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How does customer requirements affect transport efficiency?

Master's thesis in Supply Chain Management

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Abstract

Companies within the food and retail industry have noticed increased, and more complex service demands and are therefore facing challenges reaching the sustainability goals within the area of transports. Even though the transport of goods is one necessary activity to keep society going, their impact on the environment is present. This thesis aims to understand which customer requirements that exist today and how they impact the transport efficiency of shippers. How this impact could be communicated is also a part of the aim. This master's thesis was conducted by developing a framework from literature and performing two types of interviews, unstructured and semi-structured. The study shows that customer requirements impact transport efficiency in many ways and that trade-offs often are made in order to achieve high customer service. Amongst several interesting findings, delivery precision had a large impact on transport efficiency. Also, the area of where transport is executed is a factor of how customer requirements impact transport efficiency. Different ways of effectively communicate the consequences of customer requirements were also found. The findings of this study are relevant for companies within the industry and for researchers within the area of customer requirements and transport efficiency.

Keywords: customer requirements, transport efficiency, logistic trade-offs, load factor, vehicle usage, green transportation, nudging, carbon labelling

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Finally, we would like to send sincerely thanks to our supervisor Dan Andersson, Associate Professor within Logistics and Transport, and Head of Unit at the Division of Service, Management and Logistics, for supporting us in the work of this thesis. His great expertise in the field has been essential for us in the writing process.

Runa Fremstad & Alice Strand, Gothenburg, May 2020

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1 Introduction

In this chapter, an introduction to this master thesis will be presented. The introduction contains a background to the problem connected to reaching sustainable transportation, followed by the aim of the study. Lastly, the research questions of the study will be explained more in detail, and how they connect to the overall aim will be presented.

1.1 Background

Transport is one necessary part of making products available to companies and consumers. In order for transport companies to stay competitive, it is crucial to achieve high transport efficiency as the margins are low due to a mismatch in supply and demand for transportation (Lumsden, 2012). The concept transport efficiency can be measured in many ways were standard measures could be a percentage of which a truck is full, or distance driven compared to an optimal route (Samuelsson & Tilanus, 1997). To achieve efficient transportation depends on many factors where a central one is customer service requirements. For example, to demand an exact delivery time affect whether delivery can be executed in an optimal sequence or not. This can result in a longer distance driven and more emissions as well as higher costs. In most cases, there is a connection between emissions and cost as emissions come from used fuels (McKinnon, 2018).

Sustainability is an emerging trend, and people are more concerned about their actions towards sustainable choices (KPMG, 2019). One example of these actions is the initiative towards sustainable logistics taken by ALICE, Alliance for Logistics Innovations through Collaboration in Europe. The alliance has designed a roadmap towards the global goal of zero-emissions logistics of 2050 and includes transportation (ALICE, 2020). The transport sector today is one of the biggest contributors to emissions of CO2, which is why it is constantly under investigations for improvements (Naturvårdsverket, 2019). The domestic transport stands for 29% of the total emissions in Sweden today, where trucks stands for 9% out of these 29% (KNEG, 2019). Emission from this sector has increased with 28% since 1990, and an estimation shows that this increase will continue with the same pace. However, according to Pålsson (2015), it is not the transportation that is in focus when greening the supply chain as it is too complex for companies to include in their environmental strategies.

The future of how to execute sustainable transports is today not clear, but there are initiatives on how to take actions on this topic in Sweden (Pålsson, 2015; Naturvårdsverket, 2019). One especially uncertain are is the political decisions concerning the environment and urban freight transport and how this might impact different actors and the transport efficiency as the municipality amongst others can set up limits. Legislation could, for example, hinder companies from operating for short term profitability in an unsustainable way. Companies are, for example, unsure about political decisions regarding taxations of fuels and what infrastructure investments that are going to be made. Political decisions about "emission zones" for example, are already initiated in Stockholm, Gothenburg and Uppsala (Urban Access Regulation, 2020). The unsure state makes companies struggling to decide which sustainable investments to make in order to meet the future demand from both customers and politicians. An organisation that take initiatives towards sustainable transports is KNEG, an organisation that consists of different companies working together to reduce carbon emissions related to transports (KNEG, 2020). Another actor that has taken actions is ICA. They have set a goal that all their road transport should be environmentally friendly by 2030 (ICA Gruppen, 2019).

The initiative to this thesis emerges from a workshop meeting in 2019 with the organisation KNEG and invited members. The about 20 participating companies have noticed increased, and more complex service demands and are facing challenges reaching the sustainability goals within the area of food transports. Two companies within the food industry that were especially interested in investigating how the customer service requirements set limits to their operations and how it affects sustainability were Martin&Servera and Arla. They were also interested in investigating whether actors in the supply chain are aware of the impact that certain requirements have on the transport efficiency. Further, Martin&Servera were interested in understanding whether customers are willing to pay for a commitment towards sustainable transports and if customers could sort of sacrifice some demands for the sake of the environment. On this basis, there is an interest in investigating whether it is possible to affect the actors and their requirements as there is a change in behaviour needed in order to create a sustainable transport arena.

1.2 Aim

The master's thesis aims to identify current customer service requirements within the Swedish food industry and how they impact the transport efficiency. In order for the customer to make a reasonable choice of requirements, it is necessary to have access to the right information concerning the total efficiency of the system. How information can be communicated and how to influence customers is therefore a part of the aim.

1.3 Specification of issue under investigation

Three research questions have been developed in order to reach the aim of the study.

RQ1: What customer service requirements exist within the food industry today?
In order to answer how customer requirements affect transport efficiency, a background is needed to understand what requirements that exist. It is also of value to understand what the companies perceive as problems regarding customer requirements. To answer how customer requirements impact transport efficiency, the study needs to choose a set of customer requirements to limit the research to a reasonable extent. The choice will be based on what research that exist within the area and what will be most brought up by the companies during interviews.

RQ2: What consequences does customer requirements from the food industry have on transport efficiency measures from a shipper's perspective?

The first part of the aim refers to how customer requirements affect transport efficiency. This thesis looks into how the customer requirements affect the focal companies, and not how the requirements affect the customers themselves. Customer requirements could have many consequences on transport efficiency. In order to present an in-depth answer to how the requirements impact transport efficiency, specific efficiency measures are selected. To later answer how identified consequences can be communicated to customers, the research needs an understanding of what is to be communicated.

RQ3: How can the identified consequences be communicated effectively to the customer?

The second part of the aim is to investigate how information regarding the customer requirements impact on transport efficiency can be communicated effectively to the customers. For the customer to understand the consequences of their requirements and to be able to influence them, information regarding this needs to be communicated. Information can be communicated in different ways with different results, and this research question answers how consequences can be communicated effectively to a customer.

1.4 Outline

This subsection will present the outline of the report, with the aim to facilitate the reading. It is presented in Table 1-1 below.

Table 1-1: Outline of the report

Chapter	**Content**
1 Introduction	This chapter includes a background to the thesis and its aim. This is followed by research questions and why these were developed.
2 Method	The method includes what research approach that was used as well as how primary and secondary data was collected. This chapter also discusses limitations, quality and discussion of the method.
3 System	In this chapter, the system of the thesis is described. It explains how objectives, actors, subsystems, resources and activities and environment relate to each other.
4 Literature review	The literature review presents relevant literature connected to the research questions
5 Empirical findings	This chapter presents the empirical data gathered from interviews. It presents both qualitative and quantitative data.
6 Analysis and discussion	The analysis and discussion regarding empirical findings and literature is performed in this chapter.
7 Conclusion	The last chapter presents a conclusion of this thesis. Suggested further research is also presented.

2 Methodology

The following chapter presents the methodology used in this thesis. Firstly, the research approach will be introduced. Further, the literature review and its chosen topics will be explained. This section will be followed by a description of the data collection methods used in the research and also the method used for analysing the data gathered. Both the literature review and the data collection are connected to each one of the research questions to answer how each research question is approached. Lastly, validation of the chosen method and method discussion will be presented. The method of this thesis is performed in a sequence according to Figure 2-1.

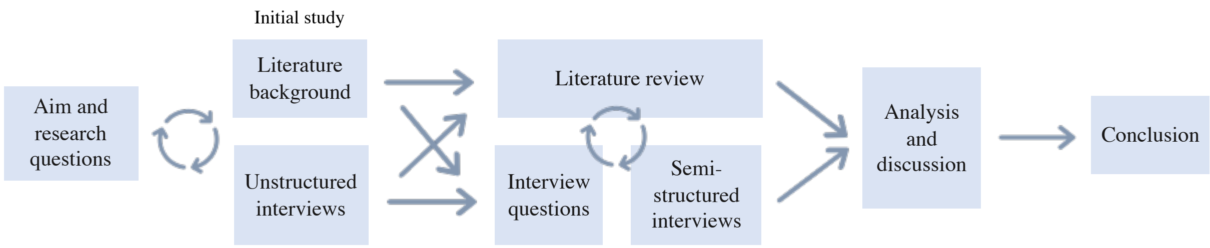

Figure 2-1: Illustration of the method used in this report

2.1 Research approach

The research approach of this report contained four combined approaches; qualitative and qualitative-, abductive- and system approach. All will be described in detail in following sub-sections.

2.1.1 Qualitative and quantitative approach

The data gathered have primary a qualitative approach as the data needed to answer the research questions are more based on opinions than hard data. The reason for this is the lack of earlier data and that this kind of situation is hard to understand without personal opinions from the actors involved. However, some quantitative data was collected to understand the proportions of the effects on transport efficiency. According to Bryman and Bell (2015) and Denscombe (2016), a qualitative approach focuses on words and visual pictures while a quantitative approach focuses more on numbers in the collection of data.

2.1.2 Abductive approach

This report has an abductive research approach to overcome the limitations with the use of deductive or inductive approaches. If a deductive or inductive approach would have been applied, the authors might would have spent time gathering unnecessary data or not focusing on relevant literature. Using an abductive approach means that it is possible to perform a process going back-and-forth between theory and empiric, and is thus more flexible (Bryman & Bell, 2015). This iterative process suited the project well since the research questions are built upon each other. The literature review was hence done continuously throughout the whole process. For example, the abductive approach made it possible to go back to the theory again to read and gain more knowledge about new interesting topics that were brought up during the interviews.

2.1.3 System approach

The thesis used a system approach in order to answer the research questions. Firstly, a system limit was set, and its parts were defined. Secondly, its structure was analysed, and the different flows of material and information, as well as its relations to the surrounding, was looked further into. The reason for using the system approach is to understand how activities within the system affect each other and not just optimize individual parts (Oskarsson, 2019). Two case companies were used in the study in order to get the possibility to go more in-depth and study the activities and actors more closely. A case study was chosen as the study aimed to explain how customer requirements affect transport efficiency. According to Yin (2014), a case study research is suitable when investigating "how" and "why" questions. Two companies were chosen as it aimed to get a representative picture of the requirements and their impact within that industry. At the same time, it would not have been possible to include more companies and still remain the same number of in-depth interviews at each company. The system of this thesis is presented in chapter 3.

2.2 Literature review

The literature review formed a framework on the relevant topics and was continuously developed during the whole writing process. The framework served as theoretical support that was used when developing questions for the interviews as well as answering and analysing the research questions. The literature review was expected to bring up new knowledge and viewpoints as well as help understanding what kind of research and theories that already exists on the topic.

The literature review was done using scientific articles, dissertations, reports, web pages and relevant books. To find the scientific articles, the main sources used were Chalmers library database and Google scholar. The books and dissertations were borrowed from Chalmers Library, while the reports and web pages were found using Google search. Relevant literature was also recommended by our supervisor Dan Andersson, Associate Professor within Logistics and Transport, as well as found by applying snowball sampling. Snowball sampling is a structured way to find new interesting references by looking at titles and reference lists of already selected literature (Wohlin, 2014).

Primary, an initial study was done were literature was read in order to gain knowledge within the area of sustainable freight transportation and green logistics. Also reports on the current market of food deliveries within Sweden was read in order to gain knowledge about new ways of producing transports and what challenges that exists in today's market. It also aimed to understand the frequency of studies on customer requirements impact and customer requirements connected to green transportation service. The information gathered in the initial study was used to develop the background of the report and the direction of the initial interviews that also was a part of the initial study.

Bryman and Bell (2015) claim that a literature review should be transparent and follow a clear structure. Therefore, each research questions corresponding literature is explained separately. To answer the first research question regarding what customer requirements that exist today, literature about service requirements were reviewed as well as it helped the authors to find a way to structure the result. Additionally, literature concerning trade-offs and total cost of ownership within logistics were studied to get a holistic view.

Research question two, the question concerning what consequences that customer requirements have on transport efficiency, was supported by literature connected to the area of transport efficiency and how customer requirements impact this efficiency. The aim of the literature reading was to get an understanding of what measures of efficiency that should be applied in this thesis and how customer requirements affect these measures.

The last research question concerning how the consequences of customer requirements can be effectively communicated to the customers was supported by literature within the field of measurement of carbon emissions within supply chains and transportation and communication tools.

2.3 Data collection

Using more than one data collection method is often done to improve the result by making sure to get a more substantive picture and to be able to verify the data collected (Berg, 2009). The use of several collection methods is called triangulation. Based on this, this report consists of data collected from both primary and secondary sources. Both the primary and the secondary data was collected through interviews where the secondary data originated from one of the case company's internal systems. The data collection was performed from the beginning of the writing process until the mid of April.

Interviews were performed in order to collect both qualitative and quantitative information that was used to answer the research questions of the thesis. This thesis used both semi-structured and unstructured interviews which will be described further in this subsection. An explanation of how the interview prospects were selected, and the interview method is also included. Table 2-1 below shows an overview of the interviews done.

Table 2-1: Performed interviews in this report

Company and interview method	Interview object	Date	Duration (min)	Focus area
Martin&Servera In-person interview, unstructured	Transport Leader and Transport Developer	29/01	90	Initial study
In-person interview and visit at the terminal, unstructured	Transport Leader and Transport Developer	03/02	120	Initial study
Telephone interview, unstructured	Transport Manager	12/02	40	Initial study
In-person interview, unstructured	Key Account Manager	18/02	90	RQ1
Skype interview*, semi-structured	Transport Manager	06/04	45	RQ2
Skype interview*, semi-structured	Transport Developer	07/04	35	RQ2
Arla Skype interview, unstructured	Fleet Manager	30/01	45	Initial study
Skype interview, semi-structured	Fleet Manager and Director Transportation	21/02	65	RQ1
Skype interview, semi-structured	Senior Manager Customer Logistics	03/03	55	RQ1
Skype interview*, semi-structured	Fleet Manager	02/04	50	RQ2
Skype interview*, semi-structured	Senior Manager Customer Logistics	06/04	45	RQ2
Scania In-person interview, unstructured	Research Manager	12/02	30	Initial study

*Interviews held online due to Covid-19

To get information about the first research question, to find out what customer requirements that exist in the food industry today, both unstructured and semi-structured interviews were performed. The data concerning the second research question, what consequences customer requirements have on transport efficiency, were gathered through semi-structured interviews and minor parts of secondary data concerning, delivery time slots and vehicle utilization. How to effectively communicate the consequences of service requirements to the customers were answered mostly by reviewing the literature. It was also answered through information gathered from the unstructured and semi-structured interviews as these will aid the authors to understand typical behaviour in the industry.

How the interview subjects were selected

When selecting the interview subjects, it was important to get input from several different business units of the case companies to get a representative picture of how customer requirement affect the companies. One of the most important subjects for the study was a person working within transport and logistics with knowledge about how their operations are affected by certain factors such as time windows. Another important subject was a person working close to the customers, for example, a sales representative, as they have the closest relationship with the customers and potentially most knowledge on customer requirements. The authors were initially introduced to some interview subjects from the organisation KNEG. From these interviews, new interesting subjects were found. This data collection method is called snowball sampling and is according to Yin (2013) an effective way to get new information relevant for the study.

Unstructured interviews

The unstructured interviews were a part of the initial study and aimed to gather background information about customer requirements and the companies themselves. Based on this, three overall questions were prepared before conducting the unstructured interviews. Unstructured interviews are held more like a conversation where few questions are prepared (Bryman & Bell, 2015). The reason for using the unstructured interviews was to create an atmosphere where the respondent could feel comfortable expressing their opinions as the respondents and the interviewers were not familiar with each other at this time. Therefore, no recording was performed in order to maintain a relaxed situation. Bryman and Bell (2015) tells that an unstructured interview allows the respondent to answer more freely to the questions. Using this type of interview makes it possible for the interviewer to have more space to follow-up interesting points which is good to get a holistic view of the situation (Berg, 2009).

Semi-structured interviews

After using unstructured interviews, semi-structured interviews were used. Semi-structured interviews were used in order to gather data that could be used to easily compare the answers of the two case companies in the study. As both answered the same set of questions, it was possible to see whether the answers were significant. The questions were constructed based on the unstructured interviews held in a previous session and according to the research questions and literature review. They involved both open and more detailed questions to cover all relevant aspects and to make sure that the data collected was useful for the research. Applying semi-structured interviews means, according to Denscombe (2016) that the majority of the questions are prepared to keep the interview to the wanted topic. However, if something is especially interesting, there is space for follow-up questions as in unstructured interviews.

Interview method

The interviews were planned to be held in-person in the greatest extent possible as Berg (2009) claims that in person interviews enables to see the whole spectre of communication, e.g. facial expressions and body gestures. However, due to the circumstances in society regarding Covid-19 during the writing of this thesis, most of the interviews had to be replaced by an online interview.

After the interviews, the writers of the report noted down their general impression of the sessions in order to remember the atmosphere of the interview or if something was unclear and needed to be followed-up. This is a suggested method proposed by Dawson (2002) which helps the researchers later in the analysis of data.

