators carry out the transports and provide, companies, households, businesses, shops, etc. with goods at a specific time and to a specific place (Dablanc, 2011).

Both OECD (2003) and Behrends et al. (2008) state that the delivery of goods in urban areas is only one part of the supply chain. A majority of the products and components which are shipped into the urban area are produced somewhere outside the area (Behrends et al., 2008). As urban freight transports, are so interrelated with other areas of transports they have to be considered with a broad system perspective (OECD, 2003). Browne, Nemoto, Visser, and Whiteing (2004) state that most of the urban goods transports are performed by private companies. However, the public needs to be involved for several reasons, e.g. dealing with negative external factors such as air pollution and road congestion, coordinating with other public authorities and issues that are cross-border an international supply chain. Despite urban transports' importance for economic growth and citizens' access to basic necessities of life, city planning has mainly focused on public transport (Barone & Roach, 2016; Lindholm, 2012). However, in the latest years research in the field of urban transport has increased and there is a higher awareness of the importance of urban freight transport for cities (Quak, Lindholm, Tavasszy, & Browne, 2016).

1.2. Urban freight transports in Gothenburg

The city of Gothenburg in western Sweden had in early 2019 almost 600 000 inhabitants (SCB, 2019). Like any other city, Gothenburg is dependent on freight and the transports connected to the freight. The traffic situation in Gothenburg is a topic of public debate in the city. For example, in 2019, freight companies operating in the city initiated a meeting with politicians as they were concerned about developments in the traffic system (Yousuf, 2019). At the same time as there are problems for the transporters, there are attempts to improve the sustainability of freight transports in Gothenburg. The local freight network (hereafter called the LFNG for Local Freight Network Gothenburg) is a collaboration platform that focuses on freight transports in the city of Gothenburg (Lindholm, 2014). The objective of the LFNG is to be an arena for discussion and for

sharing knowledge and experiences. The goal is to increase the level of understanding among stakeholders and to give proposals regarding urban freight transports. The LFNG has meetings four times a year with about 20 participants e.g. haulage contractors, business owners, local authorities and property owners. Furthermore, two organizations are working with consolidation of goods in different parts of the city. City deliver V *(City deliver Vallgraven)* is located in the city centre of Gothenburg in an area called "Innanför Vallgraven" (hereafter called IV), which translates to *inside the moat*. The area IV consists mostly of stores, restaurants, pubs, and offices which means a high demand of freight deliveries to the area. There are some streets in the area that have a regulation prohibiting access for trucks over 3,5 tonnes from 11 am to 5 am. Furthermore, at the time this thesis is conducted, spring 2019, there is a lot of construction work both in and around the area. Two transport companies are connected to city deliver V which means that they deliver parcels to a consolidation centre outside the area from which the last-mile transport with small electric vehicles is conducted by city deliver V. City deliver L delivers parcels to a C/O address shared by businesses in an urban premise in another part of the city. City deliver L combines delivery of goods with waste collection from businesses in the urban premise it serves.

Figure 2. Layout of the area "Innanför Vallgraven" (IV) outlined in black.

1.3. Thesis context, Challenge Lab

At the same time as there are huge problems in society a lot of people and organizations work for changes and transitions towards more sustainability. One place that tries to do that is Challenge Lab, at Chalmers University of Technology, which is an arena that *"creates space for students from different master programs to – in collaboration with stakeholders from industry, academia, public sector, as well as civil society – identify questions that will guide us from today's system to a sustainable future"*. During the

spring each year 12-16 students do six to eight master theses in the arena. This thesis is conducted by two students in Challenge Lab during the spring of 2019.

Challenge lab has since launched in January 2014 (Holmberg, 2014) been an arena where students can find stakeholders and create collaboration with them (Challange Lab, 2019). The stakeholders are representatives of organizations from the private and the public sector, including industry, civil society, and academia. Challenge lab has the mission to be a student-driven transition arena and to provide a natural hub that builds trust through the students which can be considered as challenging but in a non-threatening way. Furthermore, the students get unique opportunities to develop multidisciplinary work by taking a challenge-driven perspective.

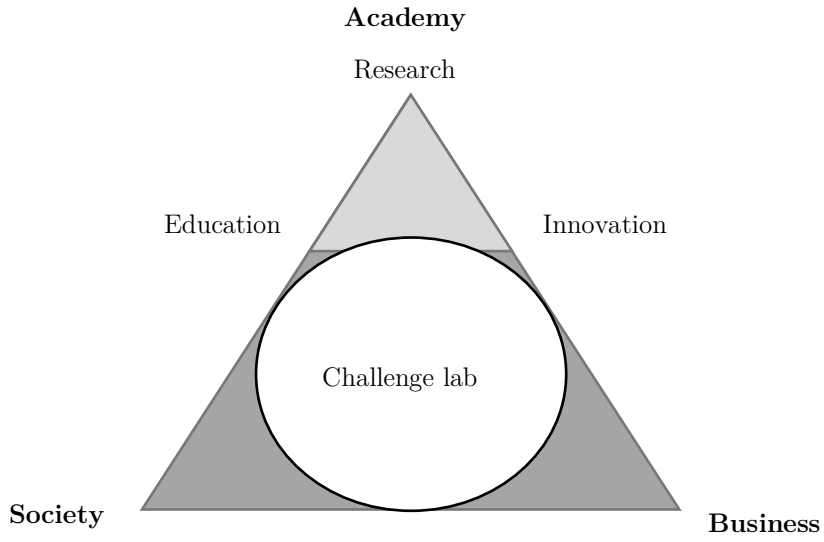

Figure 3. Academy, society and business triad. (adapted from Holmberg (2014)).

Students participating in Challenge Lab write their master's theses about sustainability challenges in the *Västra Götaland region* in the setting of Challenge Lab. The main focus is to work with system innovation in a sustainability-driven way. Furthermore, both an inside-out and an outside-in perspective is used. The inside-out perspective focuses on the exportation of motivation and drive from inside of the students. This is done by defining values and strengths that are of personal value and gives a unique sense of self ownership and importance of the thesis. The outside-in perspective is the more traditional way of learning, by looking at established theories and methods. The master thesis process in Challenge lab is divided in two phases, *Phase I* and *Phase II*. Phase I is about the theories, methods and work done to find a research question and a purpose based on

identified leverage points in society. Phase I is described in *Appendix I Report, phase I. Phase II* is about fulfilling the purpose.

1.3.1. Summary of phase I

During phase I the students used the backcasting approach to identify leverage points for phase II. The backcasting approach consists of four steps, firstly identifying criteria for a desirable sustainable future (see step 1 in Figure 4). Secondly, the present situation is analyzed and gaps between the desirable future (step 1) and the present situation are identified (see step 2 in Figure 4). Thirdly, leverage points that could bridge the gaps are identified (see step 3 in Figure 4). In the fourth step strategies that could be used to realize the leverage point are created (see step 4 in Figure 4). From leverage points in the third step the students framed a research question to work with in phase II.

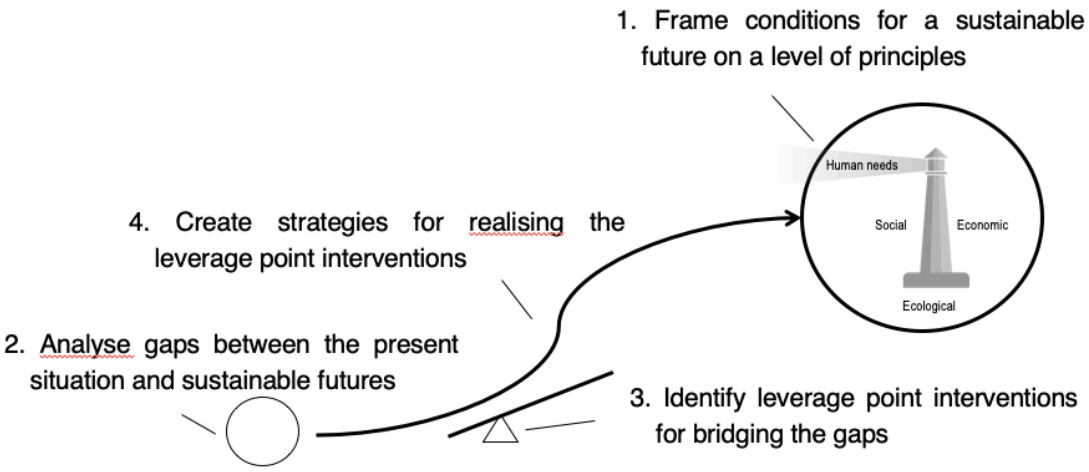

Figure 4. The different steps in the backcasting process. Holmberg (1998) and Holmberg & Larsson (2018)

Some examples of criteria that students identified for a sustainable future are, *freedom, safety* and *love and belonging*. These are connected to the dimension of *(future) human needs and wellbeing.* The other dimensions are *economic, social and ecological sustainability*. Some examples for these are *optimal use of non-renewable natural resources (economic), fair distribution of resources and knowledge with a culture of sharing and generosity (social)* and *use only the amount of resources that are renewable, not depleting resources (ecological).* These criteria, together with the other ones are presented in *Appendix I Report, phase I.* The identified criteria guide the thesis process, both in phase I and phase II, on a holistic level.

In *Phase I* students in the Challenge Lab focused on three thematic areas *food and health, energy, materials and recourses,* and *mobility.* A system mapping for each thematic area was conducted. The system mappings were partly based on the experience and knowledge of the students but also on perspectives from stakeholders connected to the different thematic areas. Stakeholders' perspectives were assessed in seven dialogues with 24

stakeholders. In every dialogue, two to five stakeholders and three to four students were actively participating.

Regarding the topic of mobility stakeholders emphasized that urbanization sets high demands on the cities. Furthermore, there is an on-demand need, which means that consumers want certain things to a certain place at a certain time. The transport system in the region is mainly based on trucks (for goods) and cars (for humans) which makes it flexible, but puts pressure on the climate and the environment. However, it could be seen that new solutions emerge such as electric busses (for humans) and small electric delivery vehicles (for goods).

1.3.2. Formulating the gap

The gap between the present situation and the desirable sustainable future was analysed and formulated. The gap that the authors of this thesis chose as starting point for their research concerned how sustainable transitions in Gothenburg's transport system can be enabled. However, to narrow down the scope, sustainable transitions for transport of goods in urban areas were chosen as a research topic. In order to narrow down the gap even more the urban area was limited to a specific geographical area, the area IV (see Figure 2). This was done in the end of phase I and in the beginning of phase II. The gap was used to formulate the purpose and research questions for the thesis. Throughout the research process in phase II, the research question was adapted several times.

1.4. Purpose and research questions

The purpose is to explore barriers against transitions towards a more sustainable urban freight transport system in the inner city of Gothenburg as well as to explore how stakeholders could collaborate to achieve changes towards higher sustainability in the system. A case study about the urban freight transport system in the area IV in Gothenburg is conducted. Stakeholders are involved in identifying guiding principles for a desirable future as well as in describing today's urban transport system.

Two research questions are supporting the purpose. The first question aims to identify what, in regard to urban freight transport, is hindering or could hinder transitions towards sustainability. As transitions are affected by and affect a lot of aspects a system perspective is used to describe urban freight transports in the case area. The second research question aims to identify in what ways the actors can use collaboration to develop the urban freight transport system.

1. **What are the main characteristics of the urban freight transport system, in the area IV and what are the barriers against sustainable development of the urban freight transport system in the area IV?**
2. **How can stakeholders in the area organize collaboration towards a more sustainable urban freight transport system?**

1.5. Limitations

The research in this thesis is limited with freight transport and will thus not consider transport of people. Freight is considered as everything, except humans, that is transported from, to or by professionals in, into or out from the area IV. Freight transport is considered as the movement of vehicles which move goods or has the purpose to move goods i.e. a truck that has delivered goods or should collect freight and is empty is still considered as freight transport. However, the main focus is on the freight that is transported to or from retailers in the area by a freight carrier of any kind. The research is limited to freight transports to or from the area IV. However, as the purpose is to study the system for urban freight transport aspects from outside the area IV will be considered if there is a connection to the freight transports conducted in the area. Stakeholders who are participating in the research are concerned with urban freight transports in and around Gothenburg. Due to time constraints and a lack of response from some stakeholders the thesis does not include every single actor concerned with urban freight transport in the area IV but a representative sample.

1.6. Thesis outline

The theories, methods, results and discussion from phase I is described in *Appendix I Report, phase I.* The report of phase I describes how the first leverage points and research question were identified. As the purpose and the research question changed a lot during the beginning of phase II, the report from phase I mainly gives a background to the thesis context. A summary of the first phase is presented in *1.3 Thesis context.*

The major part, phase II, is presented in seven chapters. The aim is to fulfil the purpose and answer the research questions presented in Chapter *1.4 Purpose and research questions.*

Chapter *2 Literature on urban freight transport* provides an understanding for urban freight transport based on previous research. The research is reviewed in order to compare it with the data collected in this thesis.

Chapter *3 Theoretical framework* describes the theoretical lens that the research has. The framework is used in all the research and aims to give new perspectives on the characteristics of the urban freight transport system and how collaborations could be used for transitions in the system.

Chapter *4 Method* presents the methods used in the research. The methods used aim to identify the characteristic of the urban fright transport system in the area IV and how stakeholders could work with collaboration.

Chapter *5 Results* describes the collected and analyzed data. The results are used to describe the characteristic of the urban fright transport system in the area IV and how stakeholders could work with collaboration.

Chapter *6 Discussion* provides a discussion of the research done in this thesis. The discussion is based on the other chapters in the thesis and mainly aims to find answers to the research questions and critically evaluate the research done.

Chapter *7 Conclusion* presents the conclusions from the research. The conclusions are based on the discussion.

2

Literature on urban freight transport

This chapter aims to give an understanding of urban freight transport through a literature review. Verlinde (2015) states that one type of research in urban freight transport aims to improve basic knowledge about how things have developed and what is expected in the future. Another type is to look at new ideas and how these could be implemented. When studying freight transports guiding fundamental questions can be used (Quak, 2008). The question *How?* is used to study the characteristics of transports and aims to explain the characteristics of urban freight transport. The question *Why?* is used to explain the importance of urban freight transports and why sustainable transitions are needed for urban freight transport. This is also connected to the question *How?* referring to how changes in urban freight transport happen. The question *Who?* together with the questions *Why?* and *How?* is used to identify and understand the organizations, individuals and societal groups that affect or are affected by urban freight transport.

This theory section follows a similar approach and starts by reviewing how urban freight transport is defined at chapter *2.1 Definition of urban freight transport* by reviewing different definitions of urban freight transport. Chapter *2.2 Sustainable urban freight transport* aims to describe economic, environmental and social sustainability aspects of urban freight transport and why there is a need for transitions. This is followed by chapter *2.3 Changes in urban freight transport* which describes why changes in urban freight transport happen and how the changes happen which includes trends, measures, and policies in or for urban freight transport. Chapter *2.4 Stakeholders in urban freight transport* describes who are affected by or affect urban freight transport and in what way

they are connected to changes. Lastly, chapter *2.5 Collaboration in urban freight transport* describes different approaches on how and why collaboration is used to make changes for urban freight transport and which stakeholders should be involved in collaborations.

2.1. Definition of urban freight transport

Various terms are employed to refer to transportation of goods in urban areas (Lindholm, 2012; Transmodal, 2012; Verlinde, 2015; Wiki Civitas, 2015). The terms *urban freight, city logistics,* and *urban distribution* are most commonly used (Lindholm, 2012). OECD (2003) uses the term *Urban goods transport* but also states that similar terms, as *urban freight transport, urban goods distribution* and *urban freight transport* often are used with the same meaning. According to Verlinde (2015, p. 1) the different definitions have in common that all of them regard the aspects of transportation, geography, and commodities. This means that the definitions usually relate to *movement* and *transport* (transport aspect) and that the adjective *urban* is used when referring to freight that is transported to, from or within an urban area (geography aspect). When it comes to the commodities aspect, most differences between the various definitions can be ascertained (Verlinde, 2015). Depending on the context the definitions are used in, authors can provide a high level of detail in their definitions (Lindholm, 2012). Verlinde (2015) and Lindholm (2012) state that most authors lack transport service and shopping trips by private persons (Lindholm, 2012) in their definitions.

Urban freight transport is defined by Dablanc (2011) as all movements of goods that are generated from local businesses‘ economic needs, e.g. deliveries and collection of mail, materials, consumables, refuse and supplies that are needed for a business to operate. Furthermore, it also includes commercial transactions to homes. OECD (2003) defines urban goods transports as consumer goods that are delivered, both by retailers and other sectors in cities and suburban areas. This also includes used goods in the reverse flow in terms of clean waste. Transmodal (2012) simply defines urban freight transport as freight vehicles movement with the main purpose to carry goods within, into and out from an urban area. Allen, Anderson, Browne, and Jones (2000) define urban freight transports as firstly, vehicles of all sizes and types that are used to deliver and collect goods in urban areas, e.g. movement of heavy vehicles, light trucks, cars, and mopeds. Secondly, they define it as vehicle goods movements from, to and between premises in the urban area e.g. ancillary goods, such as plastic bags, light bulbs, waste collection, home deliveries, and money deliveries. Thirdly, trips made for commercial purposes which are essential for the urban premises to function and which are carried out by service vehicles or other vehicles are included in the definition. Behrends et al. (2008) define urban freight transport as, provision of raw materials and semi-manufactured articles to industry, provisions of customer goods to stores and wholesalers, produced consumer goods that are in- and out-bound and professional operators conducting home deliveries. Transit

transports of goods, i.e. traffic that passes through a city, with no purpose for the households or the businesses in the city are also defined as goods transports by Behrends et al. (2008) but not by Dablanc (2011) and OECD (2003). Behrends et al. (2008) exclude building-, demolition-, and waste traffic in the definition. Furthermore, goods transported by households, like shopping trips made by private persons are excluded by both Behrends et al. (2008) and Dablanc (2011). This somewhat confirms Lindholm's (2012) statement that shopping trips by private persons are not included in most definitions for urban freight transport. Lindholm (2012, p. 6) suggest another definition of urban freight transport, *"…all movements of goods (as distinct from people) in to, out from, through or within the urban area made by light or heavy vehicles, including also service transport and demolition traffic, shopping trips made by private households and waste (reversed logistics)".* The definition aims to be used by local authorities and thus attempts to include "as much of the goods movements as possible" (Lindholm, 2012, p. 6). In order to decide on relevant approaches that consider various aspects and requirements local authorities need to cope with the complexity of urban freight transport by attempting to include all goods movements in urban areas and the interrelatedness between them. To use a broad definition, is also emphasized by Allen et al. (2000), especially when considering all activities by commercial vehicles on premises and thinking about how transport-related policy changes would affect the functioning of these urban premises.

This thesis follows Lindholm's (2012, p.6) definition for goods transports in urban areas. As the thesis takes a holistic perspective on urban freight transport in order to map the freight transport system in the area IV a broad definition as suggested by Lindholm (2012) and Allen et al. (2000) is regarded as useful. Exploring barriers against a sustainable urban freight transport system as done in this thesis requires an understanding for the system as a whole and casual relationships in the system. By taking a broad approach the complexity of the urban freight transport system can be dealt with and effects from policy changes on the functioning of the system can be considered.

2.2. Sustainable urban freight transport

Urban freight transport is essential for liveability and economic growth in cities but does also have negative impacts on urban life. For a long time little attention has been directed towards urban freight transport in cities (Browne, Piotrowska, Woodburn, & Allen, 2007; Kiba-Janiak, 2017; Lindholm, 2012; Verlinde & Macharis, 2016). However, a study involving 43 European cities shows that negative impacts of urban freight transport are a concern for local authorities in cities (Ruesch & Gluecker, 2001). In the study, cities were given a list of urban freight problems and were asked to rank the problems on a scale of one to five from very important to less important problems. The participating cities could also add problems to the list. The top six problems received an average score of 2.07 to 2.3. Among the top six problems, two problems were concerned with negative environmental impacts from urban freight transport: noise emissions (2.14) and

environmental pollution (2.3). Further, three of the top six problems could be linked to infrastructural problems concerning streets and delivery points: Lack of suitable infrastructure for deliveries (2.07), conflicts with other road users during delivery operations (2.16) and access of goods vehicles to pedestrian zones or historic centers (2.19). This somewhat confirms Cui, Dodson, and Hall (2015) statement that urban freight transport is affected by influencing factors such as infrastructure quality and the composition of freight flows. In the study, cities were further asked which main issues concerning urban freight they regard as important within the cities. The top six issues got an average score from 1.93 to 2.28 and mainly included issues of organization, coordination and information: Co-operation among all local actors (1.93), information to goods transport professionals, drivers, retailers on existing rules and regulations, available pickup/delivery areas parking spaces for goods vehicles, transit itineraries (2.16), co-ordinated urban freight policy: better collaboration among various city departments and local organizations and better co-operation between cities within the metropolitan area (2.23), integration of urban freight in transport policy and mobility planning (2.28), integration of urban freight in town planning and land-use/infrastructure planning. The need for taking urban freight transport into account in city planning is also emphasized by Lindholm and Behrends (2012) and Kiba-Janiak (2017). The importance of coordination between different actors in the urban freight transport system is also highlighted by several authors who in their research attempt to improve collaboration between stakeholders in urban freight transport (Lindholm, 2014; Nesterova & Quak, 2016).

Problems in urban freight transport as presented in the study by Ruesch & Gluecker (2001) can be described as environmental, social and economic problems. The impacts and objectives connected to sustainable urban freight transport have been evaluated by many authors (Anderson, Allen, & Browne, 2005; Behrends et al., 2008; Maclaren, 1996; Russo & Comi, 2012). Already in 1996 Maclaren (1996) stated that almost everyone who had tried to define urban sustainability agrees on that it is necessary for the future of cities to discuss the environmental impacts in the policy debate. Anderson et al. (2005) state that road freight vehicles that are operating in an urban area generally emit a higher proportion of certain pollutants per travelled kilometre, compared to other motor vehicles as freight vehicles have higher fuel consumption per unit of distance travelled. However, there should still be an approach that balances all dimensions of sustainability, environmental as well as economic and social.

May et al. (2001) define the sustainable urban transport and land use system in three groups. The first focuses on accessibility to all inhabitants in the urban area by providing them with an efficient way to access goods and services. The second focuses on the present generation's life quality by protecting the cultural heritage, ecosystem, and environment. The third focus is directed towards the opportunities for future generations who should reach, as a minimum, the same welfare levels as of today. This also includes

the welfare from the cultural heritage and the natural environment. All three groups are in line with the Brundtland-definition of sustainable development. Simply put, as the needs of today, mentioned in the first and second group have to be met, without compromising the possibilities in the future, as mentioned in the third group (WCED, 1987).

Anderson et al. (2005) and Behrends et al. (2008) state that a key problem that hinders the implementation of an achievable sustainable strategy for urban freight transport is the determination of measurement parameters. It is necessary for the actors that are involved in urban freight transport to have an applicable and understandable set of indicators in order to define actions and measures. In the literature, there are different indicators for different goals and outcomes (Russo & Comi, 2012). Maclaren (1996) explains that urban sustainability indicators should be, integrating, forward-looking, distributional and developed based on input from multiple stakeholders. The impacts, objectives, and indicators are connected to the general sustainable development principles and should apply to both the present and to future generations. The sustainable urban freight transport includes impacts, objectives, and indicators for economic, environmental, and social sustainability (Anderson et al., 2005; Behrends et al., 2008; Lindholm, 2012; Maclaren, 1996; Russo & Comi, 2012).

2.2.1. Impacts, objectives and indicators for economic sustainability

Anderson et al. (2005) group the impacts on economic sustainability as**,** inefficiency, congestion and resource waste. Economic inefficiency or economic efficiency concerns inhabitants' utility for markets and is one of six sub-objectives stated by May et al. (2001). May et al. (2001) explain that there should be economic efficiency in the markets for housing, transport, and labour. Furthermore, there should be economic efficiency in housing provision and in infrastructure. May et al. (2001) name economic growth as a sub-objective. Congestion is stated as an indicator by Russo and Comi (2012) in terms of extra travel time, travel speed, etc. Furthermore, indicators stated by Russo and Comi (2012) are the length of trips, time to delivery and costs for the infrastructure. An overall objective that a sustainable urban freight transport system should fulfil is to improve the energy- and resource efficiency and the cost-effectiveness for transportation of goods (Behrends et al., 2008).

2.2.2. Impacts, objectives and indicators for environmental sustainability

Anderson et al. (2005) group impacts on environmental sustainability as; the polluters' emissions (e.g. carbon dioxide); use of land, non-renewable fossil fuels; waste products (e.g. oil, tires), the wildlife habitat loss and threat to wild species. May et al. (2001) name the protection of the environment as an objective which includes reduced, (i) use of non-renewable recourses, (ii) energy used in transport and the distributing system,

(iii) regional emissions of NOx and SO2 and thereby the regional pollution, (iv) local health problems and damages from emissions of NMVOC and PM10, (v) land take and sprawl for transport purposes, (vi) infrastructure fragmentation and settlement in bio-diversity, (vii) activities in areas that are particularly vulnerable (viii) number of people that are, from transport, exposed to vibration and noise. Furthermore, it includes (ix) the protection of natural habitats, agriculture lands, green areas, recreational areas, and heritage sites. The (i) *use of non-renewable recourses* is mentioned by Maclaren (1996) as a key characteristic for urban sustainability and May et al. (2001) state that the objectives ii to ix can be seen as cases of the first one (i). The indicators for environmental sustainability are categorized by Russo and Comi (2012) as, habitat loss and reduction of noise and pollutants. An overall objective that a sustainable urban freight transport system should fulfil is to reduce greenhouse gas emissions, air pollution, noise, and waste to a level where there is no negative impact on the nature or on the health of citizens (Behrends et al., 2008).

2.2.3. Impacts, objectives and indicators for social sustainability

Anderson et al. (2005) group the impacts of social sustainability as; physical consequences on the public health from pollutant emissions; injuries and death from traffic accidents; noise; visual intrusion; difficulties to make essential trips without a suitable public transport or car and other issues connected to the quality of life. May et al. (2001) present three objectives connected to this; liveable streets and neighbourhoods; equity and social inclusion; and safety and severity of traffic accidents. The first objective focuses on the conditions of streets and outdoor life in urban areas, including more freedom for the road users that are vulnerable. Connected to this there should be a reduced risk for traffic accidents. Furthermore, it includes that transport strategies should give positive external effects on cultural, recreational and social activities in urban areas. This can also be connected to Maclaren (1996) focus on individual well-being and fulfilling of basic human needs. Equity and social inclusion consist of, fair shares on the market, compensation to losers, economize on taxpayers money and accessibility for those that are mobility impaired or without a car (May et al., 2001). Equity is also stated by Maclaren (1996) as one of the key characteristics of urban sustainability.

Indicators for social sustainability are presented by Russo and Comi (2012) as the city's liveability and reduction of road accidents, operating vehicles and interferences for the parts of urban mobility, (e.g. truck, car, pedestrians). Behrends et al. (2008) conclude that the overall objective for social sustainability as contribution to the urban environments is the enhancement of quality and attractiveness, without compromising citizens mobility, minimizing land use and avoiding accidents. To be able to meet the objectives for social, economic and environmental sustainability in urban freight transport changes are needed (Tanguchi et al). At the same time as some measures are

taken to improve sustainability for urban freight transports, there are trends that change the urban freight transport system and impact all aspects of sustainability.

