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Last mile distribution of goods to retailers in Oslo.

An investigation of whether increased involvement of retailers in supply chain planning can reduce last mile traffic.

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Bente Flygansvær

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Henrik Eriksen
Abstract

Increased traffic from goods handling vehicles is a problem faced by many cities. The city of Oslo expects an increase of 50 % in traffic related to handling of goods, and sees it as necessary to find alternative and more traffic friendly ways of distributing goods within the city. This thesis is therefore looking into whether increased involvement of retailers in supply chain planning, can lead to a distribution configuration where fewer vehicles operate and deliver goods.

The thesis investigates theory on last mile distribution, traffic, and transport efficiency, and use a set of variables from the theory to create a research model. A case study then investigates the variables in the model across three different cases (Oslo, Gothenburg, and Maastricht), to gain more knowledge about distribution configurations within a city.

The findings show that increased involvement of retailers potentially can reduce traffic work to 40 retailers in Oslo by 29 % - 96 % per day within a confined area of 3km². The amount of traffic reduction depends to a large degree on what the retailer obtains from the increased involvement in supply chain planning. When retailers can store goods at a consolidation terminal close to the city, and make use of a distribution service with high flexibility and a high level of integration, the biggest traffic reduction is achieved.

Findings show that the city of Maastricht is the only city with a self-sufficient initiative. Warehouse costs in Maastricht are however five times lower than in Oslo. The implication is that the initiative in Maastricht are able to successfully consolidate and distribute goods for “free”, as they generate sufficient revenue from other value added services. This will be more difficult in Oslo. Increased involvement of retailers can reduce traffic, but as warehouse costs in Oslo are relatively high, public funding should possibly be a permanent solution, not only given in trial periods for new initiatives.
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1. Introduction

1.1 Background

Distribution of goods to retailers in cities is handled by a large number of transportation companies, supplying businesses and consumers with an increasing number of products. Goods handling vehicles (GHVs) stands for only 5-10% of total vehicles in cities, but contributes with as much as 15-30% of the total pollution (Eng Larsson 2014). GHV’s also cause blockages in narrow streets, create noise, and increase risk of serious traffic accidents. As the population of Oslo is expected to grow with 30%, and goods transportation traffic with 50%, towards 2030 (NTP 2015), several stakeholders, e.g. (Oslo municipality, inhabitants in Oslo, politicians, and retail stores) sees it as important to find ways of reducing the amount of commercial traffic within the city to make the city more liveable and free of pollution. The ultimate goal is therefore to understand how transport efficiency can be improved, which can reduce commercial traffic.

Improving the overall distribution system within a city, specifically increasing transport efficiency and reducing traffic, has in numerous instances been tried accomplished by local governments with very low success (Allen et al. 2012; Quak 2012). And even though many cities agree that something needs to be done about the increasing amount of traffic from goods handling vehicles, direct interference with the industry is in many instances absent (Bontempo et al. 2014). Many cities are sceptical towards enforcing strict restrictions that could reduce traffic, because it is difficult to follow up and control the legislation. In addition, direct interference with the transportation industry, have in some instances led to law suits from the transport industry against the municipality (Marcucci and Danielis 2008).

As the EU commission puts environmentally friendly distribution high on its agenda, communicated by the “Strategy 2050” publication, numerous initiatives have been taken to reduce traffic and improve the environment by traffic reduction. Unfortunately, many of these initiatives only operate until public funding ends (Eng Larsson 2014). The main problem seems to be that new initiatives that aim to reduce amount of traffic within a city, provides a service that is unable to attract paying customers (Marcucci and Danielis 2008). Brown
et.al (2012) reviewed 117 initiatives from 1990 to 2012, that tried to reduce amount of traffic in city centres by the implementation of consolidation centres close to the city, and concluded that only 10 % maintained operation after the trial phase. The most recent similar public initiative in Norway, that tried to consolidate deliveries to reduce traffic, was called GBO “Gronn Bydistribusjon Oslo”, which was a research project undertaken by SINTEF from 2013 to 2014. With respect to how to reduce traffic, the project set out to construct a consolidation centre in downtown Oslo (Prinsens gate), but had to seize this planned centre, as the project didn’t manage to obtain sufficient demand (volumes) for the new distribution configuration. Some receivers was bound by distribution agreements (contracts) hindering change, while the majority didn’t see a reason to change their current distribution configuration.

During the fall of 2015, Oslo city council have taken a rather bold decision regarding traffic restriction in the inner city, where it is planned to make the inner city within Ring1 car free. This proposed inner city restriction, follow after the city of Oslo received a fine from the European Free Trade Association (EFTA) (OsloBy 2015), because pollution values were exceeding the agreed upon limits. This restriction, could have major implications for end receivers of goods, as well as carriers delivering goods. Better understanding of how the last mile distribution of goods could be improved, is thus a topic that potentially could benefit a large number of stakeholders.

1.2 Problem description

The primary objective of this thesis is to investigate to what extent the last mile distribution of goods to retailers in Oslo can become less traffic intensive, by better involvement of retailers in supply chain planning. The direction of my research, is partly influenced by one shortcoming of the “GBO” research project. The post-project evaluation of the project included interviews of the participating stakeholders (carriers, retailers, municipality), and indicated that too little attention had been given to the end receivers of the goods, which in many instances are the retail shops. As many initiatives previously had failed because they were unable to attract demand, it was seen as very interesting to look closer into the last part of the supply chain, and in what way better information regarding
this level could improve the last mile distribution in Oslo and reduce commercial traffic.

Without reducing the amount of goods delivered to retailers, this implies that there exist an overcapacity in the distribution system that could be exploited. Quak (2012) argues that this is the case based on two reasons; 1) many delivery trucks operate with a high utilization degree from suppliers to cities, but have to drive an unnecessary large distance within the city to deliver goods at multiple locations, and 2) many carriers operating within the city operate with a low utilization degree. This configuration is depicted in figure 1.1 below.

![Figure 1.1 - Direct distribution system. Adopted from (Hendriks 2015) with permission.](image)

Instead of making deliveries in a large geographical area, one truck could potentially be assigned to one small specific area, and then deliver to each receiver in that area to minimize travel distance and time spent in congestion. In order for this to be possible, incoming trucks delivering to a dispersed set of receivers should drop shipments at a terminal, where the goods would be reorganized for deliveries in a more efficient way. This configuration is depicted in figure 1.2 on the next page.
Figure 1.2 – Consolidated distribution system. Adopted from (Hendriks 2015) with permission.

Rearranging the distribution system for an entire city is highly complex, as retailers, carriers, and suppliers, in many instances compete against each other (Gonzalez-Feliu 2010), and work under different conditions (e.g. contracts) which often make cooperation difficult (Henning, Eiril and Grønland 2011). But as the last mile distribution often make up 20-70% of distribution costs in a supply chain (Aized and Srai 2014), there is a potential for cost reduction that would benefits several stakeholders (van Rooijen and Quak 2010).

This research is looking deeper into how end receivers of goods, retailers/shops/organizations, is involved in distribution planning, and whether they can affect the amount of commercial traffic generated. This research approach was discussed with Statens Vegvesen, who agreed that it was interesting to research how end-receiver could influence the amount of commercial traffic generated. One factor that partly led to this approach, was that previous research on traffic and pollution within governmental institutions, in some instances was to narrow, meaning that research on traffic and pollution within cities, suffered from too little focus on business development and logistics considerations. By approaching the problem of how to reduce traffic in a city, with a logistic approach, it was therefore seen as more likely that findings could be used to improve the last mile distribution of goods.
1.3 Research question
As this thesis was a collaboration project with Statens Vegvesen, a prerequisite was that part of the findings had to indicate in what way commercial traffic could be influenced. After much consideration, the research question chosen for this thesis therefore became:

“To what extent can last mile traffic be reduced in Oslo, by increasing end receivers involvement in supply chain planning”?

1.4 Scope and limitations
As this thesis have been a collaboration project with Statens Vegvesen, their involvement influenced the scope and limitations of the thesis to some degree. They expressed interest in different business models that could improve the last mile distribution in Oslo, where the goal was to estimate a commercial traffic reduction potential. As the concept of traffic became a central part of the research, the literature reviewed then became rather focused on looking into the underlying factors that influence amount of traffic in a distribution system. The concept of transport efficiency was therefore looked into rather extensively.

Regarding how different business models for last mile distribution initiatives would affect amount of last mile traffic in Oslo, it was necessary to investigate cases in other countries that actually had last mile distribution initiatives. The focus have therefore been on gaining in depth knowledge from two initiatives in Maastricht and Gothenburg, which could be used to say something about how traffic in Oslo could be reduced. In all of the cases, the focus have been rather limited to investigating the role retailers have in the supply chain. This is because they often play an important role in last mile distribution initiatives. As many previous initiatives have failed to convince retailers to participate, this limitation was seen as important in order to better understand why many retailers did not participate. Better understanding of the retailer’s role, was also perceived as important in order to understand/create a business model that could reduce last mile traffic.
2. Literature review

The first part of the literature review presents last mile distribution as a research area, where I look closer in to past research on city logistic problems. The second part presents the concept of traffic, where I look in to common measurement indicators within transport research. Lastly, the literature review presents transport efficiency, as it is an important and complex concept, influenced by a large number of drivers.

2.1 Last Mile Distribution

Last mile distribution problems typically concerns the study of the last part of the supply chain (Daria et al. 2014), often the last 1-2 % of the total transport length. According to Aized and Srai (2014), the last part of the supply chain is considered one of the most expensive parts of the supply chain and accounts for 13 % - 75 % of the total supply chain costs. Factors that often increase costs are time spend in que, and time spend on handling goods at multiple locations. Research on how to improve the last mile distribution system is becoming increasingly more popular, but agreement on a best practice solution that improve transport efficiency for the distribution system as a whole, is yet not agreed upon (Balm et al. 2014). The idea of improving transportation systems within a city is however not new, as the problem has been addressed to a large extent in the past; hub location routing problems (Aykin 1995), mixed truck delivery systems (Liu, Li and Chan 2003), and hybrid/extended transport networks (Zäpfel and Wasner 2002). One initiative that consistently have been tried implemented, with very low success, is the “urban consolidation centre” (Allen et al. 2012). These facilities are situated in relatively close proximity to the geographic area that they serve, where the key purpose is the avoidance of poorly loaded goods vehicles, thereby creating a reduction in goods vehicle traffic (Allen et al. 2012). Other research areas that have received considerable attention is “Intelligent Transportation Systems” (ITS), and “Vehicle Routing Problems” (De Marco et al. 2014). Much of the focus is on avoidance of city congestion, when to operate in urban areas to avoid congested links, and how to maintain time windows for deliveries.
One aspect that is partly missing in research on city freight distribution systems, is the fact that distribution system configurations, in many instances exist and evolves based on a set of factors that relate to customer service (De Marco et al. 2014). Research that investigates last mile distribution systems, without properly considering the factors that influence the original distribution configuration, makes an assumption that the original distribution configuration is easily changeable. This is in most instances not the case, as most of the initiatives that try to change city distribution configurations fail to sustain its business operation without public funding (Allen et al. 2012). One consideration, that possibly should receive more attention, is how end receivers, collectively, could impact the last mile distribution configuration. This area is not well researched, demonstrated by the low number of papers published on e.g. “independent retail cooperation in cities”. Cooperation between grocery retailers, third-party logistics (3PL) providers, and suppliers, is however heavily researched (Martin et al. 2011). This cooperation have resulted in many highly efficient distribution systems (Henning, Eiril and Grønland 2011). Cooperation have often evolved in to a practice where distribution is completely controlled by the retailers, and not by the suppliers.

Research on how retailers, especially independent retailers, can affect distribution configurations within a city, is therefore in many ways an interesting research field that could be better developed. The obvious problem with this theme is the fact that retailers in many instances are direct competitors. There is an emergence of research on this theme, which could be beneficial for urban freight distribution in the future (Pathak, Wu and Johnston 2014).

2.2 Traffic

The concept of traffic is defined as the movement of vehicles through an area or along a route (Vieira, Fransoo and Carvalho 2015). With respect to last mile distribution initiatives, the general goal is to reduce the amount of traffic as much as possible, without reducing the amount of goods delivered, or interfering in a way that reduce the performance of the supply chain (Kalantari 2012). According to Andersen (2010), it is important to be familiar with indicators that relate to transport activities, as these may contribute to the identification of problem areas,
as well as the development of good practices. Many of the most standard terms and formulas relating to transport indicators are discussed by Henning et al. (2011). They are beneficial for research that look closer into how traffic can be reduced. The formulas and indicators are included in figure 2.1 below.

1) \( \text{Payload} = \text{maximum capacity a vehicle is registered to transport} \)

2) \( \text{Transport work} = \text{Cargo Weight} \times \text{Transport length} \)

3) \( \text{Traffic work} = \text{Number of vehicles} \times \text{Driving length} = \sum(\text{Transport length}) \)

4) \( \text{Utilization degree} = \frac{\sum(\text{Cargo weigh} \times \text{Transport length})}{\sum(\text{Payload} \times \text{Transport length})} \)

5) \( \text{Transport efficiency} = \frac{\sum(\text{payload} \times \text{Transport length})}{\sum(\text{Transport length})} = \frac{\text{Transport work}}{\text{Traffic work}} \)

6) \( \text{Transport utilization} = \text{Capacity utilization} = \text{Utilization degree} \)

Figure 2.1 – Transport indicators/formulas. Adopted from (Henning, Eiril and Grønland 2011)

\( \text{Payload} \) is defined as the maximum capacity a vehicle are allowed to transport. Trucks in the grocery industry typically tend to have truckloads very similar to payload. \( \text{Transport work} \) is denoted as tonne/km, as it is a measure of the weight of goods transported on a given length. In general, one of the best ways to reduce traffic, without reducing amount of goods transported, is to increase the transport work. \( \text{Traffic work} \) is a measure of how many vehicles that drive on a given length. Traffic work is often denoted as vehicle kilometres. \( \text{Utilization degree} \) is a measure of how much goods a vehicle is transporting in relation to how much the vehicle are allowed to transport. \( \text{Transport efficiency} \) is often defined as transport work/traffic work.

To reduce \( \text{traffic work} \), without simultaneously reducing activity and \( \text{transport work} \), the key is to increase utilization of transport capacity. Each vehicle have a theoretical optimal transport work, which in practice would mean that load weight is full, most of the driving length, not only the transport length. Transport length is also a variable that potentially can be changed, which to a large extent is investigated by Quak (2012). According to his research, truck capacity is often optimized from suppliers to the boundary of a city, but then transport length within the city becomes unnecessary long as each vehicle in many
instances cover a large geographical area. “Vehicle Routing Problems”, often ask what the optimal set of routes is for a fleet of vehicles to traverse in order to deliver to a given set of customers. Van Rooijen and Quak (2010) argues that an even better solution would be if incoming goods to cities were rearranged at the city periphery, so that each truck only delivered to one specific area, instead of minimizing the travel distance to a set of end receivers across a large geographical area. Even if there exist a potential to reduce transport work within a city by rearranging the shipments, initiatives that try to achieve this goal, have consistently failed to create a distribution system that is sustainable without public funding (Allen et al. 2012; Quak 2012). What is partly missing in previous research on last mile distribution problems, is better explanation of the variables that influence transport efficiency, which ultimately influence traffic work. Brown (2012) argues that to many initiatives aimed at reducing the traffic work in a city, are driven by environmental motivation with a superficial view on the underlying variables that influence the distribution system. As the goal in last mile transportation problems often is to reduce the amount of traffic work, Linus et.al (2011) argue that it is imperative to fully understand the drivers that influence the utilization degree of a vehicle. These drivers are investigated in the next chapter.

2.3 Transport efficiency

Transport efficiency is defined as transport work divided by traffic work (ref figure 2.1). Efficiency is defined as “a level of performance that describes a process that uses the lowest amount of inputs to create the greatest amount of outputs (Investopedia). This thesis adopt five of the ten drivers of transport efficiency discussed by Linus et.al (2011). The ten drivers, as well as the five drivers adopted, are presented in figure 2.2 and figure 2.3 on the next page.
Figure 2.2 - Drivers of transport efficiency. Adopted from (Henning, Eiril and Grønland 2011).

Figure 2.3 - The five drivers of transport efficiency adopted into the thesis framework

In the following sections, transport price, service, distribution configuration, and retail integration will be discussed.