2.4 Compiling and analysis of data

The compiling of data was performed depending on the method used. For unstructured interviews, the answers were written down by one of the interviewers during the session. After the interview, a summary based on the answers from the interview was performed. For the semi-structured interviews, some notes were taken during the interviews by one of the interviewers parallel with a recording. Shortly after the interview session, these notes were supplemented by transcription of the recording.

The analysis of the data followed a structure individual for each research question. Research question one, what customer requirements exist today, aimed to describe the current state of the problem situation within the system. The collected data was therefore categorised according to the customer service requirements in the literature review. The analysis of the data was done by omitting the less frequent requirements and highlight the most frequent ones. A table was constructed in order to see similarities and differences between highly impacting customer requirements in the two case companies.

To analyse the research question, how the actual customer requirements affect the transport efficiency measures, each customer requirement was compared against each transport efficiency measure. This was done to explain how it affects the operations of the case companies and was evaluated from a cost and environmental perspective. The analysis model followed a pattern matching structure. Pattern matching means, according to Yin (2014) that an expected pattern is matched with an observed pattern. This means that a hypothesis was made based on specific statements and derivations from the literature review. This hypothesis was later matched against the answers from the interviews regarding the consequences of customer requirements. In some cases, literature was not found for the hypothesis after the literature review but came up as a perceived consequence during the interview. A new search with the goal to complete the hypothesis was therefore initiated after performing the interviews. However, no additional literature that could have supported the hypothesis was found. Both qualitative and quantitative data was used to create the observed pattern. Pattern matching is the most preferable analytic strategy in case study research, according to Yin (2014). Additionally, the impacts on transport efficiency were analysed by designing conceptual models of different scenarios that the customer requirements created.

Research question three, how consequences efficiently can be communicated was analysed by explaining the current state of customer behaviour towards change and currently used instruments to communicate impact described by the case companies. This was then used to answer the question together with literature. Literature was then studied to see what methods that could work effectively according to the current state. The analysis also discussed the potential use of the conceptual models that were developed from analysing the impact of customer requirements on transport efficiency.

2.5 Method discussion

This section will include discussion concerning research quality, method limitations and possible sources of error concerning the method.

2.5.1 Research quality

The reliability of the qualitative data in the study was strengthened by documenting all interviews either by notes or by both notes and recordings to have the possibility to go back and look over the data. The reliability of the quantitative data from one of the case companies was strengthened by a quantitative data. According to Abbott and McKinney (2013), reliability is defined as how consistent the result of measures in a study is. Further, the reliability of a study is strengthened if it can be easily replicated (Yin, 2014). This research was therefore well documented so others can perform the same study with a similar result.

The authors took certain actions to strengthen the validity of the study. Abbott and McKinney (2013) defines validity as if a study measures what it intends to measure. The data collected in this thesis consisted of interview respondents from different actors within the system in order to get a solid picture of the current state. Further, many of the respondents to the interviews done in the data collection were interviewed more than once. By doing this, results from the first interview could be confirmed and discussed further if needed. If even more clarifications were needed, the respondents were contacted by email. The semi-structured interview questions were sent out a few days ahead in order for the respondent to be able to reflect on the questions to provide thought-through answers. Another action that was done to strengthen the validity was that the answers from the unstructured interviews were sent out to the case companies as well as parts of the planning report in order for them to confirm that they agreed with the material. The same action was taken before submitting the final report. Finally, the validation of the study was improved by using triangulation which was described in section 3.3. For example, by using both qualitative and quantitative data in research questions one and two it could be seen if the data showed similar results.

Transferability refers to the generalisability of a study, meaning if the result is representative for not only one case study (Denscombe, 2016). Transferability for this study could be questioned as two similar companies were included in the case study. However, the authors want to highlight that they have different customers and operations, which rather strengthens the result as they have the same prerequisites.

2.5.2 Method limitations

The researcher did certain limitations on what to include in the research or not. The consequences of these limitations will be presented in the method discussion in section 2.5.3.

Regarding transport efficiency, the study has used the article by Samuelsson and Tilanus (1997) as a base. In their article, four measurement areas are identified: time, distance, speed and capacity. Speed was chosen not to be included as the authors found it irrelevant as the speed measure only concern speed limits which are hard for the case companies to affect since it is outside the system boundaries. Within the areas of time, distance and capacity, four measures to measure the transport efficiency of the chosen system were selected. The measures chosen were availability, driving factor, route factor and load factor. These four were the most relevant for the issues brought up by the companies as well as load factor is especially interesting as it is mentioned by Piecyk and McKinnon (2010) to be a key measure in measuring environmental performance. It is also one of the most attractive measures as it does not only give environmental benefits but also economical (Piecyk, Browne, Whiteing & McKinnon, 2015). A limitation that was done regarding load factor was that it is defined as the space utilised within the vehicle, meaning that it does not concern, e.g. how efficient the packaging is. Further, the return flows of the transports were excluded.

2.5.3 Possible sources of error

The customer requirements and efficiency measures were sometimes hard to describe independently, as many of the variables also affect each other. Further, some activities were described with different names during the interviews, which confused the interpretation of which transport efficiency that was impacted. For example, in some cases, the word “route optimisation” was used instead of “transport planning”. Route optimisation could, in that case, refer to optimise the load factor, total distance driven or the process of optimising them both. Initially, it was hard to understand the difference as the authors had less knowledge about the operations and different terms than later in the writing process. When the authors had gained more knowledge, it also leads to that better supplementary question could be asked.

Some of the respondents had difficulty to describe one customer requirement impact at once as this requires a lot of analysis and complementary information. In some cases, the discussion could drift away to new topics. This led to that it sometimes was difficult to make conclusions from the interviews as well as it could be challenging to ask relevant supplementary questions.

The quality of some of the literature in the literature review concerning the impact on transport efficiency can be questioned as some literature mentioned an impact but did not describe the impact in detail. It most cases it was possible to "read between the lines" even if it was not stated in words. An example from the literature review is that Fahimnia, Bell, Hensher and Sarkis (2015) mention time windows to have a negative impact on route optimization but do not mention why.

In order to get a broader picture of how requirements affect transport efficiency and what trade-offs that are made, it would have been supporting to use more companies in the case study. It would have been interesting with more companies within the same industry to strengthen the result. It would also have been interesting to include companies from other industries to get a broader understanding of customer requirements impact. Further, it would have been interesting to include more interview respondents in the thesis. However, due to the circumstances during the time the thesis was written, some interviews could not take place.

It could be questioned whether the customer requirements in this study are the "right" requirements as data is not sourced from the customers directly. However, the study only aimed to pick out requirements that are relevant from a shipper's perspective and not investigate all existing customer requirements on the market. The limitations of transport efficiency measures affected which impacts of customer requirements that were discovered. Even if it would be interesting as well as important to investigate all types of measures, it is not possible to include all efficiency measures in this type of research. Further, if fewer efficiency measures were chosen to be studied, it would have been possible to go more in-depth. However, the authors found it interesting to look at different measures as it gave a broader perspective to how customer requirements affect transport efficiency. What also was found interesting was to see the different impacts between the efficiency measures. For example, how much load factor was impacted by delivery precision compared to routing factor.

3 System

This thesis used a system approach to reach the aim of the study. The system in this thesis is inspired by the approach of Churchman (1968) and will include goals, actors, activities, environment and management of the system. The system approach means that the focus is not on how individual parts of a system can be optimised, but rather the output of the whole system (Coyle, Bardi & Langley, 1996). This system will directly affect parts of companies within it, e.g. logistics cost, but it can also indirectly affect other parts, e.g. production. An overview of the system inspired by Liljestrand (2016) can be seen in Figure 3-1 below.

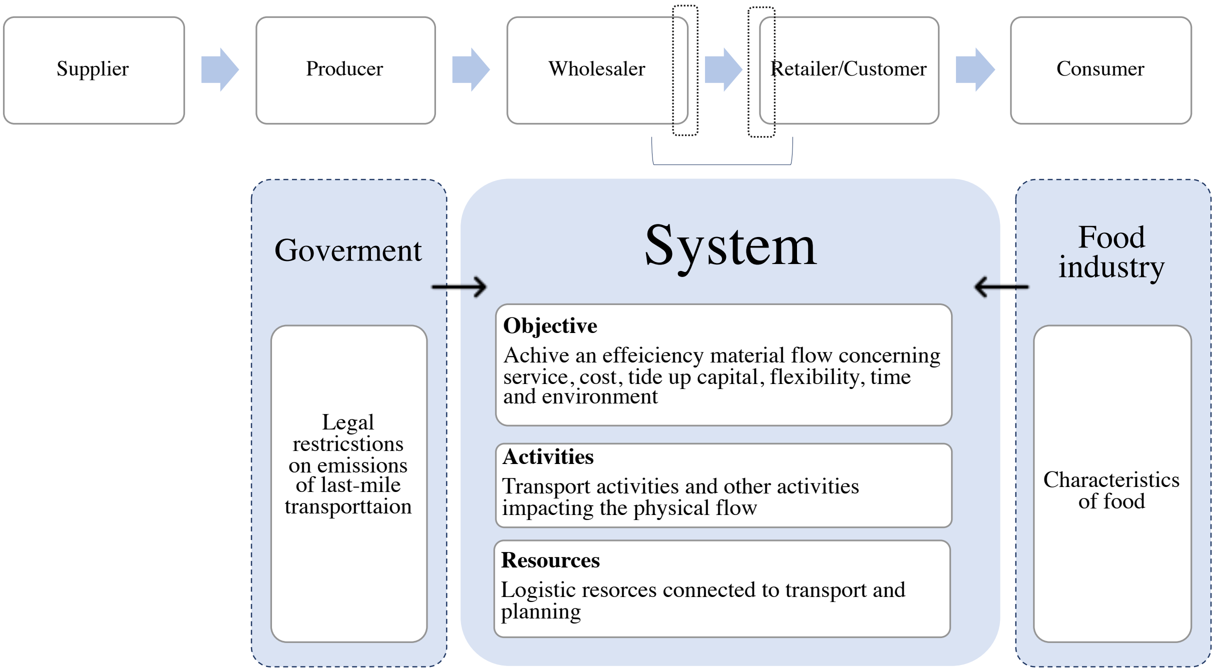

Figure 3-1: The system in this thesis

3.1 System objectives and its influencers

The common goal of the system is to have an as efficient physical flow as possible. This means using the minimum amount of resources whilst emitting as little emissions as possible combined with offering as high service as possible. Connected to this, the system will possibly have to adapt and make trade-offs between logistics cost, tied up capital, the environment and service elements. It might be that the cost of this system is higher, but the total cost is lowered. By choosing to sub-optimise, one could reach low costs, but it might be that a total optimization of efficiency is better and could enable synergies not known.

The system (and the transport arena in general) is characterised by low margins and low entry barriers (Lumsden, 2012). The system also has a high concentration of power at the customer side where decisions concerning what service level customers should get are set by them. Lindstedt and Burenius (1999) acknowledge that there is a trend concerning that power is shifted to downstream actors. Upstream actors cannot longer deny the customers will. For example, an investment in environmentally friendly vehicles will most likely have to be requested by the customer. This means that they steer how efficient the total system can be.

3.2 Actors

Within this system, there are different types of actors or subsystems. These actors can be suppliers, producers, wholesalers, retailers, customers and consumers. The system in this thesis will include the actor's wholesaler and retailer/customer. The actors within the system have similar goals as the total system but more individualistic. They are assumed to aim to achieve their own lowest total cost of distribution. Therefore, this can lead to sub-optimisations in the system. However, it is assumed that all actors act according to the knowledge they have about the system and its total efficiency. The actors within this system are presented below.

Wholesaler (case companies)
Within this system, Martin&Servera is seen as a wholesaler. Martin&Servera is one of Sweden's leading wholesaler of food and supplies restaurants, hotels and the public sector and work as an intermediary to reach as many customers as possible (Martin&Servera, 2020b). Additionally, to food and retail, they also offer services such as inventory and cost control systems. They engage a lot in sustainability work and are focusing on sustainable transportation, fuels, renewable energy, as well as running their own environmental projects. Martin&Servera are renting all their vehicles from a carrier (Transport Leader & Transport Developer at Martin&Servera, 29/1), and has a goal that all their transports are going to be environmentally friendly by 2030 (Martin&Servera, 2020a).

Arla is a known milk- and food producing company in Sweden (Arla, 2020b). Even though Arla is a producer, only activities within the area of logistics will be studied as it is the focus of the study. Therefore, Arla takes the role of a wholesaler in this system. Beyond owning the farms and their cows, they also own dairies, offices, warehouses and trucks (Arla, 2020b). Arla is working with sustainability through their whole chain, from farmers to finished goods (Arla, 2020a). Their global strategy for sustainability is focusing on both climate, animals and nature where they, for example, own their own 100% fossil-free trucks to distribute most of their goods. Arla supply restaurants, supermarkets and the public sector.

Retailer/customer
The definition of a customer in this report is not the end consumer but companies who sell products to end consumers. Within the food industry, there are different type of companies that have different type of customers. Martin&Servera and Arla's customers can be divided into two groups, public and private. The public customers include, for example hospitals and schools which both the companies supply. The type of private customers differs between the companies, and for Arla it is mostly retailers, and grocery stores companies while Martin&Servera's customers mostly are hotels and restaurants. Both private and public customers have, for example different service or product offerings, different working routines, different procurement processes which all can affect their requirements on logistics.

3.3 Activities and resources

The system has an input and an output, which can be seen in Figure 3-2 below. To achieve the output, certain activities need to be performed using the input that consists of logistics resources. According to Lumsden (2012), resources can be divided into human-, financial- and physical resources. The output of the system related to the physical flow are movement of goods, offered services to customers and emissions due to transportation.

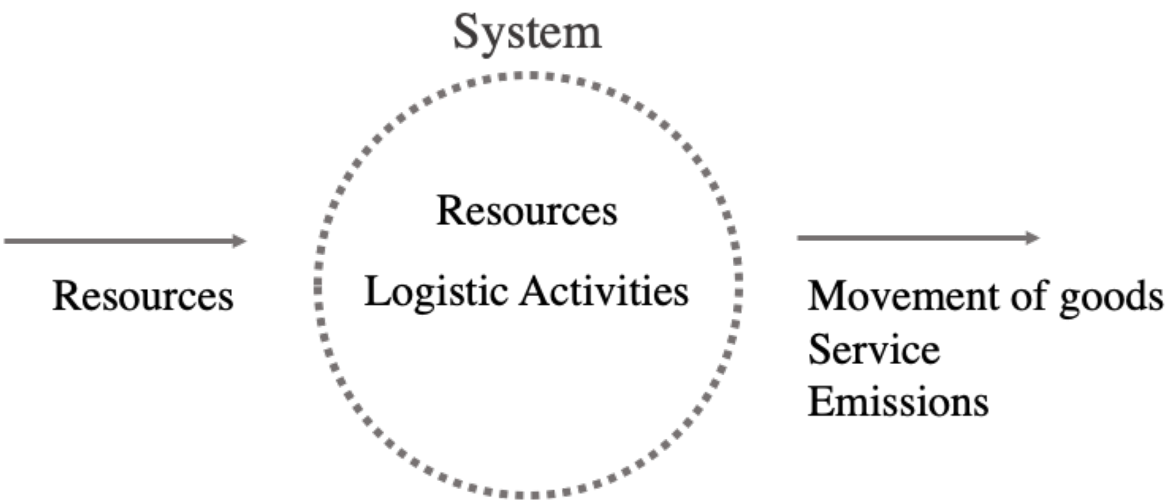

Figure 3-2: The system's input and output

Concerning activities, this thesis will primarily focus on the physical flow of the system, and hence logistic activities will concern transport activities. Although, if there are activities concerning information flow that affect the physical flow, they will be covered in the thesis. The focus on physical flow was chosen according to the aim of study which focuses on how the transport efficiency is affected by customer requirements. Some transport activities within the system are unloading, optimization of capacity regarding load factor and vehicles and the transportation of goods (activities focusing on the last part of the logistic chain).

3.4 Environment

The environment of the system consists of two areas, governmental impact on last-mile transportation and food industry. The system boundary goes approximately where the governmental impact on last-mile transportation intersect with the food industry. The system hence includes some activities that occur within both industries. The environment, according to Churchman (1968), is outside the system boundary and something which cannot be affected. An example for this system is that the characteristics of food put restrictions on the system by, for example chilled transportation and short order cycle times.

Governmental impact on last-mile transportation

The transport activities within this system relate to the activities concerning last-mile transportation and its planning and deliveries. Last-mile transportation is limited by legal restrictions connected to emissions. The government can force companies to make changes by implementing different instruments to reduce environmental impact (Jonsson & Mattsson 2011). There are both knowledge, economic (taxes, classification and fees) and legal (rules, zones and limit values) instruments. One example where a legal instrument recently was implemented is Hornsgatan in Stockholm, where it from January 2020 only is allowed with Euro 5-class vehicles (Stockholm Stad, 2020). From January 2022 only vehicles with Euro 6-class will be allowed. This can lead to that many companies needs to change their vehicle fleet, which will imply a large investment that needs to be planned strategically (Jonsson & Mattsson, 2011).

Food industry and logistics requirements

The food supply chain has a unique set of characteristics according to the research of Liljestrand (2016). The food supply chain can be divided into three segments: supplier markets, focal actor and customer markets. The supplier markets affect the food supply chain by seasonality in production and natural conditions. The focal actor is affected both by the product and flow characteristics, while customer markets affect the chain by demand variation, which is weather and seasonality dependent.