2.3. Changes in urban freight transport

Urban freight transport is essential for the liveability and economic growth in cities which provide incentives to make the transport more efficient, in terms of economic sustainability (Thompson & Taniguchi, 2007). Urban freight transports have negative impacts on urban life, e.g. congestion, environmental nuisance, safety problems, energy consumption of freight vehicles, visual intrusion and unsustainable infrastructure. This sets demands to make the transport more efficient in terms of social and environmental sustainability. There are different ways for how changes happen in urban freight transport. Overall changes that are happening in society and affect urban freight transports can be considered as trends. Measures can be developed and implemented for urban freight transports to reduce the negative impacts of urban freight transport. In this context, a "measure" refers to a specific action that is taken in order to address a specific problem related to urban freight transport. Measures can be initiated by private companies but do also include policies by public authorities.

2.3.1. Trends in urban freight transport

Today, 50% of the global population is living in cities and by 2045, the number of people living in urban areas is expected to increase by 1,5 times (Worldbank, 2019). With an increasing number of people living in cities and more than 80% of global GDP generated in urban areas cities are crucial to sustainable economic growth (Worldbank, 2019). Besides urbanization, several authors name growing e-commerce as a trend influencing urban freight transport (Cherrett et al., 2012; OECD, 2003; Thompson & Taniguchi, 2007). According to Thaller, Niemann, Dahmen, Clausen, and Leerkamp (2017) urbanization, increasing e-commerce and increased storage costs for businesses in cities results in a growing demand for small-scaled shipments delivered at a higher frequency. Due to the increased frequency of shipments the number of small- and medium sized vehicles used in urban freight transport increases as well. A higher demand for just-in time deliveries as a cause for increasing transports in urban freight transport is also mentioned by (Cherrett et al., 2012; OECD, 2003; Thompson & Taniguchi, 2007). Verlinde (2015) states that urbanization and growing e-commerce are among the trends often cited by authors in their research in the field of urban freight transport. However, Verlinde (2015) means that a more detailed picture of trends in urban freight can be provided and divides trends in the categories population trends, policy trends, commercial trends and transport trends. Browne et al. (2007) uses the same categories

as Verlinde (2015) but adds the category land use planning trends. The trends are described based on Verlinde (2015) and Browne et al. (2007):

- Land use planning trends
    - Due to higher restrictions for retail establishments out of town, city centers are expected to grow resulting in more deliveries and probably a higher amount of vehicles delivering the goods.
- Population trends
    - Besides urbanization an increasing share of older people in the population who moves to city centers is included in this category. Further, an increasing number of connected devices per person leading to a demand for faster delivery is mentioned.
- Policy trends
    - Climate goals which force private and public actors to reduce emissions as well as a trend towards increased awareness of urban freight in city planning is included in this category. Further, it is mentioned that costs caused by policy measures are likely to be transferred to customers which can affect the market negatively.
- Commercial trends
    - Besides trends towards home delivery and growing e-commerce the general increase in customer demands which leads to the continuous provision of new offerings is named. Regarding home deliveries the trend to return products and thus putting further requirements on logistics operations is mentioned. Furthermore, increasing home deliveries and e-commerce are likely to force retailers to provide more delivery options. In the retail business a shift from smaller stores to stores owned by retail groups can be observed leading to larger vehicles in the streets which deliver goods from retailer-controlled distribution centres to the stores. Moreover, a preference among customers for small stores in cities instead of large shopping centres outside the city can be observed. In the construction sector a growing number of projects in cities leads to a higher demand for transports often carried out with large vehicles leading to additional congestion. Waste transports are likely to increase due to an increasing in collection of waste that can be recycled.
- Transport trends
    - Transport will mainly be done by road but a trend towards smaller vehicles driven with alternative fuels can be observed. Moreover, a trend towards

consolidated deliveries and horizontal collaboration between logistics service companies can be seen.

2.3.2. Urban freight transport measures

Several research projects attempt to provide an overview over measures tested and/ or implemented in various cities (Allen, Thorne, & Browne, 2007; Barone & Roach, 2016; Browne et al., 2007; Roche-Cerasi, 2012; Transmodal, 2012) Common characteristics can be used to categorize different measures in urban freight transport. Roche-Cerasi (2012) and Wangsness and Johansen (2014) categorize measures in urban freight transport by spatial layers, namely urban zone, city centre, street area and delivery spaces. Although Wangsness and Johansen (2014) categorize measures by spatial zones they state that it also can be distinguished between measures initiated by businesses, government initiatives and measures as part of research projects. A categorization by measures implemented by public authorities and measures implemented by the private sector is also used by Transmodal (2012) and Browne et al. (2007). Regarding measures implemented by public authorities Transmodal (2012) further distinguishes between market-based measures, regulations, land use and infrastructure. Further, the authors remark that measures implemented by the private sector can depict the result of incentives initiated by public authorities to achieve changes in private stakeholders' behaviour. Browne et al. (2007) describe measures by the private sector as company-driven change and state that these measures are implemented when companies receive internal benefits from it, i.e improved fuel efficiency of vehicle, deliveries outside normal hours for freight delivery, consolidation of urban freight to increase the vehicle load factor. Some authors classify urban freight measures by topics such as urban consolidation centre and loading approaches (Allen et al., 2007; Ruesch & Bohne, 2013). Measures often include the interaction of different stakeholders, which can be between private actors, between public actors or between both private and public actors (Wangsness & Johansen, 2014). According to Browne et al. (2007) a combination of initiatives by companies and public policies will be needed for transforming the urban freight system into a sustainable one.

2.3.3. Urban freight transport policies

As issues connected to urban freight transports are at the local level OECD (2003) states that urban freight transport, in most countries, mainly is a local policy matter. However, the need for urban transport is not a top priority (OECD, 2003) and tends to be ignored or neglected in regional transport strategies (Dablanc, 2011) . Compared to policies for passenger transports, Cherrett et al. (2012) explains that urban fright transport policies

are highly undeveloped. When urban freight transport is considered by authorities it is mainly as a reaction to negative environmental impacts.

Ballantyne and Lindholm (2014) and Cherrett et al. (2012) conclude that involvement can be seen when there is a specific problem and a complaint in the urban area concerning transport of goods. The integration of urban freight transport in urban transport planning is not well developed due to a low level of interaction between local authorities and freight stakeholders (Ballantyne & Lindholm, 2014). Three plausible goals for policies in urban freight transports are explained by (Allen et al., 2000). The goals address both environmental and economic concerns. The goals are to improve the performed activities for goods and services,

1. by maximizing the ease and efficiency without worsening the social and environmental impact in the urban area
2. by minimizing social and environmental impacts without worsening the ease and efficiency
3. by both improving the ease and efficiency and at the same time reducing the social and environmental impacts.

Ballantyne and Lindholm (2014) describe that there is a lack of awareness and knowledge for transports of goods in urban areas. There is also a lack of involvement from stakeholders in the planning of transport. Several authors show that the first or one of the first steps to develop urban freight transport is to have regular involvement of stakeholders (Ballantyne & Lindholm, 2014; Lagorio, Pinto, & Golini, 2016; Macharis, Milan, & Verlinde, 2014; Stathopoulos, Valeri, & Marcucci, 2012). When the main stakeholders are identified, measures can be developed and implemented (Stathopoulos et al., 2012). Both market-based measures, such as policies as well as private measures are dependent on the stakeholders in urban freight transport (Transmodal, 2012).

2.4. Stakeholders in urban freight transport

There are different definitions of what a stakeholder is, for example Banville, Landry, Martel, and Boulaire (1998, p. 17) define stakeholders as, *"…people acquire the status of stakeholders because they have vested interest in a problem in any of three different ways: (1) by mainly affecting it; (2) by being mainly affected by it; (3) or by both affecting it and being affected by it*". Freeman (1984, p. 46) simply defines stakeholders as, *"…any group or individual who can affect or is affected by the achievement of the organization's objectives".*

Lagorio et al. (2016) explain that there is no shared and final perspective on how stakeholders should be involved with regard to decision making in urban freight transport. Macharis et al. (2014) conclude that when stakeholders are identified, they should be given different weights in proportion to how much they can affect or are affected by certain decisions. There are different opinions on which actors that should be

considered as stakeholders in regard to city logistics or transports of goods in urban areas. Gonzalez-Feliu and Salanova (2012); and Morana, Gonzalez-Feliu, and Semet (2014) group stakeholders into three categories, *the loaders, the transporters,* and *the owners and management companies*

- *The loaders* can also be called senders and receivers as they are the actors that send and/or receive.
- *The transporters* can be the same actors as *the loaders* if they manage the transport themselves. But it can also be third-party transportation companies that manage transportation for *the loaders.*
- *The owners and management companies* refer to the logistics real estate actors. They own or manage the logistics infrastructure e.g., cross-docks, intermodal platforms, warehouses.

Taylor (2005) and Thompson and Taniguchi (2007) identify four similar but different groups,

- *The shippers* (Taylor, 2005) or *the shippers and receivers (costumers)* (Thompson & Taniguchi, 2007), the manufacturers, wholesalers, and retailers
- *The carriers*, transporters and warehouse companies
- *The residents*, the consumers
- *The planners and regulators* (Taylor, 2005)*/the administrators* (Thompson & Taniguchi, 2007) , on a national, state and city level.

Morana et al. (2014) mention but don't take other stakeholders into account, e.g. highway companies, customs operators and public administrations, as they are *"far less involved and much less important when compared to the three main categories".* However, Ballantyne and Lindholm (2014) stress the importance to include and involve more stakeholders, such as retailers, trade, land and property owners and the local authorities. Local authorities or policy makers are also identified as main stakeholders by Stathopoulos et al. (2012). Behrends (2011); and Browne et al. (2004) also mention wholesalers, shoppers, workers, residents, warehousing and carriers.

In a more recent study by Behrends (2011) with focus on sustainable development, the author divides stakeholders into three groups, *shippers and receivers, authorities, and transport operators*. Lindholm (2012) mentions the same groups but differentiates between actors and stakeholders. An actor is a stakeholder that has a direct influence on the system, all actors are therefore stakeholders, but all stakeholders are not actors.

- Shippers
- Customers
- Authorities
- Freight transport operators.

Lindholm (2012) also mentions other stakeholders that do not have a direct influence on the system. These are vehicle manufacturers, public transport operators, trade associations, commercial organizations, land owners/property owners and non-consuming citizen and visitors. All stakeholder have in one way or another a function and an interest to the consumption of goods (OECD, 2003).

2.4.1. Shippers

The shippers (consignors) are the stakeholders that are sending the freight (Lindholm, 2012). They are the actors who set the supply of goods and services (OECD, 2003) and often order a transport (Lindholm, 2012, 2014). Sometimes they perform the transports themselves, "Own transport", but usually they do not see themselves as vehicle operators. Shippers emphasize efficiency, competitiveness (Lindholm, 2012), accessibility, cost efficiency (OECD, 2003), reliability, security and flexibility (Thompson & Taniguchi, 2007).

2.4.2. Freight transport operators

The freight transport operators are often haulers or third party logistics operators (Lindholm, 2012). They are responsible for the operations connected to the transports such as routing, the vehicles and the efficiency of the transport. The actual transport operation is performed by the driver of the vehicle, who also can be a shipper or receiver but mainly belongs to the group of transport operators. It is important to consider drivers as they affect the operation on a day to day basis. Another group of transport operator, often forgotten, are the service and maintenance operators e.g. window-cleaning services etc. construction logistics. The freight transport operators are mainly concerned about efficiency and accessibility.

2.4.3. Customers/receivers

Lindholm (2012) explains that customers can be both consignees such as shops, restaurants and offices or end customers such as residents and visitors in the urban area. Customers set a demand for goods in the area. They set the demand for the last transport which can be done by the customers themselves e.g. by car, public transport etc. or by a shipper.

According to Lindholm (2012) shop-owners play an important role in urban freight transport as they have the opportunity to influence it by how they order goods. Thompson and Taniguchi (2007) state that the residents' main interest is to minimize traffic as much as possible. Especially large trucks and regardless of the trucks carry necessary freight. The residents' main concerns are to minimize congestions, air pollution, noise and traffic crashes. Other interests for all customers are cost efficiency, environmental issues, safety, the areas attractiveness, reliability, security (Thompson &

Taniguchi, 2007), competitiveness, customer satisfaction and smooth deliveries (Verlinde, 2015).

2.4.4. Administrators/authorities

According to Lindholm (2012) regional and state authorities can affect urban freight transport but local authorities are most important in this group. They all can affect the urban freight transport system by setting laws or regulations. However, local authorities are most involved in setting regulations, creating possibilities and sometime creating barriers for a more efficient urban freight transport system. OECD (2003) explains that the main function of the authorities is to, in a balanced way, divide space and time to the involved parties. Thompson and Taniguchi (2007) state that the main objectives of the authorities are to enhance economic development, to achieve less traffic congestion, to improve the environment and to reduce the number of crashes. Verlinde (2015) mentions the same objectives but adds limited noise nuisance. At the same time as the public authorities pursue these objectives urban freight transport has for a long time received little attention in cities' local transport planning (Cui et al., 2015; Lindholm & Browne, 2013). In recent years several authors have emphasized the need to consider urban freight transport in city planning by involving private and public actors in urban freight in a systematic way via different types of collaborations (Ballantyne, Lindholm, & Whiteing, 2013; Cui et al., 2015; Gammelgaard, Andersen, & Figueroa, 2017; Österle, Aditjandra, Vaghi, Grea, & Zunder, 2015; Verlinde, 2015).

2.5. Collaboration in urban freight transport

Urban freight transport has for a long time received little attention in cities' local transport planning (Cui et al., 2015; Lindholm & Browne, 2013). However, in recent years several authors have emphasized the need to consider urban freight transport in city planning by involving private and public actors in urban freight in a systematic way (Ballantyne et al., 2013; Cui et al., 2015; Gammelgaard et al., 2017; Österle et al., 2015; Verlinde, 2015). Several authors show that the first or one of the first steps to develop urban freight transport is to have regular involvement of stakeholders (Ballantyne & Lindholm, 2014; Lagorio et al., 2016; Macharis et al., 2014; Stathopoulos et al., 2012). When the main stakeholders are identified, problems, complex problems in particular, can be addressed by analysing the different needs/constraints and interactions between them (Stathopoulos et al., 2012).

Lindholm and Browne (2013) confirm that without an understanding for both private and public perspectives, economic, environmental and social sustainability cannot be achieved in urban freight transports. One framework, in which stakeholders can collaborate in regard to urban freight transport is a Public-Private Partnership (PPP) where public and private organizations collaborate to solve problems (Browne et al. 2004). Browne et al. (2004) explain PPP with two definitions, a narrow and a broad one.

The narrow definition explains PPP as particular projects that both the private and the public sector have shared objectives and interests in. These can be formal co-operations in joint ventures where the risk and reward is shared. The broad definition of PPP refers to initiatives, of any kind, where the public and the private sector consult together. The relation between the partners is not formalized or only partly formalized and information is shared. There can be various versions of PPPs in urban freight transport. In the following different approaches for organizing collaboration in PPPs will be explored starting with collaboration in form of information exchange and ending with approaches for more action-driven collaboration.

2.5.1. Freight Quality Partnership

In the context of urban freight transport, PPPs are also referred to as "Freight Quality Partnerships" (FQP) (Lindholm & Browne, 2013). According to Allen, Browne, Piotrowska, and Woodburn (2010) FQPs are partnerships between private and public actors, where problems and solutions are discussed, identified and implemented with the intention to get more sustainable freight transports. Allen et al. (2010) state that involving a wide group of stakeholders from both the private and the public sector provides the opportunity to identify policy measures that would not have been considered otherwise.

Lindholm and Browne (2013) have studied several FQPs in Europe and identified different factors regarding the formation, management and outcome that should be met by urban freight partnerships. Regarding the formation of FQPs they recommend the involvement of relevant stakeholders, objectives that members can relate to as well as political involvement. Further Lindholm and Browne (2013) state that the partnership needs to be manageable meaning that an action plan should be followed, that there should be a strong project management, that the number of participants involved should be between 10 and 20 and that participants should attend regularly. Regarding the outcome of FQPs, Lindholm and Browne (2013) stress the fact that the complexity of the urban freight system needs to be considered and that the partnership should not seek single solutions. Lindholm and Browne (2013) confirm that without an understanding for both private and public perspectives, economic, environmental and social sustainability cannot be achieved in complex urban freight systems. Ballantyne et al (2003) provide a framework that describes the relationship between different actors and stakeholders in order to address the need of higher interaction between local authorities and private stakeholders in urban freight.

Österle et al. (2015) recognize that FQPs as described by Lindholm and Browne (2013) are the most considered partnerships between public and private actors in urban freight. However, Österle et al. (2015) state that there is a need for a structured consultation process in FQP and thus suggest a decision-making framework that facilitates interaction among urban freight stakeholders. The framework presents a participatory approach for

involving stakeholders in planning processes and is composed of four stages, namely: stakeholder analysis, problem analysis, objectives analysis and alternatives analysis. The first stage aims at clarifying stakeholders' perspective on a specific problem and identifying people and organizations that are directly or indirectly affected by the problem. In the problem analysis stage major problems and cause-effect chains are identified before transferring the identified problems into objectives in the next stage. In the last stage alternative options for achieving the objectives and their feasibility are evaluated. According to Österle et al. (2015) the framework aids to get a better understanding of the complexity of an urban freight project. The need to address urban freight problems in a structured way is also highlighted by Taniguchi, Imanishi, Barber, James, and Debauche (2014) who suggest a framework following four steps: problem identification, finding approaches and measures, implementation, and evaluation. Taniguchi et al. (2014) regard FQP as an appropriate platform for involving stakeholders in each stage of the framework and clarify that public authorities have the ultimate responsibility for the process. Taniguchi et al. (2014) emphasize that having a shared ideal situation among all stakeholders is crucial for the success of the process. Both Österle et al. (2015) and Taniguchi et al. (2014) state that it is important to achieve consensus among stakeholders but acknowledge that it can be challenging.

2.5.2. Plan-do-check-act and living lab

The framework suggested by Taniguchi et al. (2014) is a PDCA cycle, known as the plan-do-check-act cycle which is used in an iterative way. The PDCA cycle is also used in a framework for collaboration between urban freight stakeholders in Living Labs, provided by Quak et al., (2016). Quak et al. (2016) suggest stakeholder collaboration in living labs as a more action-driven form of collaboration compared with stakeholder collaboration in FQPs. Quak et al., (2016, p. 468) explain the PDCA cycle in the context of city logistic living labs: In the "plan" phase all stakeholders should be involved and shared objectives and a common system understanding should be established. Moreover, ideas on projects to be implemented are developed. In the "Do" phase concepts are tested and measured. In the "Check" phase the tested concept are evaluated and casual relationships are tried to be understood. Finally, in the "Act" phase adjustments are made based on lessons learned in the previous stage.

Lindholm and Browne (2013) and Quak et al. (2016) regard freight partnerships as an important long-term approach for building trust among stakeholders and exchanging knowledge. However, Quak et al. (2016) state that freight partnerships often not result in common innovative actions and that it can be challenging to engage all participants in decision making and planning. A living lab provides new ways for stakeholders to develop needed collaborations via an action-driven partnership (Nesterova & Quak, 2016). In city logistics living labs such a partnership can be enabled by fulfilling the conditions of inclusiveness, anticipatory capability and responsiveness (Nesterova &

Quak, 2016; Quak et al., 2016). Inclusiveness means the connection of all relevant stakeholders in a city and a common problem understanding. Anticipatory capability refers to the capability of making predictions of effects. Responsiveness is the ability to measure impacts in order to then make adaptions to finally provide a solution. Taniguchi et al. (2014) and Quak et al. (2016) state that shared objectives among stakeholders are needed when following the plan-do-check-act framework and suggest to set these objectives in the planning phase. The purpose and characteristics of living labs differ from other field tests and demonstrations (Nesterova & Quak, 2016). The purpose of field tests and demonstrations is often closed research, expert design, and analysis for a single actor. The purpose of living labs is rather open innovation, co-creation with several stakeholders and analysis for multiple actors. A living lab is characterized by complexity, tests in a real-life environment, shared stakeholder values, deep uncertainty and medium to long term orientation. The approach of a living lab is to create a common vision and a shared ambition that brings all stakeholders together. As solutions in the urban freight transport sector often set a demand for a multi-stakeholder approach, the living lab approach is suitable when testing new solutions. Quak et al. (2016) state that living labs could enable transitions in urban freight transport and explain this statement by referring to the concepts of shared situational awareness (SSA) and joint knowledge production (JKP).

2.5.3. Shared Situational Awareness (SSA) and Joint Knowledge Production (JKP)

There is no one-for-all theory about SSA but it can be explained as when there is a shared awareness and understanding of a particular situation (Kurapati et al., 2012). JKP is collaboration in production and application and exchange of knowledge in between social actors such as, policy makers and scientists (Hegger, Lamers, Van Zeijl-Rozema, & Dieperink, 2012). Quak et al. (2016) explain that there are different levels of SSA in urban freight transport. Perception as the lowest level, prescription in the middle and participation at the highest level. The levels are connected to objectives and requirements from individuals and from the system. The objective on the lowest level, perception, is goal orientation for the individual with focus on individual goal setting. For the system the objective is to set broad, high level goals that open up for negotiation and can steer the system in a wanted direction (Quak et al., 2016). The requirements from the individual are to have self-awareness and individual goals that allow integration of information and requirement for future situations. For the system the requirement is to establish a joint mission in order to have a negotiation platform.

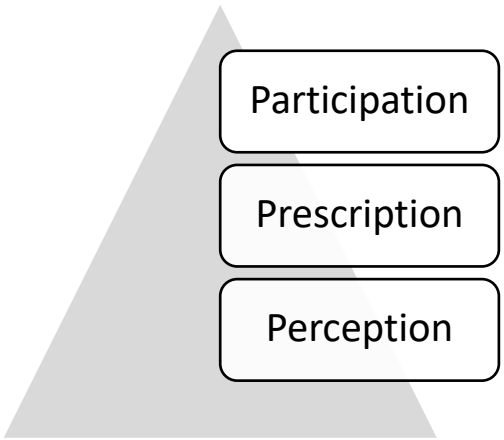

Figure 5. The three different levels of SSA in urban freight transport.

For the individual the objectives on the middle level are a reduced gap on what the individual perceives and what the individual needs as well as compliance to the planning in order to prevent deviations that could have a negative effect on the others in the system (Quak et al., 2016). The requirement from individuals is to have feedback measures that can improve the individual performance and contribute to the system's objectives. For the system the objectives are to have network governance to monitor the plans and actions of the participants in the system. On the highest level, participation, the individual objective is to have flexibility in order to be able to adapt and respond to situations that are unexpected (Quak et al., 2016). The objectives for the system are to have innovation in the operations, technologies and processes, which can be achieved by JKP. The requirements are that groups regularly engage in learning and sharing, by JKP, and by that create an environment that supports innovations and better performance in complex systems.

Living Labs can lead to a high level of SSA, meaning a high level of participation by shared values and visions that support common efforts (Quak et al. ,2016). Moreover, living labs can lead to joint knowledge production. In the context of urban freight this could be research institutions, industry actors and local authorities working together in experiments and the development of new concepts guided by a shared vision (Quak et al., 2016). In case of a high level of SSA through freight partnerships, JKP can enable system innovation (Quak et al., 2016). However, the problem of successful implementation and scaling up of local trials and demonstrations is mentioned by several authors (Gammelgaard et al., 2017; Nesterova & Quak, 2016; Quak et al., 2016). Gammelgaard et al. (2017) states that much efforts have been spent on involvement of stakeholders during the development phase or prior to political decision-making and Nesterova and Quak (2016) acknowledge that freight partnerships are a good first step towards stakeholder involvement. Gammelgaard et al. (2017) regard an understanding for what stakeholders perceive as value-adding, and practical engagement of stakeholders through relationship platforms where value is co-created as crucial for the successful implementation of urban freight solutions and thus innovation in the urban freight

system. To address the fails of many urban freight projects in the implementation phase Gammelgaard et al. (2017) requires a higher level of sensitivity towards stakeholders' and actors' different rationalities at stake in the urban freight system.

3

Theoretical framework

"The difficulty lies not so much in developing new ideas as in escaping the old ones."

John Maynard Keynes

This chapter describes the theoretical framework i.e. the theoretical lens the research takes. Transitions in urban freight transport need to be studied with a broad range of factors (Andersson, Törnberg, & Törnberg, 2014) as the system in which urban freight transport is situated is described as complex (Ball, 2012). *Chapter 3.1 Complex urban freight transport system* aims to explain the fundamentals of complex systems and the complex urban freight transport system. Societal services, as urban freight transports, are often stable and dependent on a broad range of factors, such as infrastructure, policies, and stakeholders. Problems connected to society need to be studied with a broad range of factors (Andersson et al., 2014) and to understand how transitions can happen in a complex system, Geels (2005) describes a multi-level perspective as a way of looking at several aspects of a complex system at the same time. The characteristics of the multi-level perspective and the multi-level perspective in the context of transport studies are explained in *chapter 3.2 Multi-level perspective.*

3.1. Complex urban freight transport system

There are several reasons why it is difficult to make changes in a complex system e.g. many different stakeholders and stakeholders with different and sometimes conflicting objectives (Quak et al., 2016). Further, often no one has a complete image of the system which makes it difficult to predict effects and rebound-effects of actions. Quak et al. (2016) state, as a result of many studies, that it is difficult to achieve lasting transitions in the urban freight transport system. Societal changes and innovation have usually been

a process hard to predict and control (Andersson et al., 2014). Several authors state that urban freight transport issues are complex and that the sociotechnical system that it belongs to also can be characterized as complex (Ball, 2012; Quak et al., 2016). Others explain it, as the stakeholders are so many i.e. the logistics chain consists of many participants, the urban goods transport system is complex (Nesterova & Quak, 2016; OECD, 2003). Andersson et al. (2014) explain that a complex system typically does not have any centralized description of the emerge of any order, called bottom-up self-organization e.g. behaviours of a crowd or the society. However, a complicated system is a top-down organization e.g. technology.

Urban freight transport involves a wide range of stakeholders with different and sometimes conflicting interests. Moreover, decisions on urban freight transport are made by different governmental authorities as the urban freight system is not only affected by decisions on mobility and transport but also subjects as economics and spatial planning (Verlinde & Macharis, 2016). As urban freight systems are influenced by several factors Cui et al. (2015) state that the linkage between urban freight and cities needs to be better understood and that urban freight planning processes need to take different stakeholders, institutions and influencing factors into account. As influencing factors, Cui et al. (2015) name urban-land use patterns, quality of infrastructure, the location of economic activities, regularity frameworks and composition of freight flows. According to Cui et al. (2015) and Kiba-Janiak (2017) the increasing demand for freight transports in cities implies an increasing complexity of the impacts urban freight transport has on cities.

Dent (1999) states that complexity science opens up for new perspectives, techniques and approaches, as the underlying assumptions differ from classical science. Classic problem solving techniques make sense when reductionism is assumed (Dent, 1999), in other words when phenomena are described in simpler terms (Doniger, 1999). As complexity science opens up for new perspectives and techniques there is also a need to use theories that can provide new perspectives. To encompass many aspects in a system Geels (2004) propose to look at socio-technical systems via a multi-level perspective.