2.3.1 Transport price

A given transport price will often depend on the allocation of costs, risk, and task agreement between the buyer and seller. This tends to vary considerably (Malfliet 2011). This variation can often have a rather large impact on transport efficiency (Henning, Eiril and Grønland 2011). Transport contracts are often specified in accordance to Incoterms (International Commercial Terms), which are a series of pre-defined commercial terms (ICC). Figure 2.4 depicts different incoterms, and how costs, risks, and responsibilities are shared between seller and buyer.
When seller pays and organize for the entire transport (DDP), the buyer will in general loose incentives to reduce transport costs. In practice this often leads to a practice where the buyer order at high frequencies, in small volumes, as often as he sees beneficial (Henning, Eiril and Grønland 2011). In a DDP agreement, “The seller is responsible for delivering the goods to the named place in the country of the buyer, and pays all costs in bringing the goods to the destination including import duties and taxes. The seller is not responsible for unloading. This term is often used in place of the non-Incoterm “Free In Store (FIS)”. This term places the maximum obligations on the seller and minimum obligations on the buyer. With the delivery at the named place of destination all the risks and responsibilities are transferred to the buyer and it is considered that the seller has completed his obligations” (ICC).

Malfliet (2011) argues that as a general principle, the entire transport should be organized by either seller or buyer. Logically this should result in an optimal transport price, because the overall volume of transport services purchased will be large, as it is not divided between two parties. The price paid, and the incoterm used, will in many instances be influenced by the value of the order, as most suppliers operate with threshold limits for when receivers of goods can have goods delivered “Free In Store”. How this sales practice influence transport efficiency is complicated, because it gives buyers of goods few incentives to lower order frequency, while it at the same time allows sellers of goods to plan and consolidate shipments to utilize truck capacity (Henning, Eiril and Grønland 2011).
2.3.2 Service

The perception of service often vary greatly between goods receivers, which in many instances can affect transport efficiency. Some customers value deliveries with short lead times over costs, and others the opposite (Sunil Chopra 2013). Efficiency and responsiveness in relation to customer service, is often seen as the two outer points that should be analysed when designing a supply chain (Sunil Chopra 2013). While some customers see low costs as valuable, others see flexibility and responsiveness as valuable. Being able to ensure adequate customer service, and at the same time achieve cost reductions, is the fundamental problem all logistics companies tries to solve (Bygballe, Bø and Grønland 2012). In many instances, a sufficient customer service level, can in practice be obtained, even if the distribution system change to a “slower” system (Arnäs, Holmström and Kalantari 2013). This is because many companies today operate above the necessary service level, delivering goods with shorter lead times than strictly necessary. According to Stock and Lambert (2001), the key supply management function and competence is the ability to analyse the total costs of a particular supply chain, and balance these costs in relation to marketing objectives and customer service. The way the different factors influence each other is depicted in figure 2.5.

![Total Cost Model (TCM)](image)

Figure 2.5 - Total Cost Model (TCM), adopted from (Stock and Lambert 2001)

According to the model, customer service is influenced by the total costs, not individual costs. A decrease in one, is likely to lead to an increase in another. For
example, reducing inventory costs, will in most instances lead to increased transportation costs, as trucks have to deliver more frequently. An increase in warehouses, will for example increase order processing and information costs as shipments has to be handled more frequently. All of these costs, must be balanced with the marketing variables of price, product, place, and promotion. By combining all of these variables based on the given situation, a supply chain ensures that customer service is maintained and the goods are delivered on time and are accessible when needed and that flexibility is inherent in the chosen solution (Bygballe, Bø and Grønland 2012). Lee (2004) argues that many companies tend to emphasise efficiency and cost reductions when building their supply chains, at the expense of agility, which refers to a company’s ability to react quickly to changes in customer demands.

2.3.3 Distribution configuration

Distribution configurations exist in many variations, but fundamentally two outer points of distribution strategies exist; direct shipping from the supplier or manufacturer to the retail stores or end customers, or one or more intermediate inventory storage point (typically warehouses and/or distribution centres) (Simchi-Levi 2009). Figure 2.6 depicts a range of different ways of organizing the transport from origin to destination. In the following, the direct configuration, and the hub-and-spoke configuration will be looked closer into, as they relate to the two different distribution configurations discussed in figure 1.1 and 1.2 in the problem description.

![Distribution configurations diagram](image)

Figure 2.6 – Distribution configurations. Adopted from (Kalantari 2012)
2.3.3.1 Direct link/shipment

The easiest way to connect a set of different points located in different geographical positions (production factories, distribution centers, warehouses, transit points, etc.) is by the utilization of a direct connection system. Each pair of nodes is joined by a specific link from the departure node to the arrival node (see Fig. 2.7). As the number of departure (Nd) and arrival nodes (Na) increases, the distribution network and the number of links (Nl) expand significantly (Kenth, Fabrizio and Remigio 1999).

![Diagram of direct link/shipment](image)

Figure 2.7 - Direct link/shipment. Adopted from (Kenth, Fabrizio and Remigio 1999)

2.3.3.2 Cross docking/Hub-and-spoke

In a hub and spoke system, goods are transferred from their origins to one or more terminals (Nt) where they are unloaded, possibly stored for a short time, but the goal is now to combine the shipment with other goods to a final destination. Within these types of networks, (Nt) is generally lower than the number of departure/arrival nodes, and the number of connections required in a two terminal system is less than what is common in a direct configuration (Kenth, Fabrizio and Remigio 1999)
Cooperation between different retailers in order to improve distribution systems, is a topic that receive some attention, and the general consensus is that it is difficult to get retailers to cooperate on distribution even if there exists cost saving opportunities (Bygballe, Bø and Grønland 2012). Fear of sharing private and sensitive information is often stated as one of the primary reasons why cooperation is seen as difficult (Pathak, Wu and Johnston 2014).

According to Schaffer (1997), cross-docking/hub-and-spoke systems looks easy on the surface, but nothing is more from the truth. The cause of most failures is that the implementing organization fails to understand the requirements for successful cross-docking, and not planning its execution. The six requirements for success are 1) partnering with other distribution chain members, 2) absolute confidence in the products quality and availability, 3) communication between supply chain members, 4) communication and control within the cross docking operation, 5) personnel, equipment, and facilities, and 6) tactical management.

There exist several different ways for how cross docking centres can tranship incoming goods. In a “break-bulk” solution, full truck loads (FTL), are split into several less than full truck loads (LTF). In a “consolidation solution”, (LTF) truckloads are consolidated on to (FTL). As cross-docking at first might seem like a straightforward concept, the opposite is often true, as type of product and demand uncertainty also strongly influence the argument whether a product should be cross docked or not. Apte and Viswanathan (2000) discuss in detail important factors that influence whether cross docking should be implemented.
The suitability of the cross docking concept according to them, should be evaluated according to product demand rate and unit stock out costs, see fig.2.9.

<table>
<thead>
<tr>
<th>Unit stock-out cost</th>
<th>Product demand rate</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Stable and constant</td>
<td>Cross-docking can be implemented with proper systems and planning tools</td>
</tr>
<tr>
<td>Low</td>
<td>Unstable or fluctuating</td>
<td>Cross-docking preferred</td>
</tr>
</tbody>
</table>

Figure 2.9 – Cross-docking suitability. Adopted from (Apte and Viswanathan 2000)

According to this reasoning, certain types of products are more suited for cross docking than others. If a product have high demand uncertainty, the flow rate in to the cross-docking centre will be sporadic, and there will be an imbalance between inbound and outbound trucks, and the cross docking concept will suffer. Cross docking will therefore in general work best for products with low demand uncertainty, like for example groceries. The unit stock out costs means the cost the firm must “pay” if the product is demanded immediately by a customer, and it is not possible to fulfill that order. In cases where stock outs does not mean lost sale, where consumers are willing to wait, cross docking becomes more suitable (Schaffer 1997). In a pure cross docking strategy, warehouses and distribution centres serve as transfer points for inventory, but no inventory is held at these transfer points. The basic idea with cross docking is to transfer inbound shipments directly to outbound vehicles without storing them in between (Van Belle, Valckenaers and Cattrysse 2012).

2.3.4 Retail Integration

There exist many different interpretations, types and classifications of supply chain integration. A well-known distinction is between internal and external integration (Stank, Keller and Daugherty 2001). Internal integration is typically thought of as the integration of different processes within a company, while external integration is thought of as the integration between e.g. a supplier and a carrier (Henning, Eiril and Grønlund 2011). Integration can also be understood as
1) operational integration (coordinating inventory, scheduling, transport, new product development), 2) functional integration (managing different managerial functions such as purchasing and inventory management), and 3) relational integration (improving boundary relations) (Frohlich and Westbrook 2001). Integration with retailers/goods receivers in cities seems to be a research area that have received relatively little attention within the supply chain literature. This research seeks to partly improve the understanding of how this concept can reduce last mile traffic.

2.4 Research model

The objective of this research is to investigate to what extent increased involvement of retailers in supply chain planning can reduce traffic work. It is therefore seen as interesting to look closer into how changeable the last mile distribution configuration is. Based on the fact that 80-90% of previous initiatives that tried to reduce traffic failed (Allen et al. 2012), it was developed a research model that had distribution configuration as the dependent variable, and the other five drivers for transport efficiency (transport price, retail integration, store capacity/receiving condition, and service) as independent variables. In addition, delivery frequency, and number of carriers were included as independent variables, as it was anticipated that they to some extent influenced distribution configuration and amount of traffic. Traffic work is the final output of the model. The research model is presented in figure 2.10 below, accompanied by an explanation for each stated propositions.

![Research model diagram]

Figure 2.10 - Research model
The model anticipate that transport price, and store capacity/receiving condition directly influence delivery frequency to the store. If transport agreement (price) e.g. is DDP (Delivered Duty Paid), this could lead to a higher delivery frequency to the receiver, as the receiver can order goods more frequently without any considerations of the transport costs. If storage capacity is limited, it is anticipated that delivery frequency will be influenced, as it is difficult to receive large volumes per delivery.

The model anticipate that integration influence the distribution configuration, as better integration between the goods receiver and other supply chain members, often lead to a more efficient distribution configuration. Integrated supply chains will typically have more control over distribution costs, and have a higher degree of planning, which makes the distribution configuration more consolidated than direct.

The model anticipate that service of the retailer partly dictate how the distribution configuration will be organized, as e.g. some value short lead times over low cost, and other the opposite.

It is further anticipated that delivery frequency influence distribution configuration, as a high number of deliveries to each retailer makes the distribution configuration e.g. more direct than consolidated. It is seen as rather important that delivery frequency is influenced by transport price and storage/receiving conditions, as these factors could help to explain the rationale behind a given delivery frequency.

The model also anticipate that distribution configuration affect the number of different carrier companies delivering goods to the retailer. In a direct distribution configuration, it is likely that more carrier companies operate, compared to consolidated configuration.

As distribution configurations often exist independently of how the receiver experience it, the model also assumes that a given distribution configuration influence service. The model also assumes that a distribution configuration influence the delivery frequency to the retailer. As integration and service influences distribution configuration, it is anticipated that these variables also will influence delivery frequency.
Number of different carrier companies serving the retailer is anticipated to influence traffic work. As number of different carrier companies operating within the city is anticipated to be influenced by the distribution configuration, traffic work is partly influenced by all the variables in the research model.
3. Research methodology

This chapter explains my choices regarding research methodology. The first part presents the research strategy, which is a combination between a qualitative and quantitative approach. The second part explains my choice regarding research design, and looks into why I perform a case study. A thorough description of how I studied the cases follow. This includes how I collected data, what data I collected, and how data was analysed.

3.1 Research strategy

Research strategy is defined as the general orientation to the conduct of business research (Bryman and Bell 2011). The strategy can be seen as the blueprint for how the research is to be executed, which often is very beneficial, as it is important for the quality of the research that data relating to the research question is addressed properly. There is in general two distinct type of research methods that can be applied for performing research; qualitative and quantitative methods.

Quantitative research is a research strategy that emphasizes quantification in the collection and analysis of the data, and entails a deductive approach to the relationship between theory and research, meaning that one is involved in testing of theory (Bryman and Bell 2011). It means dealing with numbers, where the data observed can be measured. Qualitative research is a research strategy that usually emphasizes words rather than quantification in the collection and analysis of data. The sequence of stages in qualitative research is often more controversial than with quantitative research, because it exhibits somewhat less codification of the research process. In addition, in qualitative research, the stress is on the understanding of the social world through an examination of the interpretation of that world by its participants. This view means that social properties are outcomes of the interactions between individuals, rather than phenomena “out there” and separate from those involved in its construction (Bryman and Bell 2011).

As this thesis investigates to what extent increased retail involvement in supply chain planning can affect traffic work, the research strategy is both qualitative and quantitative in nature. In the following, I explain why the strategy is qualitative, and quantitative.
The research is qualitative, because a large part of the research was rather explorative in nature. It was seen as explorative because I investigated a set of variables assumed to influence distribution configuration and traffic work (ref: research model), without knowing if increased retail involvement in supply chain planning would lead to a reduction in traffic work. The interview as a method for data collection, was performed both in a structured and an unstructured way, with many different stakeholders. The variety of interview objects made it possible to gain knowledge that was beneficial in the data analysis, and in the development of the self-completion questionnaire that was administered to the retailers in Oslo.

The research was partly quantitative, because Statens Vegvesen had a prerequisite that estimates for potential traffic had to be an output of the research. In order to accomplish this, it was a necessity that the data collected, made it possible to build different scenarios that demonstrated how traffic changed in accordance with any last mile distribution initiative implemented. As traffic work is defined as

\[
\text{Traffic work} = \text{Number of vehicles} \times \text{Driving length} = \sum (\text{Transport length}),
\]

estimates for the number of vehicles, and driving length, had to be constructed in order to estimate the total transport length. By collecting data on the delivery frequency to each retailer, it was possible to calculate estimates for transport length, but, one problem with this approach, was that there were some uncertainty whether receivers in the same area, were served by the same carrier. If many were, the estimated transport length would be higher than the actual number. To control for this, as much as possible, observations of deliveries to the stores in a specific area, combined with interviews, tried to capture how frequent the carriers served receivers in the same area from the same stop.

In addition, part of the quantitative strategy was also to look briefly into the costs of alternative distribution configurations for the last mile distribution. Data on costs/price schemes was therefore obtained from different last mile distribution initiatives.
3.2 Research design

A research design provides a framework for the collection and analysis of data (Bryman and Bell 2011). When choosing a research design, it is important to choose a design that suits the study that the thesis wants to explain. It was seen as interesting to come up with new knowledge that could help to improve the last mile distribution of goods in Oslo, ultimately reducing the amount of traffic work. As many previous last mile distribution initiatives that tried to reduce traffic work had failed, Brown (2012) argues that many initiatives are based on ideological, rather than theoretical, considerations. As there seem to be lacking research that could help explain how last mile distribution can be optimized, it was seen as necessary to take an approach where I tried to gain in depth knowledge of an area that seemed to suffer from limited knowledge. In these types of business research, the case study is typically preferred, as it is quite open when it comes to different procedures, both in relation to data analysis, but also with how data is collected (Bryman and Bell 2011). The case study is therefore chosen as the research design in this thesis.

3.2.1 The chosen research cases

In order to estimate to what extent increased involvement of retailers in supply chain planning could affect traffic work in Oslo, I saw it as necessary to do an in depth investigation of the current last mile distribution situation in Oslo, as well as two other cities that had implemented last mile distribution initiatives. By investigating the same set of variables (ref: research model) in all the three cases, it was possible to investigate how they differed in the way they performed the last mile distribution and learn to what extent the distribution configuration could be changed in Oslo.

One specific area in Oslo called Grünerløkka was chosen as one of the three cases for further investigation. Based on recommendations from Statens Vegvesen, focus of attention was directed at two shopping streets within the area. As focus on the last part of the supply chain in previous last mile distribution research initiatives (GBO) was somewhat scarce, the aim was to gain in depth knowledge about the variables in the research model that were perceived to relate to a distribution configuration.
The city of Maastricht in Netherlands was chosen as a second case, as the city had a last mile distribution initiative that presumably was one of the few initiatives that operated without public funding. Learning more about their business model was seen as very interesting.

The city of Gothenburg was chosen as a third case, as the city had been involved in a last mile distribution for several years. I was also recommended from many different holds (Statens Vegvesen, State Department of Transportation in Berlin, SINTEF) to investigate the case as it presumably managed to reduce traffic. Personally, I also saw it as interesting to include Gothenburg as a case, as the city of Gothenburg had 500 000 inhabitants, while Maastricht had 100 000 inhabitants. Also, by investigating a last mile distribution initiative in a city that resembled Oslo more than Maastricht in size, it was perceived that it would be more hold in the discussion of the research propositions as the data was obtained from different scenarios.