There is a wide range of food products that are included in the food supply chain such as frozen, beverage and chilled products. Different types of food products have different requirements on the supply chain, and one example is the lead time which is very important for short shelf-life products to avoid waste as products need to have sufficient shelf life left when arriving at the store (Liljestrand, 2016). This makes the food industry a complex industry with a lot of requirements. It is also an industry with many challenges because of the combination of the requirements on perishable food with factors such as variations in quality and quantity and fluctuating natural conditions. These challenges put specific requirements on logistics activities such as transport.

Many trends can be seen in the food industry today. One of them is the change in food demand and according to Liljestrand (2014) is the perishable food more attractive now than before. This puts a requirement on more frequently deliveries as the best-before date of the products is shorter.

4 Literature review

This chapter will present relevant literature for the study. Firstly, an introduction to logistics trade-offs within logistics with a total cost perspective will be presented. The literature around trade-offs and total cost perspective will work as a foundation for the discussion concerning the consequences of customer requirements on transport efficiency. The following section will consist of the definition of requirements as it is needed to describe the consequences of the customer requirements. Based on this, the customer requirements and how they affect the cost, and environmental variables will be presented. Further, to understand the consequences on transport efficiency, efficiency variables relevant for this study will be defined and reviewed from a cost and environmental perspective. The literature review will also present relevant literature in order to bring in aspects on how these consequences can be communicated to the customers. Therefore, a section concerning changing behaviour will be presented at the end of the chapter.

4.1 Logistic trade-offs

It is important to improve the efficiency of a company in order to get a positive impact on the profit (Jonsson & Mattson, 2011). Efficiency can be expressed in several variables which all can contradict to each other. This means that a trade-off has to be done, and some variables have to be prioritised. According to Chase and Jacobs (2014), a trade-off in logistics is described as an increase in one or more variables that is balanced by a decrease in other variables. Within the logistic system, trade-offs between customer service, logistics costs, tied up capital, and the environment have to be done (Jonsson & Mattson, 2011).

Customer service is affected by the activities that occur during delivery and when a supplier is in contact with a customer (Jonsson & Mattsson, 2011). Customer service is a mix of different service elements, for example, delivery lead time and delivery flexibility (Jonsson & Mattsson, 2011; Christopher, 2010).

Logistics costs can derive from different areas where some examples are the movement of goods and storage of material (Christopher, 2010). This results in costs for such as personnel, administration and information systems (Jonsson & Mattsson, 2011). Costs can also derive from risk management such as investing in overcapacity to avoid shortage of products or late deliveries fees. By investing in overcapacity, it is possible to adapt the production according to the variation in demand.

Tied-up capital is invested in fixed assets and inventory, according to Jonsson and Mattsson (2011). Fixed assets are often big investments and can, for example, include warehouses, depots and vehicle equipment that all generate depreciation costs (Christopher, 2010). The cost that each product needs to carry is then affected by how much of the capacity is used (Jonsson & Mattsson, 2011).

The environment is affected by logistics operations by, for example, emissions, noise pollution and congestion (Jonsson & Mattsson, 2011). By for example, using environmentally friendly vehicles, fuels, and high return flows, the impact can be lowered. Even though there is a trade-off between environment and other factors, it is hard to quantify the impact in monetary terms in order to compare it with, for example cost. The environmental impact could be reduced by investing in technical improvements of fuels and trucks and at the same time keep the same customer service, but this would require a higher transport cost (Lumsden, 2012). Another option is that the expected service could be lowered, which would make it possible to use resources more efficiently, but this could result in more tied-up capital in inventory.

4.2 Total cost perspective of a system

When doing trade-offs, it is necessary to have a total cost perspective as focusing on one single activity will result in sub-optimisation (Christopher, 2010). Further, Oskarsson (2019) claims that only focusing on initial costs could result in that the wrong decisions are taken and long-term consequences. Therefore, a total cost perspective is vital as in both private and public organisations, most decisions are based on cost calculations or assumptions (Oskarsson, 2019). However, there are many difficulties in applying the concept of total cost analysis (TCA). For example, in some situations, it can be hard to make cost assumptions (McKinnon, 2009).

One key aspect of understanding a total cost perspective is to have a system understanding (Oskarsson, 2019). System thinking can be described as understanding how certain components within it relates to each other in a very broad perspective. According to Waller (2015), a system thinking is the central part of logistics and supply chain management as it can create balance in the decision making between sustainability and the supply chain. An example from the study done by Oskarsson (2019) is students who try to learn about TCA faces several thresholds in their learning both concerning systems and logistics. When the students had a poor understanding of systems, they tended to focus a lot on individual costs and not the holistic view.

4.3 Customer service requirements

For a company, the impact on revenue is affected by offering good customer service achieved by activities connected to customer contact and deliveries (Jonsson & Mattsson, 2011). Good customer service means meeting the service requirements of customers by providing the level and quality of service that they expect (Christopher, 2010). It is important to remember that no customer has the same requirements making the concept of a perfect order individual for all customers (Lindstedt & Burenius, 1999). Further, customer requirements change over time which can be described by the Kano-model adapted and presented by Lindstedt and Burenius (1999). The Kano-model categorizes customer requirements as "unsurpassed, but unspoken", "spoken" and "taken for granted, but unspoken" and is illustrated in Figure 4-1 below. With time, unsurpassed and spoken requirements can be taken for granted as the customer has been used to that certain things always occur in a certain way.

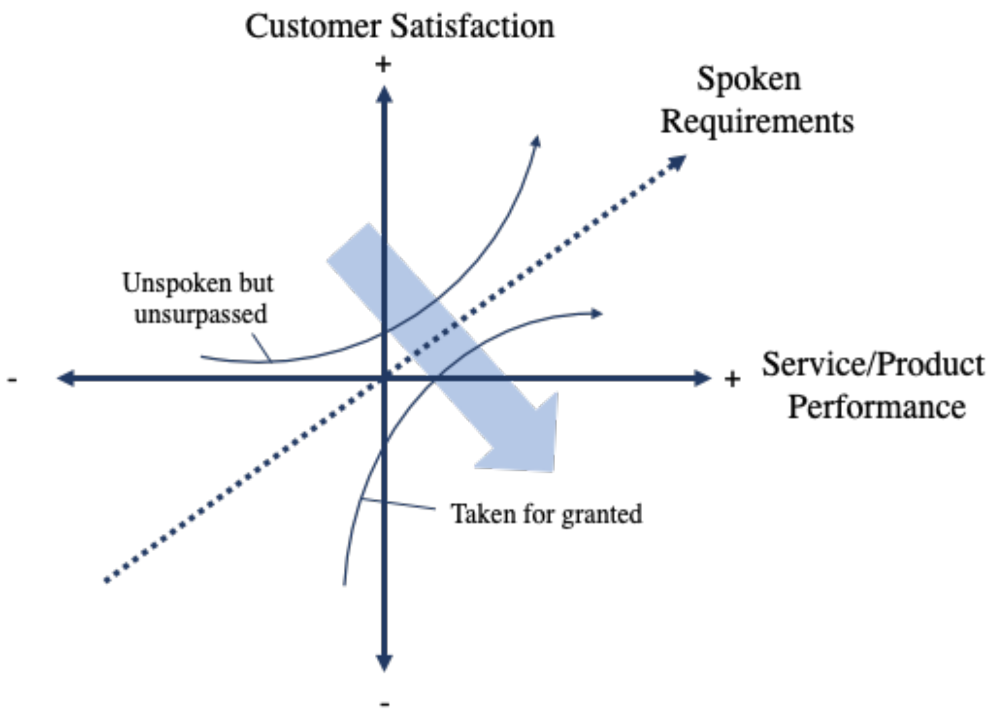

Figure 4-1: Customer requirements adapted from the Kano-model

To see if customer requirements are met, there are several key customer service elements that standards could be set against (Christopher, 2010). To set a service standard is a question of what customers request and what the suppliers are able and willing to provide. The identified key service elements relevant to this thesis are further described below. The selection of requirements is described in the method section 2.5.2.

4.3.1 Delivery precision

Delivery precision is a part of the broader term delivery service where the goal is to satisfy the customer (Lumsden, 2012). The definition of delivery precision is defined as to what extent an order is delivered at the decided time agreed with the customer (Jonsson & Mattsson, 2011). This can be measured in different ways, where for example, the delivery precision can be fulfilled if the delivery occurs within the wanted time frame (time window) or at the wanted specific time. Quak and de Koster (2009) shows that the use of time windows affects both the environmental performance and costs of a company in terms of driven kilometres. Specific time windows lead to increased emissions, both local and global and also less cost-efficient transports. Bidgoli (2010) also mentions that time windows impact driven kilometres as well as load factor as time windows drive more separate trips to customers. This occurs when there are several destinations to be visited. Further, Arvidsson (2013) tells that a consequence of that much time is spent on handling time restrictions is that less time is spent on optimizing load factor.

4.3.2 Order cycle time

Order cycle time relates to the time from order placement to the delivery of goods to the customer and is often expressed in days (Christopher, 2010). It consists of administration and order handling times as well as transport time in a make to stock environment. Jonsson and Mattsson (2011) claims that if the throughput time from receiving an order to the delivery to the customer is too long, it can result in dissatisfied customers. Fast throughput times can help reduce the tied-up capital and avoid long reaction time to changes requested from the customer. Further, shorter order cycle time increases inventory at the shipper but decreases it at the customer (Coyle, Langley, Novack & Gibson, 2016). An increased inventory means more tied-up capital (Jonsson & Mattsson, 2011).

Fast deliveries and shorter order cycle time is an increasing customer requirement and affects the possibility to perform environmental actions such as increasing the load factor (Jonsson & Mattsson, 2011). Santén (2016) also mentions that a short order lead time can be very challenging in order to achieve a high load factor. This is mainly because of the short planning horizon for packing and loading, the operations of packing and loading and additionally the execution of transport. This planning horizon also negatively impact the vehicle capacity that is required each day.

The length of the order cycle time is for many companies a critical aspect (Christopher, 2010). However, the reliability of the delivery is said to be more important than the length of the order cycle. This is the case when the impact of failure to deliver on time is more damaging than the need for a shorter order cycle time.

4.3.3 Frequency and order size

The JIT (Just-in-time) requirements from customers on deliveries are currently increasing, which leads to that customers request smaller quantities and more frequent deliveries (Christopher, 2010). Frequency of delivery tells how often deliveries are sent, which also affect the quantity delivered, assuming other factors being equal. Frequency of delivery affects both customers and shippers inventory (Christopher, 2010; Lumsden, 2012). Delivery frequency and order size are a trade-off between inventory and order handling cost (Christopher, 2010). Lower frequency leads to higher inventory cost for the customer, but lower ordering handling cost for both (Jonsson & Mattsson, 2011). For order size, the inventory cost will be higher for the customer if larger order quantities are ordered because of longer storage of goods (Lumsden, 2012). Ordering smaller quantities will result in a higher total cost per unit because of the fixed order handling cost.

With customer requirements on high frequency it is harder to achieve a high load factor (Jonsson & Mattsson, 2011; Lumsden, 2012). A high frequency also leads to that the transport provider needs to invest in resources to handle requirements in demand and that the resources are poorly used (Lumsden, 2012). Further, Santén (2016) mentions that the agreed frequency and variation in order size of transports impact the day to day transport planning in terms of vehicle route scheduling.

Order size is often constrained by the storage area at the receiver of a shipment (Piecyk et al., 2015). In certain industries where floor space is of high value, storage has been reduced in order to maximise profit. The demands on frequent small deliveries are limiting the possibility to improve environmental actions such as increasing load factor and thus reduce the unnecessary number of transports and its emissions (Jonsson & Mattsson, 2011).

4.3.4 Special requirements

It is important to have a solid plan for how to handle the unloading activity as it has a key role when managing deliveries as well as it can help reduce the total lead time from order to delivery (Manalo, 2008). Inefficiency in unloading activities can lead to, for example truck congestions. According to McKinnon (2003), congestion at delivery points are more disrupting than traffic congestion and has to be planned for. Extra time has to be added into the route planning systems for deliveries, which can negatively impact both the efficiency in transport operations and the environment. Additionally, on average, 43 minutes a day is spent on unscheduled delays at loading and unloading points.

4.3.5 Environment

Initiatives towards environmental actions differ between different actors (González-Benito & González-Benito, 2005). This partly depends on the actor size as larger actors have more resources to allocate to environmental management as well as they can invest in technology, human resources and certifications. Large companies also receive more attention from public- and private organisations such as NGO's (Non-Governmental Organisations). Lastly, due to their size, their actions affect many other actors as these companies have a large customer base.

Environmentally friendly fuels can have large benefits on the emissions produced but are more expensive than conventionally used ones (Jonsson & Mattsson, 2011; Lumsden, 2012). Vehicles using these types of fuels are often more expensive. However, it is important to analyse fuels from a life cycle perspective as the way the fuel is produced can have an impact as well. For example, fossil-free fuels also emit CO2 (Naturvårdsverket, 2020).

Environmental requirements can also be put in terms of Euro-classes which classifies the maximum emissions that vehicles with diesel engine sold within the EU are allowed to emit (Jonsson & Mattsson, 2011). Each vehicle gets a Euro-class from 1 to 6, depending on the level of emissions it contributes to the environment (Transportstyrelsen, 2020). Choosing the type of vehicle with the best possible Euro-class can help reduce the emissions from road traffic.

4.4 Transport efficiency

A broad definition of efficiency is, according to Lumsden (2012) to do the right things and what use the performed activity brings. Efficiency is also about how close a company comes to their wanted goal. The interest of efficiency in logistical operations has increased in the last decades (Samuelsson & Tilanus, 1997). One area of interest that is a part of the total efficiency of a company's supply chain is the transport efficiency. The meaning of transport efficiency has been discussed and broadened over time were transport efficiency previously only was focusing on the energy efficiency of the transport equipment (Moriarty & Honnery, 2012). Today, it has become a measure of how efficient transportation is in regard to social, economic and environmental perspectives in order to achieve accessibility, sustainability and competitiveness (Ministry of Enterprise and Innovation, 2018). The environmental perspective has been of especial interest for transport providers in the last years as the demand for reporting environmental impact is growing (Liimatainen et al., 2014)

There are many ways to measure transport efficiency and many variables that could be accounted for in an LTL (less than truckload) environment in order to come as close to reality as possible (Samuelsson and Tilanus, 1997). The efficiency measures that impact the ideal state of 100% transport efficiency can be divided into four groups: Time, distance, speed and capacity efficiency. These can further be separated into smaller measures of efficiency where all measures have a different value for different supply chains. This thesis will focus on three of the major groups, time, distance and capacity. The measurements selected within each group are presented in Table 4-1 below. How the measurements were selected can be found in the method section 3.6.

Table 4-1: Efficiency measures used in this report

Efficiency group	**Efficiency measure**
Time	Vehicle usage
	Driving factor
Distance	Routing factor
Capacity	Load factor

4.4.1 Time efficiency

The time efficiency mentioned by Samuelsson and Tilanus (1997) is described as the actual utilisation of a vehicle with respect to the time the vehicle is available. This efficiency is affected by factors such as shifts, maintenance need and stops for loading and unloading activities.

A way to measure time efficiency is to look at how much of the available time a vehicle is actually used (Samuelsson & Tilanus, 1997). The time the vehicle is not used might be because of low demand on goods delivered. Within urban areas, distribution often occur between 7am to 3pm including 2h lunch break which results in a 25% utilisation rate (Lumsden, 2012). A study on food supply chains published by McKinnon (2003) shows a similar percentage of 28%.

This is because the usage of capacity is not evenly distributed during the day, with a peak in demand from 7-11am. Further, it is not unusual with load factors on about 50% which according Jonsson and Mattsson (2011) indicates that the vehicle fleet and the transport system is adapted to peaks in demand.

From a cost perspective, a vehicle is an investment which is part of the capacity related costs (Jonsson & Mattsson, 2011). These costs derive from depreciations, maintenance and operations cost and are often fixed. Hence, they can for example be affected by how much a vehicle is used. According to Kulovic (2004) fixed costs of truck operations are around 30-50 % of the total costs. The vehicle usage will then affect the balance between the fixed and the variable costs. Further, the capacity related costs increase with variation in demand as it becomes harder to match the supply with the demand which will lead to a low capacity utilisation (Jonsson & Mattsson, 2011)

Another way to measure time efficiency is by looking at the driving factor (Samuelsson & Tilanus, 1997). The driving factor is defined as how much time that is spent on the road actually transporting goods. Activities that affect the driving factor is the loss of time during transports. The most impacting factors are loading, unloading, driving from depot to pick up spot and waiting time according to Kulovic (2004). These truck fleet operational factors affect the transport costs per ton-kilometre in a crucial way because of the loss of time.

4.4.2 Distance efficiency

Distance efficiency means how much the output of transportation is reduced if not driving the shortest route from origin to destination (Samuelsson & Tilanus, 1997). Many factors can affect why a vehicle cannot take the shortest route, and some of these are infrastructure and milk rounds created by consolidation of goods.

Routing factor is a way to measure the distance efficiency and means the inefficiency caused by not following an optimal route when visiting predefined destinations (Samuelsson & Tilanus, 1997). This inefficiency is mainly caused because the destinations has certain time windows that they accept to receive their goods, but it can also be caused by different restrictions. For example, certain vehicles and drivers can be denied visiting certain addresses. A big challenge which can be seen today is that customers require narrower time windows and increasingly more deliveries. According to a simulation performed by Fahimnia et al. (2015), time windows have a large negative impact on the efficiency of route optimisation.

Besides making the working time for drivers more efficient and improving productivity, route optimisation has environmental benefits (Fiorini & Lin, 2015). This is because visiting the predefined destinations in optimal sequence will minimise the travelled kilometres by the vehicle. The reduction in travelled kilometres also leads to a reduction in costs since it will create better routes for the vehicles and thus reduce the fuel consumption (Piecyk et al., 2015).