3.2. Multi-level perspective

Geels (2004) explains that the approach of traditional innovation systems is mainly focused on the place where innovation emerges, at the production site. To encompass production, together with diffusion and use of technology Geels (2004) proposes to look at socio-technical systems. The socio-technical approach is broader than other approaches for complex systems, sustainability and sustainable development. Geels (2002, 2004, 2012) suggests a multi-level perspective (MLP) to understand transitions from one system to another, but also to identify lock-ins in the system and possibilities for changes. Whitmarsh (2012) explains that the MLP is a useful analytical framework to understand complex systems and transitions in the system, especially in transport systems. The

multi-level perspective has been used in previous studies about transitions in complex sociotechnical systems and especially for sustainability transitions. For example, Nykvist and Whitmarsh (2008); Spickermann, Grienitz, and von der Gracht (2014) and Moradi and Vagnoni (2018) use a multi-level perspective to analyse complex multi-dimensional changes in a socio-technical system with the focus on urban mobility and transition pathways. Moradi and Vagnoni (2018) explain that the multi-level perspective is used as it is based on technologies' co-evolution and societies involvement from multiple dimensions, e.g. technology, markets, policies, infrastructure, industry etc. Furthermore, the MLP focuses on the complex dynamics of a system, it covers both the lock-ins and stability as well as radical changes and it considers the interaction between different stakeholder groups.

The MLP consists of three levels, the *socio-technical landscape*, *socio-technical regime* and *niches (*See Figure 2)(Geels, 2002, 2004, 2012). The regime level is the middle level and is of the highest interest as transitions are shifts from one regime to another. The *landscape* and *niche* levels are defined according to their relation to the regime, as technologies or practices substantially deviating from the regime level.

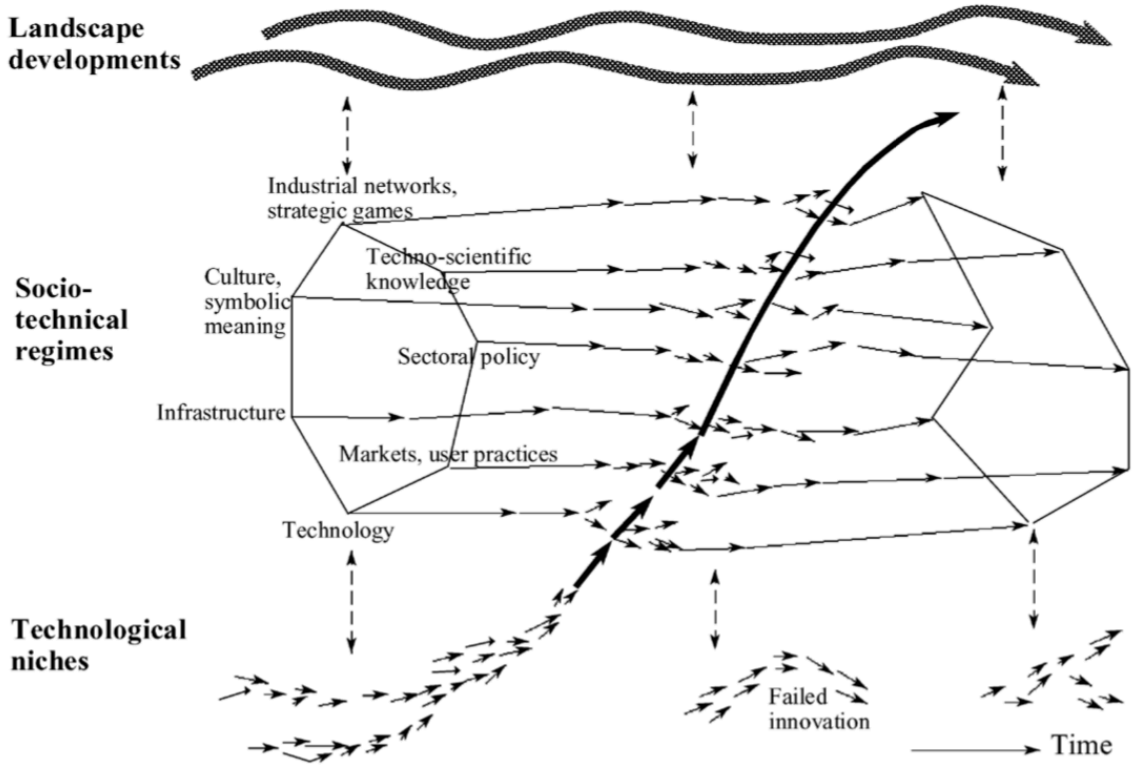

Figure 6. The different levels in the multi-level perspective (Geels, 2002)

3.2.1. Socio technical regime

Nykvist and Whitmarsh (2008) describe the dependence on oil and cars in the mobility sector as an example for a socio technical regime. This regime is depended on different aspects, such as infrastructure, customer behaviour, and manufacturing i.e. the stable

socio technical regime of cars and oil is not only dependent on cars and oil but also on other aspects e.g. roads and parking lots, and customers' reliance on fast and on-demand transport. In order to understand the socio-technical regime Geels (2002, 2004, 2012) states that three dimensions are important (See Figure 7). In practice, the dimensions are always interrelated, but to analyse them it is useful to distinguish between them. The first dimension in the socio technical system are the tangible elements which are needed for societal functions to work i.e. the roads, buildings, cars, trucks. The second dimension are the social groups, which are maintaining and reproducing the linkages and elements of the socio-technical system. The third dimension means the rules, or regimes, that guide and orient the actors and activities of societal groups.

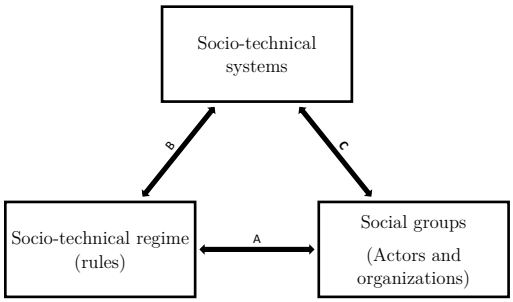

Figure 7. Interrelation between three dimensions of the socio-technical regime.

The linkages and elements in the socio-technical systems do not emerge by themselves, they are rather an outcome of human activities (Geels, 2004). The human activities are connected to the actors within the system, which are embedded within the social groups. These social groups can be, industry, public authority, research institutes, users etc. and they all have certain and different characteristics, such as responsibilities, norms, roles, perceptions etc. However, the actors within the social group share particular things such as, perceptions, norms, preferences and problem agendas. They share a particular jargon, or language, together, they meet in specific forums, tell similar stories, read the same journals etc. They act in the context of social structures and rules that are formal, normative and cognitive (Geels, 2005). These rules guide and orient actions and form a coordinating context. The rules are linked together with other rules, making them regimes, called socio-technical regimes.

Geels (2004) explains that there are interrelations in-between the three dimensions, two between every dimension (see A, B and C in Figure 7). The sociotechnical system only works from involvement of social groups (C in Figure 7), in terms of human actors and organizations. On the other hand, the conditions of the artefacts and material i.e buildings, infrastructure, a truck fleet etc. in the sociotechnical system enable and constrain the context for action by the social groups. The sociotechnical system, with its artefacts and material conditions and with the possibilities and limitations in them sets the framework and constrains for the regimes, such as rules and standards (B in Figure

7). But the regimes are also embedded in artefacts and practices. The social groups, and the actors and organizations in them operate in the context of the rules in the socio-technical regime (A in Figure 7). On the other hand, the actors and organizations are those who produce and carry the rules.

In the MLP, the characteristic of the socio technical regime is stability (Geels, 2004). In an article about low-carbon transition, Geels (2012) applies the MLP to describe transport systems. Geels (2012) explains that there are sunk investments in urban and road infrastructure at the sociotechnical regime level. Furthermore, there are sunk investments in people and their skills and there are user patterns enhancing car dependency in society. These are explained as lock-in mechanisms that stabilize the existing regime making it difficult for transitions to take place.

3.2.2. The socio technical landscape and niches

Some aspects of the sociotechnical system are formed by a wider exogenous environment (Geels, 2005). These are aspects that actors have no direct influence over i.e. the actors can't change these aspects. These aspects are at the macro-level in the MLP namely the socio technical landscape. The socio technical landscape constantly affects the socio technical regime level and vice versa. Geels (2005) explains in the article *The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930)* how urbanization on the sociotechnical landscape level put pressure on urban transport on the sociotechnical regime level. Innovations were created changing the sociotechnical regime level which, in turn, influenced the sociotechnical landscape. Geels (2012) states that there are some landscape trends affecting transportation, for example an increased demand for mobility as a result of globalisation. Furthermore, there is a physical landscape that is shaped around vehicles that stabilizes the needs for vehicles i.e. cities are built to be dependent on transportation.

The stability in the sociotechnical regime makes it difficult to create innovation. Geels (2005) highlights the importance of niches as a driver for radical innovations. Niches make out the lowest level in the MLP. They can have specific selection criteria which differ from the existing regime, as market niches, or they can be technical with resources provided by the private market as strategic investments or by the public sector as subsides. As niches are not a part of the socio-technical regime there is a high level of uncertainty and a low level of stability. However, niches create spaces for learning processes and spaces for social networks which support innovations. Geels (2012) gives some examples for niches in the transport sector. One example concerns the development of green propulsion transport technology, such as battery-electric vehicles and fuel-cell vehicles. By providing batteries for vehicles that are economically, socially and environmentally sustainable, a transition towards greener vehicles has the potential to start.

4

Method

This chapter describes the methods used in the research. A qualitative research approach is applied to explore the complex urban freight system. The abductive and qualitative research approach used in this study is explained in chapter *4.1 Abductive and qualitative research.*

Empirical observations in the area IV were the starting point for the research. Data were collected, sampled and analysed by using semi-structured expert interviews, the Delphi method and semi-structured follow up interviews. The collection and sampling of data are explained in chapter *4.2 Sampling and* data collection, followed by a description of how the data were analysed in chapter *4.3 Data analysis.* The semi-structured interviews aimed to identify the characteristics of the urban freight transport system and were analysed by applying the framework of the multi-level perspective. The Delphi method included two surveys aiming to identify strategies for the future urban freight transport system and barriers and measures that could hinder or enable transitions in the system. The aim of the follow-up interviews was, based on the barriers and measures identified with the Delphi method, to get insights on how collaboration could be used to enable transitions. After the chapters about data collection and data analysis the trustworthiness of the research is presented in chapter *4.4 Trustworthiness.*

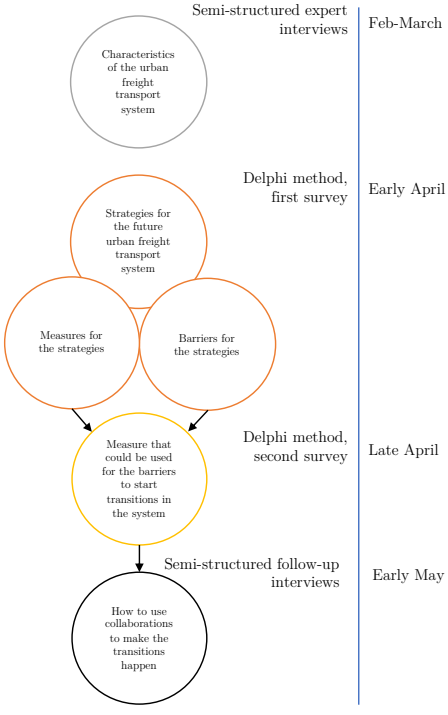

Figure 8. The methods used in the research and the aims with the methods.

4.1. Abductive and qualitative research

Deciding upon which research approach to use it can be useful to think of the relationship between theory and empirical research. Abductive research starts with empirical observations and aims at developing theories. It systematically combines theory development and data collection by attempting to find theory that suits an empirical observation. Abduction is thus a common approach in case studies where data gathering and theory development are conducted simultaneously (Kovács & Spens, 2005).

Empirical observations in the area IV were the starting point for the research. By conducting interviews with stakeholders in the area and employing the Delphi technique, data about the urban freight system in the area were collected. At the same time literature on how a complex system and an urban freight system in particular can be understood was reviewed and applied to the case IV. By systematically combining theory and empirical research there was constant interaction between theory and empirical observations.

In literature it is often distinguished between quantitative and qualitative research. When there is a focus on exploring "what", "how" and "why" questions a qualitative research approach is valuable and can be helpful to understand the functioning of complex systems (Fawcett et. al, 2014). Qualitative research helps to understand how individuals interpret the context they act in and data is often gathered in qualitative text analysis and qualitative interviews (Bryman, 2016). In this research, qualitative data in form of interviews and surveys were collected to describe the characteristics of the urban freight system in the area IV. The research approach chosen highly emphasizes the involvement of actors in the context studied.

4.2. Sampling and data collection

Data was collected in semi-structured expert interviews, surveys and follow up interviews connected to the surveys. The semi-structured expert interviews aimed to identify the characteristics of the urban freight transport system by applying the framework of the multi-level perspective. The aim of the first survey was to describe the urban freight system by taking the city's transport strategy as a starting point and ask stakeholders about barriers and measures that could hinder or help to fulfil these strategies. In the second survey barriers and measures identified in the first round were connected in statements which were ranked by the stakeholders in order to identify measures that stakeholders regard as important to achieve change in the system. Lastly, follow up interviews were conducted which, by using the measures identified in the second survey, aimed to identify how collaboration can be used to implement the measures which were regarded as important for achieving change in the system.

4.2.1. Expert interviews

Semi-structured and unstructured interviews are useful methods in research that emphasizes the interviewees point of view (Bryman, 2012). Following a semi-structured approach, the interviewee is given the opportunity to elaborate on answers and to clarify statements. In contrast to structured interviews where standardization of questions is needed, semi-structured interviews provide a higher level of flexibility as questions may not be asked in the previously planned order and new questions may be added (Bryman, 2012). In this research semi-structured interviews were conducted with experts whose professional work is related to the development of urban freight transport in Gothenburg (see Table 1)

Table 1. Participants of the semi structured expert interviews.

Interviewee	***Business/Organization***	***Title***
A	Research institute	Researcher
B	Public administration with focus on traffic	Consultant
C	Public administration with focus on businesses	Manager
D	Public administration with focus on traffic	Consultant
E	National platform for collaboration, knowledge and innovation	Project leader
F	Freight transport company	Manager

The purposes of the interviews were to (1) explore the characteristics of the urban freight transport system in the area IV and (2) to identify measures that can transform today's system towards a more sustainable one. Semi-structured in-depth interviews were chosen as primary data collection method as it was important to get an understanding for actors, activities and problems in the system and how these are interrelated. By asking questions in a flexible order and giving the interviewees the option to clarify and elaborate on issues valuable insights could be received. An interview guide was used, see *Appendix II Interview guide, expert interviews*. To find strategies for transitions it is important to focus on the future and find guiding principles for the future rather than focus on details (Holmberg & Robert, 2000). Therefore, the focus in the interviews is first on the future and then on the current situation. Some examples of questions that have been asked are:

1. *How should the future urban freight transport system look like?*
    - ***a.*** *What differs from today?*
    - ***b.*** *What is better?*
    - ***c.*** *What is worse?*
2. *What do you think needs to be done in the next step to develop sustainable urban freight in Gothenburg?*
3. *What problems do you see in the area IV regarding the development of a sustainable urban freight transport system?*
    - *a. Who are responsible for each problem?*
    - *b. Who causes the respective problems?*
    - *c. Who should solve each problem?*
4. *What solutions do you see in the area IV regarding the development of sustainable urban fright transport system?*
    - ***a.*** *Who are responsible for the solutions?*
    - ***b.*** *Who benefits from the solutions?*

For the expert interviews and the Delphi study relevant stakeholders were identified using the snowball technique in the expert interviews. The snowball sampling technique is used to identify new stakeholders with the help of initial stakeholders (Schiller, Winters, Hanson, & Ashe, 2013). As explained by King, Feltey, and Susel (1998) first, personal and professional networks and contacts are used to identify stakeholders. Then some of these initial stakeholders are asked to recommend new potential stakeholders. In this research all interviewees were asked to recommend stakeholders that should be regarded when exploring the characteristics of the urban freight transport system in the area IV.

4.2.2. Delphi study

The Delphi method is useful for describing different stakeholders' viewpoints (Zimmermann, Darkow, & Heiko, 2012). Linstone and Turoff (2002, p. 3) define the Delphi method as *"a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem"*. In a Delphi study a group of experts is selected and asked to express their viewpoints on the area investigated. The results are summarized and provided to the experts in order to get response on the viewpoints expressed in the previous round (Hsu & Sandford, 2012). While some Delphi studies explicitly aim at achieving consensus, others seek to display the diversity of viewpoints at stake (Melander, Dubois, Hedvall, & Lind, 2019). Besides exploring different viewpoints, a Delphi study can also aim at involving a wide range of stakeholders to achieve higher awareness among them and provide a base for follow-up activities enabling stakeholders to learn from the results (Zimmermann et al., 2012). As participants of a Delphi study are provided the opportunity to answer questionnaires anonymously shortcomings from group

communication processes such as group pressure and influences from other group members are avoided (Zimmermann et al., 2012). A version of Delphi is policy Delphi which aims to explore diverging views in a specific policy field in a systematic way (Linstone & Turoff, 2002). It is particularly useful to address complex problems for which different alternatives are difficult to define and where the structured Delphi process may lead to consensus building (Rayens & Hahn, 2000). By sending out questionnaires via the internet, the study's participants are able to answer the questions when it is most convenient to them (Melander et al., 2019).

In this thesis "Google Forms" was used to create the questionnaires for the surveys. A link to the questionnaires was sent out in an e-mail which shortly summarized the purpose of the study. In the first round the questionnaires were answered by 12 participants. In the second round, ten of the participants involved in the first round answered the questionnaires (see Table 2). The respondents were given two weeks to answer each questionnaire and a reminder was sent out one day before the last day to respond.

*Table 2 Participants of the survey. *Only responded in the first round*

Business/Organization	***Title***
Public administration with focus on traffic	Manager
Public administration with focus on traffic	Manager
National platform for collaboration, knowledge and innovation	Project leader
Association representing the majority of the merchants in the area	CEO*
Association representing some of the merchants in the area	Coordinator
Freight transport company	Manager
Research institute	Researcher *
Store owner	CEO
Store employee	Employee
Traffic Board	Politician
Property owner	Manager
University	Researcher

4.2.2.1. First survey

The first survey aimed to explore different views on the urban freight transport system in the area IV. As common and desirable goals among stakeholders are important for achieving transitions in a system (Taniguchi et al., 2014) the first question aimed to study the participants' agreement with the official transport strategies developed by the

city of Gothenburg. The participants of the study were asked whether they agree or disagree with every of the eight strategies in the transport strategy. Further they had the opportunity to comment on why they agreed or disagreed. Future images upon which participants achieve agreement on are useful when discussing how a change in the system towards these images can be achieved (Zimmermann et al., 2012).

To explore different viewpoints on urban freight transport in the area the participants were also asked two open-ended questions, one about barriers they see in today's system and one about measures that they regard as useful to achieve a desirable urban freight system. Open-ended questions can be used in the first round to examine a broad range of topics (Islam & Zunder, 2014). The answers of the first survey were compiled and provided to the experts as the second questionnaire was sent out. Providing feedback that includes the participants' comments gives the participants the opportunity to follow each other's reasoning (Melander et al., 2019).

4.2.2.2. Second survey

Based on the answers to the open-ended questions in the first survey the researchers formulated statements and asked the respondents to rank these (see Table 3). The participants were asked to score the statements on a scale of one to five representing (1) fully disagree, (2) disagree somewhat, (3) neutral, (4) agree somewhat and (5) fully agree. While the first round aimed at exploring different viewpoints on urban freight transport in the area IV the second survey sought to analyse stakeholders' agreement on the viewpoints expressed in the first round. The results of the ranking provide an indication on the level of consensus on different topics. By reading each other's comments and giving feedback, in this case by ranking the statements, awareness among stakeholders is created (Melander et al., 2019). The results can facilitate discussions between stakeholders in follow-up meetings as the stakeholders more likely feel ownership of the topics discussed as they were involved in the process of describing the system they act in (Zimmermann et al., 2012)

Table 3. Examples of how statements in the second survey were based on the barriers and initiatives in the first survey.

Identified in first survey		**Second survey**
Barrier	*Initiative*	*Statement*
Limited access to streets	Open up bus lanes for commercial transports	Open up the streets and bus lanes for commercial transport to achieve better accessibility.
Time regulations, Regulations on vehicle size	---	The city should not regulate the vehicles, and when these vehicles are allowed to drive in the city as it is self-regulating.
Lack of collaboration and common understanding	Enhance collaboration, Improve communication	There should be closer collaboration in the process of change between specialists, senior municipal officials and politicians.

4.2.3. Follow-up interviews

The purpose of the follow-up interviews was to get indications on how actors would collaborate on the problems and measures they identified. In the surveys the participants identified barriers in the urban freight system in the area IV and measures for how these barriers can be addressed. Furthermore, the participants reached consensus on four strategic goals provided in Gothenburg's transport strategy in the first survey and achieved high levels of agreement on statements in the second survey. In the follow-up interviews three participants (see Table 4) of the Delphi surveys were asked how they would organize collaboration on the commonly identified statements to reach the strategic goals (see Table 5). The interviews were held in a more structured way than the semi-structured interviews as questions were asked in a predestined order and phrased identically. All interviewees were asked the same questions as it enables comparability between the interviews (Bryman, 2012).

Table 4. Participants of follow up interviews.

Interviewee	***Business/Organization***	***Title***
G	Freight transport company	Manager
H	Traffic Board	Politician
I	National platform for collaboration, knowledge and innovation	Project leader

Table 5. Examples of how questions in the follow up interviews was based on the statements in the second survey.

Second survey	**Follow-up interviews**
Statement	*Question*
There should be closer collaboration in the process of change between specialists, senior municipal officials and politicians.	Background: The survey shows that 70% fully agree with the statement "There should be closer collaboration in the process of change between specialists, senior municipal officials and politicians" That is, a majority of you want specialists, officials and politicians to work more closely together. Question 1, Concretely, who would you say, should be involved in such a collaboration? You can give examples of organizations, companies or institutions and so on. Question 2, Why is such a collaboration important? Question 3, How do you think such collaboration can be organized?

4.3. Data analysis

The data collected in the semi-structured interviews, the Delphi surveys and the follow up interviews were analyzed in a systematic way. According to Pratt, Rockmann, and Kaufmann (2006) qualitative data can be analyzed in an iterative process where a structure is developed by going back and forth between the data. Pratt et al. (2006) follow three major steps to analyze the collected qualitative data: (1) creating provisional categories and first-order codes, (2) integrating first-order codes and creating theoretical categories and (3) delimiting theory by aggregating theoretical dimensions. This coding process was used for analyzing the semi-structured expert interviews, the open-ended questions in the Delphi survey as well as the follow up interviews. The semi-structured interviews and the follow up interviews which took around one hour each, were recorded and transcribed with the permission of the interviewees.

The analysis began with identifying concepts used by the participants to describe the urban freight system in Gothenburg. In the initial coding stage first-order codes of concepts from individual observations were developed (see Table 6). In the next step these first-order categories identified from individual observations were combined through axial coding to look for common patterns and themes. According to Ellram and Tate (2015) axial coding is an iterative process as data is combined in different ways to relate them to each other. The axial coding resulted in theoretical categories which then were aggregated in theoretical dimensions. For the semi structured expert interviews the framework provided in MLP was used as an overarching framework to organize the identified theoretical categories together with an additional theoretical dimension, namely desirable future.

Table 6. Examples of the codes used in the semi-structured interviews and in the follow up interviews.

Example of initial codes	***Thematic areas***	***Aggregate theoretical dimensions***
- *Type of vehicle* - *Time bans*	Regulations	Regime
- *Freight quality partnership, LFNG* - *Insufficient knowledge distribution* - *Learning between projects* - *Different areas of responsibility* - *Lack of communication*	Collaboration	Regime
- *Increased e-commerce* - *Online shopping*	E-commerce	Landscape
- *Waste collection and consolidated deliveries* - *City deliver L*	New methods	Niche
Example of initial codes	**Thematical area/ Level of collaboration**	**Aggregate theoretical dimensions**
- *Improve efficiency* - *Solve problems* - *Understanding* - *Set goals*	High level collaboration	Why is collaboration important
- *Public authorities* - *Sometimes public transport companies*	Project-oriented collaboration	Who should participate in the collaboration

Many Delphi studies seek to use a certain level of agreement among the participants in order to have a measure for when consensus is reached (Markmann, Darkow, & von der Gracht, 2013). In this thesis, stakeholders' agreement with the city's transport strategy was analyzed as common goals are important for achieving transitions in a system. Thus, measuring the level of agreement on official goals in the system was regarded as an interesting parameter for the description of the system. The "Average Percent of Majority Opinions" , APMO cut off rate provides a measure for consensus (Markmann et al., 2013). In the APMO cut-off rate consensus is defined as "a percentage higher than the average percentage of majority opinion". In the first step the number of majority agreements and disagreements was calculated, where majority is defined as above 50%. The majority agreements and disagreements were then summed up and divided by the total number of opinions expressed.

$$APMO = \frac{\text{majority agreements} + \text{majority disagreements}}{total\ opinions\ expressed}$$

In the second survey the participants were asked to rate statements on a five-point Likert- scale. The answers were used to calculate the median in order to assess whether the group tends to agree or disagree with the statement. Calculating the median instead

for the mean is recommended to avoid that outliers contribute to an unrealistic mean value (Markmann et al., 2013).

4.4. Trustworthiness

In every research it is important to establish methodological rigour (Zimmermann et al., 2012). For qualitative research the concept of trustworthiness can be applied to secure rigour in the methodology (Zimmermann et al., 2012). As an increase of qualitative research can be observed in logistics, Halldorsson and Aastrup (2003) suggest the use of the trustworthiness concept in this field and provide a description of the four dimensions of trustworthiness, namely, *credibility, transferability, dependability* and *confirmability.*

- *Credibility* is determined as the match between the respondents‘ description of reality and the researcher's presentation of these (Halldorsson & Aastrup, 2003)
- *Transferability* refers to the concept of external validity and is the extent to which results from the study can be generalized (Halldorsson & Aastrup, 2003)
- *Dependability* which is also termed reliability is achieved when the same instruments applied in the same context result in similar measurements (Halldorsson & Aastrup, 2003)
- *Confirmability* is concerned with the objectivity in the study, i.e that the findings presented reflect the result of the inquiry and not the reseracher's biases (Halldorsson & Aastrup, 2003).

In this thesis credibility was improved by strongly involving stakeholders in the process of assessing the system they act in. Different perspectives on the same system were considered in the thesis continuously challenging the researchers' perception of the system. Transferability can be achieved by rich description of the data (Zimmermann et al., 2012). In this thesis a rich description of data could be achieved by asking open-ended questions in the first round of Delphi and the expert interviews. Dependability can be enhanced by intensive interviewing and involvement in the context studied. By attending a network meeting with different stakeholders and having short informal dialogues with stakeholders in addition to in-depth interviews the reliability of the research was improved. The confirmability of the research was enhanced by establishing good and frequent communication between the researchers and the stakeholders. However, due to time constraints the results could not be evaluated by external actors which makes it difficult to fully secure confirmability in the thesis.

5

Results

In this chapter, the results from the collected and analyzed data are presented. The focus and a brief explanation of the results are presented in *Table 7.* The results from the semi structured expert interviews explained in chapter *5.1 Semi-structured expert interviews,* present characteristics of the urban freight transport system in the area IV. In chapter *5.2 Delphi study* the results from the two surveys are presented. The results gave insights on barriers against transitions in the urban freight system and on measures for how these barriers can be addressed. Based on the results in the first round of questionnaires statements regarding how barriers can be addresses were formulated and stakeholders' agreement on these statements was assessed. The statements were used in the follow up interviews which gave insights in how collaboration is used and can be used to achieve sustainable transitions in the urban freight system. The findings from the follow up interviews are presented in *5.3 Follow up interviews.*

Table 7. Focus and explanation of the results in the semi-structured expert interviews, the Delphi surveys and the follow up interviews.

	Semi-structured expert interviews	
	Focus	*Explanation*
	• Desirable future • Socio-technical landscape • Socio-technical regime • Niches	Describing the characteristics for the urban freight transport system by using the multilevel perspective as a framework and adding the aspect of a desirable future for the urban freight transport.
	Delphi Surveys	
	Focus	*Explanation*
First survey	• Strategies • Barriers • Measures	Identifying strategies that should be pursued to achieve transitions in the system by assessing which strategies achieve consensus. Furthermore, identifying barriers and measures for the strategies.
Second survey	• Measures with high interest that can be enablers of transitions	Identifying possible sustainable transitions by identifying statements that most participants agree with. The statements are based on how the identified measures could be used to overcome the barriers.
	Follow up interviews	
	Focus	*Explanation*
	Collaboration • Why • How • Who • Problems	Describing how collaboration can be used for sustainable transitions by identifying why collaboration is important, how collaboration should be managed and which stakeholders should participate in a collaboration. Furthermore, problems in collaborations are described.

5.1. Semi-structured expert interviews

The coded results from the semi-structured expert interviews can be found in Appendix III Coded results semi-structured interviews. All interviews were conducted using an interview guide, see Appendix II *Interview guide, expert interviews*. The interviews gave different insights on the characteristics of the freight transport system. The findings from the interviews are coded and analyzed. The main categories are, using the multi-level perspective, the socio-technical landscape, socio-technical regime and niche (See Table 8). Furthermore, the aspect of a desirable future is added as a separate level. The desirable future is how the stakeholders want the future urban freight transport system to be.

Table 8. Thematic groups for the characteristics of the urban freight transport system identified in the semi-structured interviews.

Thematic group/ Level	***System characteristics***
Desirable future	Minimize traffic, cleaner vehicles, consolidation, safe environment, liveable city
Regime	*Stakeholders* Freight transport operators, Customers/receivers, Administration/authorities, Shippers, Developers, Researchers, Property owners, "a neutral part"
	Freight transports Light trucks, low capacity utilization , fragmented and frequent deliveries, inefficient routing, , City deliver V
	External negative effects Noise, safety issues, congestion, emissions
	Regulations Type of vehicle, Time bans
	Consolidated deliveries *High costs of trans-shipping*, City deliver V, "freeriders", lack of incentives
	Collaboration Freight partnership, insufficient knowledge distribution, learning between projects, different areas of responsibility, lack of communication
Landscape	Urbanization, E-commerce
Niche	Night deliveries, security stuff unlocking stores, delivery by bike, using urban waterways, combination of trucks and last-mile deliveries, living labs, Electric trucks, waste collection, standardizes mini-containers, C/O address

5.1.1. Desirable future

During the interviews all stakeholders described that there should be less traffic in the city centre in a decriable future. The city centre should be an attractive and enjoyable environment were interaction between heavy vehicles and people is minimized. Almost all statements regarding desirable futures in the interviews were connected to reduced negative effects from urban freight transport. In the future there should be an increased use of small and clean transport vehicles, more consolidation and a safe and functional environment. At the same time, the need for reliable goods deliveries must be fulfilled. In general, change in the transport system is needed to achieve the emission reduction goals for 2030.

5.1.2. Regime

It is stated by all stakeholders that the urban freight transport system is complex and hard to achieve transitions in. There is a lack of awareness for urban freight transport in the system and an increased understanding, both for stakeholders in the system but also for a wider range of stakeholders is needed. For example, stakeholder A states that those responsible for city planning don't know how, or care, to include freight transports in the city planning. All stakeholders regard collaboration between the city and private companies as necessary for achieving transition in the system and consider the LFNG as an important platform for collaboration. This section aims to describe how stakeholders see the current system for freight transport in the area. First, identified stakeholders are

presented, then transports conducted in the area are explained, followed by negative effects, consolidated deliveries, regulations and collaboration in the urban freight system.

5.1.2.1. Stakeholders

The stakeholders identified in the expert interviews are listed in Table 9. In all the interviews many organizations and people were mentioned, but the stakeholders listed in Table 9 are those that were mentioned in several interviews or were emphasized by the interviewee. The interviewees focused mainly on freight transport operators, receivers and authorities. However, property owners and a "neutral part" were also mentioned as important stakeholders, especially for leading transitions. The "neutral part" is an actor who can lead a collaboration without an own agenda. Researchers or representatives from the *national platform for collaboration, knowledge and innovation* were named as actors who can be the neutral part in a collaboration. The *national platform for collaboration, knowledge and innovation* can lead projects but needs funding which they most often receive from different public funding givers.

Table 9. The stakeholders identified in the semi-structured interviews.

Category	***Example***	***Explanation***
Freight transport operators	Established logistics companies, Waste transport companies, Cargo-bike delivery company, City deliver V	These are the ones that are operating the transport. They provide the freight but have limited power as they perform a service demanded by a client.
Customer/receivers	Association representing the majority of the merchants in the area, Association with some of the merchants in the area, shop owners, residents, offices, restaurants	The ones that receive freight. Can set demands, but difficult for them to coordinate.
Administration/ authorities	Politicians; public administrations for traffic, city planning	Responsible for the city. They have power as they can set regulations. Should strive for a enjoyable city environment.
Shipper	Retail dealer, main warehouses	Often the ones who order a transport. They set the demands for the transports.
Developers	Truck developer, cargo bike developer	Developer of the vehicles used in the freight transport.
Researchers	Universities, research institutes	Are performing research on different aspects of freight transports and are experts in the field.
Property owners	Established property owners, the municipality	They want a nice environment around their properties. Can set demands and coordinate their tenants.
Others mentioned	1. Neutral part; national platform for collaboration, knowledge and innovation, researchers 2. Media; Newspapers, televisions, social media	1. Don't have so much power but are often needed to mediate and lead collaboration projects. 2. They inform the public about developments in urban freight transport.

5.1.2.2. Freight transport in the area

Transport by light trucks (3,5 ton vehicles) has increased significantly in recent years. Many senders are using their own vehicles with low capacity utilization which results in highly fragmented deliveries in the area. Stakeholder A states that light trucks are inefficient for deliveries in urban areas. Heavy trucks with high capacity utilization are more economically efficient on the way to the city centre while small last-mile vehicles such as cargo bikes are more effective for deliveries in dense areas. Different routes for delivering and collecting goods contribute to the problem of low capacity utilisation. Stakeholder B provides an example of a large transport company which uses different processes for sending and receiving goods resulting in serving the same address several times a day. Vehicles used for freight transport in the area are today mainly powered by fossil fuels. There is an awareness in the present system that alternative non-fossil fuels need to increase in the future. However, there is uncertainty regarding which type of fuel will dominate in the future. Stakeholder E explains that planning for change in the system is related to the question whether investments in infrastructure vehicles are needed first.

5.1.2.3. External negative effects

Negative effects of urban freight in the area are connected to noise, safety, congestion and emissions. Congestion mainly depicts a problem on roads to the area where construction work has deteriorated the problem. Moreover, deliveries at peak times contribute to increased congestion. Congestion has negative effects on the environment, in terms of emissions but also in terms of economic sustainability as its leads to longer transporting routes. Stakeholder A, D and E agree on that congestion is not as urgent as in other European cities and add that it is, however, important to proactively address the problem. Reducing the negative effects from urban freight transport is challenging as these effects constitute external problems. For example, stakeholder C and B explain that reducing emissions, noise and congestion leads to public gains in form of higher liveability in the city. The value of a liveable city environment and its effects on economic growth are difficult to assess. Stakeholder B exemplifies the problem by explaining that some businesses are critical towards consolidated deliveries as they cannot link it to increased sales. Transport companies cause negative effects by fulfilling the demands set by the senders. The transport companies have to follow regulations set by the city and are internally striving for delivering goods in the most cost-effective way. The senders, in almost every case, want the transports to be as cheap as possible.

5.1.2.4. Consolidated deliveries

The area IV is served by the *City deliver V* for consolidated deliveries. Goods are delivered to a consolidation centre outside the area where they are trans-shipped and consolidated before transported to the city centre. Today, two transport companies are

connected to *City deliver Vs* system for consolidated last-mile deliveries. Other transport companies still use their own vehicles to deliver goods in the area. Stakeholder B explains that this results in a "freeriding" problem as transport companies who are not connected to the consolidated delivery scheme still profit from the positive effects of less congestion in the city centre. Stakeholder A explains that it is still more economic sustainable for the transport companies to deliver freight with their own trucks i.e. stay in the current truck dependent regime. The other service for consolidation deliveries, *City deliver L*, uses a different concept with *C/O address* which means that all actors who receives parcels or smaller freights write the same address as recipient address. *City deliver L* consolidates all freight and delivers it to the receivers in the area, in that way there are no freerides in the system as all transport companies deliver to the same address. Flows of goods in the entire area IV need to be consolidated to a higher degree to reduce the number of fragmented deliveries. Stakeholder B remarks that a holistic perspective is needed to achieve the best possible effect for the city.

By using the service for consolidated deliveries transport companies save resources as they do not need to provide vehicles and staff for time-consuming deliveries to and within the city centre. However, consolidation is costly as an additional moment of transshipment is added to the supply chain. Moreover, transport companies have promised their customers service and need to assure that the same service level is provided when leaving over last-mile transport to another part. The city could set incentives for transport companies to consolidate goods by providing consolidation centres in the city, or at least space in the city for a consolidation centre. This implies that urban freight transport needs to be considered to a higher degree in city planning. Stakeholder A compares freight transport with public transport as both can be seen as ways of consolidating. Public authorities regard public transport in city planning as they provide terminals and pay for a proportion of the public transports. However, authorities do not allocate space or resources to freight transport in the same way.

5.1.2.5. Regulations

A combination of different business models and logistics solutions are needed to achieve desired changes in the system. Regulations can be used as an instrument for influencing how goods are delivered in the future. In the area IV time bans and specifications on vehicle size are used to regulate urban freight transport. Heavy trucks are not allowed to deliver goods in some streets of the area IV between 11 am and 5 am. However, stakeholder B means that these regulations have failed as they have led to an increased use of light trucks in the area. As many companies are not able to deliver goods with heavy trucks before the time ban, light trucks are used for deliveries resulting in an increased number of vehicles. Regulations that incentivize the use of electric vehicles and consolidated deliveries are named as options for achieving more sustainable freight transport in the area. Regulations are also needed to give the actors in the system clear

indications on how urban freight transport should develop in the future. Stakeholder F states that policy makers should use regulations as an indicator on how the system should be in the future and that measurements should be conducted to understand developments in the system. However, it is difficult to find regulations that do not affect some part of the system negatively or that lead to unexpected and unwanted effects. Therefore, it is important that the public and the private actors collaborate and create a shared understanding for the system.

5.1.2.6. Collaboration in the urban freight system

Collaboration between stakeholders in the area IV as well as with urban freight stakeholders in other parts of the city is important for developing a sustainable urban freight system. The diversity of stakeholders and decisions concerning different areas of responsibility depict challenges for organizing collaboration. Stakeholder E exemplifies this challenge by explaining that new business models for waste collection are difficult to implement as waste collection from private households is the municipality's responsibility while waste collection from companies is a private concern. In the area IV there is a need for shared understanding and information exchange between stakeholders. Goals for the development of urban freight transport in the area are not clearly communicated and shared by all stakeholders. For example, stakeholder F states that the tasks and missions from the public administration in charge of traffic have to be clearer and that politicians need to take more decisions regarding freight transports as private companies need a framework to plan with. In addition to improved goal communication and shared awareness, learning effects and knowledge distribution need to be strengthened. Learning between projects in the area as well as between projects in the area and other parts of the city needs to be enhanced. Knowledge is often found at an individual level and not conceptualized and shared. The LFNG is perceived as a useful platform to have dialogues and get to know each other 's perspectives. However, the scope of the LFNG is too broad to sufficiently address specific problems in the area IV. For example, stakeholder C states that problems concerning the service for consolidated deliveries in the area IV should not be discussed in the freight partnership but in some smaller forum.

5.1.3. Landscape, trends

The development of urban freight transport is influenced by urbanization and growing e-commerce. Growing e-commerce has led to an increased need for storage space on pick-up points as well as an increased level of returned parcels as many online stores offer free returns. While e-commerce depicts a challenge regarding an increased number of small parcels that need to be handled it does not have mentionable effects on congestion in the city. Stakeholder A explains that a high number of passenger cars and deliveries conducted by the sender itself have significantly higher effects on congestion. The trend towards reduced inventories and just-in-time deliveries sets a demand for more continuous deliveries during the day and as more people are moving to cities the need

for transport will increase. The increased demand for transports needs to be considered in city planning. For example, stakeholder A states that the location of consolidation centres needs to be regarded in city planning and stakeholder E explains that it must be planned for how service boxes and pick-up pints can be integrated in the existing infrastructure of the city.

5.1.4. Niches

Deliveries by last-mile vehicles such as cargo bikes or small electric vehicles are increasingly used in European cities. In order to enhance the use of environmentally friendly last-mile vehicles in the area IV incentives in the system need to be created. At present there is a lack of incentives for transport companies to trans-ship goods for the last mile. High costs of trans-shipment and a lack of consolidation centres are named as reasons for this niche not having developed faster. Stakeholder A explains that the city could provide consolidation centres to enhance consolidation and last-mile delivery by small and environmentally friendly last-mile vehicles. Another development that can be seen in several cities and that is discussed for the area IV is the use of night deliveries. Offices and stores in the area could receive deliveries at off-peak hours. However, challenges such as noise disturbance and staffing businesses at night need to be addressed before implementing this solution. For example, stakeholder D explains that security stuff could be hired for unlocking stores and receiving goods in the area as small stores do not have the resources for hiring staff outside opening hours.

Standardized mini-containers could play a key role for enhancing consolidated deliveries as trans-shipment costs could decrease and the overall efficiency in the system increase. In several European cities transport companies have already started to use their own mini-containers for last-mile delivery. The use of urban waterways is currently tested in Gothenburg and could be an alternative for freight transport to the city centre which needs to be combined with solutions for last-mile deliveries. However, the use of urban waterways is still in the development phase and confronted with challenges such as trans-shipment costs.

Waste collection combined with consolidated deliveries is discussed as a possible option for City deliver V. Business models offering waste collection with small and environmentally friendly last-mile vehicles as main part of their business can be found in Gothenburg in the area served by City deliver L and in Stockholm. For implementing combined consolidated deliveries and waste collection in the area IV collaboration with facility owners in the area is important. Stakeholder B explains that struggles regarding limited space in buildings in the area could be an incentive for facility owners to pay more for waste collection services. However, there is a need for more data on waste flows in the area and stakeholder E explains that there are regulations hindering the possibility

to use the same type of vessels for delivery of goods and collection of certain types of waste.

Demonstrations and trials are important to show that concepts work and can be scaled up. It is important for the city to test new solutions in order to find alternatives to unsustainable solutions in the system. Stakeholder A gives an example of a demonstration for transporting goods with flatboats on urban waterways, that had a negative environmental effect and was very expensive but gave insights on how to develop the use of waterways. The negative effect was only temporary, but the insights could give long term positive effects on sustainability. However, stakeholder D explains that it has been challenging in the city to continue with pilot projects after the test phase. Furthermore, it is important to have a system that opens up for several solutions that can work in parallel. For example, the system should be open to alternative business models for sustainable deliveries than the one provided by City deliver V.

5.2. Delphi study

The first survey assessed stakeholders' understanding for strategies for urban freight transport in the area. Furthermore, barriers and initiatives connected to the strategies were described. The data from the surveys were coded into thematic groups, strategy, barrier and initiative (see Table 10). Some barriers and initiatives were also identified in the second survey. In the second survey, the findings from the first round were used as the identified barriers and initiatives were linked in statements. Stakeholders' agreement upon these statements was assessed in order to identify measures that according to the stakeholders have the potential to lead to desired change. These are coded as possible drivers for transitions (see Table 10).

Table 10. Thematic groups for the characteristic of the urban freight transport system identified in the surveys.

Thematic group	***Characteristics***
Strategy	Increasing access (community planning), good accessibility, reducing negative local environmental effects, Collaborating regionally, Stimulating innovation, interconnected network of streets without barriers
Barriers	Congestion, Large vehicles, Time regulations, Regulations on vehicle size, Limited access to streets, Lack of collaboration and common understanding, construction work
Measures	Open streets for commercial transports, Certification schemes, considering urban waterways, Consolidated deliveries, enhance collaboration, Improve communication
Possible enablers of transitions	Regulations, collaboration between specialists, municipal officials and politicians, coordinated deliveries.

5.2.1. Strategies

The participants were asked if they agree or disagree with each of the strategies from “Transport Strategy for a close knit City", (see Figure 9). The APMO cut-off rate was used as a measure for consensus. Data used to calculate the APMO cut-off rate is presented in *Appendix IV Calculating consensus on strategies.* Majority is defined as above 50%. Statement 1,5,6 and 8 reached a percentage of agreement that is higher than 73%. Thus, consensus was reached on these statements. The expected outcome was not to reach agreement on all statements but to show on which strategies agreement can be achieved on in order to indicate where common action is easier to establish.

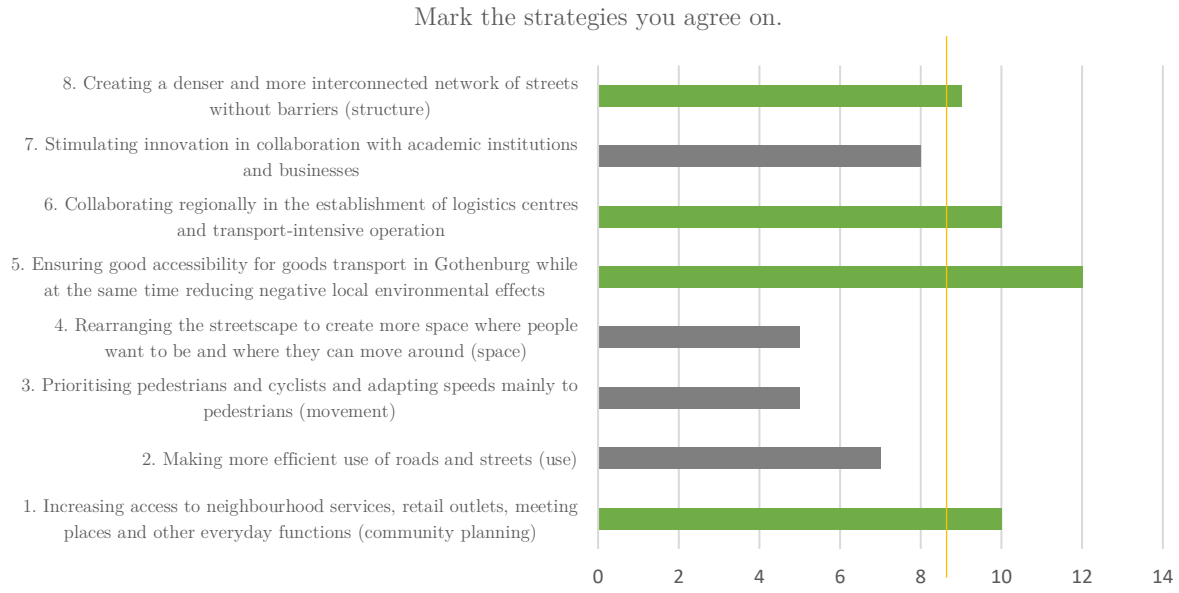

Figure 9. Results from the question regarding which strategies the participants agree or not agree on. The green represents the ones where consensus is reached. The yellow line represents the APMO cut of rate on 73%.

The participants' comments show that not only the strategies themselves are important. It is also important how the strategies are interpreted and used. As it is difficult to work with all strategies at the same time there need to be some kind of prioritizing among the strategies. Furthermore, freight transport in general needs to be prioritized to a higher extent in the city as accessibility must be provided to all road users.

In addition to the provided strategies, it is suggested to add strategies for communication and collaboration to the city's transport strategy. It is stated that clear communication is needed regarding what a desirable development of urban freight transport in the area means. Moreover, it is stated that sustainability in the urban freight life cycle should be regarded in the transport strategy. When asked to add strategies some participants provide suggestions on concrete measures that should be taken. For example, it was

suggested to change one-way streets into streets accessible from both sides to improve traffic flows and to develop the present system for consolidated deliveries.

To assess stakeholders' awareness of the official transport strategy for the city the stakeholders were asked if they have seen the transport strategy before. It was possible to choose between the answers "yes" which means that they have seen the strategies before, "no" which means that they have not seen them before and "not exactly these but similar" which means that they have some brief knowledge about the strategies. The result is presented in Figure 10. A majority of the participants had seen the strategies before.

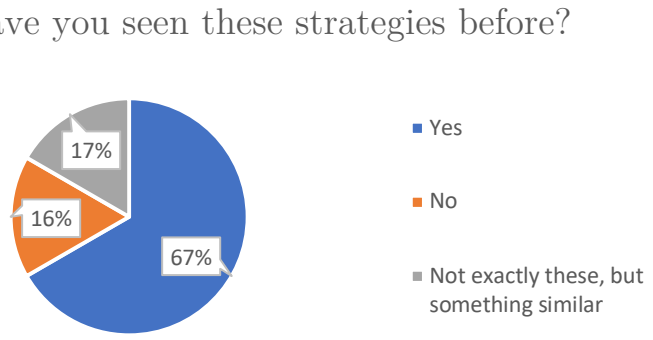

Figure 10. Percentages of how many of the participants that has seen the strategies from "Transport Strategy for a close knit City" before.

5.2.2. Barriers

In the answers to the first question several problems in the urban freight system in the area IV were described. Congestion in the streets as well as on ways to the area are described as a problem in the present urban freight system. The design of the current infrastructure as well as construction work in the city and on the ways to the city are named as causes for congestion. Frequent deliveries to serve customers the whole day are brought up as an additional cause for congestion in the city. The use of large vehicles for urban freight transports in narrow streets in the area and numerous trucks driving around in the area in the morning are seen as a problem in the system. Time regulations, regulations on vehicle types and street access are mentioned as factors hindering the accessibility to the city with transport vehicles. It is mentioned that time regulations for deliveries by trucks and the time schedule for consolidated deliveries provided by City deliver V are not adapted to businesses' daily routines. A lack of collaboration and a lack of common understanding for sustainability and the value of sustainable solutions are named as barriers in today's system.

5.2.3. Suggested measures

The answers to the second question provided suggestions on specific logistics solutions and expressed a request for enhanced collaboration and communication. Solutions

contributing to less emissions, less noise, less congestion and good accessibility were mainly brought up. In the comments it is suggested to open streets for commercial transports and reserve parking space for commercial vehicles in order to avoid that they take up parking space that could be used by visitors to the city. In another comment it is suggested to introduce certification schemes that encourage sustainable goods transports. Several comments regard developments that could be important in the future urban freight system. In one comment it is suggested to use urban waterways to a higher extend for goods transport to the area. Moreover, the use of small-scale transports, e.g. cargo bikes, and the use of consolidated deliveries such as City deliver V are suggested. The increased use of electric scooters is named as a development that could have an impact on the traffic situation in the city.

Half of the answers regard communication and collaboration issues. It is stated that communication with stakeholders who are confronted with urban freight problems in the area on a daily basis needs to be enhanced. Further it is requested to enhance collaboration between specialists, local authorities and politicians. It is stated that an increased understanding for the importance of urban freight transport for the liveability in cities is needed among political decision makers. In another comment it is claimed that facility owners should take on higher responsibility for accessibility in the city centre. The LFNG is named as an important platform to raise questions and challenges for urban freight transport. However, it is commented that the freight partnership has limited ability to decide on and implement solutions for suggestions made. A new collaboration platform for urban freight transport in the area IV where necessary decisions can be discussed is suggested.

In the second survey stakeholders were provided the opportunity to comment on the statements presented. In the stakeholders' comments further suggestions on measures for achieving change in the system were provided. It is stated that the city could request the use of zero emission vehicles if this goal is communicated in advance and part of a long-term strategy. Regarding the statement, that streets and bus lanes should be opened up for commercial transports, it is commented that public transport never should be given a lower priority as it would have negative effects on the overall transport system. It is suggested that bus lanes can be used by freight vehicles if a time table is followed.

5.2.4. Possible enablers of transitions

Based on the answers in the first survey the researchers formulated statements that were sent out to the stakeholders in a second survey to check the agreement on each statement. The data collected in the second round were mainly used as a basis for the follow up interviews. The results for the second survey are presented in *Appendix V Results from the second survey* and the statements used in the second survey are presented Table 11.

Table 11. Statements regarding possible enablers of transitions

INDEX	*STATEMENTS*	*MEDIAN VALUE*
1	To fulfil the needs of the storeowners "city deliver V" should be open more hours the day.	5
2	The city should not regulate the vehicles, and when these vehicles are allowed to drive in the city as it is self-regulating.	1,5
3	The city should regulate more which vehicles and when these vehicles can enter certain parts of the inner city to encourage more efficient and sustainable freight transport.	4
4	There should be a trans-shipment / co-loading terminal in the vicinity of or in the area IV which can be used to collect and deliver goods.	4
5	Coordinated deliveries should be used to increase accessibility.	5
6	Open up the streets and bus lanes for commercial transport to achieve better accessibility.	4
7	There should be closer collaboration in the process of change between specialists, senior municipal officials and politicians.	5

Except the second statement all statements got either a four or five in median value meaning that the participants somewhat agreed or fully agreed on the statements. The statement that got a median of 1.5, the participants somewhat disagreed/fully disagreed, was regarding regulations, and more specifically that the city shouldn't set regulations regarding vehicles. This indicates that the participants regard it as necessary to have regulations regarding vehicles i.e. the participants somewhat agree/fully agree on that the city should set regulations. The overall result also shows that the participants want change to happen and are in some way open for transitions. Statements suggesting enhanced collaboration and the improvement of consolidated deliveries were ranked highest by the stakeholders (statement 1,5 and 7), i.e. collaboration and consolidation of goods are seen as important for enabling desired change in the system.

5.3. Follow up interviews

The results for the follow-up interviews with stakeholders are described in Appendix VII Coded results follow up interviews. The interviews were conducted using an interview guide, see Appendix VI Interview guide, follow up interviews. All interviews resulted in different characteristics for how stakeholders can use collaboration to work for a more sustainable urban freight system. The results were analysed and grouped thematically. Each statement from the stakeholders, i.e. open code, was grouped with other statements in four groups depending on how it was related to collaboration. The full explanation of each group would be, why is collaborations important, how should collaboration be managed, who should be involved in collaborations and what are problems connected to collaboration. It is stated in all follow-up interviews that there is a need for broad collaboration on a high level, to set goals for the system and to create a shared

understanding in the system. Moreover, there is a need for collaboration in specific projects or to solve specific problems. Each statement was grouped depending on the level of collaboration, namely broad collaboration and project-oriented collaboration. Broad collaboration regards collaborations that are not tied to a specific problem or solution. It is important to differentiate between the different types of collaborations as the purpose of the collaboration, the actors involved and how the collaboration is managed differ.

Table 12. Thematic groups for the transition characteristic of the urban freight transport system identified in the surveys.

Thematic group	***Characteristics for broad collaboration***	***Characteristics for project-oriented collaboration***
Why	• Improve efficiency • Solve problems • Understanding • Set goals • Measure progress	• Improve efficiency • Solve problems • Understanding • Good basis for regulations • Fulfil objectives • Prepare for future problems
How	• LFNG • Do plans	• Public funded projects • Start with many actors narrow down successively • Organize with some actors first then lift it higher up • Learn from previous projects • Referral on a regulation to LFNG • Long term strategies • Make the problem owners own the solution • Use the LFNG to identify participants • Wide political support
Who	• Transporters • Property owners, representant for the store owners, • Public authorities, • Politicians	• Public authorities • Sometimes public transport companies • Private actors • Neutral part • Politicians
Problems	• Low interest • Mission of the public authorities • Bureaucracy	• Solutions/projects is not continued after the public funding • who should own the problem?

5.3.1. Why is collaboration important?

Collaboration is needed both in specific cases in project-oriented collaborations as well as in broad collaborations where an understanding for problems or solutions can be created. The need for common understanding is emphasized by all the stakeholders. It can increase the efficiency of the system and is a key aspect when problems must be solved. Stakeholder I gives an example on loading zones to clarify why common understanding is important: A property owner builds a loading zone outside a property for the transport operators to be able to deliver freight. However the freight transport company can not get to that side of the property. If there would have been a broad collaboration, the property owner might have been aware of that problem. If there would

have been a project-oriented collaboration the property-owner together with the freight transport company could have come to a better solution.

It is important to set up common goals, activities and measurement systems in the urban freight transport system. This should be done in a broad collaboration. For example, stakeholder H states that there should be a collaboration regarding regulations that can support a more sustainable system in the future. It is important to collaborate on future planning as actors in the system need to plan their work and investments on a long-term basis. Furthermore, individual plans should be in line with the goals for the system.

5.3.2. How should collaboration be managed?

The way collaboration is managed is totally depended on what the goal for the collaboration is and who the involved stakeholders are. Stakeholder G states that when collaboration is initiated many actors should be involved early, but as the collaboration goes on it will be clear who the main actors are that should stay in the collaboration. The LFNG is a good arena for broad collaboration and should mainly be used to increase the understanding mentioned in the *why* section, but also to set plans for the work in project-oriented collaborations. In the LFNG specific topics can be brought up and stakeholders that should participate in a collaboration on the topic should be identified. Further, the identified participants should work with the topic in a project-oriented collaboration. It is important that stakeholders who are affected by a topic are involved in a collaboration on this topic. A specific proposal stated by stakeholder I is that regulations regarding freight transports should be sent to the LFNG before they are decided. Stakeholders in the LFNG could provide politicians with important insights and tips regarding the topic. Furthermore, it is important to evaluate conducted projects and learn from the findings.

5.3.3. Who should be involved in collaboration?

Who the actors are that should be involved in a collaboration is always dependent the collaboration's purpose. For broad collaboration the LFNG could be the main arena with a wide range of stakeholders involved. Transporters, property owners, several public authorities, stores, researchers, politicians should all be represented in the LFNG. The stores should be represented by associations. However, it is important that not too many stakeholders are part of the network. Stakeholder I state that it can be difficult to stay focused in the discussions in case too many participants are involved. In project-oriented collaborations the specific purpose of the case determines which stakeholders should be involved. However, the public administration that is responsible for traffic in the area

should always be considered. A neutral part could facilitate the collaboration, especially when politicians are involved.

5.3.4. Problems connected to collaboration

Some specific problems, mainly problems that are hindering collaboration, were mentioned by the stakeholders in the follow-up interviews. It can be difficult to find an actor who wants to be responsible for a collaboration. The public authorities are often those who should be responsible for collaborations, but the mission of the authorities is somewhat unclear and sometimes too bureaucratic. Another problem regards the funding of collaborations. Collaborations in specific projects that are funded externally, often by the EU, ends when external funding is not provided anymore.

6

Discussion

The purpose of this research was to map the urban freight system in the area IV in order to identify barriers against sustainable development of urban freight transport in the system. Based on the description of the system in the area IV the thesis aimed to give suggestions on how actors could collaborate towards a more sustainable urban freight system. The thesis takes a starting point in the future by asking stakeholders in interviews and questionnaires how a desirable urban freight system in the area IV should look like. Expert interviews with stakeholders whose professional work is concerned with the strategical development of urban freight transport in the area have been conducted as well as a Delphi study where questionnaires have been sent out to stakeholders concerned with urban freight operations in the area on a daily basis. In the following, findings from the interviews and the Delphi study are discussed and related to literature. Firstly, findings from the system mapping as well as barriers to change in the system will be discussed. Secondly, collaboration among stakeholders in the case area will be discussed in relation to literature and suggestions for how future collaboration can be organized will be made. Finally, the methodological approach of this thesis will be reviewed.

6.1. The urban freight transport system in the area IV

The thesis takes a starting point in the future by asking stakeholders in interviews and in questionnaires how a desirable urban freight system should look like. In the interviews stakeholders expressed the desirable future as to have a liveable city centre with cleaner and smaller transport vehicles and reduced interaction between heavy vehicles and people while at the same time guarantee a well-functioning traffic system and reliable deliveries.

Negative effects from urban freight transport such as congestion and noise should be reduced. The aims for a desirable urban freight transport system expressed in the interviews coincide with the goals suggested by Allen et al. (2000) for urban freight transport policies according to which the minimization of social and environmental impacts should not affect ease end efficiency in the urban freight system negatively. In the questionnaire stakeholders ranked the strategy "to ensure good accessibility without reducing negative local and environmental effects" highest among the strategies provided. In the questionnaire three of the strategies upon which stakeholders achieved consensus on regard the improvement of accessibility in the area. Consequently, when asked about barriers against achieving the goals presented in the strategy, stakeholders mentioned barriers to accessibility such as congestion, limited access to streets and time regulations. In the expert interviews barriers named in the survey are described as part of the present regime. An increased use of light trucks due to time bans, construction work, an increase in fragmented deliveries with low capacity utilization and a higher demand for just-in-time deliveries are described as characteristics for the system that lead to an increase in the number of vehicles in the area. A growing demand for small-scaled shipments and just-in time deliveries is named as a cause for increasing urban freight transports by Thaller et al. (2017) as well. The authors identified urbanization and growing e-commerce as overarching trends contributing to these developments. For the area IV as well, urbanization and e-commerce were named as influencing trends on the landscape level.

Some interesting barriers hindering sustainable transitions in the urban freight transport system have been identified. However, it is important to emphasize that many barriers are bi-products of the possibilities that the urban freight transport system provides. For example, the data collected shows that urban freight transports should be reduced to minimize the negative effects. But at the same time, there is a need for more transports as a result of consumption patterns such as return of goods and just-in-time deliveries. The main barriers are categorized as, lack of collaboration, effects of regulations , city planning and prioritizing between economic, social and environmental sustainability. The findings confirm challenges towards sustainable urban freight transport that can be found in existing literature. However, the findings show that these challenges need to be addressed not only in a broad collaboration for freight transport in the city but also on minor platforms in geographical areas of a city.

Lack of collaboration

In the questionnaires a lack of collaboration and common understanding are mentioned as barriers for reaching the goals in the transport strategy. The need to enhance collaboration, create shared awareness, improve goal communication and knowledge distribution has also been identified in the expert interviews. The LFNG is both in the interviews and the survey described as an important tool for having dialogues among urban freight stakeholders in the city and for getting to know other stakeholders' perspectives. However, the partnership has limitations when it comes to work on specific

projects and implementation of the solutions suggested. As shown in the literature review of this thesis several authors, e.g. Österle et al. (2015) and Quak et al. (2016), state that the engagement of stakeholders in specific projects is seldom the result of a freight partnership. The need for clear communication from public authorities regarding how stakeholders are required to contribute to a sustainable freight transport system and how progress in the system is measured could be identified in the case area. Half of the answers to the question asking which initiatives could help to achieve the strategic goals for the system suggested enhanced collaboration and communication in the system. Furthermore, in the second round of Delphi 70% of all stakeholders did fully agree on the statement that there should be closer collaboration between specialists, senior municipal officials and politicians. The remaining stakeholders were neutral or agreed partly but disagreement on this statement was not expressed. The results of the questionnaires show similarities to the outcome of the urban freight study by Ruesch and Gluecker (2001) which was conducted within the BESTUF project and involved 43 European cities. Both in the study by Ruesch and Gluecker (2001) and in the questionnaires in this thesis respondents focused on problems regarding accessibility and infrastructure when being asked about barriers and problems in urban freight systems. When stakeholders in the BESTUF study were asked which main issues concerning urban freight they regard as important within the cities co-operation among local actors and information to stakeholder were ranked highest. Similar patterns could be seen in the questionnaire of this thesis were the answers to the question on measures that contribute to achieve change, as well, highlighted collaboration and communication while accessibility and infrastructure issues were named when stakeholders were asked to name barriers.

Effects of regulations

In the Delphi-study stakeholders named regulations as barriers for achieving change in the urban freight system in the area IV. In the expert interviews stakeholders described it as challenging to find regulations leading to desirable change in the system while at the same time being open to different solutions and business models. The complexity of urban freight is highlighted by several authors in the literature describing it as many stakeholders involved (Macharis et al., 2014), different areas of responsibility and influencing factors to be considered in decision making (Cui et al., 2015) and effects and rebound effects that are difficult to be predicted (Quak et al., 2016). The urban freight transport system in the area IV can be described as complex. Decision-making in the system concerns different areas of responsibility, e.g. municipalities' and facility owners' responsibilities in case of waste collection. Furthermore, in the area IV it could be seen that effects and rebound effects are difficult to predict when regulations are implemented. Regulations that aimed to reduce the number of heavy trucks in the area have resulted in an increased use of light trucks. To avoid unwanted rebound effects and fails of urban freight projects Gammelgaard et al. (2017) emphasize that a higher sensitivity towards

stakeholders' different rationalities at stake is needed. A better understanding for single stakeholders` and actors` rationalities at stake, i.e. how they make decisions and what motives that are guiding their decisions, could be useful for governance in the area IV in the process of finding regulations leading to desirable change. For example, finding the right incentives for enhancing consolidated deliveries needs a thorough understanding for how transport companies are reasoning on routing and what needs business owners in the area have. Comments in the Delphi study showed that an understanding for different needs among stakeholders is not always provided. For example, a business owner complained on that the service for consolidated deliveries in the area did not allow for sending parcels in the late afternoon while another stakeholder did not perceive the opening hours for consolidates deliveries as a problem and a third stakeholder admitted insufficient knowledge on the needs in the area.

City planning

As mentioned before Macharis et al. (2014) state that the urban freight system can be described as complex as different influencing factors need to be considered in decision making. The urban freight system can thus not be seen as an isolated system. Several authors, e.g. Barone and Roach (2016) Lindholm (2012) emphasize that urban freight transport needs to be considered in city planning as it is influenced by the infrastructure in cities. This aspect is also highlighted in the expert interviews where it is stated that it is still challenging to find ways for including urban freight transport in city planning. Many different actors are using public space together which results in many stakes affected by decisions regarding city planning. However, stakeholders in the interviews state that it is important to plan for consolidation centres in the city in order to achieve a change in the system towards more consolidated deliveries.

Address social, environmental and economic sustainability

Transports are performed by private actors but constitute negative external effects. In the area IV this correlation described by Browne et al. (2004) makes it in some cases difficult to achieve behaviour changes by private actors as they may not see that efforts to reduce negative external effects can contribute to private gains. Urban freight transport has impacts on social, environmental and economic sustainability. Congestion, lengths of the trips, time to delivery and cost for the infrastructure are according to Russo and Comi (2012) indicators for economic sustainability. A problem that can be seen in the area IV is that present solutions have higher economic sustainability than solutions that emerge in niches. For example, it is more profitable for transport companies to use their own trucks for deliveries to the city center instead for trans-shipping goods in a consolidation center. In spite of congestion on roads to the city centre which means increased time to delivery, consolidation in the city is, as of today, not considered as a profitable solution. Solutions developing in niches such as urban watertrucks and small and environmentally friendly last mile vehicles are struggling to challenge solutions in the present regime. Regulations or subsidies are named as options

for the area to incentivize the use of niche solutions. How solutions in niches could be strengthened is discussed by stakeholders as solutions in the present system do not support aims regarding social and environmental sustainability in the system. Livability in streets is named as a desirable future for the area IV. Good accessibility in the street network and to societal functions is regarded as important by the stakeholders in the questionnaires. It can be connected to Maclaren (1996) criteria to fulfil basic human needs. Several authors, e.g (Russo & Comi, 2012) and (Behrends et al., 2008) suggest liveability in streets as a criteria for sustainability in urban environments. However, in the questionnaire stakeholders did not achieve consensus on the strategy "Rearranging the streetcape to create more space where people want to be and where they can move around". It must be taken into consideration that a specific measure, namely to "rearrange the streetcape" is suggested to increase livability. However, it would be interesting to further explore the discrepancy regarding livability in streets in the expert interviews and the questionnaire. Developments on the niche level such as consolidated deliveries and electric trucks are describes as possible solutions for the future as they contribute to less emissions and noise. Behrends et al. (2008) states that the reduction of greenhouse gas emissions, air pollution, noise and waste should be overall goals for ecological sustainability in urban freight transport. Both in the questionnaire and the interviews the aim to reduce negative environmental effects from urban freight transport was expressed. However, in the present regime the number of vehicles is increasing, and fossil fuels are mainly used as driving power. Solutions in niches that could contribute to reduce negative effects of urban freight transport have not become a main part of the present regime. High costs for trans-shipment, a lack of consolidation centres, a lack of incentives, and difficulties to coordinate different interests and areas of responsibility were named as reasons for why it is difficult for emerging solutions to challenge the dominating regime even if these solutions can contribute to increased social and environmental sustainability. Both in the interviews and questionnaires collaboration was regarded as important for developing strategies that could help to overcome barriers in the urban freight transport system. Enhanced collaboration could create higher awareness for the value of sustainable solutions and for how overcoming barriers in the regime could enable sustainable development.

6.2. Collaboration towards a sustainable urban freight system

Mapping the urban freight system in the area IV by expert interviews and questionnaires showed that collaboration is perceived as important to achieve transitions in the system. What is interesting from the results is that collaboration in the present system in form of the LFNG is regarded as important and in many cases well-functioning. However, different kinds of collaboration are needed. The semi-structured interviews and the follow up interviews showed that the scope of the LFNG is too broad to address specific topics,

such as consolidation of deliveries in the area IV. This experiences regarding collaboration are in line with Quak et al. (2016) findings that FQPs, such as the LFNG, are effective for building up trust and sharing knowledge and information, but that it can be challenging to involve all participants in decision making and planning and to create innovative action. An interesting finding from the follow-up interviews is that an FQP, like the LFNG, can be used to bring up specific topics and decide on a group of stakeholders that should do further work on the specific topic. Groups working on specific projects could be organized in a living lab which Nesterova & Quak (2016) explain as an action-driven form of collaboration. Quak et al. (2016) state that the conditions of inclusiveness, anticipatory capability and responsiveness need to be fulfilled in a living lab. A sub-group to the LFNG that fulfills the criteria of a living lab could be implemented in the area IV to meet the need for a platform enabling work on specific topics identified in the area. To meet the criteria of inclusiveness all relevant stakeholders in the area IV could be connected in this sub-group. In this thesis freight transport operators, receiver, administration authorities, politicians, shipper, developers, researcher and property owners were identified as relevant stakeholders for urban freight in the area IV. The sub-group could apply the PDCA-cycle which Taniguchi et al. (2014) suggest for a structured and continuous work with the urban freight transport system and problems connected to it. In the planning phase shared objectives and a common understanding are established (Taniguchi et al., 2014). Involving all stakeholders in the sub-group in the planning phase would address the needs of shared understanding and enhanced collaboration that were expressed by the stakeholders in the area IV. In the planning phase the stakeholders can develop concepts that are tested, measured and evaluated in the following phases of the PDCA-cycle. As results are measured predictions on effects of the project can be made. For example, in the area IV regulations on time and vehicle size did not achieve the intended effect. By measuring and evaluating concepts in a more structured way, unintended effects could be avoided. Having a shared understanding, setting up goals and measuring progress on the goals is mentioned as important for a collaboration in the follow-up interviews. In the expert interviews it is stated that learning between projects needs to be improved in the area IV. By systematically implementing, evaluating and adapting projects in the sub-group problems of insufficient learning between projects could be overcome. In the interviews stakeholders stressed the importance of demonstrating and testing projects but stated that it can be challenging to continue with projects after the test phase. By implementing projects in collaboration between stakeholders in the setting of a living lab a high level of SSA could be achieved and JKP could be enabled. A collaboration platform in form of a sub-group to the LFNG, where implementation of suggested solutions can be addressed in a systematic way, could enable transitions towards a sustainable urban freight system in the area IV.

In the framework for SSA that is provided by Quak et al. (2016) three levels for SSA, i.e. perception, prescription and participation are presented. The urban freight system in

the area IV can rather be assigned to the level of perception. As the results of the questionnaire showed there are goals in the system upon which the stakeholders agree on. Furthermore, the LFNG provides a platform for information exchange where stakeholders together can establish goals for the system. However, the LFNG lack some requirements for participation, the highest level in the framework for SSA. By engaging stakeholders in the area IV in a sub-group applying the PDCA-cycle to continuously plan, implement, evaluate and adapt projects change in the system could be achieved. The involved stakeholders could systematically and jointly work with projects in niches that can challenge the present regime. Systematic collaboration in sub-groups could also enable a higher level of sensitivity towards stakeholders' different rationalities at stake which according to Gammelgaard et al. (2017) is crucial for successfully implementing solutions. A sub-group could address the need expressed by stakeholders in this thesis to collaborate on specific problems in the area IV. To work with urban freight measures for specific geographical parts in a city is also reflected in the categorization of urban freight measures by spatial layers suggested by Wangsness and Johansen (2014). However, the urban freight system in the area IV cannot be regarded as an isolated system as it is influenced by developments outside the area and earlier in the supply chain, e.g. congestion on streets to the area. Therefore, stakeholders' involvement in the LFNG were urban freight stakeholders for the whole city meet would be highly important to share information and take part of urban freight developments in the city. A sub-group could fulfil the need of enhanced collaboration between specialists, local authorities and politicians that was expressed by stakeholders in the area and could enable JKP in specific projects.

In the follow-up interviews it is mentioned that not only the need for collaboration on specific projects but also the need for uncomplicated information exchange and communication must be addressed in a collaboration. Therefore, the sub-group should not solely be used for collaboration on specific problems but also for information exchange regarding developments in the geographical area. An interesting finding in the follow up interviews is that, when there is a problem, the actor that is affected by the problem and/or the actor that is causing the problem should be the one owning the topic, or at least participate in a collaboration addressing this topic. It is also stated in both the expert interviews and the follow-up interviews that a neutral part should manage collaboration between different stakeholders. In particular when politicians are involved in the collaboration it is beneficial to have a neutral part, as the neutral part is considered to be non-bias. Political involvement in collaboration processes was regarded as important by stakeholders in the area IV and also Lindholm and Browne (2013) conclude that political involvement can be important in freight partnerships. In the follow-up interviews stakeholders suggest to classify problems raised in the LFNG according to the level of collaboration that is needed, i.e. to decide if the problem should be addressed in the LFNG or in minor groups. The sub-group for the area IV could be a platform were problems concerning the area that are classified as too specific for being taken up in the

LFNG could be addressed. Good communication channels between the LFNG and the sub-group would be needed to determine on which platform a problem should be addressed. The involvement of politicians in the LFNG provide the opportunity for stakeholders in the sub-group to discuss problems in the area IV together with politicians responsible for freight transport in the city.

The concept of a sub-group to the LFNG addresses collaboration and implementation of urban freight projects in a systematic way as suggested in existing literature. However, the concept adds the idea of establishing a sub-group for a certain geographical area of the city and to connect the sub-group to the city's freight partnership. Moreover, the purpose of the sub-group is not solely focused on action-driven innovation and implementation but also information sharing and trust-building among stakeholders in the area of the sub-group. In the sub-group problems which are too specific for being solved in the LFNG can be addressed and the needs of stakeholders in the area as well as the specific infrastructural conditions can be emphasized to a higher extent. However, as urban freight transport in a geographical area of a city is highly dependent on other parts of the city frequent information exchange with the city's freight partnership is needed. Sub-groups could also be created for other parts of the city. This would put high requirements on the coordination and management of the freight partnership involving stakeholders from all sub-groups as information exchange between stakeholders from different subgroups need to be maintained in order to address the complexity of the city's urban freight system. In the area IV the service for consolidated deliveries sets a demand on collaboration between stakeholders and an understanding of stakeholders' needs. Similar areas where sub-groups could formalize and enhance collaboration among stakeholders could be shopping malls or areas with a common C/O address.

6.3. Discussion on methodology

The thesis pursues a highly participative approach as stakeholders were involved in the system mapping from the very beginning. In the questionnaires open-ended questions were asked to explore stakeholders' perceptions of barriers and possible solutions in the system. Different results could have been achieved if the stakeholders were provided with barriers and initiatives from existing literature. However, in contrast to most research within urban freight transport this thesis aimed to give stakeholders in the area ownership of the problem by enabling a group communication process about barriers and possible solutions that the stakeholders have identified themselves. Instead of using questionnaires in the Delphi study, focus groups could have been used to enable communication about the system between stakeholders. However, to avoid shortcomings from group communication such as group pressure from other group members questionnaires were chosen for data collection in this thesis. The description of the urban freight system in the area IV would may have been different if another sample of stakeholders had been involved, a higher number of stakeholders had participated in the

Delphi study and more stakeholders had been interviewed. The multi-level perspective as a framework for system analysis has been applied in several transport studies. However, to the researchers' knowledge it has not been applied to the specific case of urban freight transport. Besides identifying developments on regime, landscape and niche level the exploration of a desirable future was topic of the expert interviews. The aspect of a desirable future was emphasized to assess stakeholders' perception on how the urban freight system should develop and to check whether developments in the system support or hinder the desired development. In the Delphi study the aspect of a desirable future was addressed by assessing stakeholders' agreement on the official transport strategy in the area and asking them to add strategies that need to be addressed. While the expert interviews provided valuable insight on casual relationships in the system, the questionnaires addressed daily problems in the system. The combination of both perspectives contributed to a broad understanding of the system.

Trying to answer the first research question, to identify characteristics and factors hindering sustainable transitions in the urban freight transport system in the area, showed in the process itself how complex the urban freight transport system is. The abductive methodology made the questions being grounded in theory, using previous literature, but also in practice, using interviews and surveys. The physical limitation to the area IV made the research somewhat easier to conduct, but as the area and the system are totally depended on more than just the area the system cannot be fully studied. Many findings in the results are not directly connected to the physical area but affect the area. One example is the problem of congestion which is not in the area but has a huge impact on when and how freight can be delivered to the area. The other physical limitation is the freight, which perhaps makes the focus to narrow. There are many more aspects that affects the freight transport system than just the freight and the transports. City planning is identified as one and in all the interviews the stakeholders talked about soft values, as relationships between the stakeholders and the reliance on one or a few individuals. This insight was a reason for why collaboration was further studied using the second research question.

7

Conclusion

Urbanization, growing e-commerce and climate goals put pressure on urban freight transport systems. Transitions towards more sustainable urban freight systems are needed but difficult to achieve. The urban freight transport system in the area IV has been analyzed by applying the MLP. The regime in the area is characterized by a multi-stakeholder environment, fragmented deliveries, an increased use of light trucks, time regulations on vehicle types and collaboration in an FQP. Developments in niches such as business models for combining consolidated deliveries and waste collection could challenge structures in the regime in the future. However, several factors have been identified that hinder a transition towards a more sustainable urban freight system in the area. Alternative modes for transportation that have developed in niches are not as profitable as transportation modes mainly used in the system today. While the LFNG provides a platform for collaboration on a broad level in the city, structures for collaboration between actors on specific projects in the area IV are not sufficiently available. Moreover, a lack of shared system understanding and goals that are not clearly communicated are barriers against achieving change in the system. Regulations in the system provide limited incentives for an increased use of more sustainable transport modes. Urban freight transport has not been prioritized in city planning in the same way as public transport and the challenges to find ways to include urban freight transport in city planning remain.

Stakeholder collaboration in the area could be improved by implementing a sub-group to the existing FQP, the LFNG, for the area IV. In the LFNG stakeholders from the area IV could take part of developments in the city, exchange information and be involved in developing goals for urban freight transport in the city. In the sub-group to the LFNG stakeholders could work in a more action-driven way with urban freight projects in the area IV as the group is limited to stakeholders from that geographic area.

The goals of the sub-group should be in alignment with the goals of the LFNG and established ways for communication between the sub-group and the FQP should be at place. The sub-group could work with specific projects in the geographic area IV. By following the PDCA-cycle the group could implement measures in a structured way and enhance learning within and between projects as measurements are taken and evaluated.

7.1. Implications

The results of this thesis could be used by practitioners in the urban freight system in the area IV when planning for measures to be implemented in the system. According to Taniguchi et al. (2014) public authorities have the ultimate responsibility for implementing policy measures. The description of the area IV could thus be useful in the planning process at the local traffic authority. As stakeholders were highly involved in the system mapping, the results of this thesis could be a basis for future collaboration and facilitate communication about the system. For example, in the follow-up interviews the results from system mapping were used to ask stakeholders who were involved in the questionnaires how collaboration between actors in the system could be organized in the future. As the follow-up interviews only involved a sample of three stakeholders it is suggested to have follow-up workshops with all relevant stakeholders in the system to further elaborate on the concept of a sub-group to the LFNG. Due to time constraints and difficulties to combine stakeholders' time schedules workshops have not been part of this thesis. The strategies stakeholders achieved consensus upon in the questionnaires provide common goals for the group and could be used as a starting point in follow-up workshops initiated by public authorities. However, as the urban freight system is dynamic, and changes occur over time It is important to adapt the strategies to new developments in the environment. As stakeholders did not achieve consensus on four of the traffic strategies provided by the city it could be interesting to investigate the reasons for this disagreement. However, as the strategies were general for all traffic in Gothenburg, some of the strategies might not be applicable to the area. The thesis showed that investments in infrastructure, e.g. consolidation centres are needed to enable sustainable change in the system. Politicians and public authorities in the city should consider urban freight transport in the context of city planning. Moreover, they should clearly communicate goals for the system and revise regulations that had unintended negative effects.

The research in this thesis was limited to the area IV. The concept of a sub-group to the LFNG has been developed based on the system mapping and identification of barriers against a sustainable urban freight system. Future research could further investigate the concept of geographical sub-groups to urban freight partnerships and explore how a system consisting of a broad freight partnership and several geographical sub-groups can be managed. The results of this thesis present barriers against a transition towards a sustainable urban freight system. As transports in cities are predicted to increase in the

future the need for consolidating goods for deliveries in cities is likely to increase. As few areas have succeeded to implement a functioning model for consolidated deliveries, the results of this thesis for the area IV could be interesting for researchers investigating how transition towards a sustainable urban freight system can be achieved. This thesis took a holistic perspective to get an overview over developments and barriers in the area's urban freight transport system. The barriers identified in this thesis could be further analysed and in-depth studies on how each of the barriers can be overcome could be conducted. This thesis used a Delphi survey consisting of two questionnaires to enable a communication process between stakeholders. Future research could develop the methodological approach used in this study by adding methods enabling open discussions between stakeholders in meetings.

8

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Appendix

Appendix I Report, Phase 1

Appendix II Interview guide, expert interviews

Appendix III Coded results semi-structured interviews

Appendix IV Calculating consensus on strategies

Appendix V Results from the second survey

Appendix VI Interview guide, follow up interviews

Appendix VII Coded results follow up interviews

Appendix I. Report, phase I

In phase I the aim is to define a research question and a purpose for a subject that has a high potential for sustainability transitions and where there is a high interest by stakeholders in the area of Västra Götaland.

The thesis is conducted in Challenge lab at Chalmers University of Technology. Theories and methods used to define a research question and a purpose are explained and discussed. The main theory used is backcasting, which also includes the lighthouse principle, multilevel perspective, stakeholder dialogues and interviews as well as stakeholder mapping.

The timeframe for phase I was initially four weeks, from 21 January to 17 February, se Figure 1. Two more weeks where added to phase I with the main goal to define a research question.

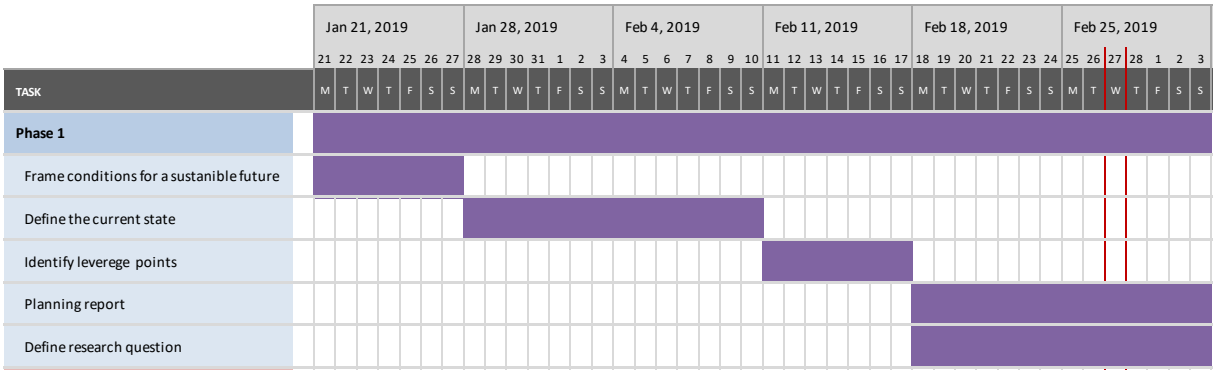

Figure 1. Gantt scheme presenting phase I.

1. Challenge lab

Challenge lab has, since launched in January 2014 (Holmberg, 2014) been an arena where students can find stakeholders and create collaboration with them (Challange Lab, 2019). The stakeholders are representatives of organizations from the private and public sector, including industry, civil society and academia. Students participating in Challenge Lab write their Masters thesis about sustainability challenges in the Gothenburg region in the setting of Challenge Lab. That means to work with systems innovation in a sustainability driven way following a the backcasting methodology. In the first phase of Challenge Lab questions regarding sustainability challenges in the Gothenburg region are

formulated involving stakeholders from the region in dialogues. In the second phase these questions are addressed by students who elaborate on an identified question in pairs.

1.1 Background of Challenge Lab/Knowledge triangle

The universities are expected to take more social responsibilities. This is mainly seen in the pressure from new policies (Vico, Serger, Wise, & Benner, 2017). One part of this expectations is the need to strengthen interaction between education, research and innovation (Vico et al., 2017). The model used for demonstrating the interaction is the Knowledge triangle, see Figure 2, defined by Melin and Blomkvist (2011, p. 15) as:

> *"The concept of the Knowledge Triangle relates to the need for improving the impact of investments in the three forms of activity – education, research and innovation – by systemic and continuous interaction".*

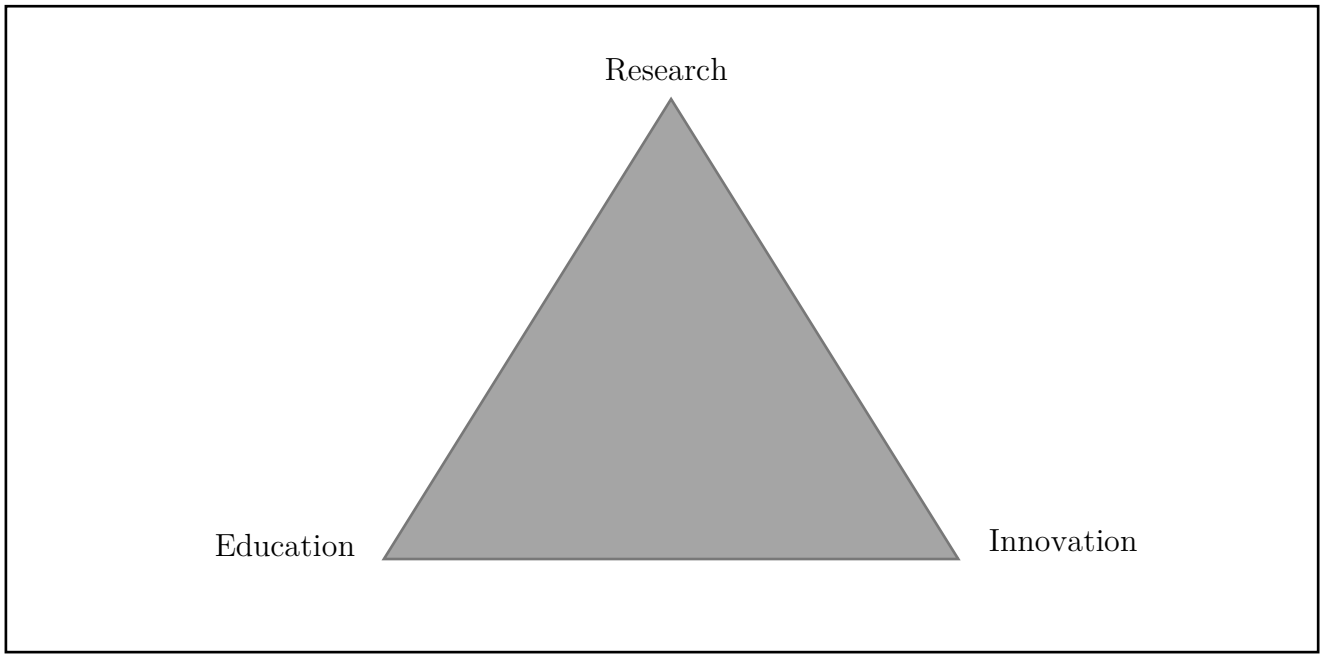

Figure 2. The knowledge triangle.

To integrate and work with the Knowledge Triangle, Chalmers University of Technology, in the year of 2007, appointed three new vice presidents (Holmberg, 2014). They had the task to increase collaboration within Chalmers and with stakeholders to Chalmers. To create change at Chalmers three building blocks have been identified: "(i)Create a neutral arena/organization, (ii) Build on individual engagement and involvement (bottom.up); and (iii) Communicate a clear commitment from the management team" (John Holmberg, Lundqvist, Svanström, & Arehag, 2012, pp. 222-223). One strategy for

Chalmers University of Technology to transform towards sustainability is the Challenge lab (Holmberg, 2014).

1.2 Mission of Challenge Lab

Challenge lab is a student-driven transition arena, see Figure 3 (Holmberg, 2014). The mission of is to:

- *"Strengthen the educational dimension in the knowledge triangle within the Areas of Advance.*
- *Provide a natural hub for the triple helix actors within the five regional knowledge clusters, where all parties are drawn because of the students, as they all have a stake in the students.*
- *Build trust within the clusters through students. A defining feature of students is that they are simultaneously non-threatening and challenging, a feature crucial to the kind of change society greatly needs, positioning the students to be powerful change agents.*
- *Give the students the opportunity to develop unique skills in working across disciplines and from a challenge-driven perspective" (Holmberg, 2014, p. 97).*

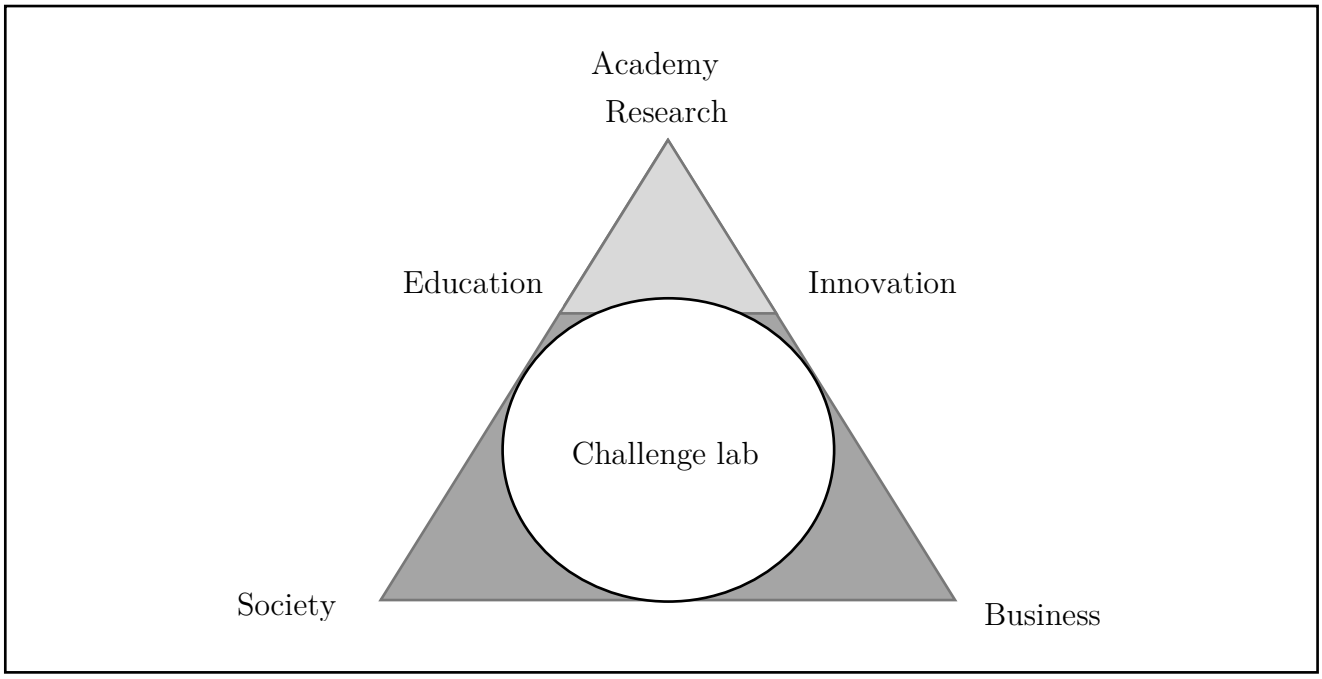

Figure 3. The relation between academy, society and business with the Challenge Lab in the middle (adapted from Holmberg (2014)).

In practice, Challenge Lab is conducted every spring with about 12 to 16 students that produce master theses in pairs of two students. The lab runs for about 20 weeks divided

into two phases. Phase I with the goal to define a challenge and Phase II with the goal to develop a solution.

1.3 Goal of phase I

The goal of phase I in Challenge Lab conducted in the spring 2019 was to identify possible research questions that had a lot of potential and energy. The topic of the research question should be limited to Västra Götalands regionen (Western Götaland region) and sustainable driven transitions.

2. Theories in phase I

The following chapter provides descriptions of theories applied in phase I in Challenge lab. Backcasting, the sustainable lighthouse principles, multi-level perspective, stakeholder identification, stakeholder dialogues and stakeholder interviews will be described in this chapter and their application in Challenge lab will be described in chapter *2 Methods Phase I.*

2.1 Backcasting

The common approach of handling future oriented studies is forecasting (Dreborg, 1996). But as J Holmberg and Robert (2000) concludes, forecasting should sometimes be complemented or replaced by backcasting. Especially when issues are complex (Dreborg, 1996) when trends are part of the problem and when a big change is needed (John Holmberg, 1998).

Backcasting is a planning methodology for solving complex problems in a coordinated way by taking general principles as a starting point. The general and non-overlapping principles should cover important aspects of sustainability and serve as a shared mental framework for stakeholders involved. According to Holmberg and Robert (2000) a shared understanding of the system facilitates communication and the development of creative solutions for the problems identified. A mental framework that is shared among individuals can provide guidance needed for individuals to work as a team.

By starting with defining what a sustainable future should be like the focus in backcasting is directed towards finding steps to attain the envisioned future rather than creating strategies based on past trends as usually done in forecasting (Holmberg and Robert, 2000). In particular when past trends are part of the current problem a strategy determined by past trends constitutes the risk of translating the problem to the future

The backcasting method is a step-by-step approach and consists of four steps (Figure 4). In the first step criteria for a desirable sustainable future are defined. The criteria are discussed on a principal level and do not suggest specific solutions for sustainability

problems. The criteria create a common understanding of a sustainable future which facilitates the coordination of actions.

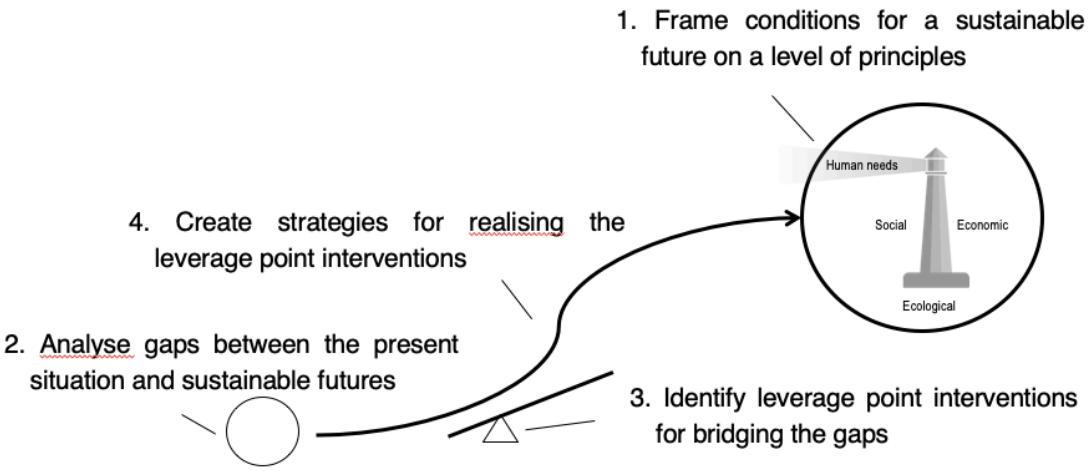

Figure 4 The different steps in the backcasting process. Based on Holmberg (1998) and Holmberg & Larsson (2018)

In the second step the present situation is analyzed and related to the desirable future defined in step 1 (Holmberg and Larsson, 2018). The purpose of this step is to identify gaps between the current situation and the desirable future. After having identified gaps, step 3 focuses on identifying leverage points that can bridge the gaps. Finally, in step 4 strategies for how to work with the previous identified leverage points are developed. Backcasting is an iterative process where the first backcasting round can have an overall approach aiming at identifying different problem areas in order to then focusing on one problem area in another backcasting process.

2.2 Sustainability and the lighthouse principle

In the first step in backcasting criteria for a sustainable future are defined as guiding words. Holmberg and Larsson (2018) suggest a framework named "the sustainability lighthouse" to structure conversations about sustainability principles. The framework

includes four dimensions of sustainability, human needs and wellbeing, economic, ecological and social (see Figure 5)

Sustainable development is defined by Brundtland as:

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987).*

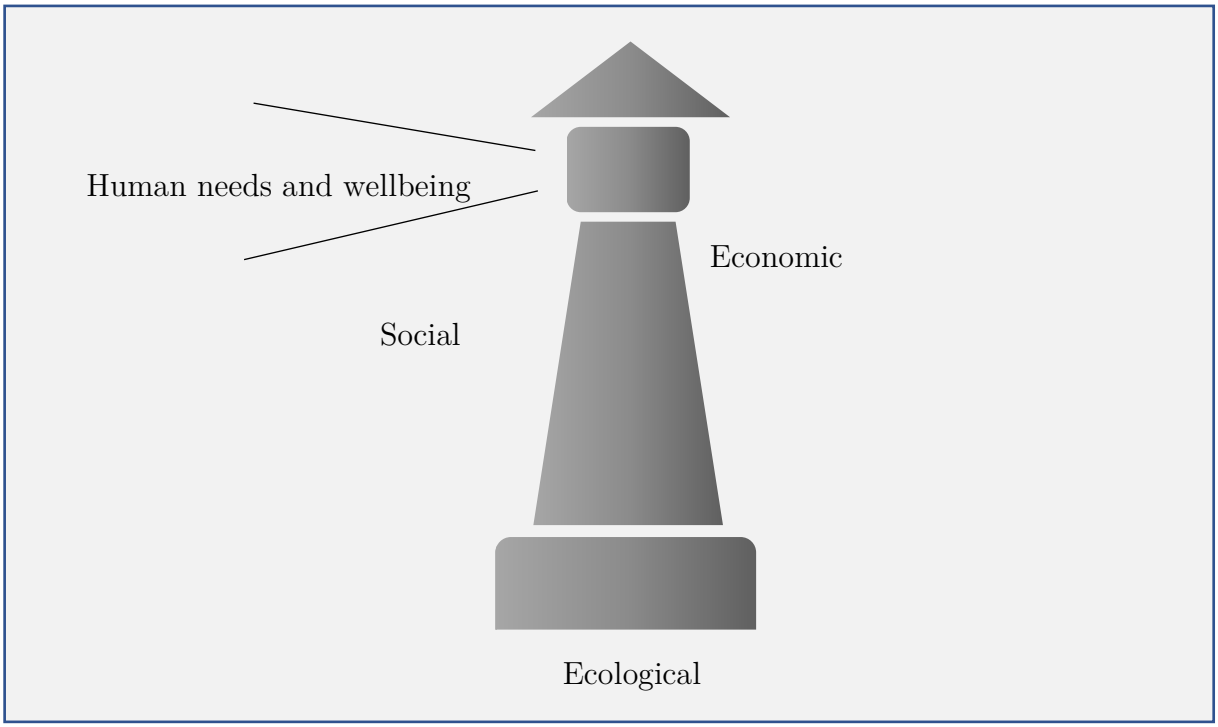

Figure 5. The sustainability lighthouse (adapted from (Holmberg & Larsson, 2018).

Human Needs and Wellbeing

In the lighthouse principle, Human Needs and Wellbeing is on the top as this dimension sets the purpose and direction for the other dimensions (Holmberg & Larsson, 2018). Symbolized in Figure 5 as the top and the light of the lighthouse as it should guide towards sustainability. Connected to Brundtland's definition human needs, both in the present and in the future is what defines sustainable development. As this dimension reflects on what life one wants to live and live in the question *"what is a good life?"* is emphasized.

Holmberg and Larsson (2018) lists nine fundamental human needs, provided by Max-Neef, Elizalde, and Hopenhyan (1989) that should be guiding when one tries to answer

what a good life is. These are *Subsistence, Protection, Affection, Understanding, Participation, Idleness, Creation, Identity and Freedom (figure)*

Ecological sustainability

In the lighthouse principle all the other dimensions rests on the ecological dimension (Holmberg & Larsson, 2018). As symbolized in Figure 5 the ecological dimension constitutes the footing of the lighthouse. Holmberg and Larsson (2018) use the question *"How can society´s activities fit within nature´s carrying capacity?"* to guide the ecology aspect of sustainability.

Three indicators for ecologic sustainability are explained by Azar, Holmberg, and Lindgren (1996, p. 90) as the:

- *societal activity indicators,* activities that occur in society, usage and extraction of minerals, usage and production of toxic chemicals and recycling of materials
- *environmental pressure indicators,* human activities that have a direct influence on the environment
- indicators of the state of the environment or environmental quality indicators, the state of the environment

Azar et al. (1996, pp. 91-92) explain four principles that should be fulfilled in a sustainable society and that are used as a framework to the indicators. These principles are:

- Substances extracted from the lithosphere must not systematically accumulate in the ecosphere
- Society produced substances must not systematically accumulate in the ecosphere
- the physical conditions for production and diversity within the ecosphere must not become systematically deteriorated.
- the use of resources must be efficient and just with respect to meeting human needs.

The principles suggested by Azar et al. (1996, pp. 91-92) are reflected in the ecologic dimension of Holmberg and Larsson (2018, p. 7) sustainability lighthouse. They can be taken as a starting point in conversations about ecologic sustainability. Holmberg and

Larsson (2018) propose to focus on the three themes, *substances form earths crust, substances produced in society* and *physical means.*

Economic sustainability

Business Dictionary (2019) defines economic sustainability as:

> *"The use of various strategies for employing existing resources optimally so that a responsible and beneficial balance can be achieved over the longer term".*

Holmberg and Larsson (2018) state that economic sustainability should serve needs and that it is about managing capital in the present and in the future. Based on that they chose the guiding question *"How can capital be managed for the future?",* see Figure 5.

In the lighthouse four themes for economic sustainability are identified by Holmberg and Larsson (2018). These themes are *natural capital, man-made capital, human capital* and *financial capital.*

Social sustainability

According to United Nations Global impact (2019)social sustainability is about

> *"identifying and managing business impacts, both positive and negative, on people".*

To guide social sustainability, Holmberg and Larsson (2018) use the overarching question *"How can we live together?"* based on the conclusion that the theme for social sustainability is social cohesion. Social cohesion refers to a social system and a functioning society.

Regarding social sustainability, Holmberg and Larsson (2018) chose three guiding themes (Figure 5). These themes are *horizontal relations, vertical relations* and *equity/justice.*

2.3 Multilevel perspective

In order to identify leverage points in the backcasting process an understanding of the current system is needed. A method for mapping the present with a system perspective is Geels' (2005) multilevel perspective.

Geels (2005) describes sociotechnichal systems as complex and suggests a multi-level perspective to describe systems and to understand how system innovations, which he defines as the shift from one sociotechnical system to another, come about. The need for taking on a system perspective to understand complex problems is even emphasized by Holmberg & Robert (2000) and Haraldsson (2004).

According to Geels (2005) system innovations can be understood by considering developments on three different levels: Landscape level, sociotechnical regime and niches. The sociotechnical regime is the current framework of rules, common practices,

institutions and infrastructure. It can be challenged by novelties developed in niches and is influenced by trends on landscape level. Examples for such trends are globalization and digitalization which influence the sociotechnical regime but cannot be directly influenced by actors in the system. System innovations occur through the interplay between simultaneous developments at multiple levels. (Geels, 2005)

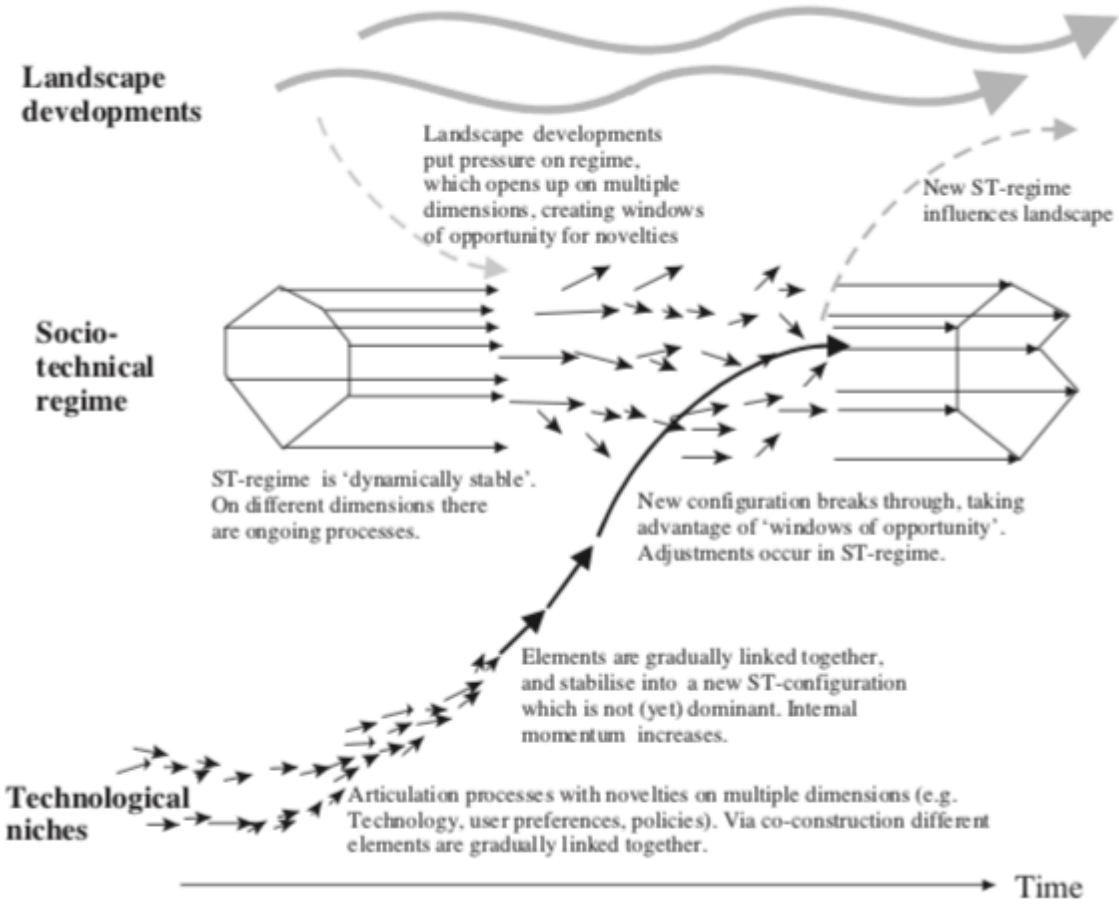

Figure 6. Multi-level perspective on transitions and system innovations, figure from Geels (2005).

2.4 Stakeholder dialogues

Dialogues can be a useful tool in backcasting to get an understanding of the present system and identify leverage points. However, preparation and a distinct approach for

how to lead a dialogue are needed in order to get relevant insights from peoples' knowledge (Isaacs, 1999).

According to Issacs (1999) four dialogic leadership abilities can support the process of getting relevant insights from a dialogue. These abilities are (Isaacs, 1999, p.2):

- To evoke people's genuine voices
- To listen deeply
- To hold space for and respect as legitimate other people's views
- To broaden awareness and perspective

Issacs (1999) emphasizes the importance of listening carefully and respecting what is said by others even if it conflicts with personal convictions. According to Issacs (1999) showing respect means to attempt to understand the points made by others. The importance of listening and respecting is even emphasized by Le Roux (2018) who suggests mirroring, summarizing and clarifying as tools for facilitating dialogues. Mirroring means to check if one has gained a correct understanding of what has been said by telling the speaker what you have heard. Summarizing is a tool that can be used before changing the topic of a conversation in order to clarify what has been said and check with the participants if they have been understood correctly. Clarifying what a speaker has been said can be done by asking clarifying questions which give the speaker an indication to clarify or elaborate an aspect.

A setting for dialogues with several participants is the fishbowl setting. In the fishbowl setting the participants of the dialogue are sitting in an inner circle and the observer of the dialogue are sitting in a circle around the inner circle, the outer circle. The dialogue is facilitated by one or two facilitators who should consider the previous described tools and abilities to facilitate the dialogue. The listeners sitting in the outer circle can focus and reflect upon what has been said. Time slots for interaction between the inner and the outer circle can be integrated in the fishbowl dialogue Le Roux (2018).

2.5 Stakeholder interviews

Semi-structured and unstructured interviews are useful methods in research that emphasize the interviewees point of view. In contrast to structured interviews where standardization of questions is needed, semi-structured interviews provide a higher level of flexibility. In semi-structures interviews the interviewer often has a list of questions that serves as a guideline for the interview. However, questions may not be asked in the previously planned order and new questions may be added. Unstructured interviews are even more flexible than semi-structured interviews and rather have the character of a conversation. The interviewer may not have specific questions to ask and instead holds

the interview by following up on seemingly interesting aspects brought up by the interviewee. (Bryman)

In this study semi-structured interviews are applied for interviews with stakeholders. Before each interview a list of questions is prepared giving the interview a clear focus and providing the opportunity to adapt the questions to each interviewee's context. Presupposed the interviewee's permission the interview is recorded in order to minimize the risk for missing aspects brought up during the interview. Following a semi-structured approach in the interviews the interviewee is given the opportunity to elaborate on answers and clarify. Providing the interviewee this opportunity and asking clarifying questions if needed is important in order to clearly understand the interviewees points of view. This is crucial for developing effective and applicable suggestions for the case investigated in the study.

3. Methods Phase I

The chapter provides a description of the methodological approaches applied in Challenge lab. A theoretical background to the methodologies used is given in chapter 2.2.

3.1 Backcasting

In Challenge Lab students apply the backcasting methodology in order to identify strategies for future sustainable solutions. The backcasting methodology is the overall method used. During the backcasting process different methods are used. In the first step of the process a common framework of principles covering the ecologic, social and economic dimension of sustainability as well as human needs and wellbeing was developed. The process of formulating principles started with taking an inside-out approach where the students were asked to reflect about their own values to write a mission statement as a guideline for their actions.

After having created an awareness of one's personal values the students used an outside-in perspective by taking into account sustainability principles explained in *1.2 Sustainability and the lighthouse principle.* The students created their own lighthouse principles to identify criteria for sustainability.

After having created a common understanding of sustainability the present situation was assessed by doing a system mapping, explained in *1.3 Multilevel perspective.* This system mapping was used to prepare for dialogues with stakeholders from the region. The results

from stakeholder dialogues on the current system were added to the initial system mapping.

Based on the common framework of principles and the understanding of the current system leverage points where formulated. This was done in groups by three to five students with the guiding words:

- What
  - What is the bigger problem to solve?
  - For example, what is the gap to address?
- Where
  - What "lock-in" to address, what local problem?
- Who
  - What individuals and/or organizations have expressed interest in this issue?
  - What ongoing processes could it connect to?

3.2 Sustainability and the lighthouse principle

In phase I of Challenge Lab the students were given the task to conclude guiding principles regarding Human Needs and Wellbeing, ecological sustainibility, economic sustanilibiliy and social sustanibility given the purpose to *Reflect upon what we mean with sustainability and formulate relevant sustainability aspects on a principle level.* The students used a process that consists of three phases, diverge, emerge and converge (Figure 7). In practice this means that groups of six students brainstorm, in the phase of diverge, using post-its and a board to try to cover all aspects of the area, in this case finding the answer for what a good life is. In the phase of emerge the post-its are clustered and a common word, of a higher level is found. After that the task is to converge, finding words on a higher level.

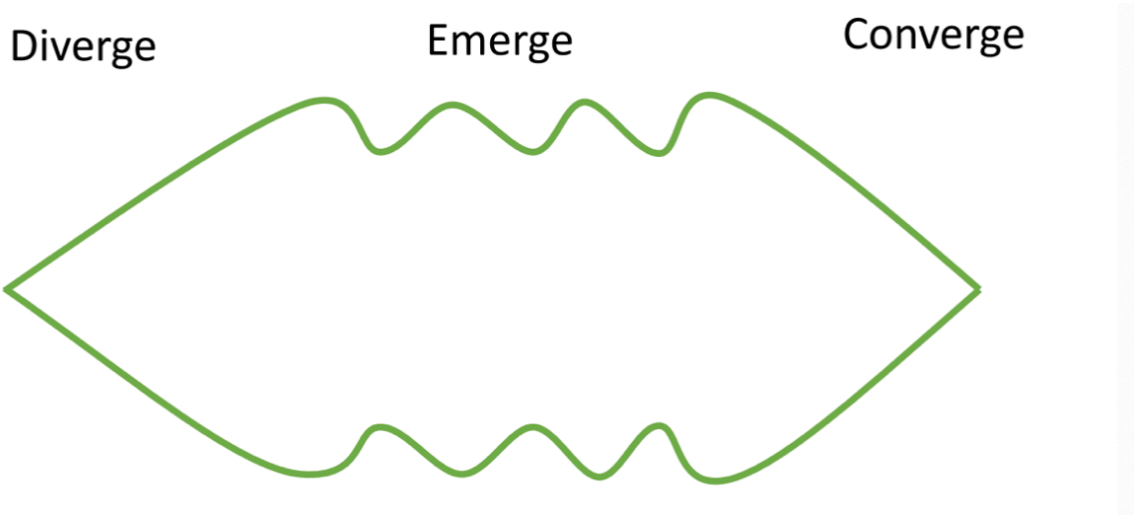

Figure 7. Process of diverge, emerge and converge. The green lines illustrate the opening up in the diverge phase where the participants tried to cover all aspects. The emerge phase is where the participants work with all the

aspects identified in the diverge phase, illustrated as an open phase. The converge phase is where the aspects are converged in to one or a few higher-level aspects illustrated as closing the green lines.

The task also included to think beyond, broad, and together while searching for basic, sufficient and non-overlapping principles. This is a part of the so-called *why principles* where one should stay within the question but try to look at the purpose and direction by asking why questions.

By thinking beyond the focus is on what should be rather what currently is. When thinking broad one looks at the core, specific meaning and gets an overview of the sustainability dimensions. By thinking together, a shared understanding in the group is enhanced.

Searching for basic, the *first order* mechanisms in the dimensions are key. Seeking sufficiency is to cover the dimension on all aspects. Non-overlapping is to seek homogeneity internally and heterogeneity externally.

3.3 Multi-level perspective

Geel's (2005) multi-level perspective was applied in the first phase in Challenge Lab in order to get an understanding for developments in niches, the socio-technical system and on landscape level. An initial system mapping for mobility of goods and mobility of people was done in small groups of three to four students before the stakeholder dialogues. Every group wrote aspects that it regarded as relevant on small post-its and placed these on niche, socio-technical system or landscape level on the board. The group starting this process placed the first post-its on the different levels while the following groups could add, replace and remove post-its. After the stakeholder dialogues the initial system mapping was restructured and aspects were added and removed. In the end of phase one after identifying a research topic to work on in pairs in the second phase of Challenge lab, the system mapping was narrowed down and adapted to the topic goods

transports in the city centre of Gothenburg by restructuring, removing and adding aspects.

3.5 Stakeholder dialogues

During the first phase in Challenge Lab 25 different stakeholders participated in dialogues about sustainability challenges in Gothenburg. Eight of the participants where in one way or another connected to mobility, see Table 1.

Table 1. Participants in the dialogues in the Challenge Lab 2018 between 29-31 January, related to mobility.

Organization	***Profession***
Researcher	Researcher exploring the role that design can play for sharing schemes or product-servie systems, within mobility
The local region	Project leader for "Det Urbana Stationssamhället" (The urban railway town), which engages militple municipalities in Gothenburg region
Startup hub with focus on mobility (MLAB)	Director for MLAB. MLAB offers young companies with pioneering ideas within mobility the opportunity to accelerate.
Independent consult	Independent consultant within mobility. 30+ years of experience from working in the automotive industry.
Start up hub	Process manager a project focusing on local economic development in segregated areas
Truck manufacturer	Director Environment and Innovation
Independent consult	Independent consultant focusing on mobility. Special focus on using urban waterways for goods transportation.
Researcher	Researcher focused sustainable supply chain management, b2b marketing and networks, sustainability both with the environmental dimension and the social dimension.

The dialogues were conducted in a fishbowl setting with two students facilitating the dialogue by summarizing the dialogue before and after break and by asking clarifying questions (Le Roux, 2018). The students sitting in the outer circle could focus on listening deeply and reflecting about what has been said (Isaacs, 1999).

4. Results Phase I

The following chapter presents the results achieved by applying the methodological approaches described in chapter 2.2. and 2.3.

4.1 Backcasting

The results from the first and second step in backcasting were used to formulate leverage points, presented in Table 2. The leverage point that was chosen to do further research

on was “Infrastructure in the future” with a focus om mobility and more specific transport of goods in the innercity.

Table 2. The leverage points regarding mobility that where formulated by the students in Challenge Lab 2019.

What gap	*Where is the lock-in to address*
"Infrastructure in the future" **We want a sustainable infrastructure in the future* *(*but who is responsible for what sustainable transitions?)*	*Small scale infrastructure fail implementing in real world , Cos of the infrastructure system that we have today, funding and power *Big companies/institutions invest more in the old infrastructure/ideas than in the new initiatives *Conflicts between goals
"Mobility as a service (people)" *Public transportation is dependet on nodes*	many personal cars in city streets - how to encourage people not to drive all the way - how to transport goods for short distances within the city - enough tools to cover the use of consumers -
	Considering social aspedcts in design of infrastructure
"Mobility as a service" *People/Companies own mobility solutions instead of buying the service of mobility*	*No platform to share and regulation to control it *The bussiness as usual is to by a service connected to one specific product *Mulit-mode transportation system
Getting new ideas out in society	Actors can't share ideas and problems Lack of coolaboration between big and small actors

4.2 Sustainability and the lighthouse principle

The students came up with guiding principles for sustainability based on the theory and the methods. The guiding words, related to Human needs and wellbeing, ecological sustainability, economic sustainability and social sustainability are presented in Figure 8.

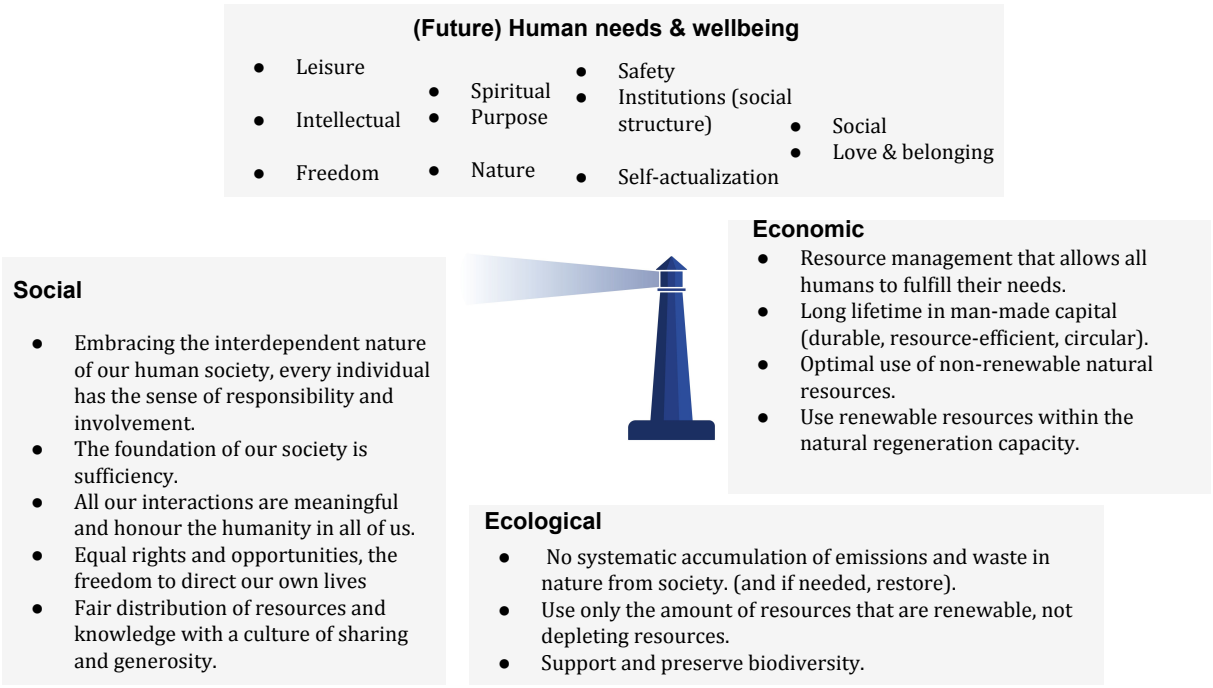

Figure 8. The lighthouse principles done by the students in Challenge Lab 2019.

4.3 Multi-level perspective

In Challenge Lab Geels' multi-level perspective was applied to get an understanding of today's system and how the different levels in the system, landscape, regime and niche, are interrelated. An initial system mapping was done for mobility of goods and mobility of people in Gothenburg (Figure 9). After narrowing down the research topic to sustainable urban logistics for transports of goods, the system for transports of goods in

the city center of Gothenburg was mapped under consideration of the initial system mapping.

Figure 9. The multi-level perspective done by the students in Challenge Lab 2019.

4.5 Dialogues

In the dialogues with focus on mobility, challenges regarding collaboration between different stakeholders in the region such as municipalities, start-ups, science parks and industries were discussed. The stakeholders participating in the dialogues agreed on that collaboration is needed in order to integrate different technical transportation solutions. Furthermore, the challenge of developing distribution systems that contribute to reduced transport emissions and congestion was raised.

To use urban waterways for goods transports in cities and to develop solutions for electric based goods distribution in city centers were suggestions presented during the dialogue. The challenges and the suggestions on sustainable solutions which could be identified during the dialogues served as an input for further research on challenges regarding sustainable urban logistics.

5. Discussion and outcome phase I

The goal of phase I was to identify possible research questions that are connected to Västra Götalands regionen (Western Götaland region) and where stakeholders showed

interest. During phase I the orientation for the thesis and phase II became clearer. The guiding principles were a good tool to have a shared and common goal in-between the students. The current system, presented in was mapped, and from that a research question was chosen:

> *"Transportation in the future. We want sustainable transportation in the future but how can sustainable transition happen and who is responsible for the transitions?"*

The focus was narrowed to study the infrastructure for transports of goods in the inner city. Still the focus was on sustainability and who should be responsible for the transitions.

The focus for the study, sustainability infrastructure transitions, with the specific focus on transports of goods in Gothenburg was chosen as goods transports cause congestion and emissions in Gothenburg's city center. According to the principles developed there should be *no systematic accumulation of emissions and waste in nature from society* and *non-renewable resources should be used in an optimal way.* Furthermore, one of the identified words about human needs and wellbeing where f*reedom* and one principle about economic sustainability was identified as *resource management that let all humans fulfill their needs.*

However, the current system had to be studied more. From the dialogues it became clear that transports of goods include many stakeholders and the problems connected to transports of goods are identified both at a concrete level, as with a low filling degree in vehicles or congestions in the city, and on an abstract level, as the lack of transferred knowledge between the stakeholders. Therefore, we have identified a need for a narrower system mapping, including to identify the needs regarding transports of goods in an urban area, which problem these needs bring and which possible solutions there are.

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Appendix II. Interview guide, expert interviews

What do you work with?

How is your work linked to the development of sustainable urban freight transports?

What is a future urban freight transport system for you?

What's differs from today?

What is better?

What is worse?

What needs do you see in the area IV regarding the development of sustainable urban freight?

Who has this need? Which industries / businesses have which needs?

How is this need met today?

What do you think needs to be done in the next step to develop sustainable city logistics in Gothenburg?

- What problems do you see in the area IV regarding the development of sustainable city logistics?

Who are responsible for each problem?

Who causes the respective problems?

Who should solve each problem?

What solutions do you see in the area IV regarding the development of sustainable city logistics?

Who are responsible for the solutions?

Who benefits from the solutions?

Who are the most important players that must be involved in achieving change in sustainable city logistics in Gothenburg?

What ongoing / completed projects in sustainable city logistics are there in Gothenburg?

Has there been an evaluation of how the projects have gone?

Based on your experience: How do you think the cooperation with and between different actors has worked?

Is there a common goal picture?

Is there an organized collaboration?

Appendix III. Coded results semi-structured interviews

AIM

First-order code	Explanation	Stakeholder	Thematic group
	Well-functioning traffic system, safe and functional environment	D	Desirable future
	Minimize traffic in the city centre and improve the experience for the city's visitors. The city's aim is to minimize interaction between people in the streets and heavy vehicles. Long-term goal to create a more attractive city centre. An attractive city environment is beneficial for the city centre in the competition with shopping centres. There is a need to maintain and further develop a livable city. Therefore, it must be able to deliver and pick-up goods during the whole day	D	Desirable future
	Consolidation and cleaner vehicles	D	
	We want to have attractive cities. We plan for sustainable cities and want to address possible problems early.	E	Desirable future
	We want to achieve a good and enjoyable city environment where people want to go for a walk, go shopping and enjoy their visit. The experience is important rather than "effective shopping". Therefore we need to have less trucks.	B	Desirable future

CITY PLANNING

First-order code	Explanation	Stakeholder	Thematic group
	For the traffic administration office it becomes more and more important to consider developments in buildings, e.g. full service boxes, electric vehicles that serve several buildings.	E	Niche
	City planning is important for planning urban transport. E.g. if we want deliveries with electric vehicle, the city need to invest in the infrastructure	E	Niche
City deliver V	Try to cover flow of goods in the whole geographic area IV to achieve best possible effect for the city. Projects focusing on buildings, such as älskade stad, may not have the same effect as other transport vehicles still need to serve the area.	B	Regime
	Goods transport are seldom considered in city planning. The city wants to consider it more but need to find ways for doing it	A	Niche
	The city needs to provide areas for consolidation centers. There is are no incentives for transport companies to collaborate and plan a common consolidation center. As the city build travel centers for public transport, they need to build consolidation centers.	A	Niche
	The city needs to pay for consolidation to make it economic profitable.	A	Niche
	Should the city build infrastructure for charging stations or do transport companies prefer to charge their vehicles at their own terminals?	E	Regime

	Transport companies need to deliver in time and may do not want o be dependent on public charging stations.		
	CHOICE OF VEHICLE		
First-order code	Explanation	Stakeholder	Thematic group
	Move-by-bike och pling transport use deliver by bike. That is a good concept for last mile delivery in cities and should increase	D	Niche
	The use of light light trucks for urban deliveries has increases drartically in recent years. They are used for transports to private households such as food deliveries.	E	Regime
Failed Regulations	Regulations contributed to an increase in 3,5 ton vehicles (mostly service vehicles “budbilar”). Between 11 am and 5 pm trucks (10m size?) are banned from the city centre. As many companies do not manage to deliver goods with large trucks before 11 am they use smaller 3,5 ton vehicles for goods delivery which contributes to higher traffic volumes in the city centre	B	Regime
	3,5 ton vehicles are used for small deliveries, e-commerce, etc. These vehicles are a bad compromise for handling the different traffic situations in the city centre and on the ways to the city centre. It would be better to take a big truck for the way to the city centre and use small electric trucks or cargo bikes for last mile deliveries. Transports should be divided so that the most effective vehicle is used for each type of transport: Trucks with high loading degree for transport to the city and small vehicles for last mile distribution. Need to use the right vehicle for the right situation. Vans (3,5 tonnes) have bad transport efficiency on the way to the city .	A	Regime
	Need to reduce number of vehicles and adapt vehicles to situation in the city. Trucks are more effective on the way to the city but cargo bikes (lastcykel?) are more effective in dense areas	A	Desirable future
Problem	Significant increase of light trucks (Lätta lastbilar) due to increase in home deliveries to private households, e.g. food deliveries	E	Regime
Problem	Uncertainty for transport companies regarding which type of vehicle power to invest in, e.g. electric or gas driven trucks, diesel trucks. Transition away from fossil fuels but uncertainty regarding dominating driving power in the future. “Chicken and egg problem”: Should the city invest in infrastructure or are investments in vehicles needed first?	E	Regime
	"A good solution: A combination of trucks and small last-mile vehicles to reduce the number of vehicle in the city centre. Large trucks are more economic sustainable on the way to the city whereas small last-mile vehicle are more effective in dense areas. "	A	Niche
	City deliver V is not the solution for everything. It takes pacelts up to 20 kg. This is about 150 paces a day (for one of the major transporting compaies connected to city deliver V) The same transporting company has about 25000 shipments every day at the terminal in gothenburg.	F	Reimge
	ECONOMIC SUSTAINABILITY		
First-order code	Explanation	Stakeholder	Thematic group

	City delivery systems developed today are environmentally sustainable. The challenge is to get economic sustainability	C	Niche, Regime
	Logistic companies save money when they do not need to deliver goods in the city centre. However, consolidation is costly which results in low economic sustainability.	C	Regime
	Tax payers pay 50% of the costs for public transport. The city should invest in infrastructure for consolidation as well in order to achieve economic sustainability.	A	Regime
	DEMONSTRATION AND TRIALS		
First-order code	Explanation	Stakeholder	Thematic group
Living labs	Living labs/ test beds are important to test and implement concepts. Important to have pilot trials to show that concepts work. Pilots can then be scaled-up.	A	Niche
Knowledge distribution	Knowledge about the urban freight transport system is "owned " by actors strategically working with the topic. However, it is in "their heads" and not well-documented which can cause difficulties in case they finish working in the area.	C	Regime
Pilot projects	Most of the pilot projects discontinue	D	Niche, Regime
Continuity	Challenge to continue with pilot projects. It would be good if City deliver V can continue.	D	Niche, Regime
Implementation	Important to make implementation happen after a test phase	E	Niche, Regime
Tests	New solutions need to be tested even if they do not have huge effects on sustainability in the city in the beginning. The market cannot pay for tests on its own.	A	Niche, Regime
	Important to mesure and follow up. Both trials and the overall system	F	Niche, Regime
	COLLABORATION		
First-order code	Explanation	Stakeholder	Thematic group
Different areas of responsibility	Different actors have different areas of responsibility. They need to collaborate to find policies and regulations.	D	Regime
	Implementing new solutions can be difficult when different when the issue of implementation concerns different areas of responsibility. For example, waste collection from private households is the municipality's responsibility while waste collection from companies is a private concern. Implementing a solution for combined transport of goods and waste collection is difficult as different actors are responsible and need to collaborate	E	Regime
Dencity	Develop an implementation strategy so that Dencity solutions can be implemented in other cities. When developing a project plan you need	D	Niche, Regime

	to state which actors to involve, which permissions are needed and which problems can occur.		
Dencity	Challenge to get different actors to collaborate	D	Regime
Collaboration on specific problems	"Godstransportnätverket" is not the right platform to discuss how economic sustainability can be achieved in City deliver V. The group is too big to address that problem. Instead discussions with transport companies are needed.	E	Regime
Communication	Those working strategically with goods deliveries are innovators and not communicators. Extra resources are needed to communicate the goals we want to achieve regarding transportation of goods in the city centre.	B	Regime
Communication	Business owner want to have a good city environment. However, they are maybe not aware of how they can contribute when they order goods.		Regime
Godstransportnätverket	Good platform to get to know others' perspectives and have dialogues between different actors		Regime
Learning between projects	Important to establish learning between projects and between organizations. Knowledge should not stay at individual level. The aim is to find a model that enable cross-organizational learning effects.		Niche, Regime
Neutral part	Collaboration between transport companies could be driven/organized by a neutral part (such as Innerstaden) Competition laws need to be followed when different transport companies collaborate.		Niche, Regime
Neutral part - Dencity	Project managers Dencity are a neutral part without own IP who coordinate the projects participants' different interests. Difficult to transfer this role to another actor in the Dencity project.		Niche, Regime
	Godstrasportnätverket is good. But it is so much more that could be done.	F	Desirable future
	TRENDS		
First-order code	Explanation	Stakeholder	Thematic group
Avatarer, e-commerce	Option to try clothes on an avatar in order reduce number of returned parcels from e-commerce	E	Landscape
Replenishment supply	Development towards reduced inventory and just-in-time deliveries meaning smaller but continuous deliveries during the day.	D	Landscape
Electric vehicles	Electric vehicles for heavy transports	C	Landscape
Urbanisation	Need of transports will increase as more people move to cities. Important to be a step ahead and plan for a flexible and robust transport network to use the limited space in city effectively.	C	Landscape
e-commerce	Increased e-commerce leads increased need for storage space at pick-up points	E	Landscape
e-commerce	E-commerce is not the main cause for congestion in the city. Passenger cars are the main problem. Construction transports, service transports, company transports use their own cars.	A	Landscape

	Nobody know what types of techniques the society wants in the furure	F	Desirable future
	E-commerce, the stores sells on free delivieries, it is inlcuded in the item. The End-costomers take the deliviery for granted and demand that it just should work	F	Regime
	WASTE COLLECTION		
First-order code	Explanation	Stakeholder	Thematic group
	There is an interest for adding waste collection to City deliver V. Collaboration with facility owners would be important for this solution.	D	Niche
	Combining waste collection with goods delivery could be an option. However, there are strict rules regarding separation of waste and goods which makes it difficult to combine these.	E	Regime
	There are plans to collect cardboard and plastics from facility owners that are connected to City deliver V. Difficult to collect compost material.	B	Niche
	Facility owners struggling with limited space in their facilities have an incentive to pay for waste collection	B	Niche
	More data on waste flows is needed in order to develop an offering for waste collection.	B	Niche
	LOADING DEGREE		
First-order code	Explanation	Stakeholder	Thematic group
	Many trucks with low loading-degree driving into the city centre	E	Regime
	Several (5-6) half-loaded vehicles deliver goods to the same address	B	Regime
	Many vehicles with low loading degree delivering goods to addresses in the city centre. Many senders that use their own vehicles and small parcel e-commerce deliveries. The number of vehicles need to be reduced	A	Regime
	The Transporters work with consolidation. It is their business model. They have invested a lot of money in terminals outside the city to be albe to consolidate goods. Gives a example with Nordstan, Almost 200 trucks delivers freight every day. 8% Of them are from "Known transporters" And these deliver 2/3 of the goods.	F	Regime
	Construction work		
First-order code	Explanation	Stakeholder	Thematic group
	Ongoing and future construction work such as Västlänken depict a challenge for urban goods deliveries	B	Landscape
	Construction work such as Västlänken contributes till increased congestion on ways to the city. Consolidation of goods becomes more urgent but still it does not correspond to the costs of consolidation.	A	Landscape

LACK OF INCENTIVES

First-order code	Explanation	Stakeholder	Thematic group
	Today, there is a lack of incentives on the market to consolidate deliveries as consolidation is costly and time consuming. Profits from consolidated deliveries do not cover the costs for planning, infrastructure etc. Too little incitement for transport companies to collaborate and consolidate deliveries. Furthermore, the fact that they are competitors makes it challenging to establish collaboration – and could be against competition law	A	Niche, Regime
	B2B transport companies do not have the same incentives as B2C companies to offer environmental friendly transports as they do not have the same visibility	B	Landscape
Geograohic planning	Incentives are needed to attract actors offering consolidated deliveries. Different actors could focus on different parts of the city	D	Niche, Regime
	The posetives media for city deliver V is given to the city. But it is the transporters who pays for it. Negative effects	F	
First-order code	Explanation	Stakeholder	Thematic group
	Create a well-functioning traffic system and a safe and functional environment on the streets in the city centre.	D	Desirable future
	noise, substances detrimental to health, safety, congestion	D	Landscape
	"The cngestion problem is not that urgent as in other cities. The last 15 years changes in infrastructure and regulations have contributed to less congestion. The main problem is not congestion in the city but congestion on the roads leading to the city centre"	D	Landscape
	Noise, safety and congestion are problems. However it is difficult to get in money into the system to mitigate these effects.	C	Regime
External effects	Many of the negative effects caused by urban transport are external problems but the costs to reduce these affects are private costs.	C	Regime, Landscape
Public space	More space in the city could be used for small businesses and cafes to expand and increase the livability in streets. However, it is difficult to assess the value of a nice city environment. It is difficult to determine the effect of a nice city environment on businesses' sales and compare it to the costs for consolidation which contributes to less traffic and higher livability in the city centre.	B	Landscape, Desirable future
External effects, City planning	City planner want to create a good city environment. A good city environment is valuable for city, society, facility owner and businesses in the city. However, for transport companies consolidation means higher costs per parcel in a low price environment where customers are used to free or low cost deliveries.	B	Desirable future, Regime
	Gains from consolidation in form of reduced noise, emission, increases life quality are gains that the city gets.		Landscape, Desirable future

	Emissions and congestion on ways to the city centre	A	Regime
	Less congestion, reduced emissions and reduced noise are society gains	B	Landscape, Desirable future
Freeriding	Transport companies connected to City deliver V pay for the consolidation system. Transport companies outside City deliver V profit from positive system effects such as less congestion but as they deliver goods with their own vehicles the positive system effects of consolidated deliveries are limited REGULATIONS		Regime
First-order code	Explanation	Stakeholder	Thematic group
	The traffic situation in the city centre has been improved by e.g. “längdbegränsningar”, “gångfartsområden“	D	Regime
time bans	Need to find a balance between regulations and other instruments to achieve a transition in the system. Regulations such as time bans and specifications for vehicles allowed to deliver in the city centre can be too strict.	D	Desirable future
type of vehicle	"Regulations on type of vehicles could incentivize smaller and electric vehicles. Another option are fees for diesel trucks"	C	Desirable future, Niche
	We want regulations that support the business models for consolidated deliveries	B	Desirable future, Niche
regulations supporting consolidated deliveries	"Challenging to find appropriate regulations. The Aim is positive effects for the city environment. However, we do not want a lock-in to one system for achieving that. Regulations that encourage development and flexibility without a lock in to one business modes for consolidated deliveries. "	B	Desirable future, Niche
	Regulations could regulate accessibility to the city centre	A	Desirable future, Niche
Combining solutions	In order to achieve the city’s traffic goals a mix of solutions is required	D	Desirable future, Niche
Policies	With the fuels used today the transport emission goals for 2030 will not be reached. Therefore, policies that support the use of alternative fuels are needed. Policies from cities and state are needed	E	Desirable future, Regime
	Goods in not on the agenda for the politicians. The transporters in gothenburg meet the politicians in gothenburg just some month ago and explained the situation.	F	Regime
	Freight transport is not a separate type of traffic. Which means that it is not measured and followed up, compared to public tranports for humans.		
	The tasks for the traffic administration office is to unclear.	F	Regime

	If the politician would dare to take desitions, on, for example zero emissions vehicles in the city, the transporters would solve that.	F	Regime
	NIGHT DELIVERIES		
First-order code	Explanation	Stakeholder	Thematic group
	Night deliveries are a possible solution	E	Niche
	Night deliveries and off-peak deliveries are possible solutions		Niche
	Could be an option for the case area as there are mostly offices and businesses. In case of night deliveries a solution for goods reception must be found as small business cannot man their businesses at night. A possible solution could be security stuff acceptin the parcel	B	Niche
	Security stuff can unlock the store, accept parcels and examine the goods. Enable off-hour deliveries to small stores who cannot hire staff outside opening hours	D	Niche
	CONSOLIDATED DELIVERIES		
First-order code	Explanation	Stakeholder	Thematic group
Standardized mini-containers	Standardized mini containers for urban deliveries could enhance the development of consolidate deliveries as it facilitated consolidation	C	Niche, Desirable future
	Consolidated delivery scheme where goods are delivered and collected on the same route with small emission-free vehicles	B	Niche, Desirable future
City deliver V	Consolidation centre in Gulbergsvass and consolidated deliveries to the city centre. Transport comapnnies save time as they do not need to drive around in the city centre.	B	Regime
Combining solutions	Different solutions need to be combined in order to achieve change in the system. Example: Combine business models for lindholmsleveransen, älskade stad and city deliver V. Financing the system by postage for packages and facility owners paying for waste collection.	B	Niche, Desirable future
C/O address	Currently working with establishing a C/O address for Nordstan. It could be a solution for the city centre	D	Niche
	Larger vehicles on roads leading to the city and small vehicles for last mile delivery. An infrastructure for consolidation is needed	A	Desirable future
C/O address	"All receivers in an area have the same delivery address. Within the area goods are delivered with a shared transport service. Example: Chalmers Campus Businesses in the city centre could take City deliver V's terminal as shared delivery address meaning that all transport companies deliver to the terminal. The last-mile delivery is conducted by another actor. "	A	Niche, Desirable future
Public transport for goods	Common system for delivery of goods. Transport companies consolidate their deliveries and send one vehicle to deliver goods to an address in the city centre instead for every transport company serving the address with its own vehicles .		Niche, Desirable future

Costs of trans-shipping	Trans-shipping of goods in consolidation hubs is costly	E	Regime
	Packaging and handling of goods at consolidation hubs is costly. This arguments is often presented by transport companies when discussing consolidated deliveries	B	Regime
	It is the transporting companies that pays for city deliver V. They do it because the city wants it. The transporting companies has promised their costomer a service, when they have to leave the freight to another part, city deliver V, it has to work all the way.	F	Regime
	PROBLEMS		
First-order code	Explanation	Stakeholder	Thematic group
Old infrastructure, old buildings	Difficult to add common delivery hubs in old buildings and difficult to find space for building new hubs in the city centre. Easier to implement such concepts in new city areas	E	Regime
Opick-up hubs	Less stores want to be pick-up hubs as parcels need to be stored for a long time and take up storing space	E	Regime, Niche
	Deliveries at peak times	E	Regime
	Increase in return of goods. Many offer free delivery and return as price for transports is too low	E	landscape
	Vehicles used for distribution in city centre are often to large, not environmentally sustainable and depict a safety risk in city centres	C	Regime
Routing	Schenker takes two different routes for delivery and pick-up of goods thus contributing to higher traffic volumes in the city centre	B	Regime
Livability in streets	The value of livability in streets is difficult to assess. It is difficult to determine the value of using space for increasing livability through e.g. cafes using space one the streets. Thus the gain of consolidated deliveries in form of increased livability in streets due to less vehicles is dnifficult to assess.	B	Regime
Parking options	There are complaints about lack of parking options for private cars. Car parks such as Nordstan which have 40% free capacity are regarded as too expensive.		Regime
	There is a huge need for understanding and information to many stakeholder, both business, politicians and officials	F	Regime
	SOLUTIONS/ NICHES		
First-order code	Explanation	Stakeholder	Thematic group
Deliveries by bike	Move-by-bike och pling. A good delivery model that should expand	D	Niche
Pick-up hubs for customers			Niche

	Larger vehicles on roads leading to the city and small vehicles for last mile delivery. An infrastructure for consolidation is needed		Niche, Future
Urban waterways	Difficult as it needs numerous trans-shipments and time-consuming to use waterways compared to transport with cars		Niche
	DHL has started to develop their own vehicles for electical transports in the city. The existing producers are expencive, to slow and are not adjusted to the needs of the company. But they are not allowed in sweden yet	F	Niche

Appendix IV. Calculating consensus on strategies

1. Increasing access to neighbourhood services, retail outlets, meeting places and other everyday functions (community planning)

2. Making more efficient use of roads and streets (use)

3. Prioritising pedestrians and cyclists and adapting speeds mainly to pedestrians (movement)

4. Rearranging the streetscape to create more space where people

want to be and where they can move around (space)

5. Ensuring good accessibility for goods transport in Gothenburg while at the same time reducing negative local environmental effects

6. Collaborating regionally in the establishment of logistics centres and transport-intensive operation

7. Stimulating innovation in collaboration with academic institutions and businesses

8. Creating a denser and more interconnected network of streets without barriers (structure)

Strategy	Agree	Don`t agree	Agree (%)	Disagree (%)	Consensus achieved
1	10	2	83,3	16,7	yes
2	7	5	58,3	41,7	no
3	5	7	41,7	58,3	no
4	5	7	41,7	58,3	no
5	12	0	100	0	yes
6	10	2	83,3	16,7	yes
7	8	4	66,7	33,3	no
8	9	3	75	25	yes

Majority agreements	56
Majority disagreements	14
Total opinions expressed	96
APMO cut off rate	73%

Appendix V. Results from the second survey

In the first question stakeholders were asked if they want the service for consolidated deliveries to be open more hours in the day. The results are presented in Figure 1a. One stakeholder comment that the service is available during the whole day and another stakeholder expressed that she has insufficient knowledge on variations in the demand of the service during the day. Furthermore, one stakeholder expresses dissatisfaction with the current service provider for consolidated deliveries and states that alternatives should be available. It is further pointed out that consolidation means additional trans-shipment which is costly and time consuming. Another stakeholder emphasises that small businesses have limited flexibility regarding time frames staff can be present at the store.

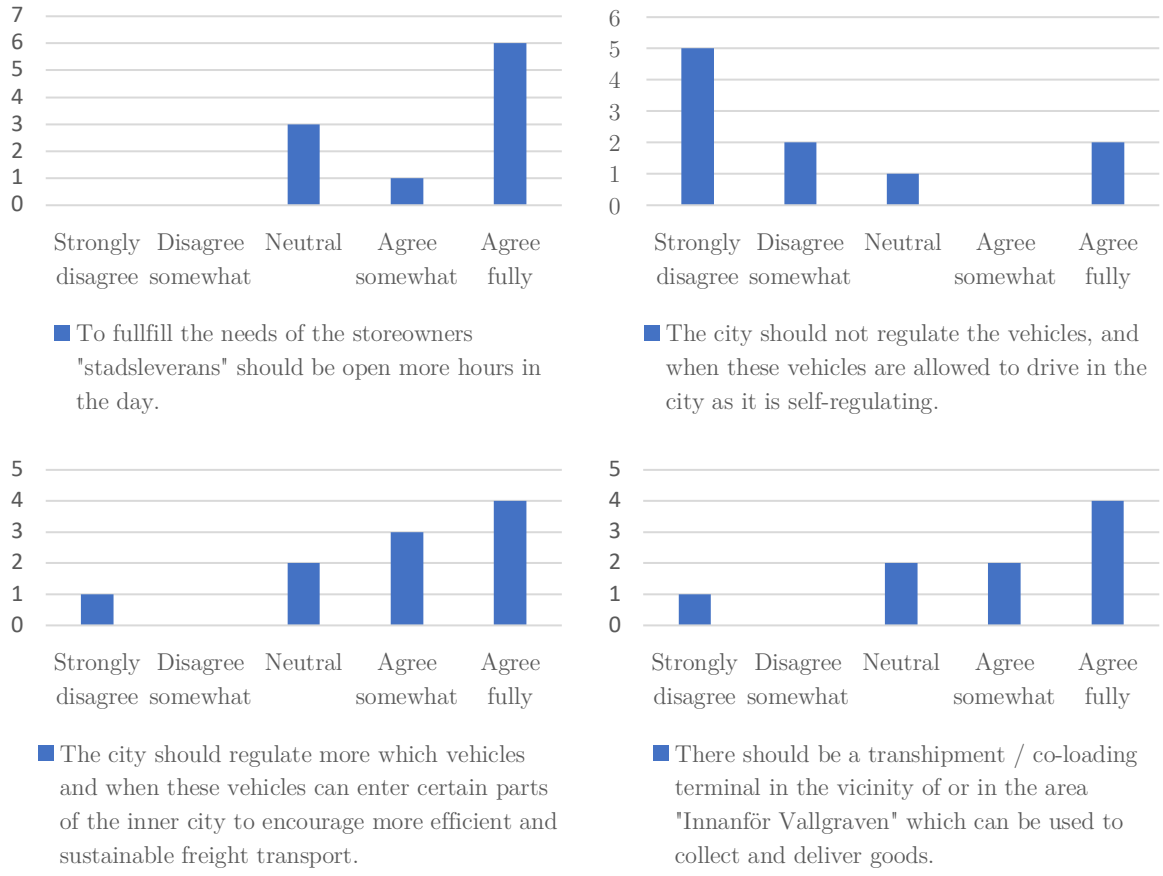

Figure 1a, 1b, 1c and 1d. Presents answers on the first four of the questions in the second question form.

In the second question stakeholders were asked if they agree on that the city should not set regulations regarding types of vehicles and time slots during which these are allowed to drive in the city. The answers are shown in Figure 1b. 50% of the stakeholders totally disagree with this statement. In the comments one stakeholder emphasizes that it is important for businesses` success to have e-commerce and that the city needs to provide the right prerequisites for businesses to continue operate in the city. Another stakeholder comment that the city could enact a law only allowing zero emission vehicles in the

future as transport companies lack incentives to switch to zero emission vehicles today. It is further remarked that regulation is necessary, especially for smaller actors, to avoid chaotic traffic situations.

In the third question the statement presented in the previous question is formulated the opposite way. Stakeholders are asked if they agree on that the city should regulate vehicle types and times for delivering goods in the city to a higher extent. Figure 1c shows that 40% of the stakeholders totally agree on this statement. In the comments it is stated that the needs in different parts of the city must be considered when deciding on regulations. Further it is commented that investments in consolidation centres are needed to achieve transport efficiency in the city centre.

In question four, the stakeholders were asked to what extent they agree with the statement that a consolidation centre where goods can be picked up and submitted should be built. The results are shown in Figure 1d. In the comments one stakeholders raises the question whether businesses in the area are interested of this solution and stresses the point that consolidation centres are costly and thus difficult to implement. Another stakeholder states that this solution has been tested and not been continued due to problems regarding operation and thefts.

In question five, the stakeholders were asked to which extent they agree on that consolidated deliveries should be used to reduce congestion. The results presented in Figure 2a shows that 60% of the stakeholders totally agree on the statement. It is commented that all transport companies need to participate in the consolidated delivery

service as transport companies not connected to the service cause congestion in the city today.

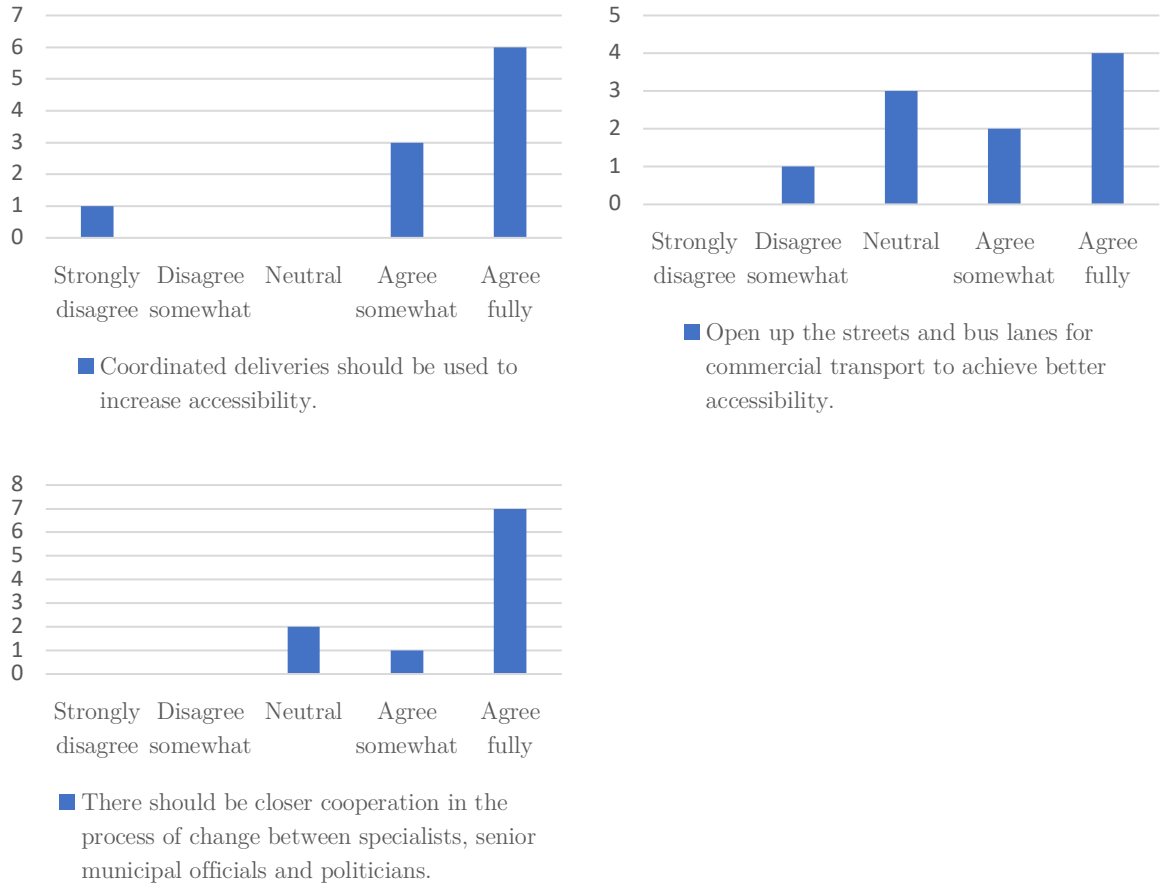

Figure 2a, 2b and 2c. Presents answers on last three of the questions in the second question form.

In the sixth question the stakeholders were asked to which degree they agree upon that streets and bus lanes should be opened for commercial transports to reduce congestion. The results can be seen in Figure 2b. It was commented that public transport is important for reducing congestion in the city and thus should not lose priority. Further it is emphasized that reliable public transport must be secured. Another stakeholder state that transports companies need to follow a time schedule for delivery of goods in case bus lines are opened for freight transport. It is also commented that flexibility is needed in times of infrastructure changes in the next years but that some streets do not have the capacity for both freight transport and public transport.

In question seven, the stakeholders were asked to what extend they agree on that collaboration between specialists, politicians and the traffic office should be enhanced. The results presented in Figure 2c show that 70% totally agree on this statement. It was commented that the freight partnership "Godstransportnätverket" enables collaboration but that there is a need to discuss how collaboration can be strengthened further. One stakeholder expresses agreement on the statement and explains that the transport

association STIF, which includes several large transport companies, has initiated a dialogue with the municipality due to concerns among transport companies regarding the present and future traffic situation in the city.

Appendix VI. Interview guide, follow up interviews

Category A. Collaboration in the change process

Our survey shows that 70% agree fully with the statement "There should be closer collaboration in the process of change between specialists, senior municipal officials and politicians"

That is, a majority of you want specialists, officials and politicians to work more closely together.

Question 1, Concretely, what would you say, would be involved in such collaboration? You can give examples of organizations, companies or institutions and so on

Question 2, Why is such collaboration important?

Question 3, How do you think such collaboration can be organized?

In Gothenburg there is a network called the Freight Transport Network, which is a network where approximately 20 stakeholders in the industry meet four times a year.

Question 4, But, what we know, there are no politicians in the freight transport network, how do you think it will be?

Category B. Collaboration on concrete ideas and solutions

40% of you voted entirely for “Opening up streets and bus files for business transports to achieve better accessibility.” Some commented, however, that it must not affect public transport. One comment that was also included was that freight transport could follow the timetable in the same way as public transport.

Say I would really like to drive this idea / solution. To open up streets and bus files for business transport and let them be controlled by timetables.

Question 5, What would you recommend to me to start with the implementation of such a solution?

Question 6, Who do you think would essentially own or drive this idea / solution?

Question 7, How do you think the people involved should work to implement the solution?

Category C. Regulatory collaboration

50% voted completely against the fact that "The city should not regulate which vehicles, and when these vehicles may drive in the inner city when it is self-regulating". Ie 50%

totally voted that the city should set regulations. 20% were totally against regulation. The other 30% were neutral or leaned towards the city should regulate.

Question 8. If the city is to set regulations. Do you think then that private actors should in some way be involved in the decision-making process? Yes or no.

Follow-up question If yes, how should they be involved?

Follow-up question If No, Why not?

One comment that came up in our questionnaire was “The city could, with reasonable advance, be able to decide that zero-emission vehicles apply but it has to be done based on long time planning” That is, the city could decide on zero emission vehicles for goods in Gothenburg, but with reasonable advance planning.

Question 9. Consider that the politicians in the city would like to work on this. How would you like such work to look or be organized?

Question 10. Which actors do you think would be involved in that work?

Category D. Collaboration to develop collective solutions

In our survey, 60% agreed that “In order to meet the merchants' needs, for example, to be able to send goods away on the same day, the City Delivery V should be in operation for a longer period of time”

One comment that then came up was that “It should not just be the City Delivery V because they are not reliable or take all kinds of packages. It also lacks knowledge of where the estates are located. "

This is about developing the work of the City Delivery V.

Question 11. Which actors do you think should be involved in developing the City Delivery work, regardless of how the development work works today?

Category E. Overall final questions

As stated, we focus on collaboration in our work.

Question 12. So, when someone comes across a problem or a solution for the transport of goods, how would you say that you should ensure that the right people and stakeholders become involved?

Question 13. How do you decide who should "own" the issue, problem or solution?

Appendix VII. Coded results follow up interviews

Level of collaboration	*Thematic group*	*First order code*	*Stakeholder*
Project-oriented collaboration	Problems	Hard to find who should be responsible for specific problems, solutions, ideas. But one should look at the "Owner" of the problem. If the problem is a unattractive city environment, the city should own the problem.	C
Project-oriented collaboration	Why	Regarding regulations. Private actors should be a part of the process. If the transporters were involved in the regualtion on the time restrictions perhaps there would be a soultion that everyone is apart of	A
Project-oriented collaboration	Why	Get several stakeholders onboard so the autorities dare to take desitions	A
Project-oriented collaboration	Why	Some specific projects demand collaboration as a part of the solution. Example in stadsleveransen, they have to learn the system from the freight transporters	A
Project-oriented collaboration	How	Look at old projects, and learn from them	A
Project-oriented collaboration	How	Start with wide collaboration, many actors, narrow down to a smaller group of actors	A
Project-oriented collaboration	How	When there is a problem. Organize with the actors close to our own business and then go to the ones responsible	A
Project-oriented collaboration	Who	The responsible public authorities should always be participating	A
Project-oriented collaboration	How	Use the freight quality partnership to identify stakeholders that should participate in solutions	A
Project-oriented collaboration	Problems	Many collaborations take place at specific projects that is funded externally. But when the project is done, the "solutions" is not continued.	A
Project-oriented collaboration	Why	It is important to prepare actors in a area if, for example a bridge or a road is going to be closed for a time	C
Project-oriented collaboration	Why	To understand the problems for other actors of what I do.	C
Project-oriented collaboration	How	One can collaborate in specific projects that often are public funded	C
Project-oriented collaboration	How	It is important to learn for projects that already has been done	C
Project-oriented collaboration	Who	Companies for public transport can be good to include in specific projects	C
Project-oriented collaboration	Who	The municipality should own solutions connected to policies and regulations. But other actors should also participate	C
Project-oriented collaboration	How	Do a macro analisys. Look at the positive and negative effects for the whole system. The posetive effects of one solution might be small compard to the negative solutions somewere else in the system	C

Project-oriented collaboration	How	To set regulations. A referral could be sent to the LFNG.	C
Project-oriented collaboration	How	Set long term strategies. Year 2030 we what this, and then go backwords and se what should be done in 2025.. And so on.	C
Project-oriented collaboration	Who	When implementing some specific solutions, sometimes the public transport companies should be a part of the dialogue	B
Project-oriented collaboration	Who	Regarding regulation. Private actors can be a part of the dialogue. But it is important that they not are a part of the decision	B
Project-oriented collaboration	How	Regarding long time regulations. It is important that it is a wide support from politicians from right to left. And some ideeas should come from the netrual part and from the reserchers which can be presented to all the parties at the same time. If the idea comes from a political party or a privet actor with an agenda for them selfs its harder.	B
Project-oriented collaboration	Who	It is important with a netrual part that can tell both the positive and the negative sides.	B
Project-oriented collaboration	Who	For some short time problems/solutions the police can be a stakeholder..	B
Project-oriented collaboration	How	Actors as close to the problems/solutions should feel that they own the question.Or at least to be involved in a dialoge.	B
Broad collaboration	Why	To set up goals, activities and measure the progress, for the system and not for the individual actors	A
Broad collaboration	How	Plans, the stakeholders meet a lot of different contexts. Set plans for specific activities so smaller groups can work with them	A
Broad collaboration	How	Closer and freight quality partnership is a good place to meet	A
Broad collaboration	Who	It's necessary to have poliicians in the Freight quality partnership	A
Broad collaboration	Problems	The freight transports are not prioritized. So the politicians show low interest	A
Broad collaboration	How	LFNG s a good way for the actors to meet and talk	C
Broad collaboration	Who	It is important to have seveal of the public autorities. Not just the one responisble for traffic, but also for city planning and so on.	C
Broad collaboration	Who	It is important to have tranporters, property owners, someone represenitng the stores	C
Broad collaboration	How	Important to not be too many participants at the same time. Hard for the discussion to stay objective othervise	C
Broad collaboration	How	LFNG is a good place to talk	B
Both	Why	Improve efficiency of the transports	A

Both	Why	Solving the problems, like congestions and quality of the air, is not self regulating. There need to be collaborations	A
Both	Problems	The mission of the public authorities is to unclear.	A
Both	Problems	Few people in the public authorities have a lot of mandate, it should be delegated. Compare with a private company as the CEO delegates responsibility town to managers and so on	A
Both	Who	Politicians has to be a part of the disscussions	C
Both	Why	It is important with collaboration to have understaning. For example a property owner think that they have donef their part for the freight by building a loadning zone. But perhaps the freight transporters say that they cant stop at that place. They rather stop at another place	C
Both	Who	It should be political involvement in the LFNG	B
Both	Why	It will rarely be good if you sit in your downpipes and try to solve things. You have to meet, I very much believe in the physical meeting in the context.	B
Both	Why	Regarding long time regulations. It is important for the actors, the transporters, to know things on the long term. To be able to know which types of whicles to buy and so on	B
Both	Who	The public administrations is important to involve, both in long term and in short term work	B