3.3 Data collection
According to Bryman and Bell (2011), exponents of the case study design often favor qualitative methods for data collection, such as participant observation and unstructured interviewing, because these methods are viewed as particularly helpful in the generation of an intensive, detailed examination of a case.

Interviews was an important method for data collection in my research, because it allowed me to obtain data that was not readily available elsewhere. This included interviews of carriers in Oslo, retailers in Oslo, a last mile distribution initiative in Netherland, retailers in Netherland, a last mile distribution initiative in Sweden, The Urban Environment Agency (Bymiljøetaten) in Oslo, the State Department of Transportation and Development in Berlin, the research institute SINTEF in Norway, and the Institute of Transport Economics (TØI) in Norway.

The case study is often said to be a vehicle through which several qualitative methods can be combined, thereby avoiding too great a reliance on one single approach (Knights and McCabe 1997). Bryman and Bell (2011) present the main aspects of data collection, and divides it into two groups; primary and secondary data. Primary data is observed or collected directly from first-hand experience. Secondary data is the information and documents the researcher
collects from external sources (Bryman and Bell 2011). It often consists of articles, previous research on the field or topic and relevant data that can contribute to assure the quality and relevance of the forthcoming study.

What data to collect for this thesis have been seen in relation to the research question. This meant that data on retail involvement and amount of commercial traffic to retailers, needed to be collected. For the case in Oslo I contacted the Institute of Transport Economics (TØI) addressing the need for data on how much goods that was delivered to retailers on average within a given time period, specified by type of product, but I was told that specific disaggregated data according to product type, was not easy to obtain, as little data existed. Therefore, I collected data from a sample of retailers that made it possible to investigate how the different variables influenced, and were influenced, by a given distribution configuration. The same approach was taken in Maastricht and Gothenburg. The only difference was that I investigated the variables in relation to a more consolidated distribution configuration, as the cities had last mile distribution initiatives that consolidated goods to reduce traffic.

3.3.1 Primary data

The aim of the primary data was to receive answers through observations and interviews, seen as difficult to obtain from secondary data. The sources for primary data were a self-completion questionnaire administered manually to 50 retailers/goods receivers, 10 qualitative interviews, and observations. In the following I will explain in more detail the different approaches that were taken to acquire the data.

Interviews are one of the most common methods to use when collecting qualitative data (Bryman and Bell 2011). However, qualitative interviewing is usually very different from interviewing in quantitative research. In this thesis, both approaches have been used. Qualitative interviews was initially performed with retailers and carriers within the chosen geographical area in Oslo to gain knowledge about the day to day deliveries. This approach was also taken when I interviewed the Urban Environment Agency (Bymiljøetaten) in Oslo, and SINTEF. The primary interest was to learn about the interviewee’s point of view on last mile distribution. Based on the qualitative interviews, I saw it as necessary
to also perform quantitative interviews, as the data I obtained, gave me no possibility of reaching the output of the thesis (transport work), and answer my research question. Thus, I created a self-completion questionnaire that was manually administered to 50 retailers in Oslo, because a more structured way of interviewing would allow me to better aggregate the answers, and say something about the distribution configuration within the specific area as a whole. After the self-completion questionnaire was collected manually, I performed qualitative interviews with the retailers, to gain additional knowledge that could be lost due to missing questions in the questionnaire. I collected 40 questionnaires, which gave me a response rate of 80 %. This is seen as very good (Bryman and Bell 2011).

The way the questions in the questionnaire were asked, was a result of the literature review, the preliminary interviews/observations with carriers/retailers/stakeholders in Oslo, and the visit to Maastricht. One goal was to ask questions that captured to what extent the retailers were involved in supply chain planning today, and, ask questions that indicated whether the retailers could become more involved. For example, if 100 % of the sample saw it as interesting to pay for additional short term storage close to their store to get more floor space, this would indicate a very low current involvement in supply chain planning. By asking if the deliveries occurred on a regular basis, it was for example possible to measure the variability in supply chain integration between the retailers. By collecting data on how often retailers received deliveries, accompanied by other relevant questions, it was possible to acquire data on delivery frequencies to each store. Did e.g. some retailer have higher delivery frequencies than others? If so, were there anything that could explain the difference? In the questionnaire I also decided to ask whether the receivers were independent or chains. This separation had been discussed with Statens Vegvesen, and it was seen as rather important. By including this separation, it was possible to cross-analyze the answers, and look for differences with respect to supply chain involvement. The complete list of questions is included in appendix 2.
3.3.2 Secondary data

Secondary data is the information and documents the researcher collects from external sources (Bryman and Bell 2011). It often consists of articles, previous research on the field or topic and relevant data that can contribute to assure the quality and relevance of the forthcoming study. Several research projects on last mile distribution initiatives were reviewed. The project documents/notes from the research project called “Grønn Bydistribusjon Oslo” (GBO2014) was especially beneficial, as it contained a detailed summary of previous problems, as well as what the main problems had been. In addition, previous investigations done by (Bohlin, Hedman and Rullander 2014) on how retailers perceived the last mile distribution initiative in Gothenburg was very beneficial. To obtain an even better understanding of the two last mile distribution initiatives investigated in Maastricht and Gothenburg, data on costs, revenue, and agreements with carriers and goods receivers were also reviewed.

3.4 Data analysis

According to Bryman and Bell (2011), one of the most important questions to ask when engaging in case analysis, is “how well do the data support the theoretical arguments that are generated”? The arguments made in this thesis, is thought to be founded on a solid foundation of data. The rather large variety of data sources, combined with the theory on transport efficiency in the literature review, is assumed to strengthen the output of the analysis.

The primary data from the self-completion questionnaire in the case in Oslo have been analyzed using a software called Surveynuts. This provided me with valuable information regarding the different variables in the research model. By utilizing a cross-analysis functionality from Surveynuts, it was possible to cross-analyze the answers received from the retailers. This made it possible to look for underlying relationships between distribution configuration and the different variables. Data from qualitative interviews have been used to complement the findings from the questionnaire. The qualitative data from the cases in Maastricht and Gothenburg, have been cross analyzed to look for similarities/dissimilarities.
The quantitative data in all the three cases have been analyzed using Microsoft Excel. The estimates for traffic work reduction in Oslo, was based on the primary data obtained from the sample in Oslo, and the two cases investigated in Maastricht and Gothenburg. In order to calculate the estimates for traffic work reduction in Oslo, a certain number of assumptions were taken. 1) Estimates for traffic work was restricted to the specific geographical area close to the two shopping streets investigated in Oslo. 2) Each vehicle entering the specific area, only delivered to one retailer. After many hours of observations, I never saw one carrier delivering to multiple receivers within the same streets. The number of deliveries to each store per week, was used as estimates, in order to calculate how many deliveries that were performed by different vehicles to each store. 3) Average driving length per vehicle within the area was estimated to be 1.7 km, which was minimum distance a carrier had to drive to be able to reach a destination within the geographical area.

3.5 Quality of research design
Reliability, replicability and validity are presented as the main criteria’s for assessing the quality of business research (Bryman and Bell 2011). In relation to qualitative and quantitative research, writers on case study research, whose point of orientation lies primarily with a qualitative research strategy, tend to play down, or ignore the salience of these factors (Bryman and Bell, 2011). Quantitative research strategies tend to emphasize the factors to a larger degree, but, the validity of the research, particularly external validity, is in general low in case research. Lee, Collier, and Cullen (2007) suggest that particularization rather than generalization (external validity), constitutes the main strengths of case study. The goal of case study analysis, should therefore be to concentrate on the uniqueness of the case, and to develop a deep understanding of its complexity (Bryman and Bell 2011).

Reliability is concerned with the question of whether the results of the study are repeatable (Bryman and Bell 2011). The variables looked into that were anticipated to influence distribution configuration, is perceived to be rather consistent as they are not constructed by me, but agreed upon factors that influence transport efficiency.
Replicability is concerned with the fact that it should be possible to replicate a study (Bryman and Bell 2011). By using a self-completion questionnaire, compared to only qualitative interviews, it was perceived to be easier for others to partly replicate this study.

Validity is concerned with the integrity of the conclusions that are generated from a piece of research (Bryman and Bell 2011). External validity is concerned with the question of whether the results of a study can be generalized beyond the specific research context. As the sample of retailer’s interviewed in the Oslo case consisted of only 40 retailers, it is not perceived that the findings can be generalized to e.g. the rest of the city. The findings can however give indications to how the distribution system operates in other parts of the city, as the shopping area investigated is similar to many other areas in the city. The variation of retailers within the sample was also seen as to low to be able to generalize the findings. In order to increase the external validity of the study, a larger sample with more industries included, would be beneficial as it would be a more representative sample.

The fact that 80 % of the respondents within the sample held positions as either shop owners or managers strengthened the data as relevant people who were familiar with the day-to-day operation of the store answered the questions. As shop owners also answered all the qualitative interviews, the quality of the data obtained was seen as high.
4. Findings/Case description

This chapter presents general information about the cases that will be further analysed in chapter 5. This includes geographical information about the cities investigated, as well as information about the last mile distribution initiatives that operate in Gothenburg and Maastricht.

4.1 Oslo

Oslo is the capital in Norway, with roughly 650,000 inhabitants (OsloKommune 2015). The city is located close to the sea, which connects it to several ports (Oslo harbour, Moss harbour, Drammen harbour) (Jean-Hansen and Hovi 2009). The city is located in immediate closeness (3-4 kilometers) to Norway’s largest logistic hub for goods called Alnabru. Within the logistic hub area, the main train terminal for goods in Norway is located, as well as a large constellation of distribution centers (DC) (e.g. Postnord Logistics, Bring, and DB Schenker Norge), wholesalers, warehouses, and importers. The Alnabru area is depicted in figure 4.4, which also depicts the main roads used when transporting goods in Oslo. The thickness of the lines, show the amount of goods that flow on the specific roads.

![Figure 4.1 - Goods transported on roads in Oslo. Adopted from (Jean-Hansen and Hovi 2009)](image)

The flow of goods in and out of the Oslo region is much larger than the flow of goods in to the retailers in the city. Roughly 30 million tons of goods are sent out of Oslo, and 23 million ton are coming in per year (Engebretsen 2010). The
volume traded by retailers in the city centre have previously been estimated to be around 1 million tons (Jean-Hansen and Hovi 2009).

The inner city in Oslo where most retailers are located, stretches 6-7 km from east to west. The city is depicted in figure 4.2 below. Grunerløkka, which have been the area within Oslo investigated closer, is located on the east side of the city. The area is roughly 4 km², and contains around 350 retailers, restaurants and cafés. The area is depicted in figure 4.3.

![Figure 4.2 - The city of Oslo. Created with Google maps](image1)

![Figure 4.3 - The specific area chosen as the research case. Created with google maps](image2)

Within the confined area, two shopping streets were used as the main source of data collection. As most of the vehicles who delivered goods to the retailers drove the streets depicted in figure 4.4, the area of Grunerløkka was further confined to these two streets of 1.7 kilometres.
The lower part of Markveien where many of the questionnaires were administered, is a relatively narrow shopping street, with driving allowed only one-way from Nordre gate down to Nybrua, and from Nordre gate up to Olaf Ryes Plass. The street is shared between commercial traffic, regular traffic, pedestrians and cyclists. Thorvald Meyer’s gate is a larger street where traffic flows in both directions. The street is shared between commercial traffic, regular traffic, the tram, pedestrians and cyclists. As of today, there is no last mile distribution initiative that work to reduce traffic to the retailers in the chosen area by consolidation of incoming deliveries. The general delivery situation today is that a large number of different carrier companies deliver goods to the retailers throughout the day.

### 4.2 Maastricht

Maastricht is a city located the south of Netherlands in the Limburg province, with roughly 100 000 inhabitants. The Netherlands have four major logistic hub areas (Amsterdam, Rotterdam, Breda/Tilburg, and Venlo), the closest being Venlo which is 80 kilometres away from Maastricht. Netherlands have more European Distribution Centers (EDCs) than any other country in Europe (Capgemini). The south of the Netherlands is well known for low warehouse costs, which is one of the reasons why so many EDCs are located here.

The city centre of Maastricht where most of the 600 retailers are located, stretches roughly 1.8 kilometres from east to vest, see fig.4.5. The city centre have many narrow streets, and certain areas of the city have restriction for commercial
vehicles. The city is however struggling to enforce the regulation, and many vehicles ignore the restrictions.

![Figure 4.5 – The city of Maastricht. Created with google maps](image)

The last mile distribution initiative in Maastricht, (Binnenstadservice), is a private company that deliver goods to 30-40 retailers in the city, from a warehouse terminal located 3 kilometres from the city center. The terminal, see fig.4.6, receives incoming goods to the city, and either consolidates directly for delivery, or keeps the goods in a buffer storage on retailer’s request. Each week roughly 300-350 units are consolidated and delivered to retailers in the city. The peak of the week is Wednesday, when the initiative typically deliver 150 units. The terminal operated by the initiative is 1000 square meter, and have a renting cost of 216 NOK per square meter per year.

![Figure 4.6 - Receiving area at Binnenstadservice in Maastricht. Adopted from Binnenstadservice with permission.](image)
The initiative generates revenue to cover the operational costs from suppliers, carriers, and retailers, depicted in figure 4.7. Most of the revenue is however generated from the additional storage service offered to retailer.

![Figure 4.7 – Revenue streams LMD initiative](image)

**4.3 Gothenburg**

Gothenburg is the second biggest city in Sweden, and have roughly 500 000 inhabitants (GöteborgsStad 2015). Sweden have three major logistic hubs, and one is located in Gothenburg. The city is located close to the Gothenburg harbour, which handles 30 % of the country’s foreign trade per year (GöteborgsStad 2015). The area is well known for being a good place to locate national distribution centers (Capgemini).

The last mile distribution initiative in Gothenburg (Stadsleveransen), is a 50% publically funded initiative, that operates in a confined area within the city called “Innerstaden”. The area consists of roughly 470 retailers, 125 restaurants, 57 cafés, and is roughly 1.5 km². The area is depicted in Figure 4.8 below.

![Figure 4.8 – “Innerstaden” in Gothenburg. Created with Google maps](image)
The initiative in Gothenburg consolidates incoming packages to the retailers in a 400 square meter terminal, 3 kilometres from the city. The terminal is currently consolidating incoming goods, with no possibility for the retailers to store goods within the terminal. The initiative delivers on average 300 units per day to 200 retailers. Due to the small size of the distribution vehicle, the initiative is unable to deliver euro pallets. The initiative does not engage in delivery agreements with the retailers, but works as a sub-contractor for different carrier companies. The initiative were planning to increase the size of the delivery vehicle, enabling them to deliver euro pallets as well. The initiative acquired 30 % of its revenue from carriers, 20 % from advertisement displayed on the transport vehicles, and 50 % from the city of Gothenburg, see fig.4.9.

Figure 4.9 – Revenue streams for the initiative in Gothenburg
5. Analysis of the findings

This chapter will first present the findings on the research variables collected from the three cases. A discussion will then follow that looks closer into how the different variables influenced the distribution configurations, and the goal of reducing traffic. The last part of this chapter use the findings from the cases to estimate potential traffic work reduction in Oslo. The structure of the chapter is depicted in figure 5.1 below.

![Figure 5.1 – Structure of the analysis](image)

5.1 Case Oslo

This section presents the findings from the self-completion questionnaire administered to the retailers in Oslo, as well as findings from the qualitative interviews with the retailers and the carriers in the area.

5.1.1 Supplementary findings from the questionnaire

The majority of the respondents on the questionnaire were either stores owners or daily managers, fig.5.2. This was seen as a factor that increased the strength of the data, as the data were based on answers from people who knew the day-to-day operation of the retail business.
Within the sample, clothes, furniture/interior, shoes, and cosmetics had the highest number of respondents. Some types of products were underrepresented within the sample, e.g. groceries and restaurants. Qualitative interviews with one independent grocery store indicated that deliveries were coming from twenty-three different suppliers within a standard week. More data from small grocery stores would therefore be interesting to investigate closer.

Most of the interviewed retailers perceived it as important to reduce pollution from distribution, fig.5.4. Even if most perceived it as important, few were interested in participating in initiatives that directly reduced amount of pollution. Some of the questions presented in the following sections demonstrate this.
Many of the retailers interviewed got deliveries directly from suppliers outside Norway, fig 5.5. As Oslo is located close to a large number of suppliers and importers, these findings were somewhat surprising. This meant that foreign carriers performed many of the deliveries to the stores.