4.4.3 Capacity efficiency

Capacity efficiency is defined by Samuelsson and Tilanus (1997) as how much the transportation output is reduced by not having the optimal capacity in a vehicle when travelling. The optimal capacity for capacity efficiency is affected by legal restrictions and technology and can be measured by looking at either the maximum or optimal capacity.

A way of measuring capacity efficiency is by looking at the load factor (Samuelsson and Tilanus, 1997). Load factor is according to Jonsson and Mattsson (2011) the utilisation of load capacity in a vehicle and can be measured in terms of area, volume and weight. McKinnon and Ge (2004) explains load factor as the ratio between required and available capacity, meaning the ratio between carried load and the maximum load that could have been possible to carry. The utilised capacity in a vehicle is often below the maximum because of the specialised requirements on the vehicle for some goods (Rizet Cruz & Mbacké, 2012). These goods make it difficult to find goods that can return in the same vehicle where two examples are chemicals and milk. Jonsson and Mattsson (2011) claims that is important to include the return flows of transport when calculating the load factor.

A challenge with load factor today is that there is no standard for how to measure it as well as it can be misleading to only measure one dimension as they do not say anything about each other (Santén, 2016). Another challenger is that is it hard to increase load factors because of the increase in high-value, low density products that are being moved, stored and handled (Piecyk et al., 2015). High inventory cost combined with the expected requirements on service force operations to become more and more 'just-in-time' and tightly scheduled. This movement leads to that companies prioritise customers request for smaller inventories and excellent service before the utilisation of the vehicle in terms of load factor.

The load factor is one of the most attractive measurements because it leads to environmental benefits (Piecyk et al., 2015). An increase in the average load in a truck will according to Liimatainen et al (2014) increase the fuel consumption on l/100 km basis, but at the same time decrease the number of km required and thus decrease the total emission of CO2. Further, Piecyk et al. (2015) also states that load factor has economic benefits. It is shown that cost per tonne carried is reduced with increased load factor (Barla, Bolduc, Boucher & Watters, 2010). This is because several cost components such as the driver's salary is fixed, and that some cost components such as fuel costs vary less than in proportional to the load factor.

4.5 Customers changing behaviour

Change in people's behaviour is a necessary action to overcome today's challenges with environmental impact, resource efficiency and climate change (Lehner, Mont & Heiskanen, 2015). There are different strategies developed with the help of technical solutions, but they are dependent on people's willingness to change. There are different ways to make people show a certain behaviour, where some examples are laws and regulations or economic incentives. However, these conventional methods do not seem very effective on their own (Stoknes, 2014).

4.5.1 Climate communication and nudging

The knowledge concerning environmental impact has grown during the past decades, but at the same time has the public concern towards climate decreased (Stoknes, 2014). Therefore, Stoknes (2014) have identified five sources of barriers for climate communication:

1. Climate change is perceived as a distant matter.
2. Climate it is often framed as a doom, a large cost and sacrifice, for example to invest in new technology.
3. Few opportunities for action weaken attitudes through dissonance.
4. Fear and guilt strengthen denial (attitudes often taken to deny threatful realities such as climate change).
5. Climate messages are filtered through cultural and political identity.

One of the actions that is suggested in order to decrease dissonance is to use nudging to facilitate decision making for daily tasks towards climate friendly options (Stoknes, 2014). Breaking daily habits is a hard task which is why new decisions have to be easy to make (Stoknes, 2014; Sunstein, 2014). Many decisions also often have long term consequences. Nudging is a way to make people take certain actions in a "liberty-perceiving" way as a nudge yet leaves the decision maker with full freedom (Sunstein, 2014). A nudge could for example be a default setting on a computer or a graphical warning for cigarettes. It is possible to ignore the default setting, but the user is steered in a certain direction.

Nudging has gained interest in recent years which has helped policy makers to design effective policies or instruments with input from behaviour insights (Lehner et al., 2015; Sunstein, 2014). It has shown to be a very effective tool in many situations for increasing or promoting savings such as for electricity saving or increasing college attendance (Sunstein, 2014). The promising and large number of nudges has also shown to help to improve climate (Stoknes, 2014). However, nudges will not work on its own as it will need economic incentives and regulations as well to be effective.

One example where nudging is being used is in the food industry where it is used to make people aware of their own consumption as this can be an efficient way to reduce climate change (Lehner et al., 2015). Further, the same factors that makes us take "bad" choices could be turned around in order for us to make good decisions (Stoknes, 2014). The Swedish burger restaurant Max is an example where nudging through carbon labelling was introduced, making the "green" hamburgers sell 16% better (van Gilder Cooke, 2012). However, McKinnon (2009) mentions there are some practical challenges using carbon labelling. Labelling using for example life cycle analysis is a difficult process because it can be hard to set the right boundaries to assign the energy consumption and emissions to the right parts of the chain. Difficulties with complexity of products, costs, scalability and variability of the supply chain can also occur, which all leads to challenges with the accuracy of the labelling. Sunstein (2014) tells that is very important to build nudges on facts rather than intuitions on how people act as well as all nudges has to be tested in real life to validate its effectiveness. The conclusion from McKinnon

(2009) is that it would be better to spend time and resources on other environmental actions than labelling as it can be seen as a “wasteful distraction”.

4.5.2 The difficulty of measuring environmental impact

Companies have gained an increased interest in measuring their environmental impact during the last years (Kaval, 2011). People are now more aware of environment impact as well as the government has begun to pay attention to issues related to this. However, there are big uncertainties on how to measure and reduce the environmental impact (Klemeš, 2015). Both Kaval (2011) and McKinnon (2019) states that if it is hard to measure something, it is also hard to manage it. This means that to be able to reduce the environmental impact, it is important to first understand what the impacts actually are. However, according to Liljestrand (2016) it can be difficult to understand where and why environmental impact take place as the systems often are big and complex with several products and flows.

Internationally, there have been attempts on developing a standardised method for measuring emissions (McKinnon, 2009). However, there are no standardised method to measure environmental impact (McKinnon, 2009; Kaval, 2011). As no standard is provided, it is often unclear which method to use as well as the methods today leaves much to interpretations and assumptions (Kaval, 2011). One of the methods that has increased in popularity the last years is the environmental footprints method, but this method is said not to be representative for the overall environmental impact on the chain (Klemeš, 2015). Environmental footprint is also mentioned as one of the two most popular methods by Kaval (2011). The other popular measuring method is life cycle analysis. This method can be difficult to use as good data is needed from start to end of the lifecycle of a product for it to give accurate result. As mentioned in section 4.4.1, it can also be difficult to decide the boundaries for what to involve and also to assign which part stands for what in terms of emission and energy when using life cycle analysis (McKinnon, 2009).

4.6 Pattern matching hypothesis

From the conducted literature review, a hypothesis for how customer requirements affect transport efficiency measures was made. This hypothesis is summarized in Table 4-2 below. The literature identified areas where customer requirements impact the efficiency variables, and table shows that how delivery precision and frequency affect transport efficiency is well covered in literature. It also shows that the effects from environment and special requirements was harder to find. The relationship between customer requirements and transport efficiency and its impacts is described more in detail below.

Table 4-2: Identified connections between customer requirements and transport efficiency according to literature

How does customer requirements affect transport efficiency?		Customer requirements (x)				
		Delivery precision	order cycle time	Frequency	Special recuirement	Environment
Efficiency measures (y)	Load factor	o	o	o		
	Vehicle usage	o	o	o		
	Route factor	o		o		
	Driving factor	o			o	

A further explanation of why the markings were set in the table is described below.

Delivery precision

In the literature review it can be derived from two examples of vehicle utilisation during a day that delivery precision affect whether a vehicle is used its whole availability time or not (Lumsden, 2012; Piecyk et al., 2015)). Additionally, it is mentioned that variation in demand (which can be derived to delivery precision requirements) leads to low vehicle utilisation (Jonsson & Mattsson, 2011). From Quak and de Koster (2009) it can also be derived that delivery precision impact routing factor as driven kilometres increase. Additionally, it can be derived from Fiorini and Lin (2015) that the distance driven will increase if the destinations are not visited in the optimal sequence, which could be caused by time window restrictions. Samuelsson and Tilanus (1997), Bidgoli (2010) and Fahimnia et al. (2015) also states that time windows affects route optimisation. Further, Bidgoli (2010) mentions that load factor is affected by time windows as they force companies to do separate trips to customers. Arvidsson (2013) also mentions that load factor is harder to optimise with much time spent on dealing with time restrictions. It can also be derived from Kulovic (2004) that delivery precision affects the driving factor. Kulovic (2004) mentions that waiting time affects the driving factor and waiting time can occur from not delivering within agreed time window.

Order cycle time

The literature review states that order cycle time is one impacting variable on the load factor as shorter order cycle time affects the possibility to increase it (Jonsson & Mattsson, 2011; Santén, 2016). It also states that the order cycle time affects the vehicle usage since the transport planning time is affected (Santén, 2016).

Frequency

It can be found in the literature review that the load factor is affected by frequency as higher frequency can lead to lower load factor (Jonsson & Mattson, 2011; Piecyk et al., 2015). Load factor is also urged to be affected by order size in that way that the requirements on frequency is limiting environmental actions where one was to increase the load factor (Jonsson & Mattsson, 2011). Order size is very related to frequency if one assumes that the customer demands the same volume. Further, it can be read that high frequency also affects the vehicle utilisation as more resources is needed to handle peaks in demand (Lumsden, 2012). The route optimisation is also affected by requirements on higher frequency according to Santén (2016).

Special requirements

It can be read that special requirements are one of the factors that affect the driving factor the most since time is then used to other things than transporting goods (Kulovic, 2004).

5 Empirical findings

The following chapter covers the customer requirements that were mostly brought up and perceived as most important by the case companies. It also covers the perceived consequences of these requirements on transport efficiency as well as customers perceived willingness to change.

5.1 Existing customer requirements at the case companies

Both Arla and Martin&Servera have the perception that customer requirements have increased with time (Transport Leader & Transport Developer at Martin&Servera, 29/1; Transport Manager at Martin&Servera, 12/2; Fleet Manager & Director Transportation at Arla, 21/2; Senior Manager Customer Logistics at Arla, 3/3). The case companies tells that price seems like the most important matter to customers (Key Account Manager at Martin&Servera, 18/2; Fleet Manager & Transport Director at Arla, 21/2), but that they also value service and support (Key Account Manager at Martin&Servera, 18/2). Further, the Key Account Manager at Martin&Servera (18/2) and Senior Manager Customer Logistics (3/3) tells that it is not always the same person that procure the transports that receive them. The wanted requirements might therefore not be matched with the actually needed requirements, and this is said to be custom within the food industry.

On a general basis, the size of a customer is crucial for the case companies when deciding how much to adjust and adapt to the requirements from the customers (Key Account Manager at Martin&Servera, 18/2; Fleet Manager & Director Transportation at Arla, 21/2). For example, a big customer gets their requirements fulfilled without any discussion while a smaller has to accept requirements from the case companies instead. It is also crucial how important the customer is (Key Account Manager at Martin&Servera, 18/2).

5.1.1 Delivery precision

Martin&Servera tells that delivery precision is one of the most frequently requested requirements in their business (Transport Leader & Transport Developer at Martin&Servera, 29/1). It is individual how customers look at their wanted delivery time, and this wanted delivery time often depends on how involved the transport buyer is and how much they know about the daily processes in their company (Key Account Manager at Martin&Servera, 18/2; Senior Manager Customer Logistics at Arla, 3/3). The Fleet Manager & Director Transportation at Arla (21/2) says that the delivery time also depends on how many other deliveries a company (grocery store) has each day as they want to spread them out.

Many customers request deliveries to arrive at a *specific time* on the day (Fleet Manager & Director Transportation at Arla, 21/2; Senior Manager Customer Logistics, 3/3; Transport Leader & Transport Developer at Martin&Servera, 29/1; Key Account Manager at

Martin&Servera, 18/2) and the time requested highly depends on the operations and routines of the customers (Senior Manager Customer Logistics at Arla, 3/3; Key Account Manager at Martin&Servera, 18/2). One example from Martin&Servera is that the restaurant personnel needs to be able to receive the shipments, and during certain hours of the day that might not be possible (Key Account Manager at Martin&Servera, 18/2). Additionally, it would be costly to have stand-by personnel waiting for a delivery. One example from the Senior Manager Customer Logistics at Arla (3/3) is that it might not be optimal if the ICA-truck is arriving 30 minutes before the Arla truck to an ICA grocery store since the personnel might not be able to manage this amount of goods at the same time. Further, it is a general perception from customers that dairy products have to be delivered early mornings which makes customer request deliveries during peak hours (Fleet Manager and Transport Director at Arla, 21/2). Peak hours are defined as when the demand for deliveries is far above average.

Martin&Servera have a product that offers the customer to pay extra if they wish to get their order a specific time of the day, were the price is related to when peak hours occur (Transport Leader & Transport Developer at Martin&Servera, 29/1). For example, to order delivery at 8 in the morning or 14 in the afternoon will result in different prices. This extra payment is put on the sales department margins and is not directly visible for the customer (Key Account Manager at Martin&Servera, 18/2). Figure 5-1 below shows the demand for deliveries during the day from the customers at Martin&Servera.

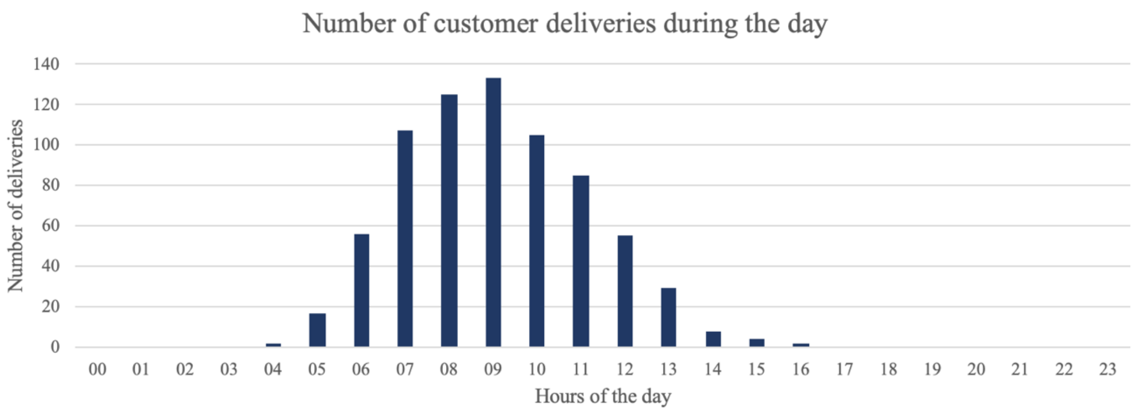

Figure 5-1: An average distribution of customer deliveries during one day

The data was collected during an undefined time period and region in 2019, using an average of all datasets of Fridays during that period Source: Transport Leader and Transport Developer at Martin&Servera (29/1).

Arla faces similar problems with uneven demand for deliveries, but more concerning *days of the week* (Fleet Manager & Transportation Director at Arla, 21/2). One example is that big private customers like ICA and Stora Coop want most of their deliveries Thursday night or Friday morning. This is because they want to offer fresh food products as most of their consumers does their “weekend shopping” on Fridays. Mondays also generate a peak in demand as schools and kindergartens often want their deliveries then.

Narrow *time windows* are one of the most requested requirements within delivery precision (Transport Leader & Transport Developer at Martin&Servera, 29/1; Key Account Manager at Martin&Servera, 18/2). Martin&Servera offer different time slots to customers with different prices, and these time slots are within 0-1h up to 6h. As seen in Figure 5-2below, there is a small number of customers who want deliveries within a time slot of 1h or less. It can also be seen that the most popular time window is between 1-2h. Further, Martin&Servera explained that even though a contract states that the time window agreed on is, for example, more than 6h, the customer expects them to arrive at the same time every delivery (Transport Leader & Transport Developer at Martin&Servera, 29/1).

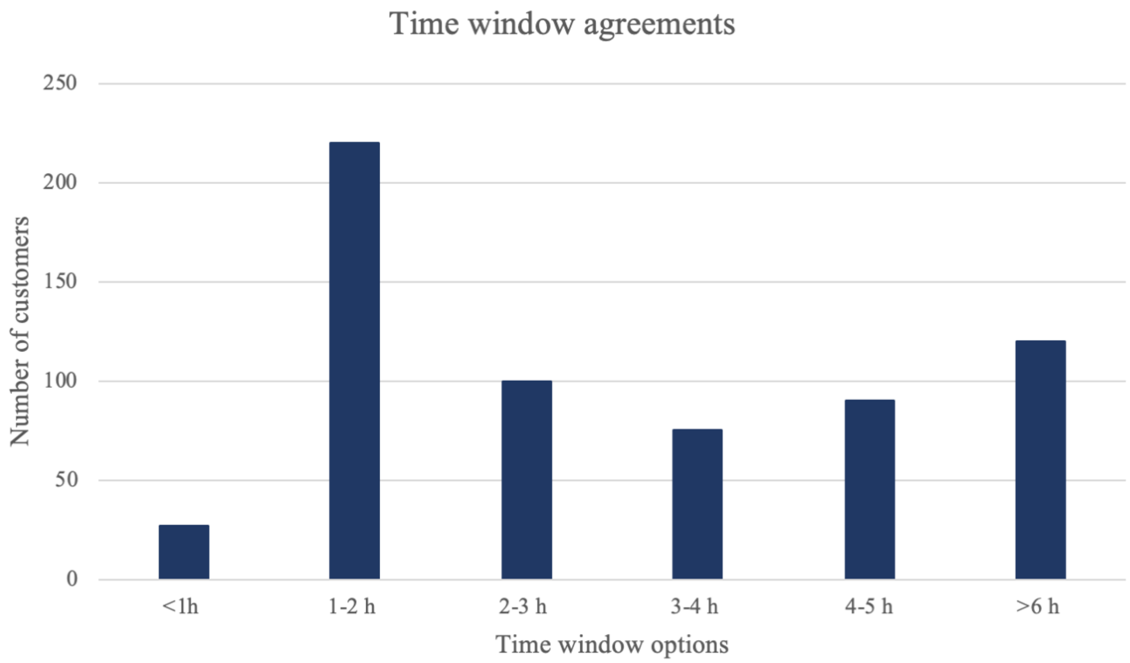

Figure 5-2: Time window agreements with customers

The data was sourced from the company's ERP system during an undefined time period and region in 2019. Source: Transport Leader and Transport Developer at Martin&Servera (29/1).