5.1.2 Store capacity and Receiving conditions

This section looks closer into the proposition that store capacity and receiving conditions influence delivery frequency. Based on qualitative interviews and observations, many stores seemed to have limited storage space, and poorly constructed receiving facilities. The findings indicate that 30 % of the retailers perceived it as maybe interesting/interesting to pay for increased storage space close to the shop, depicted in figure 5.6 on the next page.
Some of the stores were however sceptical towards engaging in new relationships with warehouse operators, but did definitely perceive it as valuable if the cost of the storage was low enough. One retailer (ChillOut) expressed that they liked to see inventory out in the shop, in order to know what they had. They therefore liked to get deliveries at high frequencies, in small batches. Due to very limited receiving conditions, they did not like to get larger deliveries as this had to be sorted outside the shop. The alternative of storing goods outside the store in a nearby warehouse was interesting, but to them it seemed complicated, and they feared it would be both time consuming and costly. Another furniture retailer (Futura) expressed interest in additional storage as the store tended to be full of packages, but was sceptical if the price would be low enough. One clothing retailer (Lykkeli) complained about very much plastic and paper floating around in the store, as well as in the basement. Regarding a question if she would like to use the basement for display of goods instead of storage of waste, the store manager said that it would be optimal, but it was not possible, due to the risk of theft. Theft was as a common problem, and the manager could only watch the first floor of the store.

5.1.3 Transport price

This section looks closer into the proposition that transport price influences delivery frequency. The most common transport price agreement between retailers and suppliers/carriers, seemed to be that the retailers sometimes bought under a “Free in Store” (DDP) agreement, and sometimes paid a separate transport price.
As can be seen in figure 5.7 below, only paying a separate transport price, or only buying under “Free In Store” was rather uncommon.

![Graph showing transport price agreements](image)

**Figure 5.7 – Transport price agreements**

Interviews with retailers revealed that many suppliers operated with relatively high threshold limits for when goods were delivered “Free In Store”. One furniture/interior retailer (Medmer) said that many suppliers operated with high threshold limits for when goods were delivered “Free In Store”. The retailer experienced this to be a common practice among many of the suppliers, and the store could seldom make use of the practice, as the store procured products cheaper than the suppliers threshold limit. The store perceived transportation prices as high, as it in many instances accounted for 25-50% of the prices of the ordered products.

Based on the qualitative interviews with the shops, perception on whether transport price were high or low, varied to some extent. Some retailers didn’t seem to care much about transport price as they perceived it as low, while others viewed it as high, hindering them from buying certain products as high transport price would make it impossible to sell products with profit.

The findings indicated that there were a difference between chains and independent stores, regarding delivery price agreement, which is depicted in figure 5.8. Independent retailers seemed to be paying for transportation separately, more frequently than chains, which partly makes sense, as chains often buy in larger quantities. This corresponds with what the retailer (Medmer) said about
product value, namely that suppliers often operate with relatively threshold limits for when goods are delivered “Free In Store”.

![Graph showing product value and transport price](image)

**Figure 5.8 – Transport price, cross analysis chain vs independent**

### 5.1.4 Integration

In this section I look closer into the proposition that integration influence distribution configuration. The findings in figure 5.9 indicated that only 20% of the retailers got deliveries on specified days of the week, 15% got deliveries on specific days of the week, but only for larger deliveries, while 65% didn’t get deliveries on specific days of the week.

![Graph showing delivery schedule](image)

**Figure 5.9 – Delivery schedule**

According to one of the interviewed carriers who drove for an express company (Sporty), the delivery system in Oslo had developed into what he called “pizza ordering”. The growth of carrier companies had exploded the three last years. It was becoming more common for customers to switch between different carries,
and choose the carrier with the lowest transport price. This trend was confirmed by (HSS Transport), who described many carrier companies as “flies”, due to their short lifespan. It was common to compete so hard on price that they went bankrupt. Accordingly, they perceived this to be a reason why deliveries were performed without much integration. Instant needs were often satisfied without much focus on planning.

Degree of integration did however seem to vary between chains and independent retailers, which can be seen in figure 5.10. The findings demonstrated that chains and independent retailers received goods rather differently with respect to specific delivery times. While 41 % of chains got deliveries at specific days of the week, only 4 % of independent stores received goods on specific days. As previously mentioned, retail chains tend to have more focus on planning, which is to a large degree confirmed by these findings.

Based on discussions with retailers, as well as observation of deliveries at the chosen geographical area, it was common that deliveries occurred throughout the day. I therefore asked if the retailers would like to get deliveries as early as possible, before the stores were filled with customers. As can be seen in figure 5.11, roughly 80% answered that they would like to get deliveries early in the morning.
The findings did also show that 46% of the receivers sold goods online. Based on the qualitative interviews with the retailers, it seemed to be a common practice that many retailers walked to the nearest postal office, and manually distributed their packages sold through the online store. This was both time consuming, and difficult, as many of the packages were heavy. Regarding increased integration with a carrier that performed outbound distribution from the store, the answers indicated that very few saw this as interesting. This could potentially change if the volumes sold through the online store increased, which would make integration more valuable for the retailers.

Roughly 20% were interested in a reverse logistics service that could handle waste, fig. 5.13. Seen in combination with the deliveries to the stores, many perceived it as a good solution if the carrier delivering goods, also could collect waste.
5.1.5 Service

This section looks closer into the proposition that service influence distribution configuration. If e.g. most of the goods receivers in the sample were satisfied with the current delivery practice, would this indicate that the current, rather sporadic system was optimal? Or could there exist another last mile distribution configuration with less traffic work and higher service?

The findings show that 80% of the retailers were satisfied with the current distribution configuration. It is however difficult to say whether the current distribution configuration is good or bad, as it does not exist an alternative to the current system.

The findings demonstrated a distinction between chains and independent receivers regarding how they perceived the service of the current distribution configuration depicted in figure 5.15. While 88% of the chains were satisfied with the current distribution configuration, only 74% of the independent stores were satisfied.
Seen in relation to figure 5.11, where only 4% of the independent retailers got deliveries on specific times of the week, and 41% of the chains got deliveries on specific times, better integration could be a factor that partly explains the difference in satisfaction.

![Figure 5.15 – Satisfaction with distribution configuration, chain vs independent](image)

The retailers who were dissatisfied mentioned the following problems:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decide when to receive the delivery</td>
<td>Chain: 88.24</td>
</tr>
<tr>
<td>Relatively high transport price compared to product value. Complicated procedures when ordering from abroad</td>
<td>Chain: 11.76</td>
</tr>
<tr>
<td>Large deliveries are often divided, and I often react to the way the goods are handled</td>
<td>Chain: 11.76</td>
</tr>
<tr>
<td>Many different carriers, many different delivery times</td>
<td>Chain: 11.76</td>
</tr>
<tr>
<td>Carriers delivering outside opening hours</td>
<td>Chain: 11.76</td>
</tr>
<tr>
<td>Carriers seldom arrive at agreed upon times</td>
<td>Chain: 11.76</td>
</tr>
<tr>
<td>Some carriers use very long time to get the products to the store after they have been custom cleared</td>
<td>Chain: 11.76</td>
</tr>
</tbody>
</table>

5.1.6 Delivery frequency

In this section I look closer into the proposition that delivery frequency to the retailers influence distribution configuration. As can be seen in figure 5.16, the most frequently reported delivery frequency was 3-5 times per week. Most of the retailer’s interviewed didn’t perceive this delivery frequency as a problem. It was seen more as a necessity. When asked if they had any interest in consolidated shipments to reduce delivery frequencies, very few saw this as interesting. The number of different carrier companies delivering the goods, were seen as a bigger problem, as the receivers had numerous carriers to relate to, who often had different practices of how they handled goods and interacted with the stores.
The delivery frequency did vary to some degree between chains and independent retailers, but not very much. As can be seen in figure 5.17 below, the general trend was that chains received goods more frequently than independent retailers did, but the differences were minor.

![Delivery frequency to retailer](image)

The answers relating to a delivery frequency reduction, fig.5.18, indicated that 8% perceived it as interesting to reduce the delivery frequency, while 30% perceived it as maybe interesting. This indicated that a relatively large portion of the retailer received more deliveries per week than what they perceived as optimal. This does however relate to transport price, and very few of the retailers interviewed, were willing to pay an additional transport price to reduce delivery frequency.
Independent stores seemed to be more positive towards a delivery frequency reduction than chains, fig.5.19. Based on the qualitative interviews with retailers and the carriers, the tendency was that chains more often organized their deliveries, which partly could explain the difference. One restaurant interviewed (LilleAsia), explained that they used to order one large delivery to one restaurant, and then deliver to the other restaurants using private vehicles.

Approximately 80% of the retailers received between 1-7 units per delivery, and the most frequently stated delivery frequency was 2-4 times per week. The variation between the retailers is depicted in figure 5.20 on the next page.
The cross analysis of the answers did show a weak relationship between size of shipment and delivery frequency. The receivers who got 1 unit per delivery, had the highest delivery frequency (2-3 times per day), and the stores who received more per delivery, seemed to have lower delivery frequency. Figure 5.21 below depicts the relationship.

5.1.7 Number of carrier companies

This section looks closer into the proposition that number of carrier companies influence traffic work. In a direct distribution configuration, there will on average, be more carriers operating, compared to a consolidated configuration, because different supplier have agreements with different carrier companies that deliver goods the last mile to retailers. Figure 5.22 indicates that many carrier companies
serve each retailer. The answers demonstrated that 50% of the sample had three or more carrier companies delivering to the store per week.

Figure 5.22 – Number of carrier companies

The findings did also indicate that retail chains got deliveries from fewer carrier companies than independent stores. To some extent, this indicated that chains were more involved in supply chain planning that directly reduced the number of different carrier companies who served the retailers in the sample.

Figure 5.23 – Carrier companies, cross analysis chain vs independent

As depicted in fig.5.24 below, 21 different carrier companies were performing deliveries to the retailers per week. The answers show that 4 large carrier companies, are reported most frequently by the retailers.
Based on discussions and observations with carriers in the specific area, there seemed to be relatively large variations regarding utilization degree of the trucks delivering goods to the retailers. Companies like DB Schenker, and PostNord Logistics, often operated with maximum utilization degree, while smaller carrier companies operated with less than full truck loads. One carrier I interviewed called (sporty), drove in to Oslo with one pallet in a truck that had a payload of 18 pallets. The order was however an express order, but it demonstrated, to some extent, the amount of unnecessary traffic work generated by one receiver.

5.2 Case Maastricht

This section looks closer into the findings on the research variables/propositions collected in Maastricht. The presentation follow in the same way as the case in Oslo.

5.2.1 Store capacity and receiving conditions

Both the independent retailer, the shopping mall, and the last mile distribution (LMD) initiative, stated that limited floor space was a problem. With little storage possibilities, the size of each delivery tended to be smaller, and the delivery frequency tended to be higher. In many instances, receiving conditions were not constructed for pallet deliveries. Pallets were therefore often placed outside the stores on the sidewalk. As delivery frequencies tended to be high, much time was spent on receiving and handling goods during the week.
The logistic service provider in Maastricht offered receivers of goods buffer storage 2 kilometres away from the city center. Most of the retailers involved with the initiative perceived it as positive to have an intermediate storage facility close to the store. Some perceived it to be positive as space in the store was limited, while others perceived it as positive because goods could be stored for shorter periods at the terminal, and then delivered in a consolidated delivery upon request.

5.2.2 Transport price

This section looks closer into the proposition that transport price influence the distribution configuration. According to the LMD initiative, transport price agreements, was a rather important factor that could influence the success of a last mile distribution initiatives. The agreements DDP (Delivered Duty Paid), and DAT (Delivered At Terminal), were presented as two agreements that had potential to alter the last mile distribution configuration. It was their view that the current DDP agreements caused unnecessary traffic work within the city, and that the agreement made receivers of goods very passive regarding supply chain planning and involvement. As goods were delivered for “free” to the stores, many didn’t see any reason to become more involved in supply chain planning.

In order to improve the last mile distribution and reduce traffic work as much as possible, the initiative saw it as imperative to understand how transport price agreements were related to consolidation of goods. They used a term called “Financial X-Dock”, to describe the situation. This is depicted in figure 5.25 below.

![Figure 5.25 - Financial X-dock](image)

Figure 5.25 - Financial X-dock. Adopted from (Hendriks 2015) with permission.
According to the initiative, it was very difficult to charge a separate transport price for the last mile. If they did, transport price would become DDP, + an additional transport price for the last mile, which would increase the total transport cost for the entire distance. The initiative argued that a DAT (Delivered at Terminal) agreement would reduce the total transport cost in the chain. In a DAT agreement, goods would be delivered directly at the terminal. As the last mile was out of the equation, transport price from supplier to terminal, should be lower than from supplier to the city centre. As the last mile distribution often constitutes between 13% - 75% of the total distribution costs (Aized and Srai 2014), this argument makes sense. Even so, many suppliers and carriers saw the last mile initiative as a direct competitor. Fear of losing market shares made many reluctant to participate in a cooperation where all members could work together, to reduce costs and other negative aspects with inner city distribution (e.g. congestion and stress). Another reason why it was difficult to get e.g. suppliers to cooperate, was that they didn’t see transport cost as their main cost concern. The company Procter and Gamble had stated in a meeting with the initiative, that instead of engaging in new relationships to save a small amount on transport cost, they would rather spend money on marketing to increase sales.

5.2.3 Retail integration

In this section it is looked closer into the proposition that integration influence distribution configuration.

The initiative in Maastricht worked closely with the goods receivers, which to a large degree increased the integration between the goods receivers, and the carrier (the LMD initiative). In the new distribution configuration, retailers increased their involved in supply chain planning considerably. The LMD initiative partly worked as a strategic partner, where regular meetings took place to plan deliveries to the store or discuss other needs from the retailer. The fact that the carrier from the initiative entered the stores, and engaged in conversations with the receivers about their needs, was a major change from the previous distribution configuration.

During the interview I had with the shopping mall (V&D), the shopping mall manager explicitly stated that he valued the close relationship they had with
the last mile initiative. To him, the relationship was much more than just
distribution, as he could buy a large number of different services from the
initiative. This included e.g. procurement of inventory at IKEA, short/long term
storage of goods, decoration of Christmas trees, and numerous other services. The
flexibility of the initiative was seen as most valuable. The initiative differed to a
large degree from other carriers, as they operated in a smaller scale, which meant
that they could integrate to larger degree with the customer.

5.2.4 Service

The research model predicted that service impacts distribution configuration, and
that distribution configuration impacts service. The consolidated distribution
configuration in Maastricht seemed to have a relatively large positive impact on
the customer service of the goods receivers. Both the independent retailer (Het
Kousenhuis) and the mall (V&D), spent less time on receiving deliveries
compared to the old distribution configuration, but, this did not seem to be the
factor that had the biggest impact on customer service. The manager of the mall
explained, “Before we started to use BSS, we had one employee who served the
receiving area all day long. Now that delivery frequency is lower, the same
employee can be used for other value adding assignments”. However, it is
important to say that if consolidation was the only offer served by the logistic
service provider, the shopping mall manager was not sure if he would be
interested in changing the distribution configuration. As the relationship with the
(LMD) initiative needed a considerable amount of time for planning, he saw it as
necessary to also be given all the other additional services as a bundle.

The relationship between receivers and the carrier had also changed
considerably in the two places I visited. Both receivers valued this. Compared to
the old situation, the fact that only one carrier company now handled most of the
deliveries, was seen as beneficial. The independent retailer explained “Previously,
I had numerous carriers delivering, who often disappeared as soon as they had
delivered the goods. With the (LMD) initiative, goods are delivered in to the shop,
they collect waste, and handle outbound deliveries from my web shop. The high
degree of integration between the initiative and the receivers, as well as the high
flexibility, seemed to be the main factors that increased the service. The reduced
delivery frequency in the new distribution configuration did not seem to be the primary factor that contributed to the increased customer service. It was seen as valuable, but only when it was bundled with a large number of other services.

5.2.5 Delivery frequency

In this section, it is looked closer into the propositions that delivery frequency influence distribution configuration, and that delivery frequency is influenced by the distribution configuration.

The last mile distribution initiative in Maastricht managed to perform a combination of store/area delivery reductions. During the visit, I visited three specific destinations; one independent retailer (Het Kousenhuis), one shopping street, and one small shopping mall (V&D). The independent retailer I interviewed thoroughly explained how the distribution to the store had changed after she had started to work with the LMD initiative. Prior to the cooperation, there was little involvement in supply chain planning. The retailer ordered goods from eight different suppliers, and four to five different carrier companies per week delivered goods to the store. The delivery frequency used to be several times per day. After engaging in cooperation with the LMD initiative, every incoming delivery was delivered directly to the transit warehouse (ref: case description), and delivery frequency was reduced to one to two consolidated deliveries per week.

The small mall I visited (V&D) was according to the LMD initiative a good case, which demonstrated the potential that lay in consolidation of last mile deliveries. The receiving area of the mall was in a small street with pedestrians and cyclist, often getting in the way of carriers. In the case before the LMD initiative had engaged in cooperation with the mall, sixty trucks delivered on average to the receiving area per week. After incoming goods were directed directly to the LMD initiative, the average number of trucks delivering per week was reduced to ten.

The shopping street I investigated, was a rather narrow street with a high number of retailers. This was an example of how the LMD initiative were able to consolidate shipments for an entire street, and deliver the goods on one truck, instead of ten to fifteen trucks. In practice, this meant that delivery frequency could be maintained high if stores requested this, as the high number of stores in
the same area could be handled from the same drop of location. Even if all the stores got deliveries each day, the total reduction in carriers operating in the area were high.

5.2.6 Number of carriers delivering goods

The thirty to forty retailers using the last mile initiative got most or all of their deliveries exclusively through the initiative. This was stated as important, as the primary objective of the consolidation service was to reduce as many deliveries to each store as possible. The high level of integration with the receivers, was seen as one of the reasons why they managed to get the receivers to redirect all their deliveries to the transit warehouse.

5.3 Case Gothenburg

In this section it is looked closer into the findings from the last mile initiative in Gothenburg. The presentation follow in the same way as in the previous cases, where findings are presented for each variable in the research model.

5.3.1 Store capacity and receiving conditions

According to the spokesperson I interviewed from the (LMD) initiative, many retailers stated that they could not handle large deliveries due to limited storage space. They therefore preferred smaller, and more frequent, deliveries throughout the week. The spokesperson stated, “Very few retailers are interested in increasing their involvement in supply chain planning. Their main concern, and preference, is to interact with customers. The fact that frequent deliveries, often take up valuable floor space in the shop, as goods are temporary stored before handled, does not seem to be a concern”. As of now, the (LMD) initiative did not offer the stores the possibility to store goods at a buffer storage. Many of the interviewed stores did state that they would like to get more deliveries early in the morning, as deliveries during the day often got placed in store, taking up place and making the store little welcoming for customers. This was however a problem, as the initiative got deliveries in the morning which had to be consolidated, and then delivered to 200 retailers. Deliveries were therefore often performed throughout the day.
5.3.2 Transport price

According to the spokesperson for the LMD initiative in Gothenburg, it was common that retailers either paid for transportation to the supplier directly, or that the supplier paid for transportation. This was often dependent on the amount of goods ordered by the retailer.

In the (LMD) initiative in Gothenburg, transport price was not paid by the retailers. The shops who received goods from the initiative, were engaged in the same transport price agreements as before the initiative started to deliver. The transport price was charged to different carrier companies delivering goods to the specific area.

With respect to delivery frequency, this transport price scheme did not seem to affect the delivery frequency to a large degree. As the initiative negotiated transport price agreements with individual carrier companies, they were not able to consolidate all the shipments that were coming in to each store, as each store in general got deliveries from many different carrier companies.

5.3.3 Retail integration

The degree of retail integration between the initiative and the receivers seemed to be rather low. In practice, the initiative was not engaged in any form of cooperation with the receivers of the goods. The initiative was to a larger degree integrated backwards with a few larger carrier companies. This meant that many retailers suddenly started to get deliveries from the last mile distribution initiative, without being informed. This happened because carriers had hired the initiative as a sub-contractor. Deliveries going through the carrier had to be consolidated, regardless of what the retailer wanted.

In a distinction between direct and a consolidated distribution configuration, it seemed that integrating backwards with the carrier, didn’t have a large effect on the distribution configuration. If the initiative integrated more with the receiver, it would be easier for the receiver to increase involvement in supply chain planning. As this was not the case, distribution configuration hadn’t changed considerably from the situation with many carriers delivering to the same store.
5.3.4 Service

Based on the information I got from the interview with the initiative, and also from previous interviews with the retailers (Bohlin, Hedman and Rullander 2014), the goods receivers’ service wasn’t improved much. Some retailers complained about unprofessional drivers from the initiative, others experienced damage to the packages due to the double handling, some complained about lack of focus from drivers on keeping count of number of units delivered (as this related to insurance). Others complained about problems locating packages through the web portal as packages sometimes got “lost” at the initiative. Many perceived it to be positive to have the same person from the initiative delivering. However, as many carrier companies still delivered to each store, the distribution configuration was perceived to be similar to the previous situation.

5.3.5 Delivery frequency

The total delivery frequency to each store was not reduced after the last mile distribution initiative had been implemented. The distribution configuration within “Innerstaden” did seem to be rather direct, even if the initiative delivered on average 300 units to 200 retailers per day. According to the last mile distribution initiative, most of the retailers served, also got deliveries from other carriers. Many of the retailers in “Innerstaden” stated that the total amount of deliveries within the area were perceived to be the same, even if the initiative delivered to a large number of retailers. The main reason seemed to be that the initiative only cooperated with a few large carrier companies.

5.3.6 Numbers of carriers delivering goods

Roughly 70% of the stores that used the initiative, got deliveries from other carriers as well. The distribution configuration was therefore rather direct, as most deliveries were performed in a direct configuration. It was not possible to acquire data on how many different carriers that served each store, but the data from previous interviews (Bohlin, Hedman and Rullander 2014) indicated that the streets often were full of different carrier companies.
5.4 Discussion of the three cases

The findings from the different cases have revealed many differences with respect to the last mile distribution configuration. The main differences are included in figure 5.26 below, which depicts findings from the case in Oslo without a LMD (last mile distribution) initiative, and the findings from the cases that have last mile distribution initiatives. When there exist a LMD initiative, the findings on the variables in figure 5.26 depicts the situation with the initiative.

<table>
<thead>
<tr>
<th>Case</th>
<th>LMD initiative</th>
<th>Delivery frequency to retailer</th>
<th>Integration</th>
<th>Transport price</th>
<th>Store capacity/Receiving condition</th>
<th>Carrier companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oslo</td>
<td>No</td>
<td>high</td>
<td>low</td>
<td>DDP + Regular</td>
<td>Low/Bad</td>
<td>Many</td>
</tr>
<tr>
<td>Maastrich</td>
<td>Yes</td>
<td>low</td>
<td>high</td>
<td>DDP / (DAT) + Regular</td>
<td>Low/Bad</td>
<td>Few</td>
</tr>
<tr>
<td>Gothenburg</td>
<td>Yes</td>
<td>medium</td>
<td>medium</td>
<td>DDP + Regular</td>
<td>Low/Bad</td>
<td>Some</td>
</tr>
</tbody>
</table>

Figure 5.26 – Comparison of cases

The comparison between the two cases with last mile distribution initiatives also demonstrated rather large differences with respect to how revenue was generated, what value added services that were offered, costs for operating a warehouse, and general market conditions. The main differences are included in figure 5.27.

<table>
<thead>
<tr>
<th>Case</th>
<th>LMD initiative</th>
<th>Source of revenue</th>
<th>Value adding services</th>
<th>Warehouse cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oslo</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Maastrich</td>
<td>Yes</td>
<td>Retailer, Carrier, Supplier</td>
<td>Buffer storage ++, Flexibility++, Reversed logistics+</td>
<td>Low</td>
</tr>
<tr>
<td>Gothenburg</td>
<td>Yes</td>
<td>Municipality (50%), Carrier (30%), Advertisement (20)</td>
<td>Non</td>
<td>High</td>
</tr>
</tbody>
</table>

Figure 5.27 – Comparison of cases

In the following, I discuss and compare the different cases with respect to the different variables. The section presents the variables in the same manner as the previous sections.

5.4.1 Store capacity and receiving conditions

Store capacity was to some extent seen as an issue for the retailers in all of the three cases. Many retailers in Oslo perceived it as valuable to have more space, but whether they were willing to change the current distribution system, and have
goods go directly to a facility for buffer storage, was dependent on the cost. The findings from the questionnaire and the qualitative interviews in Oslo indicated that many receivers saw store capacity as one of the reasons why they ordered in smaller volumes, at higher frequencies. In all the three cases, it was not common for retailers to view floor space as valuable space that usable for product display, rather than storage. Thus the trade-off between paying extra for storage outside the store, to have more floor space for sale was often absent. The only interviewed participant who expressed this view was the shopping mall manager in Maastricht, who saw it as valuable to store goods away from the store, as it both took up space and reduced the image of the stores as goods made the store look untidy.

The findings indicated that the effect of storage space, on delivery frequency, was positive. When retailers got the option to pay for storage of goods close to the city centre, the delivery frequency to each store went down. The reduced delivery frequency thus affected the distribution configuration, making it more consolidated.

The case in Oslo and Gothenburg differed from Maastricht in relation to the possibility of offering storage as a service to the retailers. The fundamental difference is that while a reduced delivery frequency in Maastricht only increased warehouse cost in the total chain incrementally, implementation of a warehouse close to both Oslo and Gothenburg will increase cost to a much larger degree. The difference in costs for the warehouse service in the three cases is discussed in section 5.6 after all the variables have been compared.

5.4.2 Transport price

The findings on transport price agreements in Oslo indicated that it was common that both the suppliers and the receivers paid for transportation of goods to the stores. Very few answered that they only paid transport separate, or only got products delivered DDP. Independently of whether goods where DDP or paid for by the receiver, transportation was in most instances organized by suppliers, meaning that the supplier had engaged in arrangements with different carrier companies, who delivered the products to the retailer. According to Malfliet (2011), the most economically transport price is achieved if either buyer or seller organizes the entire transport.
The findings from the case in Maastricht indicated the existence of an alternative distribution configuration that potentially reduced total transport cost from supplier to receiver. If the buyer of the goods engaged in a DAT agreement (Delivered At Terminal/Named Destination), the goods could be delivered directly at a transit location close to the city for consolidation at a reduced transport price. Since the carrier didn’t drive in to the city, the transport efficiency of the last mile would increase. As the last mile transportation according to Aized and Srai (2014) often make up 13% -75% of the total transport cost, the removal of the last leg could enable transport price negotiations with carriers resulting in lower tariffs. But as argued by Stock and Lambert (2001), it is imperative to evaluate the total cost of the supply chain, not only individual parts. This means that when transport agreements switch from DDP to DAT, there will be an additional warehouse cost. The findings indicate that this warehouse cost differ substantially in Maastricht, Gothenburg, and Oslo, and it will have rather important implications for the last mile transport price. Maastricht offered last mile transportation free to goods receivers, as they were able to collect substantial revenue from other value added services as reversed logistics and buffer storage.

When the case in Gothenburg were put up against Maastricht, both sought to reduce traffic work by increased consolidation of goods, but they differed very much regarding how they “charged” the last mile transport price and collected revenue. In the Gothenburg case, carriers paid the last mile transport price. This means that the additional costs for consolidation were covered by revenue that was already paid to the supply chain. In order to reduce total supply chain costs, transport efficiency the last mile has to increase to a level that offset all cost associated with the operation of the terminal. As carriers only accounted for 30% of the revenue to the initiative in Gothenburg, this didn’t seem to be the situation. If it was, more carriers would most likely make use of the consolidation.

The transport price that needs to be charged for any additional services in Oslo will be many times the price indicated by the case in Maastricht. The difference in warehouse costs, and impact on transport price, will be further discussed in section 5.6.
5.4.3 Retail integration

The findings indicated that better integration between retailers and a carrier (last mile distribution initiative), could have a rather large impact on the distribution configuration, which ultimately could reduce traffic work. In the case in Gothenburg where the last mile distribution initiative only integrated with the carrier, the effect on traffic work reduction to each store was relative small. By focusing more on carriers, it seemed that the initiative failed to consolidate all the goods delivered to the stores, as each store were served by many different carriers. The findings from Maastricht did also demonstrate that degree of retail integration was influenced by another factor, namely the degree of flexibility and degree of value added services. The retailer and the shopping mall manager interviewed in Maastricht stated that they most likely would not increase their level of integration with the chain if all they could obtain were a reduced delivery frequency.

5.4.4 Service

The level of service perceived by the retailers differed in the different cases. While the initiative in Maastricht seemed to increase level of service considerably from the previous distribution configuration, the initiative in Gothenburg seemed to have little impact on service. In some instances, retailers actually experienced a lower service in Gothenburg.

The researched model proposed a relationship between integration, distribution configuration, and service. The findings indicate that when there is little integration with retailers, and the distribution configuration changes, perception of service will in some instances go down. This was contrary to the case in Maastricht, where there seemed to be a high level of integration when distribution configuration were changed. This seemed affect service positively. The perception of service in the case in Oslo, demonstrated that many were satisfied, but that 30-40 % were interested in delivery frequency reductions and additional storage.

5.4.5 Delivery frequency

In the baseline situation, before retailers were given the option of consolidating goods in Maastricht, they received goods at the same frequencies as in Norway. It
also seemed that the retailers in Maastricht, as in Norway, operated with high delivery frequencies as their shops couldn’t receive large shipments due to little storage space. This is rather important, because if the store doesn’t have the possibility to store goods at an additional storage, high delivery frequency is often a necessity to make sure that the store doesn’t experience stock outs. When the retailers were given the option to consolidate goods from different suppliers with the possibility of storage, the delivery frequency went down in all the three cases investigated in Maastricht. In Gothenburg, the findings indicate that the delivery frequency to the stores was impacted to a lesser degree than in Maastricht. The indicator used to compare delivery frequencies were number of units delivered per retailer. The case in Gothenburg had an average ratio of 1.5 units, meaning that 1.5 units were delivered to each retailer on average per delivery. The data from the case in Oslo, indicated that each retailer on average received 4.5 units per delivery. This data is indicative on how delivery frequency were impacted by the initiative, if one takes the assumption that retailers in Gothenburg on average receive the same number of units per delivery. This mean that only around 1/3 of the total deliveries to each store in Gothenburg got consolidated, while Maastricht to a much larger extent managed to reduce delivery frequencies of incoming deliveries to each retailer. As none of the retailers paid for transport costs, the only factor that was different, was the possibility of additional storage in Maastricht. Based on the findings, additional storage, did seem to influence delivery frequency to a relatively high extent, as it made it more attractive to engage in cooperation with the last mile distribution initiative.

5.4.6 Number of operating carrier companies

In all the three cases, it was common that retailers were served by multiple carrier companies. The findings show that only Maastricht were able to reduce the number of operating carriers. In the research model, it was anticipated that this was directly influenced by the distribution configuration, and the findings indicated that the Gothenburg case struggled to a much larger degree to change the distribution configuration. To each of the stores they delivered to, it was common that many other carriers delivered as well. So while Maastricht was able to change the distribution configuration to some stores completely from a direct to
a consolidated distribution configuration, Gothenburg managed this to a smaller degree.

5.5 Reduction of traffic work

This section looks closer into the last output of the research model, namely traffic work. The first part of the chapter looks into the traffic work in the chosen geographical area in Oslo without any last mile distribution initiatives. The second part looks into estimates for traffic work reduction, for two different approaches to last mile distribution. The two approaches are based on how the investigated cases in Maastricht and Gothenburg differed with respect to the research variables.

5.5.1 Estimated traffic work without any last mile initiative

Based on the assumptions previously stated in section 3.4, the total estimated traffic work per day to the 40 retailers in the two shopping streets accumulated to 46 vehicle kilometres.

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Number of retailers consolidating per day</th>
<th>% of retailers consolidating per day</th>
<th>Number of deliveries (vehicles) per day</th>
<th>(E)Traffic work</th>
<th>Traffic work reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1: No consolidation</td>
<td>0</td>
<td>0 %</td>
<td>27</td>
<td>46</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 5.28 – Estimates of traffic work without consolidation

This was seen as relatively high, as the amount of goods delivered per delivery was relatively low. The 121 units delivered to the 40 retailer per day within the area, means that 0.38 kilometres of vehicle traffic was generated to deliver one unit to one retailer, see fig. 5.29.