Arla, on the other hand, offers the same time window to all their customers (Senior Manager Customer Logistics at Arla, 3/3). This time window is a span of + - 1h from the wanted delivery time, and if the delivery does not make it within this interval, the driver needs to wait until the next available delivery time. However, the Senior Manager Customer Logistics at Arla (3/3) says that the most important is that the estimated time of arrival is known by the customer meaning that if any disruptions happens, it has to be announced.

Arla also offers the biggest retail customers a discount if they can deliver whenever they want (Fleet Manager and Director Transportation at Arla, 21/2). One example is that large retail customers can get a 1% discount if they do not put any requirements on delivery time. Customers within big cities are often more fond of keeping their requirements compared to customers in rural areas who rather accept the discount.

5.1.2 Order cycle time

One requirement that is custom for the food industry today concerns the short order cycle time from order to delivery (Key Account Manager at Martin&Servera, 18/2; Fleet Manager & Director Transportation at Arla, 21/2). The custom lead time within the industry today is one-day delivery (Key Account Manager at Martin&Servera, 18/2). This requirement partly emerges from the industry where unforeseen happenings like events, concerts and weather that the companies cannot influence have a large impact on the daily demand.

The Fleet Manager and Director Transportation at Arla (21/2) tells that Arla's customer's order cycle time differs based on the distance from the customers to the dairy farm, but that the average delivery lead time is 24h. Some customers require an even shorter lead time and expect to get their delivery the same day (Senior Manager Customer Logistics at Arla, 3/3). One of the reasons for this is the strong requirement on fresh food since customers want to sell their products with as long best-before date as possible (Fleet Manager at Arla, 30/1). An example is milk, which is currently produced during the night and delivered to the grocery stores the same morning. It also happens that an order can be placed during the morning hours and that the customer expects to get it delivered later the same day. However, not all customers get deliveries the same day they order even if they want to. For Martin&Servera the "freeze zone" for their orders are usually around 3 pm the day before delivery, but some customers also have as late as 5 pm (Transport Leader & Transport Developer at Martin&Servera, 29/1; Key Account Manager at Martin&Servera, 18/2). Many of the customers place their orders close to this time. Some customers also place their order after this time but are then charged with a penalty fee (Key Account Manager at Martin&Servera, 18/2). However, this penalty fee is internally seen as low.

5.1.3 Frequency

Both Martin&Servera and Arla are struggling with requirements connected to the frequency of deliveries as customers more and more request to get their deliveries with less goods (Transport Leader & Transport Developer at Martin&Servera, 29/1; Key Account Manager at Martin&Servera, 18/2; Fleet Manager & Director Transportation at Arla, 21/2). This requirement has become more popular because of the increasing rent cost and regulations concerning restaurant spaces which causes restaurants amongst other to minimise their inventory to increase sales space (Key Account Manager at Martin&Servera, 18/2). Arla also tells that the wanted frequency from their customers is affected by the storage area (Fleet Manager & Director Transportation at Arla, 21/2). Recently built restaurants have even less space which confirms the trend (Key Account Manager at Martin&Servera, 18/2). The public customers often have bigger storage areas (Key Account Manager at Martin&Servera, 18/2) and less requirements on expiration date which in many cases leads to fewer frequent deliveries (Fleet Manager & Director Transportation at Arla, 21/2).

For Arla, internal rules about delivery terms are stated (Fleet Manager & Director Transportation at Arla, 21/2). Depending on how much goods a customer is ordering, the number of delivery days is decided. However, there is a possibility to get one extra delivery day if an extra amount is paid. Martin&Servera manage small order sizes by charging a penalty fee to customers if they place orders with quantities below the minimum order quantity set by the company (Key Account Manager at Martin&Servera, 18/2). A general rule at Arla is that customers ordering over 15 tons a week gets delivery every day (Fleet Manager & Director Transportation at Arla, 21/2). However, for the biggest customers like big grocery stores, no general agreement is stated (Fleet Manager & Director Transportation at Arla, 21/2). In some cases, they can get deliveries up to two times a day (Fleet Manager & Director Transportation at Arla, 21/2; Senior Manager Customer Logistics at Arla, 3/3).

A trend is that small grocery stores close to people's homes are getting more popular than the big stores that have everything (Fleet Manager & Director Transportation at Arla, 21/2). People are starting to shop their food online and are instead just buying some goods in the grocery store close to home to complement. A consequence of this is that more frequent deliveries (days) are needed as the storage areas will decrease.

5.1.4 Special requirements

Some customers have requirements on special products like delivery to the shelf or to the fridge, not just to the unloading area (Transport Leader & Transport Developer at Martin&Servera, 29/1). This makes the driver spends less time on the road and instead carry goods for the customer. Martin&Servera charges extra for unloading activities that take up more than 30 minutes. This service has historically been offered to customers, and they still expect it today (Transport Developer at Martin&Servera, 7/4). Similarly, unloading is not a direct requirement from Arla’s customers, but rather an expectation as delivers historically always has been performed that way (Fleet Manager at Arla, 2/4; Senior Manager Customer Logistics at Arla, 6/4). Milk, for example, needs to be delivered “chilled-to-chilled” to guarantee good quality. Further, public customers tend to have better infrastructure connected to unloading areas (Key Account Manager at Martin&Servera, 18/2; Fleet Manager & Director Transportation at Arla, 21/2).

5.1.5 Environment

Both Martin&Servera and Arla tells that there are few requirements from their customers on environmental aspects regarding transport (Transport Leader & Transport Developer at Martin&Servera, 29/1; Fleet Manager & Director Transportation at Arla, 21/2; Transport Manager at Martin&Servera, 6/4; Senior Manager Customer Logistics at Arla, 6/4). However, there are some requirements regarding Euro-class and types of fuel, but they are mainly required from the municipally and public customers (Fleet Manager at Arla 2/4; Transport Manager at Martin&Servera, 6/4; Transport Developer at Martin&Servera, 7/4). The private customers mostly follow the regulations in the area where they are operating.

Martin&Servera experience that their private customers are not very concerned about the environment when they book transports (Transport Leader & Transport Developer at Martin&Servera, 29/1; Transport Manager at Martin&Servera, 12/2; Key Account Manager at Martin&Servera, 18/2). In general, customers seem to care more about if the food products and if their packaging is environmentally friendly. For Arla, some environmental requirements regarding transportation are starting to be seen from the largest private customers (Senior Manager Customer Logistics at Arla, 3/3). One example is that large customers have their own ambitions about what type of fuels that should be used. However, the way environment is discussed occurs primary on a strategic level and is hence not a current transport requirement.

The Transport Manager at Martin&Servera (12/2) tells that the cost for environmentally friendly vehicles is higher than for conventional ones. For example, an electric vehicle is three times more expensive than a diesel vehicle. For this investment to be paid off, the vehicles have to be utilised more efficiently.

5.1.6 Summary

From the empirical findings, a set of customer requirements was identified and categorised. These are visualised in Table 5-1 below.

Table 5-1: The most important customer requirements perceived by the case companies

Customer service requirement	**Arla**	**Martin&Servera**
Delivery precision Day, Hour, Time Window	D, H, TW	D, H, TW
Frequency of delivery	x	x
Lead time	Min: 8 h Average: 24 h	Min: 15 h Average 24 h
Special requirements	x	x
Environment (transport related)	x*	x**

* This requirement is only discussed on a strategic level
** Requirement from municipality, not private customers

5.2 How customer requirements affect the case companies operations

The case companies perception is that customer requirements affect their production of transports and their efficiency (Transport Leader & Transport Developer at Martin&Servera, 29/1; Transport Manager at Martin&Servera, 12/2; Fleet Manager & Director Transportation at Arla, 21/2; Senior Manager Customer Logistics at Arla, 3/3). The different transport efficiency measures and the perception from the case companies on how they are affected by customer requirements are presented below.

5.2.1 Route planning at the companies

Arla's planning of long-term routes occur approximately four times a year and is something they call "master routes" which include around ten customers (Fleet Manager & Director Transportation at Arla, 21/2). The master routes are then fixed routes for all customers and consider what time of the day the delivery of goods to a customer is going to happen. On a daily basis, these routes can be adapted to the demand by day to day planning to manage, for example, overbooking. The day to day planning can also move customers between routes to optimise the driven kilometres and in some cases, create new routes.

Martin&Servera has a similar set up as Arla regarding long term route planning as well as day to day planning. The difference is that Martin&Servera is changing their long-term routes when they feel it is necessary (Transport Leader & Transport Developer at Martin&Servera, 29/1). Further, each customer is signed to a specific master route, and can only book according to that route's schedule. For example, a customer signed to get deliveries only at Monday's can only place orders to Mondays. A customer does not necessarily need to place an order.

5.2.2 Delivery precision

In this subsection, findings on how delivery precision affects load factor, vehicle usage, routing factor and driving factor will be presented.

Load factor
Without time windows set by customers, it would be possible to do more day to day planning and hence plan for a better load factor (Fleet Manager at Arla, 2/4). The Transport Developer at Martin&Servera (7/4) tells that the load factor often varies from 40 - 100%, but that it sometimes only reaches 15 % due to time restrictions from the customers. Without time windows and time restriction, it would also be possible to even out the delivery flow (Transport Developer at Arla, 7/4). Martin&Servera's demand for deliveries during a day is distributed according to Figure 5-1 in subsection 5.1.1. As the figure shows and the Transport Developer at Martin&Servera (7/4) tells, the demand for transports between 7-10 am in the morning is very impacting on the operations and the company's load factor of the transports done during the afternoon. This is because many of the vehicles have to stand still or run half-full in the afternoon since the wanted delivery times are concentrated to the morning hours. Arla also has a large number of their deliveries requested in the morning by the big customers (Fleet Manager at Arla, 2/4). It is not possible to be at the same place at the same time, which leads to an increase in capacity to cover peaks with low load factors as a result (Transport Developer at Martin&Servera, 7/4).

Besides varying from time of the day, the demand for deliveries also varies from day to day. According to the Fleet Manager (2/4) and Senior Manager Customer Logistics (6/4) at Arla, the demand for deliveries is highest at Mondays and Fridays and lowest in the middle of the week which causes load factors to drop in this period. For Arla, the load factor varies between 80-100% (Fleet Manager at Arla, 6/4). The variation between days causes certain delivery days to have a higher volume demand and create the need for an extra vehicle whilst certain days, it will transport air (Senior Manager Customer Logistics at Arla, 6/4).

Further, both the Fleet Manager (2/4) and the Senior Manager Customer Logistics (6/4) at Arla tells that it is easier to reach a higher load factor in urban areas as the distance between customers is shorter. In these cases, the time windows do not impact as much as it does in rural areas because it is harder to rearrange delivery routes as it is less demand to cope with.

Vehicle usage
By levelling out the deliveries over the day and perform more deliveries in the late afternoon, the capacity of the number of vehicles needed could be lowered to the new highest peak (Transport Leader & Transport Developer at Martin&Servera, 29/1; Transport Manager at Martin&Servera, 6/4). The Senior Manager Customer Logistics at Arla (6/4) also considers that evening out the demand for one day and removing time windows would have an impact on needed vehicle capacity. The Transport Developer at Martin&Servera (7/4) also agrees that time windows affect the vehicle usage and mentions at the same time that time windows seem more impacting than days of the week as the current situation with time windows causes many vehicles to stand still in the afternoon (Transport Manager at Martin&Servera, 6/4; Senior Manager Customer Logistics at Arla, 6/4; Transport Developer at Martin&Servera, 7/4). For Martin&Servera for example, the current situation is that 28 out of 30 vehicles stands still between 3-5 pm while 30 out of 30 are running at 8 am-12 am (Transport Developer at Martin&Servera, 7/4). This is illustrated in Figure 5-3 below where the blue line shows the current vehicle fleet while the grey line shows the number of operating vehicles.

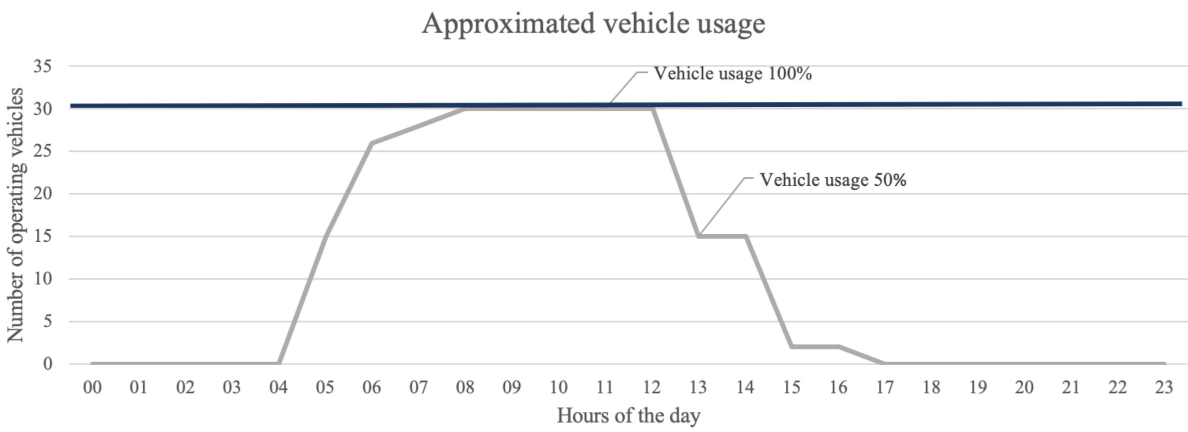

Figure 5-3: Approximated current vehicle usage

The data was collected during an undefined time period and region in 2020. Source: Transport Developer at Martin&Servera (7/4).

If the demand could be spread out during the day without time restrictions, Martin&Servera could eliminate as much as 50% of their vehicle capacity according to the Transport Developer at Martin&Servera (7/4). This number derives from a calculation example visualised in Figure 5-4 below, which is an illustration of Martin&Servera's current demand for deliveries during one day compared to the wanted levelled demand. The figure shows that levelled demand could lead to that the number of vehicles could be lowered from the blue to the grey line. According to the Transport Manager at Martin&Servera (6/4) a more levelled demand would make it possible to plan for how many vehicles that are needed as well as it would be easier to promise a delivery time to the customer. Right now, Martin&Servera is using an over-capacity.

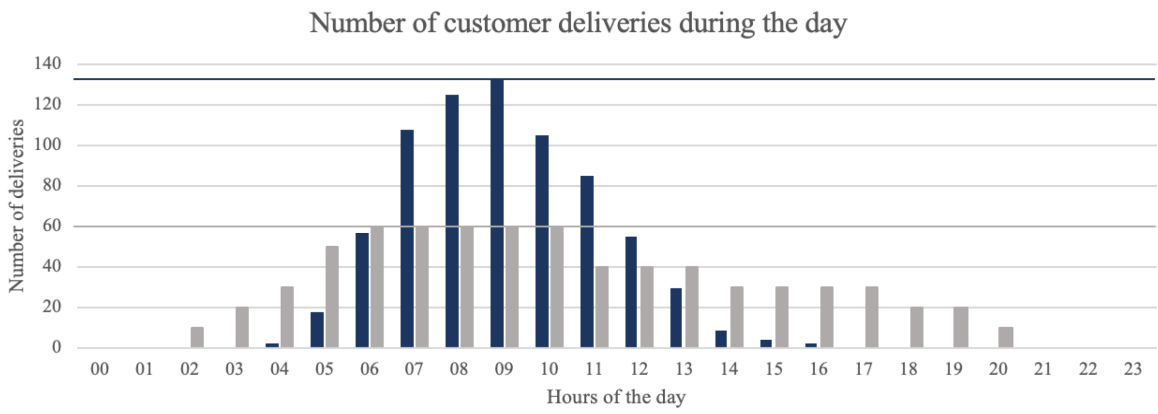

Figure 5-4: Levelled and unlevelled demand of deliveries

The data was collected during an undefined time period and region in 2019, using an average of all datasets of Fridays during that period. Source: Transport Leader and Transport Developer at Martin&Servera (29/1).

Evening out the demand over the days of the week could also have a large impact on the overall vehicle usage according to the Fleet Manager at Arla (2/4) and the Transport Manager at Martin&Servera (6/4). Additionally, it would also be easier to match their capacity connected to personnel (Fleet Manager at Arla, 2/4). By evening out the demand, an approximation was given that the number of vehicles could be reduced by 10% in Stockholm (Fleet Manager at Arla, 2/4). Additionally, dynamic planning could manage variations in demand in a better way by an improved day to day route planning, and possibly reduce the number of vehicles (Senior Manager Customer Logistics at Arla, 6/4).

Time windows restrictions have a large impact on costs as more resources needs to be spent on transport planning (Transport Manager at Martin&Servera, 6/4). According to the Transport Manager at Martin&Servera (6/4) it would be possible to increase the usage of vehicles as well as it would be easier to be on time without time windows. Further, the fixed cost could be lowered as it would be spread out on more hours and more stops.