<table>
<thead>
<tr>
<th>Number of retailers</th>
<th>Number of deliveries</th>
<th>Units delivered</th>
<th>Traffic work</th>
<th>Traffic work/ unit delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>27</td>
<td>121</td>
<td>46</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Figure 5.29 – traffic work per unit delivered

In the following section, I look into how the amount of traffic work potentially can be reduced when a last mile distribution initiative is implemented in Oslo.
5.5.2 Estimates of traffic work with a last mile distribution initiative

This section presents two different scenarios based on how Maastricht and Gothenburg differed with respect to how they operated the last mile distribution initiative. The main difference seen as relevant for the analysis, is the distinction between buffer storage. The retailers in scenario 2 are not offered buffer storage, while the retailers in scenario 3 are offered buffer storage. The implication, is that amount of goods consolidated to each retailer varies considerably. In scenario 2, only 33% of the deliveries per retailer is consolidated. In scenario 3, 100% of the deliveries to each retailer is consolidated. Based on the estimates, the biggest reduction in traffic work is achieved when the last mile distribution initiative offers the retailers a warehouse service, in addition to consolidation. The reduction in traffic work for the two scenarios is presented in figure 5.27

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Number of retailers consolidating per day</th>
<th>% of retailers consolidating per day</th>
<th>Number of coll. consolidated per day</th>
<th>Number of deliveries (vehicles) per day</th>
<th>(E)Traffic work</th>
<th>Traffic work reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1: No consolidation</td>
<td>0</td>
<td>0 %</td>
<td>0</td>
<td>27</td>
<td>46</td>
<td>-</td>
</tr>
<tr>
<td>Alternative 2: no buffer storage</td>
<td>10</td>
<td>25 %</td>
<td>10</td>
<td>26</td>
<td>44</td>
<td>5 %</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>50 %</td>
<td>20</td>
<td>24</td>
<td>40</td>
<td>13 %</td>
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<td></td>
<td>30</td>
<td>75 %</td>
<td>30</td>
<td>21</td>
<td>36</td>
<td>21 %</td>
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<td></td>
<td>40</td>
<td>100 %</td>
<td>41</td>
<td>19</td>
<td>32</td>
<td>29 %</td>
</tr>
<tr>
<td>Alternative 3: buffer storage</td>
<td>10</td>
<td>25 %</td>
<td>30</td>
<td>21</td>
<td>36</td>
<td>21 %</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>50 %</td>
<td>61</td>
<td>15</td>
<td>25</td>
<td>46 %</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>75 %</td>
<td>91</td>
<td>8</td>
<td>13</td>
<td>71 %</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>100 %</td>
<td>121</td>
<td>1</td>
<td>2</td>
<td>96 %</td>
</tr>
</tbody>
</table>

5.30 – Reduction of traffic work

The logic behind the difference seems to be that that when the retailer is offered an additional warehouse service, integration increases to a larger degree than when only consolidation is offered. As integration increased, there seemed to be a positive relationship with willingness to consolidate all incoming deliveries. Without the warehouse service, the receiver of the goods had fewer incentives to increase involvement, as the only benefit from the involvement was reduced amount of deliveries from different carriers. Based on the findings from the two cities, it thus seemed to be a trade-off between number of stores to serve, and how much to consolidate per store. While Maastricht served 30 retailers and
consolidated a large degree of the incoming deliveries to each retailer, 
Gothenburg served 200 retailers and consolidated fewer of the total deliveries to 
each retailer. Based on the findings in this thesis, it seems that the highest amount 
of traffic can be reduced in a scenario where the retailers are offered additional 
storage, because this increase the involvement in supply chain planning to a larger 
extent, than when retailer are not offered additional storage.

5.6 Impact of consolidation on supply chain costs

The three cases demonstrate that the cost for reducing traffic work through 
consolidation will differ rather much based on where goods are consolidated. In 
figure 5.31, costs per square meter for a warehouse (only floor storage, no rack 
storage), shows how much more an additional warehouse in Oslo will costs. Oslo 
1 depicts cost for renting a warehouse with similar size as the initiative in 
Gothenburg. Oslo 2 depicts warehouse costs for renting a facility with the same 
size as in Maastricht.

<table>
<thead>
<tr>
<th>Case</th>
<th>Price/sqm per year</th>
<th>Size sqm</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maastricht</td>
<td>216</td>
<td>1000</td>
<td>216 000</td>
</tr>
<tr>
<td>Gothenburg</td>
<td>400</td>
<td>400</td>
<td>160 000</td>
</tr>
<tr>
<td>Oslo 1</td>
<td>1000</td>
<td>400</td>
<td>400 000</td>
</tr>
<tr>
<td>Oslo2</td>
<td>1000</td>
<td>1000</td>
<td>1 000 000</td>
</tr>
</tbody>
</table>

Figure 5.31 – warehouse costs

The case investigated in this thesis consisted of 40 retailers, whom on average 
received 121 units per day. The case in Gothenburg demonstrated that 400 square 
meters was a necessity for consolidating 300 units per day. The case in Maastricht 
demonstrated that 1000 square meter was a necessity for consolidating + storage 
to 30-40 retailers receiving 300-350 units per week. In order to strictly 
consolidating 121 units per day destined for “my” geographical area in Oslo, it is 
necessary to operate a warehouse of approximately 200 square meters. Thus, the 
additional warehouse rent cost per year will be roughly 200 000 NOK. The 
fundamental question is how and where to collect revenue to cover these costs.

Under the assumption that 121 units are strictly consolidated per day, it is 
however not correct to use the sample of 40 retailers investigated in this thesis as a
revenue source. This is because when only consolidation were offered to retailers, it seemed less likely to consolidate all deliveries to each store. The case in Gothenburg who only consolidated, delivered on average 300 units to 200 retailers per day. Thus, it is more appropriate to calculate with the assumption that the 120 units per day should be delivered to 120 retailers in Oslo.

The ratio between units delivered and retailers served, will most likely impact transport costs. In general, the more retailers served per given amount of units, the higher the costs will be (e.g. more time has to be spend per unit delivered due to driving, walking, talking, etc.).

In the case in Oslo with 40 retailers, assuming all units were delivered to the 40 retailers, 3 units could be delivered per delivery, compared to 1 unit per delivery when 120 retailers are served. This means that transport costs in case where there doesn’t exist additional buffer storage, will be 60-70% higher due to the additional time it takes to deliver the same amount of units.

Based on the findings from the questionnaire in Oslo, 30% of the sample (12 retailers), saw it as interesting to pay for storage. Payment for storage and transport in Maastricht was 300 NOK per month. Only looking at the 40 retailers in this research, the 12 retailers interested, would per year contribute with 43 200 NOK in revenue to the LMD initiative, assuming a price 300 NOK per month for warehouse and transport. By scaling the numbers up to compare with Maastricht, it is possible to see how many retailers that have to use the (LMD) initiative in order cover the warehouse costs. As can be seen in figure 5.32, 280 retailers need to pay a monthly fee of 300 NOK for storage + delivery, to cover the warehouse costs of 1M NOK.

<table>
<thead>
<tr>
<th>Retailers</th>
<th>Number of units delivered to retailers /day</th>
<th>Revenue buffer storage per month incl. Transport’</th>
<th>Buffer Storage revenue per year</th>
<th>Warehouse cost</th>
<th>Revenue - Warehouse costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>121</td>
<td>12000</td>
<td>144000</td>
<td>-1 000 000</td>
<td>-856 000</td>
</tr>
<tr>
<td>80</td>
<td>242</td>
<td>24000</td>
<td>288000</td>
<td>-1 000 000</td>
<td>-712 000</td>
</tr>
<tr>
<td>120</td>
<td>363</td>
<td>36000</td>
<td>432000</td>
<td>-1 000 000</td>
<td>-568 000</td>
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<tr>
<td>160</td>
<td>484</td>
<td>48000</td>
<td>576000</td>
<td>-1 000 000</td>
<td>-424 000</td>
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<td>200</td>
<td>605</td>
<td>60000</td>
<td>720000</td>
<td>-1 000 000</td>
<td>-380 000</td>
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<tr>
<td>240</td>
<td>726</td>
<td>72000</td>
<td>864000</td>
<td>-1 000 000</td>
<td>-136 000</td>
</tr>
<tr>
<td>280</td>
<td>847</td>
<td>84000</td>
<td>1008000</td>
<td>-1 000 000</td>
<td><strong>8 000</strong></td>
</tr>
</tbody>
</table>

Figure 5.32 – Revenue/costs
The entire area of Grunerløkka depicted in figure 4.3, consisted of 350 retailers/shops. Based on the estimates for willingness to pay for warehouse service (30%), 105 retailers could be willing to increase their involvement in supply chain planning, and pay for additional storage. Thus, the number of retailers in the chosen case in Oslo is not enough to cover the cost for a distribution initiative similar to the one in Maastricht. In order to cover costs, the size of the sample should based on the estimates be 934 retailers (280/0.30). This is roughly three times as many as the total number of retailers at Grunerløkka.
6. Conclusion

The findings in this thesis show that increased involvement of retailers in supply chain planning, can influence distribution configuration from the current configuration (many deliveries from different carriers), to a more traffic “friendly” last mile solution, where goods are consolidated before delivered.

The willingness to get involved in supply chain planning is however based on which benefits the retailer obtains from the involvement. The findings from the cases in Maastricht and Gothenburg highlight an important difference. The potential reduction in last mile traffic, seems to be highly dependent on whether the retailers are offered additional storage space close to the shop, in combination with a distribution service that exhibits a high degree of integration with the retailer. Retailers that were offered additional storage at a relatively low price in Maastricht, consolidated more of their incoming goods than the retailers in Gothenburg. This demonstrated that storage space had a rather strong impact on delivery frequency to each retailer.

Findings in this thesis do however show large differences in warehouse costs for the different cases. This makes the problem of last mile distribution more complicated than current literature often indicates. The best way to achieve a traffic work reduction, will after my opinion, be to establish a consolidation centre in combination with storage facilities. As price per square meter is relatively high in Oslo, goods should to be stored in racks, not on the floor as in Maastricht. Public funding, if planned, should help to cover warehouse costs, and ensure a large enough space to attract carriers and suppliers to make use of the service. If the solution reach a sufficient size, I see it as likely that transport agreements could gradually change from DDP to DAT, which could increase the transport efficiency for the last mile distribution.
7. Further research

It would be interesting for future research to look closer into how retailers and a last mile distribution initiative, could make use of new IT solutions to increase the attractiveness, and the transport efficiency, of a last mile distribution terminal outside the city centre. IT was one of the drivers of transport efficiency in fig.2.2 that was excluded from this research. FedEx and UPS, have co-created a solution called “TrackPin”, which makes it possible for carriers to deliver at unmanned locations, as they make us of one time access codes integrated with pad locks. The future research could then e.g. investigate to what extent carrier companies could be interested in delivering goods during the night at an unmanned location when traffic on the roads are minimized. The implication would be that less time was spent in traffic, which ultimately could mean that transport tariffs to suppliers and retailers could be reduced. As previously discussed regarding transport agreements, the change from DDP to DAT, could be an interesting consideration to look closer into, as a the last mile distribution initiative, with e.g. unmanned receiving areas at night, could improve the value offering to the chain as a whole.

Another research area seen as interesting relates to the cooperation between independent retailers and the last mile distribution initiative. Could there e.g. be created a centralized procurement function at the terminal, that “consolidate” orders to the same supplier from different retailers? Could the consolidation terminal e.g negotiate better transport agreements for the retailers? .

Both these concepts could potentially reduce traffic work, and at the same time reduce transport costs in the supply chain. They are most likely difficult to implement with the technology that exist today, but as technology advances, it is seen as interesting to look closer into how technology can improve last mile distribution and improve the city both for inhabitants, and distribution companies who operate under tough conditions to make the city function on a day to day basis.
8. References


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9. Appendix

Appendix 1 - Delivery frequency and volumes to retailers in Oslo

<table>
<thead>
<tr>
<th>#</th>
<th>Industry</th>
<th>Average number of deliveries per week</th>
<th>Average volume (colli) received per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Groceries</td>
<td>1,5</td>
<td>22,5</td>
</tr>
<tr>
<td>2</td>
<td>Restaurant</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>shoes</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Cosmetics/toilet products</td>
<td>1,5</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>Clothes</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td>Cosmetics/toilet products</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Hobby</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>8</td>
<td>Clothes</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>9</td>
<td>shoes</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>10</td>
<td>music</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>11</td>
<td>flowers</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>12</td>
<td>Kafé</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>books</td>
<td>1,5</td>
<td>1,5</td>
</tr>
<tr>
<td>14</td>
<td>Clothes</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>optical products</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>16</td>
<td>Furniture/Interior</td>
<td>1,5</td>
<td>4,5</td>
</tr>
<tr>
<td>17</td>
<td>shoes</td>
<td>1,5</td>
<td>9</td>
</tr>
<tr>
<td>18</td>
<td>Clothes</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>19</td>
<td>optical products</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>20</td>
<td>Clothes</td>
<td>1,5</td>
<td>9</td>
</tr>
<tr>
<td>21</td>
<td>Furniture/Interior</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>22</td>
<td>shoes</td>
<td>1,5</td>
<td>4,5</td>
</tr>
<tr>
<td>23</td>
<td>Others</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>24</td>
<td>Clothes</td>
<td>0,5</td>
<td>15</td>
</tr>
<tr>
<td>25</td>
<td>Cosmetics/toilet products</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>26</td>
<td>Furniture/Interior</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>27</td>
<td>Gold/Silver products</td>
<td>1,5</td>
<td>1,5</td>
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<tr>
<td>28</td>
<td>Cosmetics/toilet products</td>
<td>1,5</td>
<td>22,5</td>
</tr>
<tr>
<td>29</td>
<td>Hobby</td>
<td>0</td>
<td>0</td>
</tr>
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<td>Clothes</td>
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<td>12</td>
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<tr>
<td>31</td>
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<td>1,5</td>
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<tr>
<td>32</td>
<td>Clothes</td>
<td>15</td>
<td>90</td>
</tr>
<tr>
<td>33</td>
<td>Others</td>
<td>6</td>
<td>90</td>
</tr>
<tr>
<td>34</td>
<td>shoes</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>35</td>
<td>Furniture/Interior</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>36</td>
<td>Others</td>
<td>0,5</td>
<td>15</td>
</tr>
<tr>
<td>37</td>
<td>shoes</td>
<td>0,5</td>
<td>1,5</td>
</tr>
<tr>
<td>38</td>
<td>Others</td>
<td>1,5</td>
<td>4,5</td>
</tr>
<tr>
<td>39</td>
<td>Cosmetics/toilet products</td>
<td>1,5</td>
<td>1,5</td>
</tr>
<tr>
<td>40</td>
<td>Furniture/Interior</td>
<td>1,5</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>162</td>
<td>726</td>
</tr>
<tr>
<td></td>
<td>Per day</td>
<td>27</td>
<td>121</td>
</tr>
</tbody>
</table>
Appendix 2 - Self-completion questionnaire

1) What is your job description?
   o Store owner
   o Manager
   o Procurement manager
   o Fulltime employee
   o Part time employee

2) In what industry does your store operate?
   o Restaurant
   o Cafe
   o Kiosk
   o Clothes
   o Furniture/interior
   o Cosmetics/toilet products
   o Hairdresser
   o Gold/silver products
   o Books
   o Shoes
   o Flowers
   o Pharmacy
   o Bakery
   o Optical products
   o Healthcare products
   o Music
   o Pub
   o Others;

3) Is your store organized in a chain structure, or does it operate independently?
   o Chain
   o Independent

4) Are you satisfied with the delivery of goods to your store today?
   o Yes
   o No

5) How often do you on average receive deliveries?
   o 2-3 times per day
   o 1 time per day
   o 3-5 times per week
   o 1-2 times per week
   o 1-3 times per month
   o < 1 time per month

6) How many Colli do you receive on average per delivery?
   o 1 Colli (1- 35 kg)
   o 2-4 Colli
   o 5-7 Colli
   o > 7 Colli
   o 1 Euro pallet (200-800 kg)
2-3 Euro pallets
> 3 Euro pallets

7) How many different carriers deliver to your shop on average per week?
   - 1
   - 2
   - 3
   - 4
   - 5
   - >5
   - I don't know

8) Are you familiar with the names of the carriers who deliver to your shop? Please specify as many as you know

9) Do you pay for products included transport price ("Free In Store"), or do you pay the transport price separate?
   - Products are "Free In Store"
   - Transport price is paid separate
   - Combination of "Free In Store" and separate transport price
   - I don't know

10) Are the deliveries to your store performed at specific days of the week?
    - Yes
    - Yes, but only for larger shipments. Smaller shipments are delivered based on need
    - No

11) Do you see any problems with the current delivery system to your store? Are there anything in particular you would like to change?

12) Do you see it as valuable to receive deliveries early in the morning?
    - Yes
    - No

13) Does your store sell products online, as well as from the physical store?
    - Yes
    - No, only sales through store

14) What agreements does your store have regarding outbound shipments?
    - No agreements for outbound deliveries
    - Differentiated discount from carrier, dependant on volume
    - Regular transport agreement without discounts

15) Where does your goods come from?
    - From suppliers in the Oslo area.
    - From suppliers outside Oslo (in Norway)
    - From suppliers outside Norway
    - From centralized warehouse

In several european big cities, many stores have taken a more active role in logistics planning.
Instead of the goods being delivered directly to the store, they are instead delivered first to
transit location/warehouse close to the city. This inventory can provide a variety of additional services. Try as best as you can to answer whether the subsequent additional services are interesting for your shop

16) Does your store perceive an additional short/long term warehouse service as interesting, assuming your shop only pay per pallet used? Goods are delivered to store when needed
   o Interesting
   o Maybe interesting
   o Not interesting

17) Assuming you have an online store, do you perceive a service that offers order picking, as well as direct outbound shipments to customers, as interesting?
   o Interesting
   o Maybe interesting
   o Not interesting

18) Does your store perceive a reversed logistics service that takes care of different types of waste (e.g. paper/plastic) as interesting?
   o Interesting
   o Maybe interesting
   o Not interesting

19) Does your store see it as interesting to get a reduced number of deliveries per week?
   o Interesting
   o Maybe interesting
   o Not interesting

20) How important do you think it is that pollution is reduced as an effect of a more environmentally friendly distribution system?
   o Very important
   o Important
   o Not important
Appendix 3 – Interview guide Maastricht

Interview guides Maastricht

Interview «guide» – Binnenstadservice in Maastricht

1) How is the last mile distribution situation in the city of Maastricht? Many different carrier companies?
2) How many different retailer use the consolidation service at Binnenstadservice?
3) Who do you cooperate with?
4) Have retailers increased their involvement in supply chain planning after they started to work with the Binnenstadservice?
5) What value added service do you offer to the retailers?
6) Where does the carriers originate from?
7) How much do you pay for the warehouse?
8) How many units do you consolidate per week/day?
9) Do you use an IT system?
10) What parts of the business generate most revenue?
11) Do you also work with suppliers and carriers?

Interview guide retailers Maastricht

1) Why do you use the consolidation service?
2) Do you see any problems with the service?
3) How did you receive deliveries before the consolidation service?
4) How many carriers deliver to your store per week?
5) How many deliveries do you get in the new consolidated solution?
6) Would you increase involvement if consolidation were the only service?
7) Do you see it as beneficial for the store to receive goods in an environmentally friendly way?
8) Do customers care about how goods are delivered to the store?
9) Does goods often stand in the way for customers?
Appendix 4 – Revenue retail industries

<table>
<thead>
<tr>
<th>Product category</th>
<th>Revenue (1000 NOK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groceries</td>
<td>36 358 382</td>
</tr>
<tr>
<td>Pharmaceutical products</td>
<td>14 154 791</td>
</tr>
<tr>
<td>Vine &amp; Liquer</td>
<td>12 642 880</td>
</tr>
<tr>
<td>Clothing</td>
<td>8 125 769</td>
</tr>
<tr>
<td>Hardware</td>
<td>7 543 754</td>
</tr>
<tr>
<td>Fuel</td>
<td>2 679 328</td>
</tr>
<tr>
<td>Furniture</td>
<td>2 638 800</td>
</tr>
<tr>
<td>Books</td>
<td>1 272 448</td>
</tr>
<tr>
<td>Cosmetics</td>
<td>980 212</td>
</tr>
<tr>
<td>Shoes</td>
<td>619 447</td>
</tr>
<tr>
<td>Decoration</td>
<td>502 758</td>
</tr>
<tr>
<td>Computers</td>
<td>493 905</td>
</tr>
<tr>
<td>Sport equipment</td>
<td>490 690</td>
</tr>
<tr>
<td>Total</td>
<td>88 503 164</td>
</tr>
</tbody>
</table>

Appendix 5 – Volumes traded in Oslo

<table>
<thead>
<tr>
<th>Partial shipments (stykkgods)</th>
<th>Volume 1000 ton (Oslo)</th>
<th>Volume 1000 ton (Oslo city)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groceries consum</td>
<td>1259</td>
<td>252</td>
</tr>
<tr>
<td>Beverages</td>
<td>270</td>
<td>54</td>
</tr>
<tr>
<td>High value products</td>
<td>638</td>
<td>128</td>
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<tr>
<td>Live animal</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Construction</td>
<td>638</td>
<td>128</td>
</tr>
<tr>
<td>Div partial shipments (intermediate goods)</td>
<td>416</td>
<td>83</td>
</tr>
<tr>
<td>Div partial shipments (consumer goods)</td>
<td>1995</td>
<td>399</td>
</tr>
<tr>
<td>Wood</td>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>5246</td>
<td>1049</td>
</tr>
</tbody>
</table>

| Groceries consum              | 1259                   | 252                         |
| High value products           | 638                    | 128                         |
| Div partial shipments (consumer goods) | 1995 | 399                       |

| Groceries consum              | 24 %                   | 24 %                        |
| High value products           | 12 %                   | 12 %                        |
| Div partial shipments (consumer goods) | 38 %               | 38 %                       |
## Appendix 6 Receiving orders Maastricht

### Ritlijst binnenstadservice

<table>
<thead>
<tr>
<th>Reclame</th>
<th>Ophalen</th>
<th>Retour</th>
</tr>
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<tbody>
<tr>
<td>3236</td>
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<td></td>
</tr>
<tr>
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</table>

<table>
<thead>
<tr>
<th>BEDDIJK</th>
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</tr>
</thead>
<tbody>
<tr>
<td>LIETEN</td>
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### De Toffers Mode

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<th>Retour</th>
</tr>
</thead>
<tbody>
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<td></td>
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Appendix 7 Interview guide Stadsleveransen

“Interview guide Stadsleveransen”

1) How is the last mile distribution situation in the city of Gothenburg? Many different carrier companies?
2) How many different retailers use the consolidation service?
3) Who do you cooperate with?
4) Have retailers increased their involvement in supply chain planning after they started to work with the Stadsleveransen?
5) What value added service do you offer to the retailers?
6) Where does the carriers originate from?
7) How much do you pay for the warehouse?
8) How many units do you consolidate per week/day?
9) Do you use an IT system?
10) What parts of the business generate most revenue?
11) Do the initiative plan to expand to other parts of the city?
12) Do retailers like to get deliveries from Stadsleveransen?
13) Is self-sufficient operations the ultimate goal?
Oslo, 26/08-2015

Agreement regarding sharing of rights concerning “Preliminary Thesis”

It is agreed upon that the rights to the “Preliminary Thesis” is shared 50/50 between Henrik Eriksen (0892504) and Bjørn Staavi (0876431).

Bjørn continue to research the topic in the preliminary thesis, and Henrik choose a new theme for the master’s thesis.

Bjørn Staavi

Henrik Eriksen
Preliminary Thesis Report
BI Norwegian School of Management

-Sustainable Investments in Posten Norge-

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Bente Flygansvær

Campus:
BI Nydalen
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This preliminary thesis considers a real world problem of investigating the consensus between top management and postal drivers attitudes towards sustainable supply chain practices at Posten Norge, and a problem of analyzing if Posten’s new electronic vehicle distribution systems is sustainable. The analysis of the distribution system will compare the old conventional diesel fueled system with a more green electrically driven system. The problem was introduced by Posten Norge, as they were not sure what the total costs and efficiency of their new distribution system was, as well as whether they should continue to expend their focus on more sustainable green transportation methods as they were unaware what this would do to their competitiveness.

Reducing the impact humans have on the environment is a major priority for many governments. The Norwegian government has implemented mandatory requirements that all state owned companies have to use nonpolluting distribution modes by 2020. Therefore, we see the need for research on this topic as it may demonstrate important findings green logistics can have on the general supply chain competitiveness.

Several models will be used when evaluating Posten’s sustainable distribution strategy and system. Literature on sustainability will be used as a framework when investigating Posten’s involvement in green initiatives. Theory on firm competitiveness, the value chain (Porter, 1985) will be used as a framework for explaining how companies can stay sustainable in the long run, literature on distribution networks will be included, as well as previous studies that have tried to measure change in logistics cost efficiency.

The findings regarding employee attitudes will hopefully show whether Posten’s sustainability strategy is well adopted within the company. The findings from the distribution analysis will show if the change in the distribution system is sustainable. Hopefully this will enable us to give recommendations to whether they should continue their shift towards a more green sustainable distribution system.
1 Introduction

1.1 Background information

Environmental technology stands as focal point for the EU’s main focus for improving the environment. Use of petrol and diesel cars on the shorter routes in cities should to be halved by 2030 and phased out before 2050 (toi 2014). It is expected that this will have implications for the Norwegian distribution industry. As a response to the climate focus in EU, the Norwegian government has stated in their climate plan “klima-kur 2020” that the public sector needs to drive Co2 free, or climate neutral cars within 2020 (foa 2010).

For businesses that focus on being more sustainable, reduction of CO2 emissions is most frequently viewed as the primary initiative one can take to be sustainable. In Norway, 30 percent of the greenhouse gas emissions, 85 percent of the noise nuisance, and about 65 percent of the NOx-emissions comes from transportation (Samferdselsdepartement 2013).

Historically, environmental management was perceived as a threat to competitive advantage due to the entailed additional costs. However, some have started to argue that firms can improve their competitiveness by incorporating the natural environment and its constraints into their business strategies (Hart 1995, Melissa and Lenita 2007, Porter and Linde 1995).

The discussion on environmental issues was first raised in Stockholm in 1972, when UN had their first climate meeting. The result from this establishment was UN’s environmental program UNEP, and today, we are still celebrating the world’s climate day every year on the 5th of June.

The focus on sustainable development has been present since United Nations and the World Commission lead by Gro Harlem Brundland defined sustainable development to be “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Harlem 1987).
Posten Norge is a public logistic service provider, fully owned by the Norwegian government. It employs over 20,000 employees all over Norway (Posten 2014). The company handled over 2,07 billion letters, and 37,8 million packages in 2014 (Posten 2014). Posten Norge have monopoly on delivering letters and packages with weight below 0,5 kg. This monopoly is of today under revision. The EU Postal Legislation is determined to remove monopoly on postal services to secure that an efficient, reliable and good-quality postal services are available through the European Union.

Posten Norge meets the market demand with two different divisions. Posten Norge, and Bring. Posten Norge serves the private customer market, and they have responsibility for the daily mail distribution and all of the postal offices in Norway. To meet the demand from the business market, Posten Norge has established BRING. Bring is a result of several acquisitions over a time period of 10 years (Posten 2014).

As a governmentally owned company, Posten Norge is expected to be a pioneer within environmentally friendly solutions. Posten Norge sees environment as the concerns most important focus within their social responsibility. As one of Scandinavia’s biggest logistic service providers, Posten Norge has a big impact on the environment when it comes to CO2-emissions. In Norway, carbon dioxide (CO2) emission was 82 per cent of the total greenhouse gasses (Miljøstatus 2014), and the road freight distribution contributes with 57 per cent of the worlds total CO2 emissions (Dey, LaGuardia, and Srinivasan 2011) Road freight is therefore maybe one of the most important aspects to consider for Posten Norge when improving their green supply chain.

Due to the impact of CO2 emissions, and as a part of their environmental strategy, Posten Norge has renewed their distribution fleet substantially since 2009. Over the last 5 years, Posten Norge has renewed their car park to a more environmentally friendly distribution fleet. With incentives from the Norwegian government, they become a leader in the Norwegian market in environmental sustainability. As a governmentally owned business, Posten Norge has the financial backup, and the right incentives to be able to become an environmental friendly business.
From 2009 to 2013, Posten Norge had invested in the biggest electric vehicle park in Norway, with 335 electric mopeds, 239 Electric Jeeps, 24 Electric cars, and 163 Electric trolleys. In total, they had over 761 Electric vehicles. Their strategy of a more environmental friendly business has in 2014, lead to a reduction from 4500 to 3500 petrol driven cars. (Posten 2014)

The increasing importance of sustainability in logistics has therefore drawn us towards looking at the sustainability of the supply chain in Posten Norge.

1.2 Problem Statements

This chapter presents the problems, which are divided into two main parts, an overall sustainability strategy problem, and a distribution network problem. Each problem will be described thoroughly. After the problems are described more detailed, we will present a research questions for each of the problems, as well as several sub-questions that we want to address. These questions are all related to the problems of sustainability in logistics, and we see the need to find even more literature that helps us increase the list of relevant sub-questions.

1.2.1 Sustainability strategy problem

Three megatrends stimulate the need for sustainable development: declining resources, radical transparency and increasing expectations. These trends become a significant market force that alters competition (Laszlo and Zhexembayeva 2011).

For Posten Norge, which is Scandinavia’s biggest logistics service provider, many problems can occur when implementing sustainable strategies. There is a long way from the warm executives offices to the cold electric mopeds that distribute mail in Norway. Therefore, it is interesting to investigate if the entire organization feels organizational commitment to the sustainable changes.
The first preliminary research question addressing the problem of implementing sustainability in organizational culture is therefore:

“Is top management, and postal drivers perception on green logistics initiatives aligned?"

1.2.2 Distribution network problem

Understanding how sustainable investments in the transportation fleet of cars, could change competitiveness is important. As for any investment, it is important to be aware of what the return on the investment will be.

In the case of transportation, especially for logistic service providers, their main concern has been to ensure reliability for a low price(Christopher 2005). It is therefore interesting to see how sustainable investments in the car fleet may have affected the two most cited concerns, namely price and reliability. In addition we see the need of evaluating other important factors as well.

The research question addressing the problem with the distribution system is therefore:

“Is the investment in a new environmentally friendly distribution system sustainable according to logistic sustainability theories?”

Some sub-questions to be able to answer the research question is:

- Have Posten Norges lead times to customers increased?
- Have employee satisfaction changed?
- Have Posten changed the routing system?
- Is the changes accepted and integrated with the drivers?
- How does the sub suppliers feel about the sustainability investment?

1.3 Limitations

Investigating all three aspects of the triple bottom line, namely environment, financial, and social aspects could be to broad for a master thesis report. Instead, just focusing on two layers, could allow the analysis to be more accurate and
useful. After thoroughly investigating literature about the sustainability concept, and also assessing Posten’s overall sustainability strategy, we see that it might be a possible solution to exclude the environmental scope of sustainability. This can be justified because Posten is in many ways a leader in its class when it comes to focusing on the environment. We will therefore just focus on the Financial, and the Social aspect of the sustainability framework.

1.4 Purpose of the thesis

The results of the thesis will be recommendations for how Posten, as well as other distributors, can plan for a competitive sustainable distribution system.

In order to achieve this goal, several factors will be analyzed, shedding light on the complex implementation process of making the distribution system as green as possible. Analyzing the overall sustainability strategy of Posten in accordance to relevant literature on sustainable supply chain management, as well as analyzing a small fraction of their distribution system. More particularly, we will look at their investments in an electric/environmental distribution fleet, measuring cost efficiency on the system before and after the investments. This will hopefully give us enough information, so that we can draw reasonable conclusions, and potentially give recommendations when investing more in the green distribution system.

2 Relevant literature and theory

At the broadest level, the main subject of this thesis will be about sustainable supply chain management in Posten Norge. This means that literature and theories about supply chains will be relevant, literature on the sustainability concepts is of interest as well as frameworks on how to implement sustainability in supply chain, theory on distribution system is also of interest since the Posten Norge is a logistic service provider.