Routing factor
Customers put requirements on delivery precision and as the Transport Developer at Martin&Servera (7/4) says "*if all customers want this time window it becomes difficult. It is not possible to be at two different places at the same time*". This customer requirement could also imply that customers need to be visited in an order which is not the optimal one just because they require different time windows (Senior Manager Customer Logistics at Arla, 6/4; Transport Developer at Martin&Servera, 7/4). If there were no time windows at all, Arla and Martin&Servera would be able to optimise their routes fully and achieve the shortest total distance driven (Fleet Manager at Arla, 2/4; Transport Developer at Martin&Servera, 7/4). With time windows, it can, for example, happen that they are forced to drive back and forth to the same area (Transport Developer at Martin&Servera, 7/4). The Transport Leader and Transport

Developer at Martin&Servera (3/2) tells that even the largest time windows affect the route optimisation as the company need to adapt their planning. The Fleet Manager at Arla (2/4) describes that a route optimisation without any time restrictions could decrease the total distance with 10% in urban areas and 5% in rural areas. However, this was seen as an impossible scenario to achieve.

A widening of 1h of a time window would help Arla to adapt to day to day disturbances or be able to for example move customers between different routes and hence be more flexible (Fleet Manager at Arla, 2/4). Theoretically, it would also be possible to reduce the number of vehicles used and thus reduce the number of routes (The Senior Manager Customer Logistics at Arla, 6/4; Transport Developer at Martin&Servera, 7/4). Further, Martin&Servera states that it only takes that one customer demand a tight time window in order to disturb the whole route planning (Transport Leader & Transport Developer at Martin&Servera, 3/2).

Driving factor

For certain delivery flows, time windows are very strict (Senior Manager Customer Logistics at Arla, 6/4). If there is a delay which results in that the driver is late to the customers unloading point, it could possibly imply that the driver needs to wait for the next slot of delivery. This is common for big customers with central warehouses who has unloading slot times.

5.2.3 Order cycle time

The following subsection will present how order cycle time is considered to affect the load factor and routing factor as well as vehicle usage.

Load factor and routing factor

Today the transport planning at Martin&Servera and Arla is done in a very short time as some customers have a short lead time from placing their order to delivery (Fleet Manager at Arla, 2/4; Transport Developer at Martin&Servera, 7/4). For Arla, one example is that some customers have an order stop time 9 am in the morning before they get the delivery at 6 pm the same day. This short order cycle time creates some uncertainty in the companies transport planning as they have limited time to optimise the load- and route factor (Fleet Manager at Arla, 2/4; Transport Developer at Martin&Servera, 7/4).

Earlier order placing would make it possible to plan more against actual orders than forecast since the final planning not can be done before the last order is placed (Fleet Manager at Arla, 2/4). A longer order cycle time would make day to day planning plan for more efficient work (Fleet Manager at Arla, 2/4; Senior Manager Customer Logistics at Arla, 6/4). More specific, a longer order cycle time would make it possible to optimise the load factor (Fleet Manager at Arla, 2/4; Transport Manager at Martin&Servera, 6/4; Transport Developer at Martin&Servera, 7/4) and to achieve a better day to day route optimisation (Fleet Manager at Arla, 2/4; Transport Manager at Martin&Servera, 6/4; Transport Developer at Martin&Servera, 7/4). Additionally, it would also be possible to reduce the working time for the storage personal during the night, which is a large cost component.

A longer order cycle time would also improve service as it is easier to get back to the customer if there is lack of a specific product (Transport Manager at Martin&Servera, 6/4). With Martin&Servera's current order stop time at 5 pm, most sales personnel have left the office for the day and can thus not call the customer if any problems occur. With a longer order cycle time, both the customer and Martin&Servera could plan and solve the issue better by, e.g. ordering something else. This could decrease the number of "panic deliveries" and missing order lines.

Vehicle usage
The number of vehicles needed is affected by the order cycle time as a longer planning time would enable more optimized routes and load factors which would make it possible in some cases to reduce the number of vehicles (Fleet Manager at Arla, 2/4). One example that was given during the interview was that longer time than the initial 30-60 minutes for transport planning could decrease the number of trucks from, for example 20 to 19.

5.2.4 Frequency

This subsection will present the impact frequency has on load factor, routing factor and vehicle usage.

Load factor and routing factor
As mentioned in section 5.2.1, each customer at Martin&Servera is signed to a specific route and can only book according to that route's schedule (Transport Leader & Transport Developer at Martin&Servera, 3/2). A customer does not necessarily need to place an order which implies that in order to get a good fill rate, more customers are signed to the route than it actually can handle (if everyone placed an order). In case of under- or overload, orders need to be rescheduled to other routes or even new vehicles.

A demand on frequent deliveries makes the load factors drop. and occurs especially when the distance from the depot to the city is long and the demand for products is low, for example to a smaller city (Transport Developer at Martin&Servera, 7/4). Further, the Senior Manager Customer Logistics at Arla (3/3) tells that in some cases, customers even require two deliveries a day which forces Arla to drive with half-full trucks.

In order to get a more optimal load factor, the Fleet Manager at Arla (2/4) thinks that it would be optimal to deliver an FTL once a week. However, due to the characteristics of chilled food, it would not be possible. This means that for example milk, needs to have as long time to due date as possible when it is delivered. Based on this, it would be difficult for Arla to sell the milk if only delivering once a week. In order to get a high load factor, Arla offers a "delivery-staircase" (delivery agreement) which implies that the larger the order is in tons, the higher frequency the customer will be allowed to have. This delivery agreement was also mentioned in 5.1.3.

Vehicle usage
Both Martin&Servera and Arla adapt their capacity to the demand which means that if the frequency is lowered it would result in fewer transports (Fleet Manager at Arla, 2/4; Transport Manager at Martin&Servera, 6/4). In that case, it would be possible to reduce the number of vehicles used. However, in some cases, it could be better to spread out the transports on more days to utilise the vehicles better during the whole working day and to visit more customers each day (Transport Manager at Martin&Servera, 6/4). This is because the vehicle will pass close to the customer anyway since it is visiting other customers on the route that the customer is signed up to. In those cases where there are a lot of volumes in the same area of the customer as well as if the customer orders a lot of volume, the frequency does not impact (as much) the efficiency of transports. If the transport is not spread out on more days and the customer orders its whole demand for a week on one delivery day, the delivering vehicle can only serve a few more customers that day. The rest of the day, it will stand still as it does not have time to go back to the city for more deliveries due to time window restrictions.

Arla is having the same thoughts about the advantages with more transport days, and the Senior Manager Customer Logistics at Arla (6/4) tells that it is sometimes better to offer more deliveries as it will even out the flow over the week. According to the Senior Manager Customer Logistics at Arla (6/4), this will make it possible to avoid the biggest peaks in transport demand and even cut out some vehicles. More frequent transports would also enable a better flow efficiency, but perhaps not a better resource efficiency. The risk of having very frequent deliveries is that volumes drop. When they do, a very low load factor in the vehicles can occur. A solution could be to create peaks in demand which leads to that a vehicle can stand still one day and operate the next. This might not be to use the vehicle in an optimal way, but by doing this, there is no cost for operating the vehicle such as fuel and driver as well as risk for damages. The optimal situation would be to have both an optimal load factor and even flows. However, it does not necessarily apply for all customers that more delivery days is desirable from Arla's side. If the customer does not order enough volume, they will not be able to get such frequent deliveries.

When there is a low transport demand, the Fleet Manager at Arla (2/4) tells that they are doing maintenance on those vehicles that are not in use. This to prepare the vehicles so that when the peaks come, all vehicles are available. Maintenance takes up a larger part of the time in urban areas due to traffic accidents.

5.2.5 Special requirements

This subsection contains the perceived effects of special requirements on load factor, driving factor, vehicle usage and routing factor. Special requirement in this thesis is defined as time-consuming unloading.

Load factor and driving factor
A route is often limited by time, and if unloading is required, fewer stops are possible to be scheduled on that route (Transport Developer at Martin&Servera, 7/4). This makes load factors

and deliveries per hour go down. Further, variations in volumes ordered by the customers affect how much time the unloading takes and makes it hard to plan as it can be for example 50 kg one day and 100 kg the next (Transport Manager at Martin&Servera, 6/4). The Transport Manager at Martin&Servera (6/4) also states that each stop is a cost component as both the vehicle and the driver stand still to unload. Additionally, it affects social sustainability as these types of requirements puts a lot of pressure on the driver such as heavy lifts and performing tasks which the drivers do not see as part of their job (Transport Developer at Martin&Servera, 7/4).

Arla agrees that unloading take up a lot of time, and that it will negatively affect the utilisation of the vehicles during its route (Senior Manager Customer Logistics at Arla, 6/4). One example is that sometimes drivers need to walk 300m from the truck to deliver the goods instead of keeping driving. However, the Senior Manager Customer Logistics at Arla (6/4) says it is difficult to say how much it affects. The impact on their operations is rather theoretical where special requirements limit the number of stops a vehicle can perform. Even if it affects negatively, Arla needs to perform these deliveries in many cases as it is custom within the industry.

Vehicle usage
A vehicle is often only used on one route per day (Transport Developer at Martin&Servera, 7/4). If special requirements are set, it is even harder to use a vehicle for a second route as the first route will take longer time. If deliveries could take less time, the Fleet Manager at Arla (6/4) thinks it would be possible to plan for a better route and possibly remove some vehicles under the condition that customers can accept deliveries during the afternoon.

Routing factor
Arla is using GPS in their vehicles that have provided them with statistics and an average value about the duration of each delivery and its unloading (Fleet Manager at Arla, 2/4). One example of usage of this data is within their route optimisation tool. The data tells them how long a delivery takes on both low peak days such as Tuesdays and high peak days such as Fridays. These variations in demand can then be planned for. The Fleet Manager at Arla (2/4) tells that if it could be possible to save much time on each customer, the route optimisation could be done better. Martin&Servera also agrees on that the route optimisation is negatively affected by the unloading requirements, especially when they occur in the morning until lunch which is during the peak in demand (Transport Manager at Martin&Servera, 6/4). This is because there is less time to visit more customers.

5.2.6 Environment

This subsection will present how the customer requirements on the environment affect routing factor.

Routing factor
In general, the Transport Manager at Martin&Servera (6/4) tells that customers have no understanding of how delivery time is connected to environmental impact and therefore it is

hard to have a discussion about it. Further, Martin&Servera expresses that environmental requirements have an impact on the route optimisation (Transport Manager at Martin&Servera, 6/4; Transport Developer at Martin&Servera, 7/4). One example is that the municipality of Gothenburg asks for Euro-6 deliveries for all their public customers. However, the agreement says “in most cases possible” which makes it easier for Martin&Servera to perform their route planning (Transport Developer at Martin&Servera, 7/4). Martin&Servera’s solution is to use such vehicles on routes that cover most of their public customers which will then also include some of the private ones (Transport Manager at Martin&Servera, 6/4; Transport Developer at Martin&Servera, 7/4). As Martin&Servera rent their vehicles, it is the transport provider that needs to invest in new vehicles (Transport Developer at Martin&Servera, 7/4).

5.2.7 Observed consequences of customer requirements from interviews

From the empirical findings that were based on the interview answers of the respondents in this study, Table 5-2 below was created. In each box, a marking was set after the interview if the respondent did imply that a requirement was impacting one of the efficiency measures. The table is the same used in the hypothesis. Not surprisingly, the respondents perceived that many customer service requirements have an impact on transport efficiency.

Table 5-2: Perceived consequences of customer requirements from empirical findings

How does customer requirements affect transport efficiency?		Customer requirements (x)					
		Delivery precision	order cycle time	Frequency	Special requirement	Environment	Total
Efficiency measures (y)	Load factor	xx	xxx	xxx	xx		10
	Vehicle usage	xxxx	x	xxx	xxx		11
	Route factor	xxxx	xxx	x	x	xx*	10
	Driving factor	x			xxxx		5
	Total	11	7	6	10	2	

* Requirements from the municipality, not from the private customers.

5.3 Customers perceived willingness to change

Today, customers ask for sustainable food products and less plastic packaging at the same time as they demand customer service requirements, such as highly frequent deliveries (Transport Leader & Transport Developer, 29/1). To ask for deliveries every day and at the same time ask for environmentally friendly goods, and packaging does not match. From the Transport Manager at Martin&Servera (12/2) a quotation was given: *“do customers understand their effect on deliveries?”*. Further, the Key Account Manager at Martin&Servera (18/2) says that it is harder to drive the question regarding sustainable transports with customers if they lack sustainable food options in their assortment. However, there is very little time to focus on transports during a sales meeting as there are more things to discuss. The cost of transport is seldom discussed separately as the customer receive a total price, including all costs instead. If the customer’s requirement increases the transport cost, it is put on the sales department’s revenue. For Martin&Servera to not lose sales, it might be that the customer is getting a discount on food products instead.

Some requirements in the food industry seem to be custom (Key Account Manager at Martin&Servera, 18/2; Director Transportation and Fleet Manager at Arla, 21/2). For example, the order cycle time is usually very short. As mentioned in section 5.2, one specific example from Arla is that they have problems with the delivery time of milk as it is custom for milk to arrive in the morning (Fleet Manager & Director Transportation, 21/2). Customers in the food industry also seem very driven by routine and often is every task during a day done in a specific sequence (Key Account Manager at Martin&Servera, 18/2). The customers have a picture in their head of when and how everything is going to happen which affects what delivery time they want.

The potential to change is according to the Key Account Manager at Martin&Servera (18/2) biggest with the public sector, hotels and restaurants as they receive requirements from their customers. The Fleet Manager and Director Transportation at Arla (21/2) also tells that the public customers seem to be more open to change. They are also easier to influence as transports are procured by the municipality who work to promote sustainable solutions (Key Account Manager at Martin&Servera, 18/2; Fleet Manager & Director Transportation at Arla, 21/2). Further, it is easier to drive change towards municipalities and actors on the regional level with hard facts (Fleet Manager & Director Transportation at Arla, 21/2). Three years ago, Arla tried to offer discounts to private customers if they were willing to be more flexible with delivery times. The result showed that many customers are not open for change, and especially customers in large cities like Stockholm were hard to convince (Fleet Manager at Arla, 30/1). As mentioned in subsection 5.1.1, Arla offers 1% discount to large retail customers who are willing to be more flexible about time (Fleet Manager & Director Transportation at Arla, 21/2). However, Arla thinks that most customers do not seem to understand the advantage that it gives except the monetary win. A question that was raised during the interview is if 1% is enough for changing.

Some customers have started to accept changes according to both the Director Transportation and Fleet Manager at Arla (21/2) and the Transport Manager at Martin&Servera (6/4). One example is that both actors have tried to convince customers to move their delivery time to the afternoon or night, and some customers are starting to see the advantage of that. For the customer, one of the advantages is the decreased risk of a delayed delivery as normally: *”they have today's lunch on the truck”* (Transport Manager at Martin&Servera, 6/4).

6 Analysis and discussion

The following chapter will answer and provide an analysis regarding all the three research questions. Research question one, which customer requirements that exist, and two, what are the consequences of these requirements on transport efficiency, will be analysed together. This is because the consequences on transport efficiency will be analyses from the existing customer requirements. Research question three, how to effectively communicate these requirements to customers, will be analysed separately. The analysis of all the research questions will be connected to the system and the logistics trade-offs within it. It will focus on the factors tied-up capital, cost and environment.

The question regarding what customer requirements that exists within the food industry today is very interesting to look into. Requirements are constantly changing (Lindstedt and Burenius, 1999) and for the research to be relevant and usable for the case companies, other companies within the same industry and those who will perform research within this area, this thesis looked into which ones that exist today. Research question two, what the consequences of customer requirements are on transport efficiency, is interesting as focus earlier has been given more to how one should adapt to the customers will rather than how customer's requirements affect the operations of a company. The third research question, how one can effectively communicate the consequences of customer's requirements to them, is very interesting as it aims to explain a way to communicate consequences. By that, it can possibly make customers change behaviour regarding which requirements they put on deliveries. This question is important as there is a large focus on price on today's transportations. According to the empirical findings, customers do not seem to understand the effect on rather the environment or their own operations. In other words, this indicates that it is a lack of system understanding as there are other effects of transports than just costs.

6.1 Consequences of existing customer requirements

The following section will include the consequences of the existing customer requirements within the food industry that were most brought up by the case companies. It will start by presenting a pattern matching between literature and empirical findings which will state if there is a connection between customer requirements and transport efficiency or not. It will be followed by a sub-section concerning why these requirements are asked as well as the impact on transport efficiency will be discussed more in detail. After that, analysis concerning why these requirements are fulfilled is presented.

6.1.1 Customer requirements impact on transport efficiency

The result of the pattern matching between literature and empirical findings is presented in Table 6-1 below. If the empirical data showed an impact of the requirements on a transport efficiency measure, it was marked with a cross. If literature showed that there was an impact, it was marked with a circle.

Table 6-1: Customers requirements impact on transport efficiency according to both empirical findings and literature

How does customer requirements affect transport efficiency?		Customer requirements (x)				
		Delivery precision	order cycle time	Frequency	Special requirement	Environment
Efficiency measures (y)	Load factor	xo	xo	xo	x	
	Vehicle usage	xo	xo	xo	x	
	Route factor	xo	xo	xo	x	x*
	Driving factor	x			xo	

* Requirements from municipality, not from private customers.
x = empirical data, o = literature

Driving factor = how much of the used time that is actually spent on driving goods.
Special requirements = time-consuming unloading.

Almost all of the requirements mentioned by the case companies are documented in literature as well. However, some differences were seen. The impact on driving factor from delivery precision was not found by the authors in the literature but was mentioned during the interview with the Senior Manager Customer Logistics at Arla (6/3). However, the impact was seen rather theoretical than something that actually impacted the operations. Further, how routing factor is affected by order cycle time was discussed by three out of the four interview respondents (Table 5-2 in subsection 5.2.7). Therefore, this relationship can be seen as strong. Surprisingly, it was not found in literature, but it might be that literature focuses more on long term route planning, whereas the respondents are more focused on day to day planning. Special requirements were during the interviews mentioned to affect all the four transport efficiency measures. However, only how special requirements affect the driving factor were found by the authors in the literature. This might be because the area is not so highlighted. When discussing unloading in the literature, the infrastructure at the unloading site is discussed to a larger extent than the actual consequences of it. The impact of requirement on environment on the routing factor was not found in the literature either. Even though there is a lot of literature on vehicle routing problems with environmentally friendly vehicles and heterogenous vehicle fleets, no impact was found. This literature was more focused on mathematical models rather than the impact on logistics.

Table 5-2 in subsection 5.1.1 assembled from interviews can be used to see what customer requirements the case companies either think is most impacting, or they have the most knowledge about. Often is these two strongly related. In total, the customer requirement *delivery precision* and the transport efficiency measure *vehicle usage* were brought up most by the case companies. Both were mentioned eleven times. However, eleven times does not implicate that delivery precision is the most impacting requirement or that vehicle usage is the most impacted measure. However, the authors of this thesis got the impression that delivery precision was the requirement that both Arla and Martin&Servera perceived affected the transport efficiency the most. They also gave the impression that vehicle usage efficiency was on the top of the agenda as the question regarding the fleet size was constantly brought up. It might also be because it is strongly connected to other transport efficiency measures such as load factor. What was mentioned less during the interviews, and also perceived by the authors as the less important customer requirement, was environment. Unlike delivery precision, environment was mentioned only two times. This implies that the case companies do not think it affects their transport efficiency so much which might be because it is yet not a frequently asked and developed customer requirement.

There are some small differences in customer requirements between the case companies customers, even though they operate roughly in the same industry. These differences can be seen in Table 5-1, subsection 5.1.6. The differences could be derived from that Arla relates even more to the food industry than Martin&Servera that also is related to retail and distribution of other types of goods than just food. This might imply that Arla is more affected by the characteristics of food.

6.1.2 Why are these requirements asked and what are the trade-offs?

In the following subsection, customer service requirements and their impact on transport efficiency measures will be analysed together. Many of the service requirements brought up in this thesis will have an impact on transport efficiency. How and why will, therefore, be analysed below.

Delivery precision
One interesting aspect that was found during the interviews is that the agreements concerning contracted time windows are quite "open", such as 4-6 h. In reality, as customers get deliveries at the same time of day anyway as they are planned into a route schedule, they expect deliveries at the same time of day each delivery. This means that even though customers have a time window agreement of 6h, they expect their deliveries to always occur at the same time. This empirical finding goes well in line with the Kano-model that mentions some requirements as unspoken and taken for granted (Lindstedt & Burenius, 1999). This could partly also depend on that the transport buyer is not always the one involved in the daily operations. If they are not involved, they might not understand which requirements to ask for, such as suitable time windows. This can be seen as transports buyers later are reaching out to change the agreed service requirements.

Delivery precision was perceived to be very important to the customer, but one interesting point that the Senior Manager Customer Logistics at Arla (6/4) brought up during the interview was that the most important for the customer is that the delivery time is known rather than it is delivered a certain time. Christopher (2010) similarly mentions that the most important is to know the delivery time rather than having a short order cycle time. What seems to be important is that the delivery does not occur on specific times (Key Account Manager at Martin&Servera, 18/2). Delivery precision is to a large extent driven by the working- and opening hours of personnel and the business, for example, when a restaurant serves their food. E. g. during the lunchtime of a restaurant or when other vehicles are delivering goods. This aspect is important to consider when setting agreements on delivery times. According to this finding, it seems that offering time windows could complicate the process when creating delivery agreements as it might be easier for the customer to express what times that is *not* suitable for receiving deliveries.

Setting time of day-requirements causes many vehicles to stand idle in the afternoon, which make vehicle usage go down and tie up capital. Empirical findings show that vehicles sometimes also run with a low amount of goods in the afternoon. This decreases the load factor as few customers want deliveries in the afternoon. As was found in empirical findings, there are differences in demand during the days of the week as well, which will have a similar impact on vehicle usage. If it would be possible to even out the demand during the day and the week, fewer vehicles are needed in the fleet which is connected to the goal of achieving high resource efficiency. That a company can reduce the number of vehicles needed by evening out the delivery times was also a finding in the study published by Rogerson and Santén in 2017. The demand needs to be evened out on a long-term perspective, as vehicles are a large investment and not a day to day purchase. It is interesting that the Transport Developer at Martin&Servera (7/4) thinks that approximately 50% of the vehicles could be eliminated if no time windows would exist which can be derived from Figure 5-4 in subsection 5.2.2. This high percentage shows that time windows have a large impact, and as the Transport Leader and Transport Developer at Martin&Servera (3/2) also mentioned; *"even the largest time windows affects"* and *"only one customer is needed to disturb the whole route planning"*.

Time windows set limits on the transport planning and consequently also the load factor as more time is spent on handling the time restrictions than optimising the load factor (Arvidsson, 2013). This indicates that companies are prioritising customers service requirements rather than focusing on optimising their own resource efficiency. Driving with low load factor leads to that more vehicles are needed to serve customers with their demand, and thus more kilometres are driven, more fuel is used, and more emissions are emitted. Fahima et al. (2015) and Quak and de Coster (2009) mentions that time windows affect the driven kilometres as customers is not visited in the optimal sequence. This can be illustrated conceptually with numbers in Figure 6-1 below where a route is set with and without time windows, and in Figure 6-2 further below.

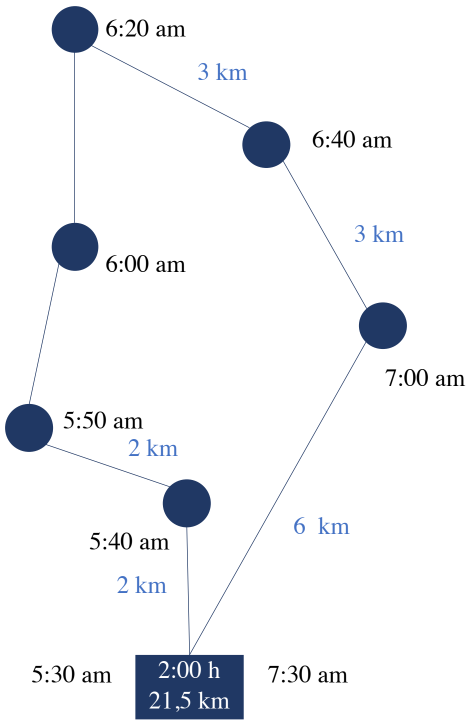

Figure 6-1: Route planning without time windows

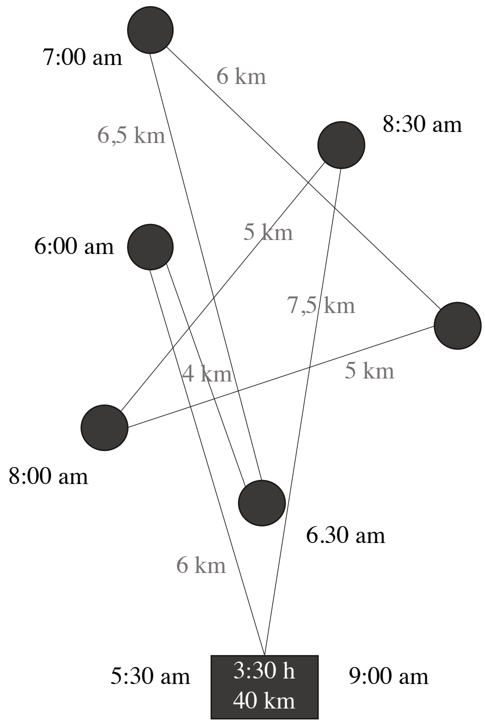

Figure 6-2: Route planning with time windows

As seen, the distance driven will conceptually be longer, which besides more emission will lead to more costs as more fuel is used. It will also lead to that the degradation of the vehicle condition is expedited. Further, more costs components will appear as a result of that more time has to be spent on planning because of time restrictions. The driver-cost will also increase with time windows as visiting the same customers in a sub-optimal sequence would take more time which might require an extra driver. Theoretically, a route with the optimal sequence would consume less time, and hence, the vehicle would have more available time. If that was the case, it would might be possible to add one extra customer to the route, which would improve the load factor. Additionally, it could be possible to add one more route to the driver's schedule. A cost might also arise if the driver is not on time to the agreed time window, and thus has to stand still and wait until the customer has time for receiving the goods. This will also have a big impact on the driving factor as according to Samuelsson and Tilanus (1997), driving factor is affected by the time that is not used transporting goods.

It was also mentioned during the interview with the Transport Manager at Martin&Servera (6/4) that customers do not understand the environmental impact that is connected to their requirements on delivery precision. However, it could be hard for the customer to understand this impact as they do not have access to information about the operations. If the customers could be willing to widen their time windows with for example one hour, it would result in a positive impact on a company's transport efficiency without the customer possibly taking big sacrifices. It was mentioned during the interviews that a widening of one hour would help them to adapt to day to day disturbances and be more flexible, as well as it could reduce the number of vehicles needed. A larger positive effect will be achieved if more customers were willing to sacrifice one hour of their time window as the planning then becomes less restricted.

Special requirements
Unloading requirements affect the driving factor both according to Samuelsson and Tilanus (1997) and the empirical findings. The most efficient would be to deliver as much goods as possible in as short time as possible. This is because all time that is not used transporting goods will generate a cost for the company. According to Kulovic (2004) is unloading an impacting variable on transport costs per ton-kilometre because of loss of time. With time-consuming unloading, for example, 30 minutes, the route would theoretically take up more time than without requirements on unloading. Time-consuming unloading could cause consequences such as not being able to reach certain customers in the same area on time which might cause that more vehicles are needed to cover these customers. As seen in the conceptual Figure 6-3, all the requested time windows are not fulfilled due to long unloading times. The ones that are not fulfilled are highlighted seen in red. The conceptual Figure 6-4 shows that one more vehicle is a way to manage the time windows. This might result in worse resource efficiency but at the same time that less kilometres are driven.

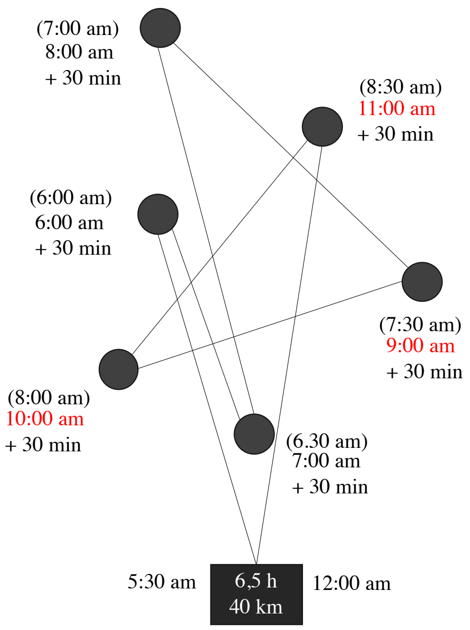

Figure 6-3: Route planning with unloading requirements and unfulfilled time windows

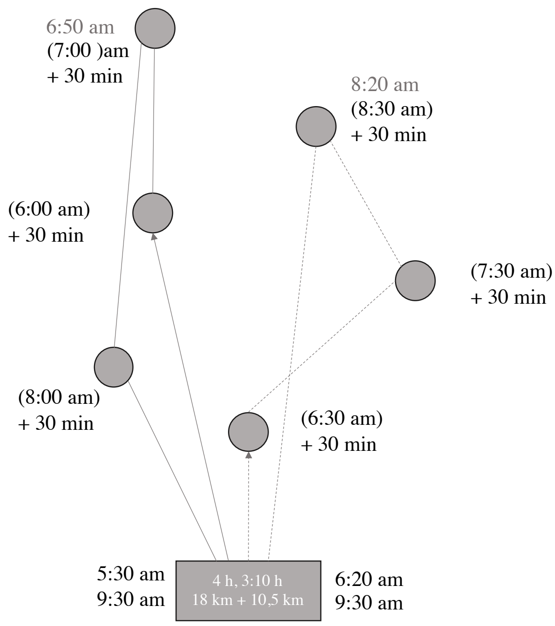

Figure 6-4: Route planning managing both unloading requirements and time windows

Arrival time, later arrival time, (requested time). Time window set to +/- 1 hour.

As found during the interviews, unloading can also cause that a vehicle does not have time to do a second route before the driver's working hours is over which will lead to a negative impact on vehicle usage. It could also imply that vehicles might stand still the last hour(s) of the drivers working time because it does not have time to take a new round, or that more vehicles might be needed to cover these. In the case where customers request low order quantities, long unloading times would also cause load factors to drop. Additionally, the driver's situation could be discussed as it can be questioned whether drivers should perform this type of unloading and heavy lifts.

Order cycle time
Today both Arla and Martin&Servera have a short order cycle time with average on 24h from placing the order to delivery. At Arla, it can be as short as 8h and for Martin&Servera, 15h. The demand for short order cycle time drives from planning difficulties in the food industry for the customer. The demand for long "due date" in the food industry also implies that very short order cycle times and a high frequency of deliveries is requested. However, for customers who sell food without markings such as schools or restaurants, it could be less important.

In the literature review, it can be found that a short order cycle time gives a short planning time for optimising the transportation of goods regarding load and route factor (Santén, 2016). Even vehicle usage could be better as it then might be possible to reduce the number of vehicles (Santén, 2016). The effects of short order cycle times were also found in the empirical findings. With the current short order cycle time, much work has to be done on late evenings or during night-time, which is costly. This leads to a less resource-efficient system which implies more costs.

An interesting aspect during the interviews was that the short order cycle time makes it harder to fix possible errors with a delivery. These errors might result in a higher total cost in the end. These errors could be, for example, that the wanted product is not in stock and has to be replaced or that wrong goods are delivered, and an express delivery is needed to please the customer. To set short order cycle time requirements without understanding its consequences indicates that there might be a lack of system understanding which according to Oskarsson (2019) is needed to make a total cost analysis and not sub-optimise. However, it could be that the customer has done an extensive TCO analysis (Total cost of ownership) from their point of view, which included other aspects which led to this short order cycle time requirement. It is understandable that customers want to keep their inventories low and get deliveries very close to the point of consumption, but it implies a great risk if the delivery is delayed as the sales for the day might be on that vehicle. This was also brought up by the Transport Manager at Martin&Servera (6/4) during the interview. This requirement could, therefore, result in a higher cost in the end, even though the initial thought was to keep costs low. It is important that customers and shippers understand what the consequences are of different decisions.

Frequency
The demand for frequency has a different impact on transport efficiency depending on the context. It can be questioned if the best is to offer low or high frequency. From the empirical findings, it can be seen that in general, load factor drops with high frequency. Jonsson and Mattsson (2011) and Lumsden (2012) also says that it can be harder to achieve a higher load factor with high frequency. However, in urban areas where customers are situated close to each other, it is easier to move volume between routes (Transport Manager at Martin&Servera, 6/4). This makes it possible to fill the vehicles even though more delivery days are asked for, given that customers can accept changes in their wanted delivery time.

Frequency also affects the vehicle usage, and Lumsden (2012) mentions that more resources are needed in order to handle peaks in demand. It can also lead to that vehicles needs to stand still in the afternoon, which ties up capital. This because deliveries with high load factor cannot take enough other customers on its route to fill the driver's workings hours. Also, it is not enough time to go back and forth before the working hours are over. In urban areas, on the contrary, a high frequency can sometimes improve vehicle usage because of the short distance between customers. It can help to level out the delivery flow over the days and hence reduce the highest peaks in demand. This was illustrated in Figure 5-4 in subsection 5.2.2 and was also the finding of the study published by Rogerson and Santén in 2017. By offering a higher frequency in urban areas, it could be possible to avoid the trade-off between service such as delivery precision, cost and tied up capital as the total service is not lowered. However, a high frequency in urban areas leads to more damage to vehicles due to more traffic, according to the Fleet Manager at Arla (2/4). This impact the time when a vehicle is available as more maintenance needs to be performed. From a system perspective, it is important to consider in what type of area transports are executed when deciding what frequency to offer customers or what frequency to ask the shipper for.

During the interview with the Fleet Manager at Arla (2/4) it was mentioned that it would be optimal to send an FTL (full truck load) a week to a customer with its weekly demand (low frequency). It can be questioned if this would be optimal or not. If one assumed a rather theoretical situation where all customers have demand corresponding to an FTL a week, a milk run delivery route with LTL shipments would result in a longer distance driven compared to direct transports with FTLs. Longer distance driven will result in higher fuel consumption and thus more environmental impact. Similarly, Santén (2016) mentions that the route optimisation is affected by higher frequency. This is conceptually illustrated in Figure 6-5 and Figure 6-6 below.

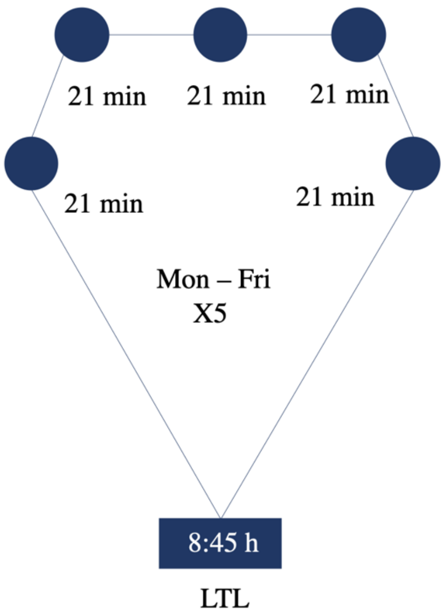

Figure 6-5: LTL delivery

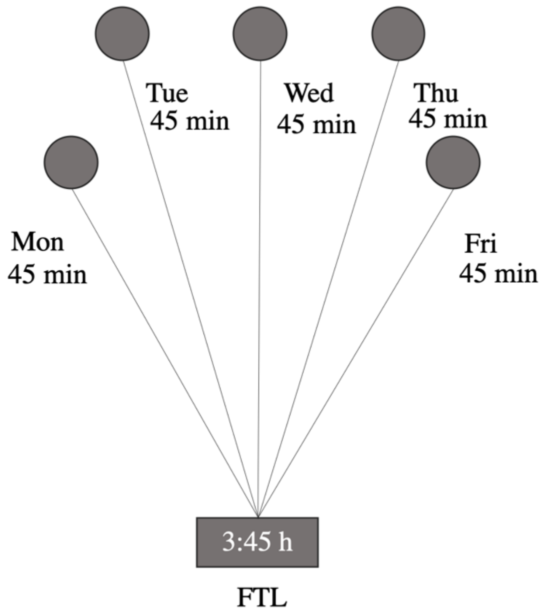

Figure 6-6: FTL delivery

Fixed time = 15 min, variable time = 1 min / unit, total demand / week = 30 units

Figure 6-5 shows that the total unloading time per customer per week would be longer with an LTL (less than truck load). This can be because of the fact that the driver needs to drive up to the loading zone and park no matter how much goods that are delivered (fixed time). Figure 6-6 is an illustration of FTL shipments during a week and shows that the total unloading time is shorter which affects the driving factor positively. An LTL delivery would also require more planning time compared to an FTL. However, with FTL transportation, food perishability would be challenged because of few deliveries (Liljestrand, 2016) as well as the inventory at the customer would be higher (Jonsson & Mattsson, 2011).

It is interesting that both empirical data and literature by Piecyk et al. (2015) state the fact that the storage space at the customer is shrinking. One of the reasons for this is that storage space cost at the customer is becoming more expensive due to rent costs. This can lead to that the total cost of the system becomes higher if goods are stored at the customer. Hence, there is a trade-off between low transportation cost and low inventory cost in the system. Additionally, more transportation produces more emissions. However, as the Fleet Manager at Arla (2/4) mentioned and one of Liljestrand's findings from 2016 shows, the food characteristics affect what possibility there is to implement improvement actions. In other words, some requirements are not to be compromised. However, a delivery transport system does not need to consist of either LTL or FTL but can be used in combination in order to find an optimal solution between inventory, food perishability and cost.

Environment

Environment was not an occurring requirement as it was believed to be. The case companies experience that more requirements from the customers are put on the packaging and quality of food rather than how the transport is executed. This can be a big challenge in order to reach the globally stated goal, zero-emission logistics in 2050 (ALICE, 2020), as it is often the downstream actors (or restrictions) that has more power (Lindstedt and Burenius, 1999). This means that it might be that the customers need to set requirements for changes to happen. However, there are some requirements on what type of fuel and Euro-class the vehicles used should have, but they are mainly seen from the municipality and large public customers. According to the empirical findings, the private customers seem to mostly follow the restrictions in the area they are operating in, but ICA is an example of a private customer that is starting to change their attitude. According to ICA Gruppen (2019), ICA wants all their road transports to be environmentally friendly by 2030. This could be the start for the discussion in developing environmental transportation, and it could also influence other actors to put requirements on their upstream actor. It is often bigger actors that take environmental actions towards reducing their environmental impact first (González-Benito & González-Benito, 2005).

Even though the case companies perceive that most of their customers do not put so many requirements regarding environmental transport of goods, Arla has started to push the question regarding the environment. They have advanced in the area on their own initiative by investing in environmentally friendly trucks. Martin&Servera have also started to consider this question and have a goal to only use environmentally friendly vehicles by 2030 (Martin&Servera,

2020a). This initiative is advantageous as environmental requirements on transports are starting to emerge and as it probably will be even more requirements in this area in the future.

A system understanding is important when setting requirements. For example, to demand environmentally friendly vehicles for all your delivery addresses but at the same time expect high delivery precision could cause a negative impact on the environment even though the initial thought was to reduce it. One example that was brought up during interviews was that a municipality in Sweden demands that environmentally friendly vehicles should visit all their addresses even though some of the addresses are too far away from each other for the route planning to be efficient. The total emissions on that route would therefore certainly be higher, which the customer, according to the case companies do not seem to understand. This is illustrated in Figure 6-7 and Figure 6-8 below, where the blue line is representing a delivery with an environmentally friendly vehicle and the blue dots represents addresses who should be visited with this type of vehicle. Figure 6-7 shows a conceptual model of how it would look like if the municipality got their requirements on green deliveries to all their customers fulfilled. Figure 6-8 shows a more efficient use of environmentally friendly vehicle, which is how it is managed today. The black dots represent public customers while the black dots represent private customers.

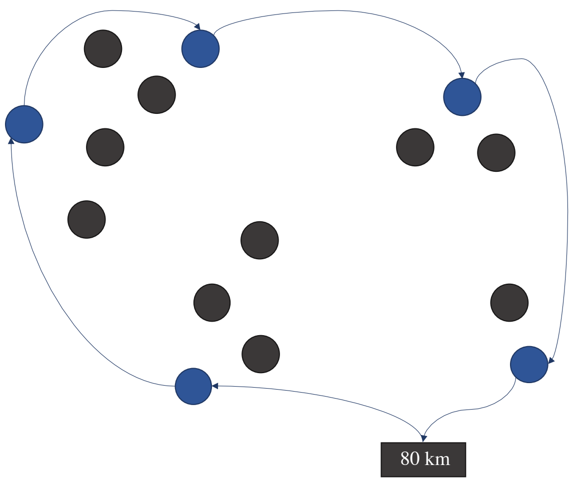

Figure 6-7: Deliveries with green vehicles to all public customers

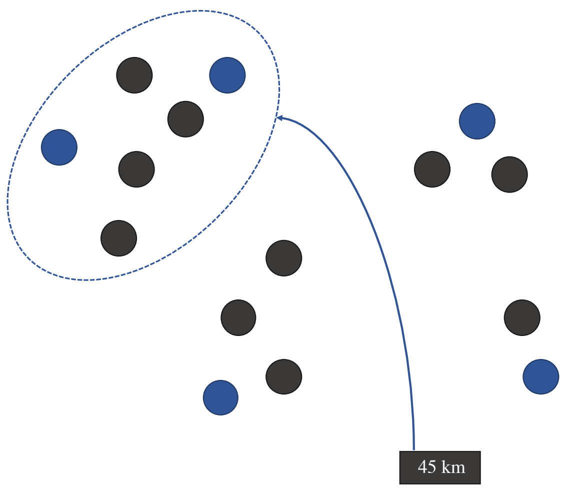

Figure 6-8: An efficient use of green vehicles

Relating to the objective of the system, it might be that actors in the system want to achieve the common system goal of an efficient physical flow. However, it is not certain that they understand how to do it. This finding of conflicting requirements with green vehicles can have implication for other companies as well in the future as it can be useful in a discussion concerning the environment and the efficiency of the system. Already now, some customers have their own ambitions on what type of fuels to use. Arla has had the possibility to invest in a fully fossil-free vehicle fleet and is therefore not yet faced with this issue.

Summary

To summarise, Table 6-2 was constructed based on the analysis. It shows an overview of the impact of the customer requirements on transport efficiency.

Table 6-2: Summary of the impact of customer requirements on transport efficiency

How does customer requirements affect transport efficiency?		Customer requirements (x)				
		Delivery precision	order cycle time	Frequency	Special requirement	Environment
Efficiency measures (y)	Load factor	-	-	-/+	-	
	Vehicle usage	--	-	-/+	-	
	Route factor	--	-	-	-	-
	Driving factor	-			--	

+: Positive impact
- : Negative impact
-- : Strongly negative impact
-/+ : Either positive or negative depending on the context

An interesting result was both the positive and the negative impact between frequency and vehicle usage as well as the load factor. It was also interesting that some customer requirements had a stronger negative impact on transport efficiency than others. The strongly negative impact can be derived from that four out of four interview respondents mentioned the connection, as well as the interview answers, indicated a great impact. The area was also well covered in the literature.

6.1.3 Why are customer requirements fulfilled?

As seen in the empirical findings, larger customers who have more power or is of greater importance to the case companies get their requirements fulfilled to a larger extent. For example, there are no general delivery rules for bigger customers, and they can sometimes get up to two deliveries a day (Senior Manager Customer Logistics at Arla, 6/4). Though, it could be argued that Arla and Martin&Servera are quite large actors as well. Therefore, it is interesting that the customers still get requirements fulfilled even though it impacts the operations negatively. There could be many reasons for why requirements are fulfilled, and some examples are in order for the wholesaler to grow or get a competitive advantage. It could also be because of the possibility to gain power in strategic questions. Further, good customer service can be perceived by the customer as getting their service requirements fulfilled. Jonsson and Mattsson (2011) mentions that good customer service affects the revenue of a company.

From the empirical findings, it was clear that some of the perceived customer requirements are unspoken or custom and hence they are expected but not stated. This goes in line with the Kano-model adapted by Lindstedt and Burenius (1999). This makes it hard for the case companies to bring up a discussion or to not fulfil the requirements. For example, the special requirements for unloading are needed in order to keep the chilled food refrigerated as it otherwise could lose its quality. If the quality is not maintained, it could impact the brand of the company. Short order cycle time is also expected, which can be derived from the high requirements on perishability. Further, it also has a history for both the case companies.

6.2 Effective communication of consequences

In order to answer how consequences can be communicated effectively to the customer, it was of value to understand the perceived attitude of customers towards change. From interviews with the case companies, it is clear that driving the sustainability question regarding transport is difficult for the case companies. According to them, customers seem to be more conscious about the environment in other areas than the transportation of their deliveries. This indicates that they might not understand the actual consequences of their requirements. It was brought up during the interview with the Key Account Manager at Martin&Servera (18/2) that during the sales meeting, little or no time was given to discuss transports which makes it harder to initiate the discussion of environmental transports or impacts of for example time windows.

The increased logistics cost that the customer's requirements results in are not always visible to the customer directly as they might get the same total price anyway. This was mentioned by the Key Account Manager at Martin&Servera (18/2). Sometimes, an increased transport cost is compensated with discounts on products to be able to offer the same total price. In other words, they do not get the know the consequences of their requirements and do not need to deal with them. This is one example where the sales representative of a service is responsible for the customers inability to understand the consequences of their requirements. The sales representative's behaviour might lead to that customer get used to the "increased" service and that the perception of what transports are supposed to cost is threatened. Similarly to the Kano-model by Lindstedt and Burenius (1999), the satisfaction of the offered service will decrease with time and customers will sooner or later expect the low price and high service standard.

There also seem to be a resistance to change even though it was seen in the empirical findings that for some customers who have changed, it was for the better for their own operations. For example, it implied less risks for them in terms of lost sales. Still, they were hard to convince. In general, most people do not like to expose themselves for unknown happenings. People are driven by routine, which also was mentioned by the Key Account Manager at Martin&Servera (18/2) during the interview.

The former chapter discussed the customer requirements impact on transport efficiency in many ways, and some of these connections were explained by conceptual models. As it was used to effectively communicate the findings of this thesis, it can also be used as an effective tool and work as a foundation in the discussion between customers and shippers. Conceptual figures could draw up simple examples and use simple mathematics to effectively explain the impact of customer requirements. It can also give the customer an overview of how transport operations are performed and what needs to be done in order to fulfil their requirements. The use of conceptual models goes in line with the finding of Liljestrand (2016) who states that it is difficult to understand the environmental impact on systems as they are often big and complex. It is important to understand the impacts in order to reduce it, according to Kaval (2011) and McKinnon (2019). It is reasonable to believe that this can be applied to other logistics impacts than just environmental such as transport efficiency.

Another way to communicate and make customers understand the consequences of their requirements on transports could be by exploit nudging. According to Stoknes (2014), nudging is a good complement to legal and economic regulations. Further, it has shown to be effective in order to make people take certain actions (Sunstein, 2014). Especially in those cases where the aim is to break old habits as this is seen as difficult (Stoknes, 2014; Sunstein 2014). Nudging was also brought up in the context of transports at Transporteffektivitetsdagen 2019 as a way to reach environmentally friendly transporting (CLOSER, 2019). One example where nudging is currently being used is by doing carbon labelling. Carbon labelling has, according to literature, seemed to be an easy way to get people to pay attention to their consumption. It is interesting to see that the burger-restaurant Max got an increase of 16% sold burgers on their more environmentally friendly choice after implying it (van Gilder Cooke, 2012). However, McKinnon (2009) states that it is hard to make the labelling accurate enough. It can be questioned whether it is okay or not to present numbers that can be far from reality, but if it can be a way to help customers to make the right choices regarding which requirements to set, it could be a good method to influence customers.

Nudging could work as an effective tool as the economic incentives such as penalty fees and compensation used in the system today does not seem very effective. This was also touched upon by the case companies during the interviews. Today, Martin&Servera charges the customer with penalty fees for breaking agreements connected to service. They also charge a higher cost if an extra delivery day or a tighter time window is wanted. Arla, on the other hand, offers big retail customers 1% discount if they draw back deliver precision requirements. However, customers seem very fond of keeping their requirements. It might be that the penalty fee and the discount is too low for any effect to be obtained. This is also a finding of Gneezy (2003), who states that sometimes, an economic incentive can work contra-productive. When fines are introduced, people start to perform cost-benefit-analysis rather than adapting to a social norm such as the embarrassment of placing a late order. It might also be that customers do not understand the size of the consequences of their requirements. In this case, customers might think that 1% represents the impact that delivery precision requirements have on transport efficiency.

6.3 Future research

Many interesting impacts of customer requirements have been found in this thesis, and it would have been interesting to look even deeper into this. It would also be interesting to see how they impact other industries. This thesis has brought light upon the trade-offs between customer requirements and transport efficiency as well as how these can be communicated. The area of communication and especially nudging concerning transports is something that would have been interesting to look further into. If this research had more time, the topic concerning how to change customers requirements would have been giving more focus. Additionally, how willing customers are to change towards more sustainable requirements would have been examined further. In this thesis, the customer requirements presence was only researched from a shipper’s perspective, and in future research, it would have been interesting to conduct research with customer perspective as well. This research could show if there is a trend in asked requirements and to what extent environmental requirements are asked.

Recommendations for companies would be to consider the trade-offs between service, cost, tied up capital and environment as well as use the findings of this report in discussion with the customer. Whether customers are willing to pay for a commitment towards sustainable transports have been touched upon in this thesis, and alternatives to economic instruments have been discussed. Companies could use these instruments in order to develop their own strategy of communication. It is also important to consider the Kano-model when offering service as, by time, service performance gives less satisfaction.

7 Conclusion

Within the food industry, there are several requirements on delivery service from customers. There are reasons for why some of these requirements are asked, for example, because of food characteristics and the customer's operations. Some of the requirements from customers are contradicting, which indicates that there is a lack of understanding regarding the logistic operations performed by shippers.

Many of the customer requirements on service impact the transport efficiency in this system and hence how well resources are used. In many cases, requirements have to be changed in order to improve transport efficiency. The customer requirements often result in trade-offs such as higher tied-up capital, cost and environment impact in order to achieve the required customer service. It is sometimes also possible for customers to maintain the total service level by doing trade-off between their own requirements. This is exemplified by agreeing to a higher deliver frequency instead of high delivery precision in order to level out the demand and achieve a higher vehicle usage. Sometimes trade-offs are not possible due to the characteristics of food and hence limits what changes in requirements that can be made in order to increase the transport efficiency.

In general, it is hard to advance in the discussion regarding the consequences of customers requirements and environmental transports. It is clear that the studied industry is imprinted by old habits. Several methods are today used in the system to make customers change behaviour and to communicate the impact on transports. However, they do not work very effectively which can depend on both sale representatives from the shipper side or the customers. It can be either In order to communicate the impacts of customer requirements on transport efficiency, alternatives to economic and legal instruments such as nudging, and carbon labelling can be used. The use of conceptual models in order to describe simple cause and effects on transport efficiency is also an alternative.

To conclude, this thesis has identified current customer service requirements within the Swedish food industry and how they impact the transport efficiency as well as given examples of how information can be communicated and how to influence customers.

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Appendix A

Interview guide for unstructured interviews.

1. Could you tell us about your organization? What role do you have?
2. What do you want to get out of this study?
3. What is your perception of customer's requirements?

Appendix B

Interview guide for semi-structured interviews.

Delivery precision
Time windows, days, specific time of the day

1. How does this customer requirements affect your business in general? How is this requirement managed?
2. How is the capacity utilization affected?
3. How is your day to day planning affected?
4. What would happen if the time window was changed by 1h? Would it have any effect?
5. What is worst: time windows, days or specific time of day?
6. Does it become more expensive? In what way?

Order cycle time

7. How does this customer requirements affect your business in general? How is this requirement managed?
8. How is the capacity utilization affected? Are more transport planners needed?
9. If the last time of order was scheduled earlier, what would that imply for you?

Frequency

10. How does this customer requirements affect your business in general? How is this requirement managed?
11. How is the capacity utilization affected?
12. Does it become more expensive? In what way?

Special

13. How does this customer requirements affect your business in general?
14. Have any of your drivers mentioned anything?

Environment

15. How does this customer requirements affect your business in general?
16. What actions are taken when customer state these requirements?

End

17. Are there any customer requirements that combined together makes the situation even worse?

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