When starting to investigate the literature involving sustainability in logistics, we soon found out that this is a heavily investigated area. Based on a literature review performed by Craig and Easton (2011), there has been an increase in the logistics
academic literature. The studies of sustainability rose from 0% in the 1991-2000 period to 25% in 2001-2010 period (Craig and Easton 2011). According to Seuring and Müller, the main focus on sustainability research has been on the environmental aspect. As Carter and Easton point out, Seuring and Müller also see a pattern of increasing research around sustainability on logistics the from 1991-2014. (Seuring and Müller 2008)

2.1 Sustainability

By definition, sustainability takes many different forms. The Brundtland Report (WCED 1987) defined sustainable development as;

“Development that meet the needs of the present without compromising the ability of future generations to meet their needs”

This definition is very general, and current literature states that many companies struggle to incorporate this definition into their daily operations. (Kemp, Parto, and Gibson 2005). The main reason is that they do not know how to actually measure their green initiatives, and consequently, measure the effect of the initiatives. Many studies have therefore been developed to help companies change their supply chains into more sustainable green supply chains. (Kemp, Parto, and Gibson 2005)

From our literature review, we encountered numerous definitions of sustainability. Jonathan Scott has defined the concept in two ways we believe to be good in a business context (Scott 2013):

1) In business context, sustainability involves the processes and actions that keep a firm solvent over time

2) Sustainability is about reducing expenses, including future expenses in every conceivable form so as to facilitate profitability, competitiveness, and longevity

Yet another definition from Srivastava highlights other relevant factors important for the sustainable company (Srivastava 2007):

The potential for reducing long-term risks associated with resource depletion, fluctuations in energy costs, product liabilities, and pollution and waste management”
From our literature review, we have read several articles discussing what sustainability is, and how it should be implemented into supply chain management. From a large-scale literature review, done by Carter and Rogers (Carter and Rogers 2008), the concept of “The Tripple Bottom” line is proposed as the consensus of what sustainability actually encompasses. The “Tripple Bottom Line” is a concept developed by John Elkington (Elkington 1999, 2004), and consists of the three concepts; social factors, financial factors, and environmental factors.

Based on the literature review from Carter and Rogers, there are four other supporting facets of the triple bottom line that were not included in earlier definitions; Risk management, transparency, strategy and culture. From these “new” supporting facets, we want to explore the facet “culture” and risk management in Posten Norge.

In Elkington’s article “enter the triple bottom line” (Elkington 2004) he looks at seven different drivers towards sustainability, and describe these as “sustainability revolutions”. We see these drivers as important, but we think that the five drivers in the article “drivers of sustainable supply chain management” (Mann et al. 2010) are more precise. The drivers are classified into five categories. The first to are external to business; Legislation, environmental drivers and the latter three are internal to business; i.e. financial drivers, internal business process drivers and the drivers related to the customers. (Mann et al. 2010)
In relation to Posten Norge, and every logistic service provider, it is therefore important to be aware of these drivers, and acknowledge that there are several drivers that need focus to obtain sustainability.

To be successful in operating sustainable, (Pagell and Wu 2009) point out two unique common themes for successful companies that are able to operate sustainable:

1) Financial goals and environmental goals are aligned, and
2) Supply management has a deep social dimension and is integral to the organizational culture that attracts and retains dedicated employees and suppliers.

Literature from Van Hoek and Johnson states that economic performance consideration, and not environmental and social performance, still largely drives organizational decision-making (van Hoek and Johnson 2010).

It will therefore be interesting to investigate what is most valued in Posten’s distribution system.

If a company successfully manage to combine the three concepts in the triple bottom line (Economic, social, environmental), Carter and Rogers (2008) argues that it exist several economic advantages that a company can obtain:

- Cost savings due to reduced packaging waste, and the ability to design for reuse and disassembly
- Reduced health and safety costs, and lower recruitment and labor turnover costs resulting from safer warehousing and transportation and better working conditions
- Lower labor costs – Better working conditions can increase motivation and productivity, and reduce the absenteeism of supply chain personnel
- Proactively shaping future regulations - companies that proactively address environmental and social concerns can influence government regulations when this regulations is modeled after a company’s existing production and supply chain process, leading to a difficult to replicate competitive advantage for companies and their suppliers
- Reduced costs, shorter lead times, and better product quality associated with the implementation of ISO 14000 standards, which provide a framework for environmental management systems.

- Enhanced reputation – engaging in sustainable behavior can make an organization more attractive to suppliers and customers, to potential employees, and to shareholders.

By looking at these potential benefits, there are huge benefits for companies that pursue sustainability as a strategy, and as Dey et al. states “Firm runs a major financial risk by not conforming to sustainability” (Dey, LaGuardia, and Srinivasan 2011)

Much of the literature have argued that sustainability no longer can be about these potential benefits, because there is so much pressure on the corporation to conform to external pressure. As mentioned by Mann et.al, i.e. legislation is a major driver for many corporations in the 21st century. “As the mother of all drivers, the legislation leaves no option for a firm to comply with it, or to exit the market” (Mann et al. 2010). As in the case with Posten Norge, the Norwegian government has demanded that all governmentally owned companies must comply with the regulation of a Co2 free distribution systems within 2020

Wong and Avry argues that sustainability goes beyond the triple bottom line of social, environmental, and financial performance of triple bottom line. Changing organization to be sustainable in the long is not simply about putting ticks on the ISO 14001 report. An organization must exist with intent, that is, sustainability should be the intent of the entire existence of an enterprise (Wong and Avery 2008). This means that the entire Posten Corporation need to be aligned with the sustainability strategy.

In addition to theory on sustainability, we also see the need for logistic theory, as well as strategic frameworks that describes the functions of Posten Norge’s supply chain, to be able to understand if sustainability strategies provides Posten with a competitive advantage.
2.2 Logistics

“Logistics is the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profits ability are maximized through the cost effective fulfillment of orders” (Christopher 2005, 4)

2.3 Supply chain management

“Supply chain management is a wider concept than logistics. It is not only related to move and position inventory, but also deal with the relationship between actors in supply chain, i.e. supplier, customers, and the organization itself. The goal is providing all parties in the chain with a more profitable outcome” (Christopher 2005, 5).

In order to understand how a company can improve its supply chain, a much-appreciated framework, is the value chain introduced by Michal Porter (1985) (see figure 2). The idea of the value chain is based on the process view of organizations, the idea of seeing a manufacturing (or service) organization as a system, made up of subsystems each with inputs, transformation processes and outputs. Inputs, transformation processes, and outputs involve the acquisition and consumption of resources - money, labor, materials, equipment, buildings, land, administration and management. How value chain activities are carried out determines costs and affects profits (ifm 2013).

![Figure 2](image-url)
For Posten Norge, and every logistics service provider, who wishes to become a leader in sustainable business practice, it may useful have this theory in mind. Porter (1985) argues that the value chain model is a useful analysis tool for defining a firm’s core competencies and which activities companies should focus on in order to get a competitive advantage. It can either be through cost leadership or differentiation.

**Cost advantage** is generally viewed as producing in large quantities in order to achieve a low per unit cost. There is however many ways logistic companies can reduce cost that can be linked to sustainable supply chain management. Much of the literature argues that there is a potential for firms to obtain cost advantages (Carter and Rogers 2008) from focusing on sustainability, but it can be debated if this costs are big enough to give firms a competitive advantage. This is something we see as interesting to investigate.

**Value adding** services that gives the company a competitive advantage means that the company are able to provide a service to the market that are difficult for other to imitate, and that gives the company a competitive advantage. There is a potential that companies focusing on sustainable supply chain practices actually can increase the value they provide to their customer, e.g through being early adopted to governmental regulations as well as increasing their reputation with customers (Carter and Rogers 2008), but as with cost, it can be debated if these value adding activities are large enough.

In this thesis, the outbound logistics will be of most interest, as the company of interest is a logistic service provider. Therefore, we see it as necessary for the paper to discuss important aspects of transportation, which role it plays for logistic companies, and what measures companies can take to implement sustainability into their transportation activities.

### 2.4 Transportation

Transportation entails moving inventory from point to point in the supply chain. Transportation can take the form of many combinations of modes and routes, each with its own performance characteristics. Transportation choices have a large impact on supply chain responsiveness and efficiency (Chopra and Meindl 2013, 53).
A company involved in distribution of goods, should analyze and identify several key components:

1) **Design of transportation network**

Transport network is the collection of transportation modes, locations and routes along which products can be shipped. Due to Posten Norge’s huge transportation network, we need to analyze the differences between the old and the new distribution network. A result from this could possibly be a better understanding of possible future changes in the distribution.

2) **Choice of transportation mode**

The mode of transportation is the manner in which a product is moved from one location in the supply chain network to another. Companies can choose among air, truck, rail, sea, and pipeline as modes of transport for products. Each mode has different characteristics with respect to the speed, size, of shipments (individual parcels to pallets to full trucks to entire ships), cost of shipping, and flexibility that lead companies to one particular mode over others (Chopra and Meindl 2013, 62).

3) **Transportation-related metrics**

Inbound transportation decisions impact the cost of goods sold, while outbound transportation costs are part of the selling, general, and administrative expenses. Thus, transportation costs affect the profit margin. A manager should track the following transportation-related metrics that influence supply chain performance:

- Average outbound transportation costs
- Average outbound shipment size
- Average outbound transportation cost per shipment
- Fraction transported by mode

Overall trade-off: Responsiveness versus efficiency

We see the need for more literature involving comparison on different systems where cost efficiency has been the primary goal.
3 Research Methodology

3.1 Research Strategy

Research strategy is the general orientation to the conduct of business research (Bryman and Bell). There is in general two distinct type of research methods that can be applied for performing research; qualitative and quantitative methods.

Qualitative research can be constructed as a research strategy that usually emphasizes words rather than quantification in the collection and analysis of data (Bryman and Bell 2011). The role of theory in relation to research is said to be inductive, where generation of theory is the primary role. Observable, but not measurable data is typical of qualitative research (Bryman and Bell 2011). Qualitative research methods are design to help researchers to understand people in social and cultural contexts, and generate rich, detailed and valid data (Bryman and Bell 2011). By using a qualitative approach, it might be difficult to extend the findings to a wider population without further testing of the data.

Quantitative research can be constructed as a research strategy that emphasizes quantification in the collection and analysis of the data, and entails a deductive approach to the relationship between theory and research (Bryman and Bell 2011). It means dealing with numbers, where the data observed can be measured. Quantitative research is most often seen as a method trying to demonstrate causal relationships under standardized conditions (Casebeer and Verhoef 1997). The role of theory in relation to research is deductive in nature, meaning that one is involved in testing of theory.

In this thesis, we are interested in using prior sustainability theories and findings, and compare how Posten Norge is implementing and managing their green initiatives. To be able to analyze the different situations, we will use a mix between quantitative and qualitative approaches. We will need in-depth knowledge about how the current distribution system is performing, therefore a qualitative strategy where interviews with employees from different business units in the corporation will fit what we want to discover.
To be able to understand if the distribution system is sustainable, it is necessary to look at data prior to Posten Norge’s transformation in their distribution fleet in 2009. From the qualitative interviews, we hope to understand more precisely what quantitative data to collect. There may exist many other factors worth investigating. Therefore we see the need to collect both qualitative information, and quantitative data to be able to identify the right input data.

A research strategy that is a combination of both qualitative and quantitative methods is referred to as a mixed research strategy. (Bryman and Bell, 2011, p.716) The qualitative interviews enable us to have an unstructured approach to data collection, in which participant’s meanings are the focus of attention. This is a good way to measure the social concept of the triple bottom line(Elkington 1999).

From the quantitative approach, we want to investigate a specific set of issues through the more structured approach of quantitative research. This will be used when measuring the economic and the social concepts of the triple bottom line model.

3.2 Research Design

A research design provides a framework for the collection and analysis of data (Bryman and Bell 2011). When choosing a research design, it is important to choose a design that suits the study that the thesis wants to explain.

Five prominent research designs are mentioned in the literature (Bryman and Bell 2011): experimental design, cross sectional design, longitudinal design, case study design, and comparative design.

Experimental research is frequently held up as a touchstone because it engenders considerable confidence in the robustness and trustworthiness of causal findings. True experiments tend to be very strong in terms of internal validity. (Bryman and Bell, 2011, p.45)
Cross sectional design entails the collection of data on more than one case (usually quite a lot more than one) and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables (usually many more than two), which are then examined to detect patterns of association (Bryman and Bell, 2011, p.53).

Comparative design entails the study, using more or less identical methods of two or more contrasting cases. It embodies the logic of comparison in that it implies that we can understand social phenomena better when they are compared in relation to two or more meaningfully contrasting cases or situations.

The basic case study design entails the detailed and intensive analysis of a single case. Case study research is concerned with the complexity and particular nature of the case in question. The case study approach is a very popular and widely used business design in business research (Bryman and Bell, 2011, p.59). What distinguishes a case study from other research designs is the focus on a bounded situation or system and entity with a purpose and functioning parts. The emphasis tends to be upon intensive examination of the setting. We feel that a case study suits our thesis well, since this enables us to understand and investigate Posten Norge’s organization, and will help us to answer the previously mentioned research questions.

In the level of analysis, it is common that research focus on different levels of analysis; Individuals, groups, organizations, and societies. This is often referred to as the SOGI model (Bryman and Bell, 2011, p.67). Some research designs draw on samples that combine different levels of analysis, and this is something we will do when determining the sustainability of Posten Norge’s investment in a new distribution system. Bryman and Bell states that it can be problematic to combine data from different levels to produce a meaningful analysis. In our thesis, we will have in-depth interviews with individuals, consider the organization, Posten Norge, and also consider the society aspect of the term sustainability.

Each design is normally assessed according to the following set of criteria’s: Reliability, replication, and validity. These criteria’s will be explained further in section 2.4.
3.3 Data Collection

In this thesis, both secondary and primary data will be used in order to obtain the triangulation in our data collection. The idea of using triangulation research is that we can be more confident with the result if different methods lead to the same results. Triangulation can operate and within different research strategies (Bryman and Bell, 2011, p.634). Yin purpose six different types of methods to consider when collecting data; Documentation, archival records, interviews, direct observations, participant’s observations, and physical artifacts(Yin 2014). In this thesis, we will look at previous documentation of KPI’s within distribution system, and we will also use interviews. The aim is to operationalize important factors that affect the triple bottom line model (Elkington, 1999, 2004) as well as the efficiency of the distribution system.

3.3.1 Secondary Data

Secondary data is typically data that others have collected(Bryman and Bell, 2011, p.313)

Since the goal for this thesis is to look at Posten Norge´s strategy and distribution system, and Posten Norge have been great at gathering data about their organization, secondary data will be gathered from Posten.

Secondary analysis offers numerous benefits when carrying out our research project (Bryman and Bell, 2011, p.313). By using secondary data, we are able to save a lot of costs and time, compared to gather all the data ourselves(Bryman and Bell, 2011, p.314)

Secondary data is also often high quality data, since the framework within the sample size gives you a good image of reality (Bryman and Bell, 2011, p.314)
In this thesis, Posten Norge will provide us with data regarding investment costs, lead times, and employee attitudes towards the change.

3.3.2 Primary data

Primary data are data that we are planning to collect directly from the company. We will use interviews and possible direct observations through participating in postal routs. This will hopefully give us valuable insight about the organization,
and also help us to decide what secondary data that is important to consider when creating a model that fits their distribution system.

3.4 Quality of the Research

The quality of given design will be judged by validity, replicability and reliability. Reliability, replicability and validity are presented as criteria for assessing the quality of business research. Validity entails an assessment in terms of several criteria; Measurement validity, internal validity, external validity and ecological validity (Bryman and Bell, 2011, p.40).

3.4.1 Reliability

Reliability is concerned with the question if whether the results of a study are repeatable. The term is commonly used in relation to the question of whether or not the measures that are devised for concepts in business and management (such as employee motivation, organizational effectiveness) are consistent. Reliability is particularly at issue in connection with quantitative research. The quantitative researcher is likely to be concerned with the question of whether a measure is stable or not (Bryman and Bell, 2011, p.41) Using Posten Norge’s data which is measured through GHG protocol, Global compact, GRI and the international post corporation(IPC) standards(Colin Campbell, Posten Norge), we are ensured that the data has a high degree if reliability.

3.4.2 Replicability

Replicability or replication refers to the degree of which the results of a study can be reproduced. (Bryman and Bell, 2011, p. 41)

3.4.3 Validity

Validity is defined as how well you measure what you intend to measure. Validity is concerned of the integrity of the conclusions that are generated from a piece of research. It is important to be aware of the main types of validity that are typically distinguished; measurement validity, internal validity, external validity, ecological validity (Bryman and Bell, 2011, p.42)
Our purpose is to gather a combination between quantitative research, and qualitative data. We therefore assume that the data collected from Posten Norge as valid, but we see the interviews with employees as the biggest threat to the validity of the thesis. We need to ensure the validity of our qualitative data collection, and therefore need to interview people with good insight in the distribution system. Both top management, and mailmen will be interviewed.
4 Project plan

4.1 Future time disposition

We have already have been in one meeting with environmental director in Posten Norge, Colin Campbell. We will start our data collection soon, and use more time at reading literature, and cooperate with supervisor on the scope of the thesis in the nearest future. We see the subject as broad, and hope to make our scope narrower in the future. We are looking forward to further collaboration with Posten Norge, and with our supervisor.
References:


