STARFISH

Coopetition for innovative freight transport solutions in Swedish retail

ANDREAS HOLMBERG

KLAS ÖRNE

Faculty of Engineering, Lund University
Lund, Sweden 2013

Abstract

Many companies today strive to reduce their environmental impact. A potential strategy to reduce CO_2 emissions is horizontal cooperation between actors on the same level of different supply chains. The strategy opens for cooperation, in for example such non-core activities as distribution and transportation, between companies with a competitive relationship. Larger transport networks increase the possibility to combine optimal routes and consolidate goods. There is also an opportunity for joint facilities which further decrease costs and possibly reduce the total driven kilometres due to more direct routes.

This master thesis will analyse participating companies' transport networks and identify collaboration synergies. This to be able to investigate the effects on costs and the environmental impact that horizontal cooperation has. In order to quantify these effects, a constructed case has been built up consisting of two case companies. The case companies are the two largest grocery retailing companies in Sweden - ICA and Coop, with a total market share of around 70%. The purpose of this master thesis has been to test how a dyadic horizontal distribution cooperation effects the CO_2 emissions and costs for large grocery retailers in Sweden.

The transportation networks for each company have been built in the Supply Chain Guru software. The networks have then been combined with joint distribution terminals to investigate how shared distribution facilities influence the total cost and CO_2 emissions. Given the underlying assumptions in the models, the results show a potential to reduce distribution costs by 6.2% and reduce CO_2 emissions by 1%. These results show a great potential for horizontal cooperation and the potential could increase even more when adding more aspects such as joint distribution planning and supplier collections.

The analysis requires a state-of-the-art supply chain design software and a software analysis has been carried out. The software is needed to be able to build up large network models and see how changes in the supply chain design affects the environmental impact and the costs. Out of 13 software, six software was possible candidates and out of those two where thoroughly tested. The software analysis showed that out of these two, LLamasoft Supply Chain Guru was the most suitable software and has been used in the analysis.

Horizontal cooperation opens new innovative ways for companies to act and cut logistics costs and reduce the environmental impact. This master thesis' purpose was to test how a dyadic horizontal cooperation affect CO_2 emissions and logistics cost and shows that horizontal cooperation has a large potential for the two largest companies in the Swedish retail industry. This should invite to more research in the area, including more companies and other industries to truly investigate the vast possibilities of horizontal cooperation.

Key words: Horizontal cooperation, retail, distribution, collaboration, joint transportation network

Acknowledgement

Writing this master thesis would not have been possible without a lot of help and support from a large number of people. We would like to express our deepest appreciation to all who has contributed to the work.

First we would like to thank our supervisor Dr. Henrik Sternberg for your strong support in every aspect of this work. You have always been happily sharing your expertise with us and with a strong focus shaping both our research and business skills. We are happy you selected us as your thesis workers and working with you has been a true pleasure from the first to the last day and a great experience for the start of our careers.

The participating companies ICA and Coop have both been very helpful and we are grateful for their willingness to participate. Special thanks to Kjell Håkansson at Coop and Marcus Gustafsson at ICA for letting the environmental commitment precede competition. You have both been very supportive and we hope the good cooperation can continue. Thanks also to Carl-Fredrik Bernman at Coop for your help with information and support.

Many thanks go to Emma Tranarp and Andreas Karlsson at Optilon for their quick and competent response and support with the software Supply Chain Guru. Furthermore we would also like to acknowledge Frans Cruijssen at ArgusI in Rotterdam for your generosity and willingness to support the project. Your help has inspired us to perform and contributed to a good result.

Thank you Martin Stjernström (Nordanå Transport), Thomas Morell (Sveriges Åkeriföretag), Ingemar Resare (Sveriges Åkeriföretag) and Per-Erik Nordh (Nords åkeri/Vegby transport) for your interest in the project and help with information and support.

We would also like to thank Patrik Rydén, Dr. Daniel Hellström and Prof. Annika Olsson for all your help and support with various practical issues.

Thank you all for making Starfish possible. It has been fantastic to work with this revolutionary and innovative project and we hope this is just the beginning of a long successful Starfish!

Lund, September 2013

Andreas Holmberg Klas Örne

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Definitions

Coopetition
The terminology coopetition used in the title defines a type of horizontal relationship between two actors that are competing and cooperating simultaneously and is further explained in the frame of reference, chapter 2.2.1.

Definitions have been taken from Supply Chain Visions list of SUPPLY CHAIN and LOGISTICS TERMS and GLOSSARY (Vitasek, 2006) and are listed below.

Fast Moving Consumer Goods (FMCG)
"Fast Moving Consumer Goods are packaged commercial products that are consumed through use. They include pre-packaged food and drinks, alcohol, health and beauty items, tobacco products, paper products, household cleansers and chemicals, animal care items, anything that we need, can buy right off the shelf, and use up through daily living."

Third Part Logistics (3PL)
"Outsourcing all or much of a company's logistics operations to a specialized company. The term "3PL" was first used in the early 1970s to identify intermodal marketing companies (IMCs) in transportation contracts. Up to that point, contracts for transportation had featured only two parties, the shipper and the carrier. When IMCs entered the picture—as intermediaries that accepted shipments from the shippers and tendered them to the rail carriers—they became the third party to the contract, the 3PL. But over the years, that definition has broadened to the point where these days, every company that offers some kind of logistics service for hire calls itself a 3PL."

Third Party Logistics Provider (in this master thesis ->Logistics Service Provider, LSP)
"A firm which provides multiple logistics services for use by customers. Preferably, these services are integrated, or "bundled" together by the provider. These firms facilitate the movement of parts and materials from suppliers to manufacturers, and finished products from manufacturers to distributors and retailers. Among the services which they provide are transportation, warehousing, cross-docking, inventory management, packaging, and freight forwarding.

Back-hauling
"The process of a transportation vehicle returning from the original destination point to the point of origin. The 1980 Motor Carrier Act deregulated interstate commercial trucking and thereby allowed carriers to contract for the return trip. The backhaul can be with a full, partial, or empty load. An empty backhaul is called deadheading."

Cross-docking
"A distribution system in which merchandise received at the warehouse or distribution centre is not put away, but instead is readied for shipment to retail stores. Cross docking requires close synchronization of all inbound and outbound shipment movements. By eliminating the put-away, storage and selection operations, it can significantly reduce distribution costs."

1 Introduction

This chapter will introduce the reader with a general background of the master thesis followed by a more detailed problem discussion. The purpose is formulated and delimitations are presented.

1.1 Background

In Sweden, the transport sector accounts for 31% of the Swedish total CO_2 emissions and the dominant polluter is road transportation. Between 1990 and 2011 the emissions from road transports have increased by 9%. The increase is entirely due to truck transports, since emissions from private cars have decreased during the same period. The Swedish government has a vision to reach a zero net emission level by 2050 (SwedishTransportAdministration, 2012). Measures have to be taken in order to break this trend and reach this ambitious vision.

Companies in general often have strategies to reduce their environmental impact but still the emissions are increasing. This can be due to an increased flow of goods, but also higher demand on customer service. Cruijssen et al. (2007c) express that the customers' environmental awareness has gotten stronger. At the same time, their demands for perfect goods at lowest price puts high pressure on companies to cut costs and streamline their activities. They further argue that companies today are struggling to satisfy customers' demands individually or in dyadic outsourcing relationships. Horizontal cooperation is one strategy to redesign logistics processes in order to meet the increasing demands. This strategy aims to find synergies with other actors on the market in order to increase the efficiency and fill rates. That would reduce the environmental impact and cut costs.

The Transport Analysis (TransportAnalysis, 2012) yearly presents a report about Swedish road transport. The 2011 report states that Swedish trucks executed 35.2 million transports and drove 2.7 billion kilometers. The national road goods traffic is dominant with 99% of all transports. Empty running trucks represented on average 17% of the total kilometers driven. However, this number only considers completely empty trucks. The transported goods are divided in different groups. The second biggest group contains grocery, beverages, and tobacco with a distance of 348 million kilometers travelled per year. The empty running distance travelled in this group is 9.9%.

Grocery and beverages are included in the concept of Fast Moving Consumer Goods (FMCG) but the concept is wide and also includes for example health items, household chemicals, and all that we need and buy right off the shelf (Vitasek, 2006). The empty running for the grocery, beverages, and tobacco group is somewhat lower than average, 10%. But this still represents about 35 million kilometers yearly wasted (TransportAnalysis, 2012). As mentioned, the empty running only includes completely empty trucks and not trucks returning with recycling or driving with only a few pallets. Therefore, the potential is greater than the empty running indicates due to the possibility to consolidate almost empty trucks.

The logistic cost is often a significant part of the total cost for companies and has therefore gained much attention (Leitner et al., 2011). However, difficulties to optimize limited shipment volumes with no access to larger networks (Leitner et al., 2011) make it problematic for companies to improve their logistic system.

1.2 Problem area

In the last decades the logistic market has changed from an internal focus to better managing external relationships. The efficiency within a company has been in the centre of attention for a long time and has led to that external relationships have been found to have greater potential for further improvement. This is the background to why the concept of supply chain management (SCM) has become such an elementary concept (Skjøett-Larsen, 2000). Now the tendency is to go one step further in different kinds of horizontal cooperation (Cruijssen et al., 2007c). Many large companies have been working with customer and supplier relationships but horizontal cooperation opens new opportunities to further improve efficiency and cut costs to stay competitive.

The concept of horizontal cooperation is formulated by Cruijssen et al. (2007c).

"Horizontal cooperation is about identifying and exploiting win-win situations among companies that are active at the same level of the supply chain in order to increase performance. These companies can be suppliers, retailers, customers, or LSPs"

The interest of horizontal cooperation in Europe started in 2008 when the European Intermodal Research Advisory Council (EIRAC), which is a group of more than 50 large industry players related to European Supply Chains, identified the critical issue to increase the capacity utilization of European freight transport systems. This led to the start of a European Union sponsored project called CO^3, Collaborative Concepts for Co-Modality. The mission with the project is to increase the efficiency and bundling of European logistics flows through horizontal collaboration between European shippers. To achieve the mission a number of repeatable test cases will be created and a shipper who believes in horizontal collaboration can make use of the services of the CO^3 consortium to identify potential bundling partners and to set up test projects (CO3-Project, 2013).

A national project in the UK that investigated the potential for horizontal cooperation was conducted by Palmer and McKinnon (2011). The British retail organization IGD sponsored the project, where the purpose was to identify opportunities for both back-hauling and consolidation for retailers, wholesalers, and manufacturers. Reducing empty running by consolidation contributes to both reducing the environmental impact and cut costs. The result gained a lot of attention in the UK with a total identified potential to reduce CO_2 emissions by 14.2% and costs by 17.6%.

The research on horizontal cooperation is still at an early stage (Cruijssen et al., 2010b, Leitner et al., 2011, Wallenburg and Raue, 2011). However the authors have found some articles that have studied the subject (Bahinipati et al., 2009, Cruijssen et al., 2007b, Cruijssen et al., 2007c) and two Swedish examples investigate the potential for horizontal cooperation. The first one is a research conducted by Hageback and Segerstedt (2004), investigating the potential of cooperation in sparsely populated areas and the second one is by Frisk et al. (2010), studying the collaboration potential between eight companies in the forest industry. The reported cost savings for the latter example is around 15% and a 20% reduction of emissions from the trucks.

A number of successful cases from The Netherlands (Cruijssen et al., 2007a) further confirm that these kinds of cooperation can be beneficial and executed in reality. The study by Cruijssen et al. (2007a) investigates different characteristics that influence the potential synergy effects from horizontal cooperation. The results show that the synergy value increases as the average distance between customer increases, figure 1. They also state an indication that joint route planning, through horizontal cooperation, is more profitable when customers are located across a large region. This statement makes research in Sweden highly interesting since UK and especially The Netherlands are relatively small countries with big populations. This gives an indication of a large potential in Sweden where few customers are spread over a large region. An empirical study to complement the findings of Cruijssen et al. (2007a) is in focus when formulating the problem area. The projects in Europe has inspired a Swedish research initiative, called *Starfish*, with the purpose to match companies and find synergies in both inbound and outbound networks.

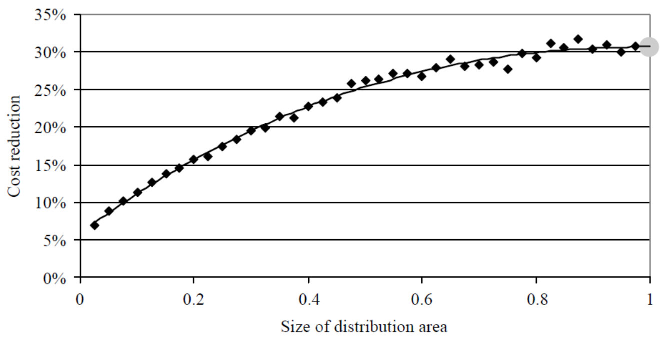


Figure 1 Size of distribution area from Cruijssen et al. (2007c)

To seek external cooperation at the same level in the supply chain includes competitors or at least actors in the same market. One of the major obstacles is therefore to find suitable partners that can be trusted. A large hurdle, especially for small and medium sized companies, is to afford the research cost related to find potential partners and also to evaluate their competence and reliability (Cruijssen et al., 2007b). In a survey consisting of Belgian logistic service providers, 69% of the respondents consider difficulties in finding partners to be a critical issue for horizontal cooperation (Cruijssen and Salomon, 2004).

Horizontal cooperation is an area with great potential to increase efficiency. It is a relevant strategy for all types of companies; LSPs, manufactures, and producers. The UK study (Palmer and McKinnon, 2011) included 27 companies from the FMCG sector and showed on a great potential for this specific sector. This master thesis aims to continue this research and apply it on Swedish conditions. A weakness in the UK study is that Palmer and McKinnon have used standard estimated values for calculating cost reduction. This lowers the accuracy of the result since costs differs between different regions. The result is a potential saving and has not been implemented and builds on many such activities as consolidation, backhauling, larger vehicles, and out of hour deliveries.

This master thesis will contribute to start filling the gap of research in horizontal cooperation under Swedish conditions, taking in consideration what has been done in previous horizontal initiatives from Europe. The CO^3 projects are mainly focused on large European shippers and this study will apply the concept between retailers like the UK study. However, compared to the UK study this project will use actual costs on transports, collected from the companies and transportation sector which increases the accuracy of the potential results. Swedish grocery retailing companies and their potential cost and emission reductions gained from horizontal cooperation will be in focus.

1.3 Purpose

The purpose of this master thesis is to test how a dyadic horizontal distribution cooperation affects the CO_2 emissions and costs for large grocery retailers in Sweden.

In order to determine the effects, a supply chain design software needs to be used to build up the transport networks. A supporting analysis of which software is suitable has been done to facilitate the analysis of the effects of horizontal cooperation.

1.4 Delimitations

Impediments and risks with cooperation is discussed and mentioned in the report, but will not be taken into consideration when presenting the result. Before implementing a cooperation, a deeper analysis about implementation issues is critical.

ICA and Coop are already cooperating to some degree, but it is limited and operated completely by a 3PL and has not been taken into account.

Due to the limited time available, only joint distribution centres have been analysed. Joint route planning and customer to customer transports have been left outside this report.

1.5 The principal CLOSER

CLOSER was established by VINNOVA, the Swedish Governmental Agency for Innovation Systems, in 2010 (VINNOVA, 2011). The objective for CLOSER is to stimulate research, development and innovation in logistics and transport. This is done by bringing academia, business, and society to work together and improve the process all the way from research and innovation to finished and implemented projects on the market. An important role is to overcome the gap between science research and industry. Partners within CLOSER are Swedish Transport Administration, Region Örebro, Region Västra Götaland, Schenker, Scania and Volvo. CLOSER is located in Gothenburg and is a part of Lindholmen Science Park. Jerker Sjögren, programme manager at CLOSER, expresses CLOSER's activities like this: *"CLOSER will bring together researchers, business and the public sector to initiate major collaborative projects. It will be a national node for running projects in fields such as Green Corridors and for developing sustainable goods and passenger transport." (LindholmenSciencePark, 2013)*.

2 Frame of Reference

This chapter will introduce collaborative transportation management and present the concept of horizontal cooperation. The research and examples that already exist within the field have been studied. The purpose is to give the reader a good view and understanding of different kinds of cooperation, opportunities, impediments and also a picture of what has already been studied.

2.1 Supply chain transport collaboration

2.1.1 Collaboration and cooperation

Mentzer et al. (2003) have interviewed a focus group of twenty supply chain executives and they consider collaboration to entail a lot more than cooperation. Particularly aspects like sharing information, risks, knowledge, and profit are more related to collaboration. However, most often the difference between them is vague (Cruijssen et al., 2007c) and this master thesis will not differentiate between cooperation and collaboration.

2.1.2 Collaborative transportation management

Mentzer et al. (2001) discuss the wide concepts of supply chain. The occurrence of the term has increased dramatically in article titles and conference headings. Despite the popularity, no common definition exists, but many authors have defined it. They present a number of definitions and define what they include in the term.

Supply chain as illustrated in figure 2:
"A set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer."

Figure 2 Supply Chain as illustrated by Mentzer et al. (2001)

Esper and Williams (2003) discuss that traditional approaches to supply chain management collaborative processes, have primarily focused on the buyer-seller relation but the entire supply chain involves more actors. Further, they present two dimensions of collaboration: Collaborative Planning, Forecasting and Replenishment (CPFR) and Collaborative Transportation Management (CTM). CPFR has the goal to automate and improve sales forecasting and replenishment between trading partners and involves upstream partners in the supply chain. CTM is an extension of CPFR and involves converting order forecasts developed via CPFR into shipment forecasts. This includes collaborative relations between buyers, sellers, carriers, and 3PLs to improve service, efficiencies, and costs associated with the transportation and delivery process. The more holistic CTM approach has become a critical aspect associated with shorter planning windows, inventory reduction, and overall operation performance. Esper and Williams (2003) also list a number advantages of CTM such as reduced transportation costs, increased asset utilization, improved service levels, and increased visibility.

2.1.3 Horizontal, vertical, and lateral cooperation

Simatupang and Sridharan (2002) differentiate between three structures of collaborative supply chains: vertical, horizontal, and lateral. Vertical collaboration occur when actors in the same supply chain, such as the manufacturer, the distributor, the carrier, and the retailer are involved in for example, sharing resources and responsibilities. CTM is an example of vertical cooperation within the same supply chain. Horizontal cooperation occurs when competing or unrelated companies cooperate. Finally, lateral collaboration is a mixture of horizontal and vertical collaboration.

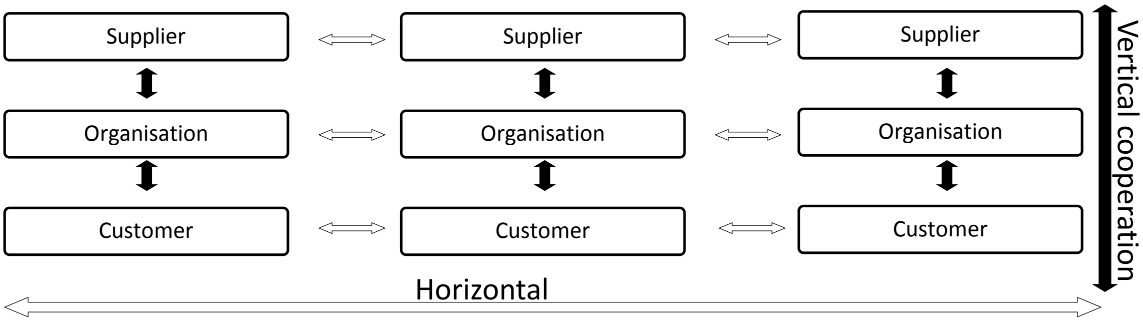


Figure 3 Illustration of vertical and horizontal cooperation

In a literature review, on horizontal cooperation in transport and logistics, Cruijssen et al.(2007c) define logistic horizontal cooperation for the landside in more detail: "*cooperation between two or more firms that are acting at the same level of the supply chain and perform a comparable logistics function on the landside.*" The definition set by the European Union (2010) express that a cooperation of 'horizontal nature' in an agreement is entered between actual or potential competitors, and also between companies acting in the same product markets, but in different geographic markets.

2.2 Types of horizontal cooperation

2.2.1 Coexistence, Cooperation, Competition, and Coopetition

Bengtsson and Kock (1999) investigate the characteristics of horizontal relationships between companies and state that there are four different types of horizontal relationships: coexistence, cooperation, competition and coopetition.

Coexistence

Coexistence is defined as a relationship without commitments and no economic exchange, only information and social exchanges exist. Trust is regarded important and the companies' goals are stipulated separately.

Cooperation

A cooperation relationship can have many different kinds of commitment, for example social, knowledge, and legal/economic commitments. Companies that cooperate can also be competitors and do not necessarily need to trust each other, depending on if the relationship has a formal or informal character, where an informal relationship is built on norms and trust. Companies in a cooperation relationship follow shared goals.

Competition
Competition describes an action-reaction relationship, where companies share or have similar suppliers and target the same customers. The companies' goals are stipulated independently.

Coopetition
Coopetition is a very versatile relationship, since it depends on if the activities are cooperating or competing. Firstly, a coopetition relationship can consist of both economic and non-economic bonds. Secondly, the cooperating activities have clear norms and can be stated in a formal contract, but can also be based on trust. The goals in these activities are stipulated together. Lastly, the competing activities have invisible norms, they do not have mutually stipulated goals and the dependence is related to the strength and position of the actors. A coopetition relationship is best suited if the cooperation regards activities that are not close to the customer.

Two firms can benefit from both cooperation and competition simultaneously, but it is important to separate the two parts to be able to manage the complexity of the relationship. Bengtsson and Kock (2000) define coopetition as when two companies cooperate in one area or with some activities while simultaneously competing in other areas or with other activities. They also state that this type of relationship is the most advantageous one since companies can cooperate and help each other (product development, shorten lead-times, core competence contribution, etc.), but at the same time compete and generate development and become more efficient. It is best to have a cooperation relationship in non-core activities far from the customer, while a competition relationship is best for core activities that are near the customers. One concrete example from Bengtsson and Kock (2000) is in the Swedish lining industry where two companies cooperate in the R&D department but compete on the market side.

2.2.2 Scale of cooperation
Lambert et al. (1999) identify that there is a scale of cooperation, going from arms'-length relationships to integrated firms, illustrated in figure 4. However, in between these two extremes there are a number of vague defined cooperation types. In their article they show that a vertical partnership can be divided into three types. Cruijssen et al. (2007c)refers to this model and states that it can be transformed to be applied in horizontal cooperation.

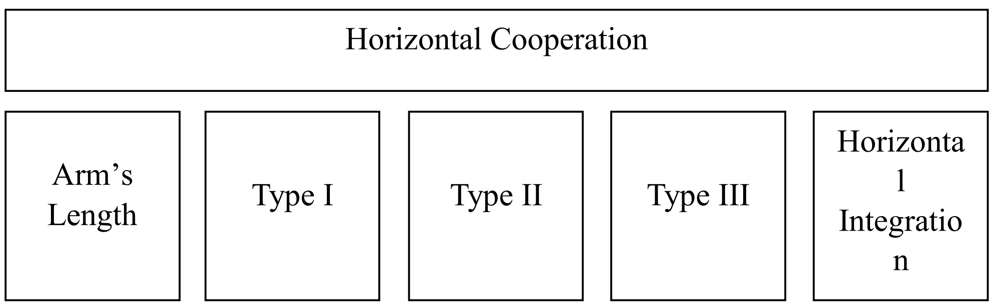


Figure 4 Scale of cooperation illustrated by Cruijssen et al. (2007a)

In a "Type I" cooperation involved partners recognize each other as partners and, to some degree, have coordinated activities and planning. The cooperation is limited to only one part, activity or division, of each participating company and has a short-term focus. The second type takes the cooperation one step further and involves more than one part of each involved company and they get integrated into the business plan. The relationship has a long-term focus, but not infinite. In the third and last type of cooperation the involved companies have integrated their operations to such a degree that they consider each other as an extension of themselves. Such a relationship has no “end date” (Lambert et al., 1999). The type three cooperation is often referred to as a “strategic alliance” (Cruijssen et al., 2007c).

2.2.3 Insinking

Cruijssen et al. (2010a) describe the concept of insinking, a new strategy that could be explained as reversed outsourcing. In outsourcing, activities are chosen to be executed outside of the company, because of different reasons. Insinking is instead initiated by the service provider and that is why the concept also is called supplier-initiated outsourcing. Another way of explaining it, is to say that outsourcing is a push approach and insinking a pull approach. Insinking enables LSPs to gain maximum synergy effects, thanks to the possibility of choosing ideal customers to optimize the distribution networks. This is an example of horizontal cooperation because cooperation takes places among potential competitors, acting on the same market. It is most probably beneficial for the LSP if the shippers (customers) act in the same sector due to more unified and similar goods. The strategy of insinking facilitates horizontal cooperation without the difficulties regarding sensitive information sharing. The complex tasks to initiate and coordinate the cooperation and to set prices lie on only one actor, the service provider.

2.3 Opportunities with horizontal cooperation

Cruijssen et al. (2007b) execute a large survey on LSPs in Flanders, Belgium, and evaluate their view of benefits from horizontal cooperation. Seven propositions were formulated and divided in costs and productivity, service, and market position. All groups were statistically significant and supported as opportunities in the survey. Schmoltzi and Wallenburg (2011) complement the survey in Flanders with a survey on German LSPs and focus on motives for companies to cooperate. The literature on opportunities (and impediments) within logistic horizontal cooperation is focused on cooperation between LSPs.

2.3.1 Environmental impact

In a large horizontal cooperation study in the UK, executed by Palmer and McKinnon (2011), the reduction of CO_2 emission was considered to have a reduction potential of 14.2%. Arguments that the environmental impact decreases through horizontal cooperation is scarce. However decreased cost and productivity mean less travelled distance and improved utilization rate with positive effects also for the environment. A reason to the scarce connection to environmental impact can be due to difficulties to quantify the positive effects.

2.3.2 Costs and productivity

The most supported proposition in Cruijssen et al. (2007b) relates to if horizontal cooperation increases a company’s productivity for core activities resulting in decreased empty hauling and increased use of warehouse facilities. Over 75% of the respondents agree or strongly agree with that proposition. The increased productivity is due to knowledge sharing and a better ability to control costs and reduce the costs of the supply chain. Joint purchasing is also mentioned as a possibility to cut costs. Schmoltzi and Wallenburg (2011) rank the motive 'to increase productivity of core activities' as the fourth most important. An increased productivity will potentially cut costs and savings (Audy et al., 2011, Cruijssen and Salomon, 2004, Palmer and McKinnon, 2011).

2.3.3 Service

Cruijssen et al. (2007b) report a strong support for the proposition that horizontal cooperation helps broadening companies' services. This indicates that companies consider cooperation to be a possibility for increasing their customer service. In the study by Scholmtzi and Wallenburg (2011) such motives as 'to improve service quality' and 'to specialize while broadening service offerings' are considered to be among the top three most important incentives to cooperation by the responding companies. Another example of improved service is presented in a study conducted by Audy et al. (2011), where a company gained from horizontal cooperation. The cooperation enabled that consignments were sent more frequently, due to increased transported volume, and each company's customer service increased. Additionally, the combined volume increased the cost savings and negotiation power position towards the carriers, and reduced the delivery time.

2.3.4 Market position

The companies in the survey by Schmoltzi and Wallenburg (2011) consider 'to protect or enhance market share' to be the second most important motive to cooperation. The market share argument is though among the lowest ranked propositions in the study by Cruijssen et al. (2007b), but still supported.

2.4 Impediments with horizontal cooperation

Most of the literature focuses on opportunities, presenting successful case studies and theoretical advantages (Cruijssen et al., 2007c). However, there are also impediments and possible pitfalls. Perhaps as many as 70% of all started strategic alliances fail due to a number of reasons. It could for example be due to lack of coordination between management teams or lack of clear goals and objectives (Zineldin and Bredenlöw, 2004). This is confirmed by Schmoltzi and Wallenburg (2011) who state that the failure rates of horizontal cooperation range from 50 to 70% in the manufacturing industry. However, their study on horizontal LSP cooperation indicates rather stable and successful partnerships, with an upper bound of industry-specific failure rate of 18.9%. In addition, more than 50% have had no experience with any kind of cooperation failure.

2.4.1 Profit sharing

Cruijssen et al. (2007b) present that 75.9% of the participants in a large survey in the Netherlands agreed or strongly agreed with the statement 'A fair allocation of benefits to all partners is essential for a successful cooperation'. Dividing the benefits or sharing the profit was one of the statements with highest degree of agreement, indicating that it is a crucial aspect to consider. Empirical research indicates that problems in quantifying the operational savings are a major obstacle to share the profit properly.

Krajewska et al. (2008) propose an approach for the logistics sector to understand how to share the benefits of cooperation. This is done by using a cooperative game theory that offers a promising framework on how to deal with sharing the benefits gained from cooperation. However, the research on the distribution of both costs and savings arising from horizontal cooperation is scarce (Cruijssen et al., 2007b).

2.4.2 Partner selection

Partner selection is a major obstacle for horizontal cooperation, especially for small and medium sized companies. In the survey by Cruijssen et al. (2007b) the statement 'It is hard to find a reliable party that can coordinate the cooperation in such a way that all participants are satisfied' was agreed or strongly agreed by 72.2% of the participating companies.

2.4.3 Information and communication technology

A lack of IT technology can be an issue for cooperation with high intensity of data exchange, especially for small and medium sized enterprises (Cruijssen et al., 2007b). Small companies tend to lag behind in information technology due to large investments. This impediment is also tested in the survey by Cruijssen et al.(2007b) but was the least supported statement. In-depth interviews confirmed the suspicions that it was because it mostly concerns small and medium sized enterprises.

2.4.4 Unequal bargaining power of partners

The relative bargaining power between the partners can be an issue and a key to understanding if the relationship is likely to lead to a takeover. The bargaining power depends on three factors: the initial strengths and weaknesses of partners, how those strengths and weaknesses change over time, and potential for competitive conflict (Cruijssen et al., 2007b).

2.4.5 Cooperation complexity

In an empirical study by Schmoltzi and Wallenburg (2012) the performance of governance mechanisms for horizontal cooperation among LSPs is discussed. Depending on the specific cooperation, complexity is considered to be an impediment to general cooperation success. An increasing complexity in a cooperation leads to increasing management challenges.

Organizational complexity is mainly driven by two factors. Firstly, the number of cooperating companies and secondly, the number of business functions involved in the cooperation. The amount of cooperating companies is referred to as *relational complexity* because many co-operators lead to many relationships. The number of business functions is referred to as *functional complexity (García-Canal et al., 2003)*.

2.4.6 Conflicts

Wallenburg and Raue (2011) present a survey on German LSPs where they discuss conflicts in horizontal cooperation. There is a difference between conflicts in vertical and horizontal cooperation where the latter have a higher potential for opportunism and dysfunctional conflicts, due to a competitive nature. They make a distinction between two kinds of conflicts; functional and dysfunctional. Functional conflicts refer to task related form of conflicts and dysfunctional conflicts refer to personal disagreements. The conducted survey shows that conflict has different impact on cooperation performance, than on cooperation-based innovation. Even though functional conflicts can increase the innovation, all kinds of dysfunctional conflicts will be bad for both performance and innovation. However, most often all kind of conflicts should be avoided and it could be done with proper governance. Both formal and social control governance is discussed and considered to reduce the quantity of conflicts. The result also shows that conflicts are not common in horizontal cooperation, but an increased number of companies involved also increase the quantity of conflict.

2.4.7 Risk of decreasing system efficiency

When distribution routes, through horizontal cooperation, are planned more efficient, the average road factor of the trucks increases. However, the system efficiency becomes more sensitive for interruptions, such as delays when loading/unloading or due to congestions. The increased load factor could therefore have a negative impact on the reliability of service to the customer (Cruijssen and Salomon, 2004). Complex backhaul networks, containing additional journey legs, are exposed to greater risk of delay (McKinnon and Ge, 2006), which means that if cooperating horizontally the risk of delayed transport could be higher.

2.5 Horizontal cooperation in different industries

A survey on German LSPs, with a response rate of 11.6% and 400 valid responses, conducted by Schmoltzi and Wallenburg (2011) shows that 57% of the companies already belonged to at least one horizontal cooperation between LSPs. However, the survey includes LSPs not just from road-based companies, but also rail, sea, air, intermodal and value-added segments. Horizontal cooperation is a common concept in the maritime shipping and aviation industry (Cruijssen et al., 2007c), which indicates that the cooperation rate in the road sector is not that high. Horizontal cooperation is about identifying win-win situations for all parts involved (Cruijssen et al., 2007c), and it seems like if the German LSPs have understood the benefits. However, the concept should be applied not just between LSPs but among all kinds of companies and industries.

2.5.1 Manufacturing industry

Bahinipati et al. (2009) write about horizontal collaboration in the semiconductor manufacturing industry. The focus in this sector has been on internal factors to become more efficient and competitive. However, the drive to improve even more has now led to that these companies are looking externally to seek vertical and horizontal cooperation. The aims of collaboration raised are for example improving the development process, such as sharing the development of new technologies, and enhancing the efficiency in manufacturing chain.

2.5.2 Maritime industry

A conference is a common concept in the maritime industry. A conference is an alliance of multiple ocean carriers that offers unified tariffs and service levels. The advantages with conferences are economies of scale due to larger volumes shipped and increased customer service (Cruijssen et al., 2007c).

2.5.3 Aviation industry

Fan et al. (2001) evaluate the evolution of airline strategic alliances and consolidation. Strategic alliances in the aviation have been reality since the late 1980s, and the number of alliances has risen since then. There are strong economic incentives for airlines to operate in large networks. The collaboration in strategic alliances is a deep relationship with coordinated schedule and fare planning, shared lounges and dedicated marketing entities for the cooperation. The purpose is to offer an uninterrupted travel experience for the traveller across the network.

2.5.4 LSP industry

As previously written on the survey by Schmoltzi and Wallenburg (2011), 57% of the LSPs use a horizontal cooperation strategy. However, they also conclude that research on horizontal cooperation between LSPs is at an early stage and is not as usual as in the other industries mentioned.

2.6 Examples of logistic horizontal cooperation

The actual numbers of cooperation in smaller scales can be large even though they have not been mapped and researched. Björnfot and Torjussen (2012) study the extent of horizontal collaboration among small and medium-sized enterprises in the Swedish and Norwegian construction industry. They have found a number of existing collaborations and describe three of them in more detail.

In Belgium and the Netherlands, Cruijssen et al. (2007a) are aware of 50 horizontal logistics partnerships. They also argue that horizontal cooperation in logistics are most common in Western Europe, indicating that the concept is not widely spread. A good example of a successful implementation of horizontal cooperation is reported in the same article. Three companies in the Dutch catering sector, delivering frozen products to hospitals, schools etc., started a distribution collaboration with joint route planning and one mutual distribution center. The total distance travelled was decreased by 30.8%!

The literature review conducted by the authors of this master thesis confirms that successful examples from Europe are scarce. With the focus on Sweden, just a few examples of this subject were found and are presented below.

2.6.1 Forest industry

The first one is a study by Frisk et al. (2010), studying a potential collaboration between eight companies in the Swedish forest industry. It is rare that as many as eight companies together analyse the potential savings through transportation collaboration. The result of the analysis shows that up to 14.2% of the transportation costs could be saved.

2.6.2 Co-distribution in Pajala

The second example is a study by Hageback and Segestedt (2004) that investigates the potential and need for co-distribution in sparsely populated areas. An interview study is conducted in Pajala and the answers indicate an almost required need for cooperation in order to survive, but the knowledge is often inadequate.

2.6.3 Coopetition in the Swedish brewing industry

The third example is the study by Bengtsson and Kock (2000), they mention a coopetition relationship among Swedish brewers. They, the brewers, are fiercely competing when delivering their goods to the stores but at the same time cooperating when collecting empty bottles, crates etc. from the stores.

One part of the Swedish Breweries' sales is from beverages in glass bottles. The breweries used to keep the reverse recycling inside their own company, resulting in that they needed to ship crates of glass bottles all over the country. The Swedish market is widely spread and the worst case scenario is northern breweries delivering to the southern parts. That leads to a lot of transports of empty bottles going back to the origin brewery to be filled them up again. Sven Romander, working for the Swedish Trade Association for Breweries, suggested a cooperation possibility.

The new cooperation approach is that the nearest breweries collect the empty glass bottles and crates from the shops. Then the breweries report the imbalance to the trade association who shares the information among the breweries. A brewery with a negative imbalance then orders a transport from the brewery with a positive imbalance. In this way the travelled distance with empty bottles is significantly decreased.

The glass bottles are fragile and have a high risk of breaking. Depending on where the bottles break, it affects the balance of bottles among the breweries. The procurement of the bottles is done centrally by the trade association, which is beneficial for all parts. Before all breweries needed a safety stock of glass, but since the trade association has all the information from the breweries, they are able to procure glass when it is actually needed, leading to considerably lower need of safety stocks.

The involved parties have been positive to the cooperation from the beginning and it is working very well today. All parties feel that the situation is better in comparison to before the cooperation and that they gain from the cooperation, even though the gain cannot be put in numbers.

2.7 Transport modes

Lumsden (2006) writes about the fundamentals of logistics and chapters 5 and 6 of his book, which cover road transport and rail transport, have been the source of this section.

2.7.1 Road transport

The road transports have dramatically increased in the last decades and that is an effect of the increased efficiency using longer vehicles and trailers. Road transport has many advantages compared to other alternatives such as rail transport. To begin with, the transported volume is relatively limited which leads to a high degree of adaption to the customers' needs in terms of special handling. Further, the flexibility is high because the driver can be contacted which makes it possible to make late changes. One responsible driver that follows the goods also guarantees good security, reliability and service. However, there are length and weight restrictions that limit the road transport. The restrictions differ from country to country, but in Sweden the maximum length is 25.25 m, maximum width is 2.6 m, and the maximum total weight is 60 tonnes. The regulations in Europe are similar but with a maximum total length of 18.25 m.

2.7.2 Rail transport

Rail transports request large flows to be profitable and consolidation of flows is often necessary. A single handling of a waggon can cost more than 500 SEK which contribute to that train sets often are kept together. If the flow is large enough rail transports can be cost effective due to the low cost per travelled kilometre and if possible contain a whole train set between two terminals. For the rail bounded traffic, distribution is almost impossible and it has to be combined with road transport. The problematic side of rail transport is the inflexibility and lack of possibility to late changes and adjustments. However, rail transport is environmentally friendly as a consequence of the energy effectiveness over long distances. Correlated flows to the train terminals with road traffic can lower the total environmental aspect.

2.7.3 Road vehicle types

There are a number of different types of trucks with diverse trailer combinations. The most common trucks are briefly described below.

Distribution truck

This kind of truck obviously is used for distribution and has a lift at the back to make unloading easy. Important to point out is that the standstill (loading, unloading, and handling) often takes more time than the driving for this kind of truck(Sternberg, 2011).

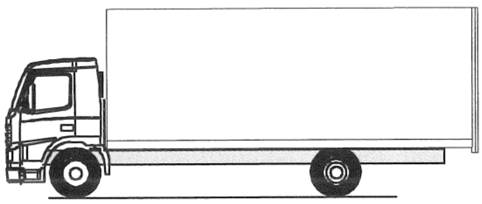
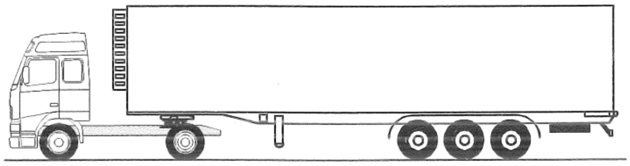


Figure 5 Distribution truck

Maximum length: 12 m Total weight: 12 – 16 tonnes Capacity: 18 – 24 EUR pallets

Truck with a semi-trailer

The use of truck with semi-trailer is more and more common. The advantage is to be able to leave the semi-trailer at the terminal while loading. The expensive, high technology part of the equipage therefore does not need to wait during loading, unloading, and handling which decrease the non-value added time for the driver.

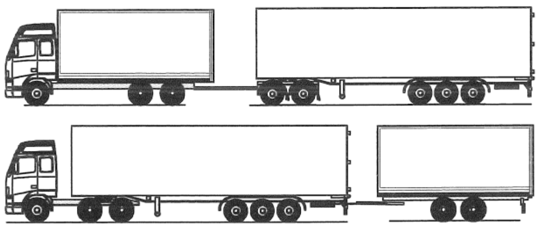


Maximum length: 16.5 m
Total weight: 40 tonnes
Capacity: 33 EUR pallets

Figure 6 Truck with semi-trailer

Truck with trailer (25.25 m and 24 m)

Trucks with trailers are common in domestic long-haul traffic. However, they cannot be used for international traffic due to the restricted length of 18.25 m in most of the European countries. An option is to use the same truck with a shorter trailer for transports going out of Sweden. Within the European Union so called Giga liners (25.25 m) are in the process to be allowed on specific roads like wide high ways. Both 25.25 m and 24 m equipages are already allowed in Sweden.



Maximum length: 25.25 m or 24 m
Total weight: 60 tonnes
Capacity: 52 or 48 EUR pallets

Figure 7 Truck with trailer

2.8 Consolidation of goods

Freight terminals are used to consolidate many shipments to larger loads without sacrificing service frequency. However, when a terminal is poorly located or loads are large, direct service may be most efficient (Kalantari and Sternberg, 2009). Hall (1987b) presents an analysis on the problem whether to distribute directly from origin to destination or through a distribution terminal. This depending on, for example, numbers of origins and destinations and if all origins distribute unique products to all destinations.

Hall (1987a) propose definitions to make a distinction between *inventory consolidation*, where time is the reason for consolidation, *vehicle consolidation*, where trips are consolidated to fill large loads, and *terminal consolidation*, where many transports converge at one point. This is illustrated in figure 8. He also argues that the consolidation benefit must overweigh the penalties of consolidation. The extra handling cost due to consolidation must be covered by the cost benefit of cheaper transport. There is also an extra cost for holding inventory and operating terminals to enable consolidation that must be covered by the benefit.

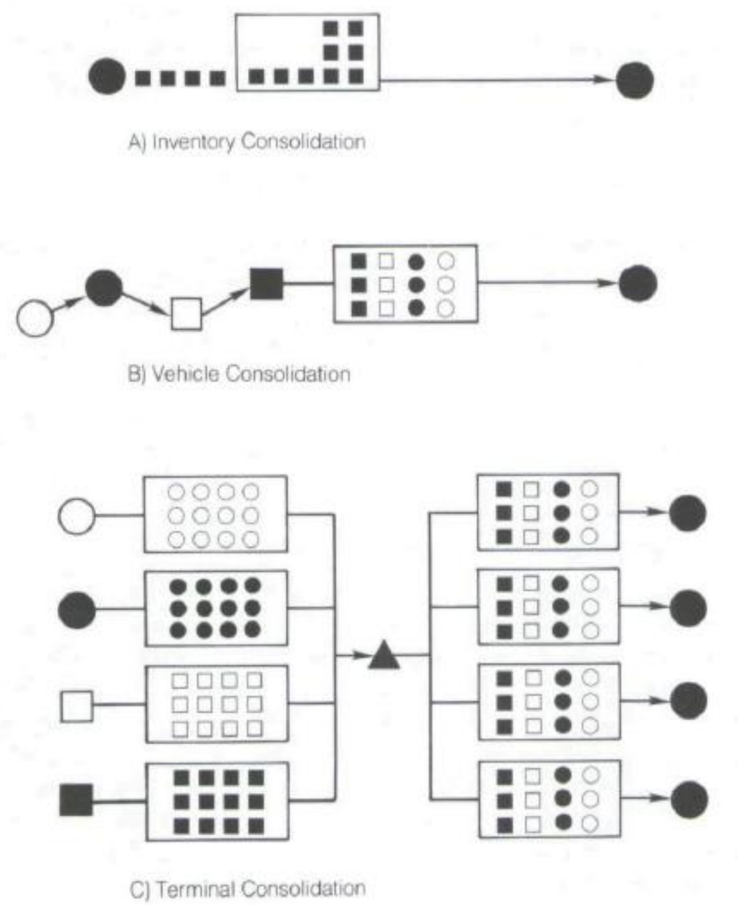


Figure 8 Consolidation strategies

The use of distribution terminals, also called transhipment centres and hubs have increased and changed the logistics context. It enables consolidation and improves the loading of trucks in terms of both volume and weight. The possibility to use external carriers increase and could be used exclusively or in coordination with a private fleet which reduce cost (Lapierre et al., 2004).

Kreng and Chen (2008) describe cross-docking as a great strategy to consolidate goods without increasing inventory. Cross-docking is presented to be effective in large distribution systems with numerous vehicles engaged. The vehicles can to larger extent be full loads when consolidated in the cross-dock facility which lead to significant cost savings.

Ballot and Fontane (2010) discuss the concept of building joint supply chains with common facilities and activities. They highlight that common physical parts of the supply chain could be shared warehouses, distribution centres and the line haul network with common transports. This is shown in figure 9 where the effect of a pooled network is illustrated. At the top, there are plants belonging to a supplier *i* and numbered for each supplier *i* from 1 to n_i. A plant only serves warehouses dedicated to a supplier *i* and the warehouses are numbered from 1 to j_i. The goods are transported from the warehouses to distribution centres which are dedicated to the operations of a single retail chain indexed by m and numbered from 1 to k_m for each retail chain. Finally, the distribution centres serve their specific geographical area. The lower part in the figure illustrate the same supply chain, with pooled warehouses. The same principle applies for the distribution centres, i.e. they can also be pooled. They further present that the positive impact on transportation will be the long-term pooling of flows that previously have been split.

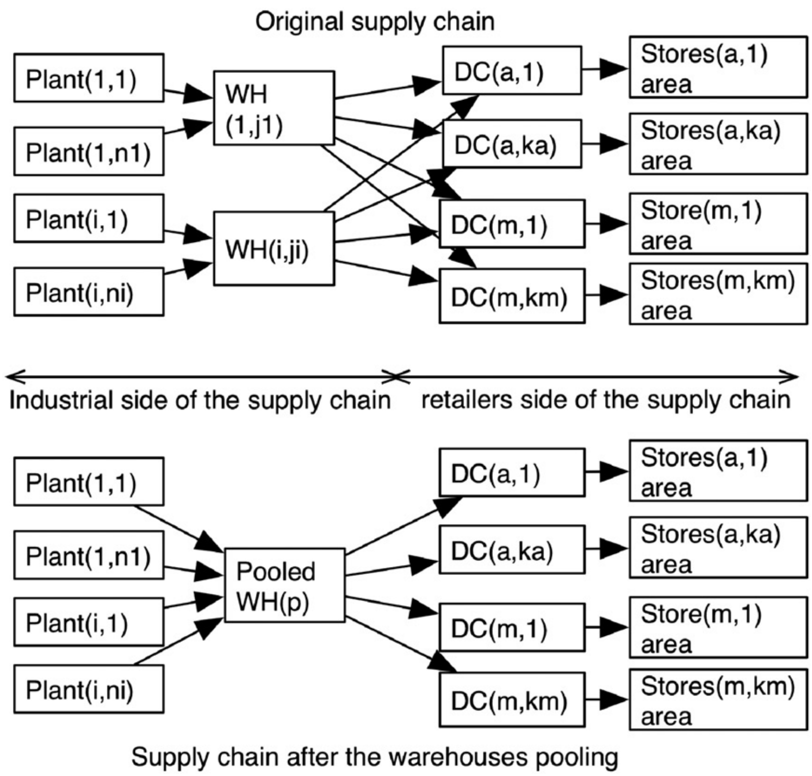


Figure 9 The principle when pooling supplier's warehouses(Ballot and Fontane, 2010)

3 Research Method

In this chapter the research method used in this master thesis will be presented. First the research strategy and approach are presented followed by an explanation of the project process and different data collection approaches. Then the data analysis method is described and reliability, validity, and objectivity of the thesis are discussed.

3.1 Research strategy

This master thesis is investigating a fairly new concept in logistics - horizontal cooperation (Cruijssen et al., 2010b, Leitner et al., 2011, Wallenburg and Raue, 2011). The authors both have prior knowledge in logistics theory and experience from working in logistics activities but lack experience of the concept of horizontal cooperation. Therefore, the first step in this research was to do a literature review to cover the existing theory. The literature review includes known authors that have been performing research in this area the last decade, as well as some practical examples of already implemented horizontal cooperation. However, to broaden the literature review it also includes theory closely related to horizontal cooperation and cases applied in other industries such as the maritime, aviation and manufacturing industry, presented in chapter 2.

The question that the purpose in this master thesis aims at answering is how horizontal cooperation affects a specific set of companies. In order to answer how-based research questions there are several different types of research methods that possible could be used; modelling or case study being two of those (Björklund, 2003, Höst et al., 2006). Further Ellram (1996) says the following about case studies:

"Case studies focus on holistic situations in real life settings, and tend to have set boundaries of interest, such as an organization, a particular industry, or a particular type of operation".

This further add to that the case study method is a suitable research method for this master thesis since the concept of horizontal cooperation is applied on the real life settings of the case companies with a clear set of boundaries.

Ellram (1996) describe that case studies as a research methodology explain, explore, or describe a phenomenon of interest. The case study method generally builds on an in depth qualitative study of one or a small number of cases. However, case studies can also be built on quantitative data but it demands a thorough analysis and therefore the number of cases are often limited – which is the case in this master thesis. The case in this master thesis is constructed with two case companies making it a single-case-study. Yin (2003) states that there are 5 situations where this is suitable, one of which is the revelatory case - A single case study is justified when a researcher has the opportunity to observe and analyse a phenomenon prior inaccessible to scientific research.

Studies with a quantitative approach contain information that can be measured or valued numerically. There are limits of what can be measured which open for qualitative studies. Qualitative studies are used to create deeper understanding of a specific subject. Observations and interviews are often applied in qualitative studies and mathematical models and simulations are usually applied in quantitative studies (Björklund and Paulsson, 2003). This study is focusing on quantitative empirical data simulated in a network optimization software.

The possibility to investigate the effects of a cooperation between the case companies have been impossible for several reasons, e.g. unwillingness, competiveness, and legislation. Therefore, the authors of this master thesis see it as a unique possibility to be able to work with these two companies.

The case study is constructed by data from the two case companies. The data has been collected through interviews and on-site visits. The distribution network for each company was then built up separately using the modelling software LLamasoft Supply Chain Guru.

Thereafter, the case study was constructed, investigating the two companies' networks with joint distribution terminals, also called horizontal analysis. This analysis will show the effects that horizontal cooperation has on CO_2 emissions and costs, stated in the purpose.

3.2 Research approach

Corley and Gioia (2011) discuss two dimensions that influence a study's theoretical contribution: originality and utility. These are then both divided in two subcategories, underlying each of these main dimensions. The dimensions are presented in figure 10. An incremental insight to science is when theoretical contributions gradually enhance our understanding of a subject, in contrary to the revelatory insight which gives a "surprising" or revealing contribution to theory. Scientifically utility gives future scholars a foundation to further develop the theory whilst the practically usefulness aims to apply theory in real-life situations.

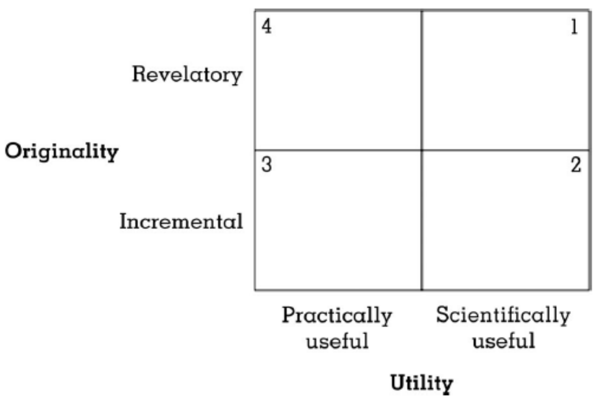


Figure 10 Dimensions for theoretical contribution (Corley & Gioia, 2011)

As stated in the first chapter, the purpose of this thesis is to determine a potential for Swedish grocery retailers which is a new market for horizontal cooperation which is placed in the second quadrant. However, the base of the thesis is to examine existing theories and practical examples of horizontal cooperation, thus placing the thesis in the third quadrant. Since horizontal cooperation has not been researched in this scale before, or in the Swedish grocery retailing market for that matter, the thesis covers the first and fourth quadrant.

3.3 Project process

The project process is described below in figure 11. A new company is contacted in the initial contact phase. However, in this master thesis has already established contacts been used. Benefits, such as cost reduction and decreased environmental impact, in combination with successful cooperation projects should be promoted to convince the company to join. Data collection is a crucial phase where all the relevant information is collected. The data collection form is presented in appendix A. With the collected data the reference models can be built and verified with the companies. When the models have been finished after the companies input, the horizontal analysis can start where the models are combined in one large model to investigate the potential benefits regarding cost and environmental impact which is the result of the analysis.

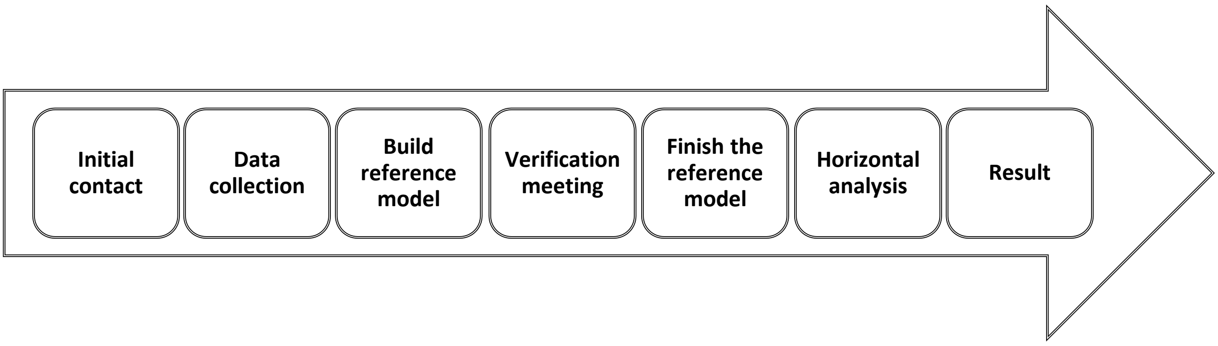


Figure 11 Illustration of the project process

3.4 Sampling of case companies

In December of 2012, before the start of this master thesis, a workshop organized by CLOSER was held where the Starfish idea was presented. In connection to this workshop, Coop and ICA expressed interest of participating in the project.

The Swedish grocery industry is highly dominated by a few large actors. ICA has around 50% of the market share, Coop 21%, Axfood (Willys and Hemköp) 15%, and Bergendahls (City Gross) 7%. Two smaller actors are Lidl, with a market share of 3%, and Netto, with a market share of 2% (Delfi, 2013). ICA and Coop account for 70% of the market share and have unbalances in their transport flows which indicate that they have potential for horizontal cooperation. Therefore they were chosen to be the participating companies in this study.

3.5 Data collection

3.5.1 Literature review

Kitchenman (2004) describes systematic literature review guidelines in a detailed way. It has the purpose to identify, evaluate, and interpret all available research connected to a specific topic area or particular research question. This kind of systematic review is a form of secondary study. The three most common reasons to execute a systematic review are listed:

- To summarise the existing evidence concerning a treatment or technology.
- To identify any gaps in current research in order to suggest areas for further investigation.
- To provide a framework/background in order to appropriately position new research activities.

Systematic reviews provide a wide range of information about a topic and research area. The results have been found with different methods and by different authors. If the results are consistent the review can provide evidence that the researched topic is robust and transferable. However, a proper systematic literature review requires a large effort and a number of features must be fulfilled. For example a predefined research strategy, documentation of the searches and a review protocol that specifies the research question (Kitchenham, 2004).

The literature review in this thesis aims to provide a background to position the thesis' research, but also summarize the existing evidence concerning horizontal cooperation. Extra focus will be put on Sweden because that is the geographical area of execution. Due to limited time all aspects to perform a proper systematic study have not been fulfilled even if it has been well structured.

LUB Search was used as a search engine to cover a number of databases. Table 1 shows the key words used in different combinations. A detailed view of the searches and structure of the literature review can be found in appendix D. In addition, to eliminate missing articles, an ancestry approach has been used in combination with searches on specific, relevant authors.

Table 1 Key words used in literature searches

Key words	Data base
Horizontal	LUB Search
Cooperation	LUB Search
Collaboration	LUB Search
Coopetition	LUB Search
Transportation	LUB Search
Logistics	LUB Search
Transport bundling	LUB Search
Cross-company	LUB Search
Distribution	LUB Search
Supply chain	LUB Search
Alliance	LUB Search
Joint-route-planning	LUB Search
Supply networks	LUB Search

3.5.2 Interviews and on-site visits

Höst et al. (2006) describe three types of interviews; unstructured, semi-structured and structured. As the names indicates they have different objectives and arrangement where the unstructured has open questions within chosen topics, the semi-structured has fixed questions with specific answer alternatives in combination with open questions, and the structured only has fixed questions with answer alternatives.

The quantitative case study are also based on qualitative data. The qualitative data has mainly been collected by interviews and on-site visits. Before the interviews was held, information was gathered from internal information documents, presentation material, and excel files. Based on this information the interview guides were created. These interview guides consisted of mostly open questions with specific topics in order to understand the structure of the network. According to Höst et al. (2006) this defines the interviews as unstructured with specific topics.

When testing the two possible software, two consultant firms, ArgusI and Optilon, working with supply chain design were visited to get a deeper understanding of the two software considered in this master thesis. The work started with IBM LogicNet and the software was thoroughly tested before a visit was organized at ArgusI. The visit was a mix between an unstructured interview and lecturing organized more like a workshop. The prepared discussion bullets at the workshop can be found in appendix F.

After the Coop model was finished in IBM LogicNet, contact was made with the consultancy firm Optilon in Malmö, which is working with the Supply Chain Guru from LLamasoft. After the initial meeting a model of Coop was prepared before the unstructured interview and workshop was organized at Optilon.

In table 2 the interviewed managers at the case companies and the software experts are presented connected to the role they have at the respective company. The interviews are presented in more detail in appendix E.

Table 2 Roles and company of the persons that has been interviewed in this master thesis

Role	Company
Project manager 1	Coop Logistics
Facility manager	Coop Logistics
Transport procurement manager	Coop Logistics
Project Manager 2, Transport development	ICA Sweden AB
Sales Manager	Optilon
Optimization analyst 1	Optilon
Optimization analyst 2, project manager	ArgusI
Optimization analyst 3	ArgusI

After the separate networks were finished, another visit was made at each case company where the model of the networks were shown to the respective project manager in order to validate the models. In connection to this a finishing interview was held with fixed questions aiming at answering specific questions. This is defined as a semi-structured interview according to Höst et al. (2006).

3.5.3 Framework for data collection

The used software Supply Chain Guru (see 4.3.2) and IBM LogicNet (see 4.3.1), is based on a MS SQL-format. The framework is summarizing the needed data and excel sheets have been used to be able to collect it from the participating companies. The requested data includes for example suppliers, customers, warehouses, and transported volumes. However, the framework is just to show the company what data is required. The data framework, presented in appendix A, was also sent to optimization analyst 2 and 3 in order to confirm that nothing was missed.

3.6 Data analysis

The data collected was both qualitative and quantitative and has been treated and used in different ways. The qualitative data was collected and structured to get a picture of the companies' networks, with all nodes, e.g. supplier, warehouse and store location.

The quantitative data is more relevant when it comes to data analysis and building up the model in the software. The data has been structured and analysed according to the software requirements specified in the workshops with the software partners. The empirical study has modelled separated transport networks in two reference models where the flows have been steered to follow the delivery plans as they are today.

The actual data analysis that ends up with the result has then been executed by the software when the two models were combined in one model with joint distribution terminals and the sourcing policies freed to let the software optimize from which distribution terminal to source from. The sourcing terminal for a Coop store can be an ICA distribution terminal and vice versa. Joint distribution terminals increase the possibility to find a more optimal path for the flow and decrease the distribution cost.

3.6.1 Analysis tool

The analysis tool is the core in this kind of study and puts high requirements on the software since Starfish involves analysis on both strategic and tactical level. The software needs to be able to perform network analyses and handle large databases and easily expand the networks when adding more companies. In addition, it also need to complement the network analysis with route planning where the synergies in both collection and distribution are critical parts of the result. Below are also other aspects, which need to be taken into account when choosing software, presented:

- Is it suitable for the market where the analysis is taking place?
- How is the availability of support?
- Are there any available cooperation partners using the software?
- Is the output reliable?
- The cost and availability of licenses.

3.7 Reliability, validity, and objectivity

These three concepts can be seen as different aspects of a study's trustworthiness and should always be considered in a scientific context. The endeavour should be to reach as high level of reliability, validity and objectivity as possible. Shortly described, validity is to what extent you measure what you want to measure, reliability is to what extent the measuring tools and techniques are appropriate, and objectivity is to what extent opinions have affected the result (Björklund and Paulsson, 2003).

3.7.1 Reliability

Ellram (1996) discuss that a reliable study is repeatable, which means that a replication is possible and will achieve the same results every time it is performed. She identifies two elementary keys to case study reliability: use of a case study protocol and development of a case study data base. The protocol relates to the procedures to follow and how to execute all the steps in the study and the data base consist of various information collected by the researchers.

To reach a high reliability in this thesis the data collection form has been well structured and standardized for all companies. This to ensure that the collection can be replicated by other researchers and with other companies involved. The form can be found in appendix A. The study's database consists of the conducted literature review and the empirical collected data. The empirical data cannot be presented due to a secrecy agreement with the companies.

The software used in the analysis has been recommended by the consultancy firm Optilon which have been using the software with proven great success. In addition, the authors have compared the outcome from the software with both the real cost and the outcome of a second software, the IBM LogicNet, this is further explained in section 5.3.

3.7.2 Validity

Mentzer and Flint (1997) write that much of the robustness of the research is addressed in the concept of validity. They argue that the concept often are misused and present four dimensions of validity. However, just the two most relevant dimensions is presented and discussed below.

Internal validity

Internal validity relates to if the logistic research contributes to bring considerable value or in other words really provide evidence for the research problem (Mentzer and Flint, 1997). The internal validity is strengthened in this thesis through the extensive literature review and a similar study in the UK (Palmer and McKinnon, 2011) confirms the relevance of the research.

External validity

External validity relates to the degree to which the research findings can be generalized to other situations. To achieve high external validity such aspects as random sampling, proper sample size, and adequate response rate are important to consider. It should also be pointed out that no single study can ensure external validity (Mentzer and Flint, 1997). The sample size for this master thesis is only two companies, due to the time constraint. The response rate cannot be applied in this case because no large scale survey has been conducted.

The company selection has not been a random sampling, which negatively affects the validity. The study can be replicated with the same, or other, companies but the results cannot be generalized. Ellram (1996) discuss the generalizability of case study research and argue that the generalizability increases with a clear understanding of the research methodology. She further considers many case studies to be preferred and keep out delimitations and special conditions. For this thesis a number of delimitations are used and the analysis and result are specific for the single cooperation.

3.7.3 Objectivity

Paulsson (1999) discusses that it is almost impossible for a researcher to be completely objective. It could also be questioned if a researcher should try to reach totally objectiveness. He also mentions that the initiator's expectations on the outcome can affect the objectivity. The researchers should listen, understand the issues, and take advice from the principal, but all decisions should be taken by the researcher.

The organisation CLOSER is the principal of this master thesis, but the work has been done with no influence from them, since the authors have been spending all their time with the involved companies, at LU Open, and the Division of Packaging Logistics. The role of CLOSER has been to present the idea, arrange the first company contacts and funding. There is a risk in all research that the authors want to show a good result, but the quality of the work has been in the centre of attention in this master thesis. In addition, since sharp transport costs have been used the results will be lower but also more realistic.

4 Empirical Study

In this chapter the empirical work of this master thesis will be presented. It will follow the research method and describe how the collected data has been studied and how models of the participating companies have been built up.

4.1 Transport networks of case companies

The participating companies' transport networks, flows, and facilities have been studied in detail. Thereafter, it is possible to analyse horizontal cooperation according to the purpose. The case study includes the two biggest grocery retail companies active on the Swedish market. They are large companies with over 2000 stores together. The companies have been modelled separately in Supply Chain Guru and the companies are presented one by one in this chapter. The flows in the reference model have been steered to follow the reality as close as possible. The sourcing and transportation policies that are followed today are added to the model, e.g. a store sourcing from a specific distribution point has been forced to only source from that terminal in the reference model.

The collected data has been limited to include an average week of November, 2012. November is chosen because it does not include any holidays or other seasonality. This is preferred since the network should be optimized after normal conditions rather than peaks and valleys in demand. The CO_2 emission levels have been collected from NTM (NTM, 2013) and are presented below in table 3.

Table 3 NTM emission values

Transport type	CO_2 / Km
Truck with trailer, 24m	0,817
Trailer with semi-trailer, 18m	1,141
Train, 500 tons	0,19

The capacity of the trucks and fill rates have not been taken into account in the analysis. A cost per pallet and mile has been used and is not affected by the capacity. This is a consequence of that route planning has not been included in the models.

Since an average week is simulated small average demand flows appear. These are not representing the normal flow and represent less than 0.01% of the total flow. They have therefore been deleted according to the following steps.

a. All flows that just have been delivered one specific weekday once or twice that month, i.e. only one of the 5 Thursdays in November 2012 has a delivery.
b. All average flows smaller than 1 pallet.

In addition, deliveries going direct from suppliers to the stores have been neglected since they are less than 0.1% of the total inbound flow. Load units that do not take up any floor space have been deleted since they are not a constraint for the loading of trucks. It could for example be medicals, tobacco and other small boxes.

4.1.1 COOP

4.1.1.1 Company description

Coop is the second largest actor in Swedish grocery retailing with about 20% of the total market share (Delfi, 2013). The collected data contained around 650 stores spread all over Sweden. The size of the stores are spread from small Coop NÄRA to large Coop FORUM.

Coop is a part of the Swedish Cooperative Union which is a federation of 41 cooperative societies with over 3 million individual members. The grocery retail trade is the core business (Coop, 2013). Coop has a long tradition in Swedish retail and has in the past been divided in different regional groups operated completely separate. However, the business has been more and more centralized and the Swedish region Värmland is the only region still operated separately from the others.

4.1.1.2 Collected data

The data collected from Coop consisted of several files for each terminal. The flows dry, fresh, and frozen were separated. The data was converted and streamlined in order to fit the MS SQL database. How the data has been structured for Coop is described in appendix C.

The network description is based on interviews with a project manager, a facility manager and a transport procurement manager. These interviews are presented in appendix E.

4.1.1.3 Network description

Coop has three terminals, one for dry goods situated in Bro, one for fresh goods situated in Västerås and one for frozen goods in Enköping. All goods are going through one of these terminals and then either direct with distribution out to stores or to a distribution terminal. Coop separate the three flows of dry, fresh and frozen goods which means that they are delivered in separate trucks due to the temperature difference. In addition to the three terminals they have ten distribution terminals to be able to consolidate goods in distribution. There is also a terminal in Karlstad. The Karlstad terminal is operated independently and receives bulk goods from the terminals in Bro, Enköping and Västerås and handles both packing and distribution to all stores situated in the region of Värmland. This is the last remainder of the old decentralized organisation. All the flows are illustrated in figure 12.

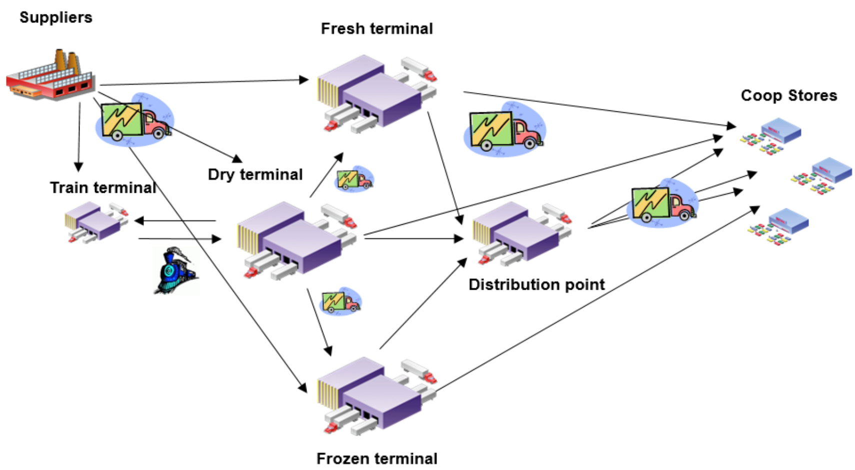


Figure 12 Distribution network of Coop

Coop has a train set going between Helsingborg and the terminal in Bro. Five days a week a train set departs in both southerly and northerly direction with a number of trailers in each direction. In the south direction there is a stop in Alvesta where the outbound flow to the distribution terminal in Växjö is unloaded. All the flow to the distribution terminal in Växjö goes by train except for the fresh flow, which is transported by truck. The flow going south to Helsingborg is distributed directly out to large stores with semi-trailer or to the distribution terminal in Malmö. Many suppliers are located in the southern Sweden or Europe which means that there is no problem to fill the train-set going north. Most of the customers are not in the area covered by the outbound train transport which makes it problematic to fill the train going south. The goods going with train is loaded on semi-trailers. These trailers are owned by Coop and are in a closed system. The trailers are unloaded at the terminal in Bro and the flow to Enköping and Västerås are pulled by trailers from Bro. Collection at suppliers is done with trucks with semi-trailers going to the train station in Helsingborg.

The inbound flow from suppliers can also be collected by truck in to the terminal. The total number of suppliers, where Coop are responsible for the collection, is approximately 220. There is also a large number of suppliers where Coop are not responsible for the in-bound (to terminal/store) delivery. Those flows are operated by the suppliers and delivered in to the terminals. To split that flow from the rest, a facility has been placed in Hamburg, which has free transports to the terminals in the model. Some local suppliers deliver directly to the distribution terminals, that flow is then merged with the distribution of the large flow from the terminals.

The distribution and inter facility transports are dominated by the truck with trailer (24 m with 48 pallets) equipages. In large cities single trucks are used and in the central parts of Stockholm smaller distribution trucks. The type of truck and flow influence the cost and how the costs have been handled is described in section 4.2.

The flow of fruit and vegetables is outsourced to Everfresh in Helsingborg and they mostly deliver directly to stores but also to Västerås or Malmö where smaller flows are co-distributed with the fresh flow. The direct flow is not included in the analysis while the flow that has been co-distributed with the fresh flow is included in the analysis.

The distribution terminal in Malmö is used for consolidating inbound flows from suppliers and then transported by a 24-meter equipage to the train station in Helsingborg. The distribution terminal in Malmö is also used to consolidate fresh goods with fruits and vegetables for the stores on the west coast.

The trucks collect empty pallets, waggons, cardboard and other empty wrappings on the way back to the terminal or distribution terminal. The return flow at Coop can fill up to 50% of the truck.

4.1.1.4 Coop model

The model in figure 13 shows the Coop model and their total network from suppliers to warehouse facilities and out to stores. The model gives a good overview of the total network and is later used for the analysis when combining the distribution terminals with ICA's distribution points. The model has been verified in a meeting at Coop logistics in Solna the 6th of May 2013 and some valuable insights about the flows and costs were discovered. The data was also verified at the meeting and in addition a summary of average flows to stores and terminals in combination with questions have been sent to more operative parts at Coop for verification.

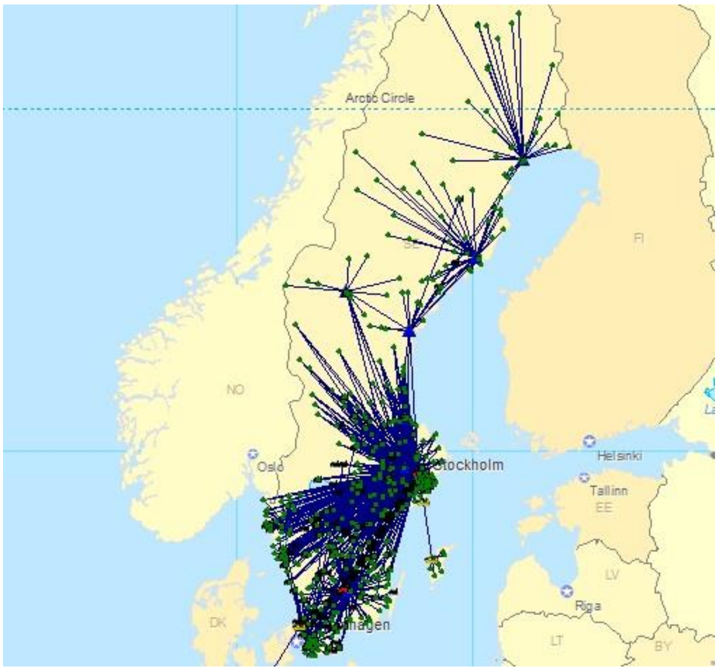


Figure 13 Supply Chain Guru view of the Coop model

4.1.2 ICA

4.1.2.1 Company description

ICA is the dominant actor in Swedish grocery retailing with about 50% of the total market share (Delfi, 2013). The collected data contained around 1480 stores spread all over Sweden and they are divided in different concepts depending on size. The size of the stores reaches from small ICA NÄRA to large MAXI stores with hundreds of pallets delivered weekly.

4.1.2.2 Collected data

The collected quantitative data from ICA was well prepared and consisted of one file for distribution, one for inbound and one for all sites such as central warehouses, warehouse terminals and distribution points. ICA delivers fresh and dry goods together in refrigerated trucks to lower the number of deliveries per store. However, the frozen flow is separated and that data was provided in a separate file.

The network was described and discussed in a meeting with a project manager 2 at the ICA terminal in Helsingborg the 2^{th} of May 2013.

4.1.2.3 Network description

Helsingborg is where the strategic transportation team is situated. ICA has six terminals, including two central warehouses in Västerås and Arlöv. The other four are distribution warehouses situated in Helsingborg, Kungälv, Borlänge and Kallhäll. The largest facilities are the central warehouse in Västerås with an area of 97 000 m^2 and the terminal warehouse in Helsingborg with an area of 64 000 m^2.

There are seven distribution points to be able to consolidate distribution. ICA has mentioned that they also have a few more distribution points completely operated by a 3PL, however no information about them has been provided and they have therefore not been included. The flow is described in more detail below and illustrated in figure 14.

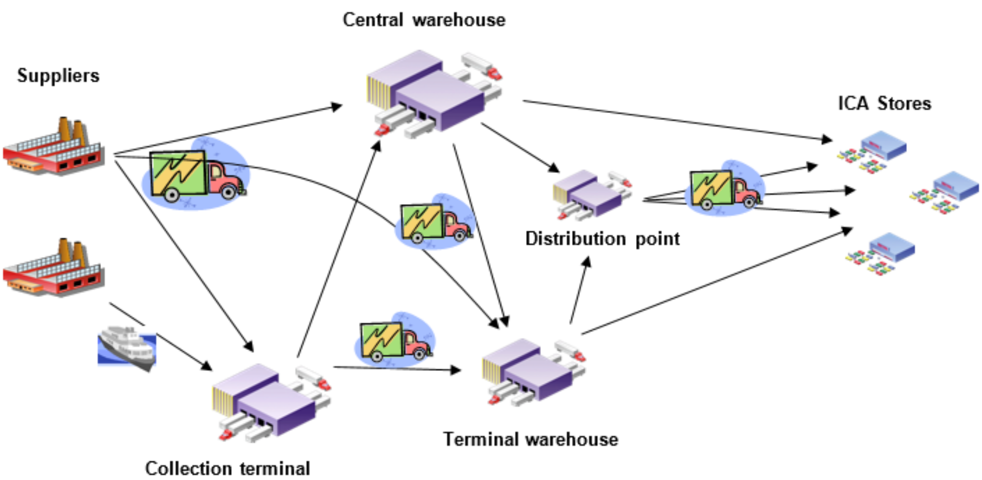


Figure 14 Distribution network of ICA

ICA collects goods and are responsible for the transport from a group of around 100 suppliers. These transports are executed by trucks with trailers and go to one of the six warehouse units. The collections can also be consolidated in one of the two collection points in Göteborg or

Helsingborg. The rest of the inbound goods from suppliers are delivered directly by the suppliers to one of the ICA warehouse facilities. These transports are therefore not included in the analysis and has been modelled as free inbound from a facility in Rostock. Many suppliers are also located in Europe and they have been placed in northern Germany to clearly separate these transports from the rest.

Due to limited time, the inter facility flows in the ICA model have been simplified to follow the allowed paths and flow constraints have been added to some extent. This means that the model steers the amount of pallets transported when there is no flow constraint.

All transports have been modelled as 24 meter equipages. However, the cost has been adjusted for frozen and fresh transports and also for transports in different parts of the network.

The trucks collect empty pallets, waggons and plastic on the way back to the terminal. The return flow at ICA can fill up to 30% of the truck.

4.1.2.4 ICA model

The model in figure 15 shows the ICA model and their total network from suppliers to warehouse facilities and out to stores. The model gives a good overview of the total network and is later used for the analysis when combining the distribution terminals with Coop's distribution terminals.

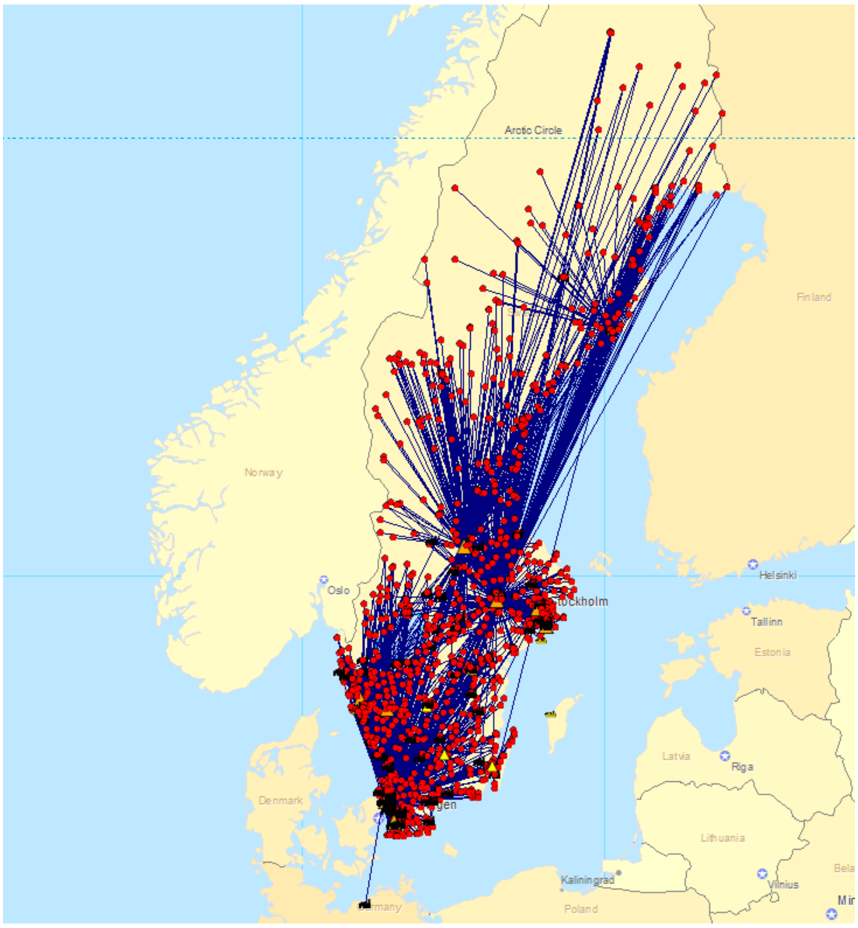


Figure 15 Supply Chain Guru view of the ICA model

4.2 Costs

The effects on transportation cost from horizontal cooperation is stated in the purpose. The accuracy of the costs in the modelling is crucial to be able to present a trustworthy result. The following two sections present how the costs have been provided and handled. The provided costs in this study follows the price differences for different flows. The rates differ between different regions and direction of the flow due to imbalances between consumption and production. Using flat rates would not give accurate results for the specific companies but is enough for a general holistic potential for a wide range of companies like the study in the UK.

4.2.1 Road transport cost

The transportation cost structure in Sweden is highly fragmented due to imbalanced flows. Henrik Sternberg and his contacts in Swedish road haulier firms have provided a large number of pricelists and costs to support the understanding of Swedish transportation cost structures. Their expertise has also been available for discussion about how the transportation costs are built up.

Total transportation costs for each warehouse/distribution unit have been provided by both ICA and Coop. The costs are not presented due to secrecy agreements. The system costs have then been transferred to a cost per pallet and mile with the help of the number of pallets shipped. The cost structure from a big actor with a network covering the whole of Sweden, has been applied to adjust the cost structure for different regions. Different kinds of trucks, city distribution, and handling cost have been included in the cost structure.

4.2.2 Extra handling cost

The Coop train going from Helsingborg to Bro results in extra handling of trailers. Handling cost for lifting trailers has been taken from an academic research by Jonas Flodén (2007) who presents that the cost for handling one Intermodal Transport Unit (ITU) can vary from 150-250 SEK depending on the size of the flow, terminal and equipment used. An average cost of 200 SEK for one lift has been used and confirmed by Coop.

The extra handling of pallets related to the train transport is not included in the transport cost. The handling cost per handled pallet or other standard unit has been discussed with Coop and 12 SEK for each handling has been used.

4.3 Supply chain design software

A software is necessary to be able to quantify the effects on CO_2 emissions and costs according to the formulated purpose. Palmer and McKinnon (2011) developed an own model in their UK study but there is also an alternative to use an existing software. Therefore the software on the market were identified, to evaluate if a proper software could be found.

Funaki's article “State of the art survey of commercial software for supply chain design” (2009) presents 13 possible software. These software are mainly focused on supply chain design looking at the network perspective, but some are also including more tactical focused questions. Of these software, six were identified as possible candidates to use and of these candidates, LogicNet and Supply Chain Guru have been thoroughly tested and are presented in the following sections. In chapter 5.3, the analysis of the software is presented and comments on each software can be found in appendix B.

The Starfish project will continue after this master thesis which puts even higher requirements on the software. The software must fulfil all requirements for future development of the Starfish project and not just for this master thesis. Therefore the software also has to be able to handle more tactical decisions such as multi-stop routing and backhauling.

The authors have been in contact with a consultancy firm for each software in order to learn how to work with the software and analyse the suitability of the software for the purpose of this master thesis. Regarding the IBM LogicNet one Skype-meeting has been held with optimization analyst 2 and a visit to the consultancy firm ArgusI in the Netherlands has been made. Regarding the Supply Chain Guru two meetings with the consultancy firm Optilon has been held. This is more thoroughly explained in appendix E.

4.3.1 IBM LogicNet

IBM's webpage (2013) informs that the software facilitates quick analysis of the trade-offs between production, warehousing, transportation costs, carbon footprint, and service requirements. Several leading experts have documented advanced modelling work using IBM LogicNet (Simchi-Levi et al., 2007). In addition, calculations of the optimal network configuration are possible for different cost and service objectives. They also list a number of benefits and features, and two of them are highly relevant for the analysis in this study:

- Rationalize global distribution and manufacturing networks to help identify the most cost-efficient supply chain network.
- Consolidate distribution and manufacturing networks following mergers or acquisition activities to more quickly realize your return on investment (ROI).

In order to be able to take multi-stop routes and backhauling in consideration in the analysis, LogicNet has to be complemented with a transportation tool, the IBM tool Transportation Analyst (IBM, 2013). This is a separate tool that cannot be integrated into LogicNet.

4.3.2 LLamasoft Supply Chain Guru

LLamasoft presents their optimization software called Supply Chain Guru at their Webpage (LLamasoft, 2013). Different features such as network optimization with detailed costing and behavioural characteristics for all key supply chain elements are presented, but also features such as product flow-path optimization in combination with visualizing and reporting tools.

The Supply Chain Guru is similar to IBM LogicNet, but its transportation tool, the Transportation Guru, can be integrated with the Supply Chain Guru, enabling smoother future analysis. LLamasoft claim to offer the only software that integrates network design and transportation routing. The software enables optimization of warehouse to customer routes with multiple stops and includes pick-up routes. Transportation Guru can be a fully-integrated component of Supply Chain Guru or used as a stand-alone product which makes it very powerful and suitable for this analysis.

5 Analysis

In this chapter the analysis based on the theory study will be presented. The software analysis will explain the choice of software followed by the horizontal analysis of the participating companies with the result presented in the end.

5.1 Case companies

The case companies are, as described in chapter 4, large Swedish actors in the grocery retail sector. ICA and Coop dominate the market and are to be seen as major competitors. However, it is still possible to cooperate in none core activities placing them in the coopetition type of relationship described in section 2.2.1.

The cooperation includes distribution which is not close to the customer since distribution is not a core activity for Coop and ICA. According to theory is coopetition best suited if the cooperation regards activities that are not close to the customer, which is the case for ICA and Coop. Both companies have expressed their willingness to consider this kind of cooperation and have in some areas indirectly started co-distribution completely operated by a third part since the distribution rural areas is outsourced.

Figure 16 illustrates the principle of horizontal cooperation and the organisations have been circled to show the horizontal nature. The case companies have their own supply chains and act as competitors but can still cooperate in horizontal cooperation in none-core activities.

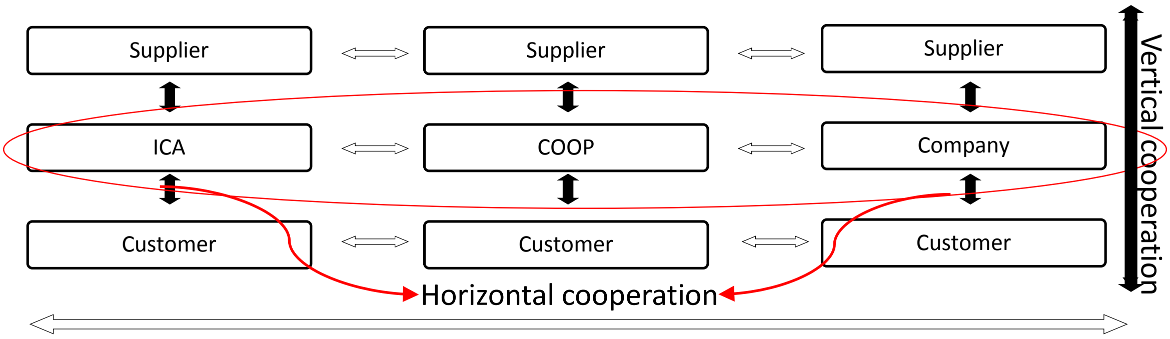


Figure 16 ICA and Coop in horizontal cooperation

The scale of cooperation is mentioned in section 2.2.2 and for the cooperation between ICA and Coop the most relevant relationship to start with is of a “Type I” nature. As described in theory “Type I” is a cooperation involving coordinated activities but only one kind of activity. For ICA and Coop that activity is transportation through joint distribution terminals. However, theory describes the focus to be short term but hopefully the cooperation is turning to a long-term “Type II” cooperation with more activities such as joint terminals, route planning and supplier collections. The initial cooperation type is illustrated in figure 17.

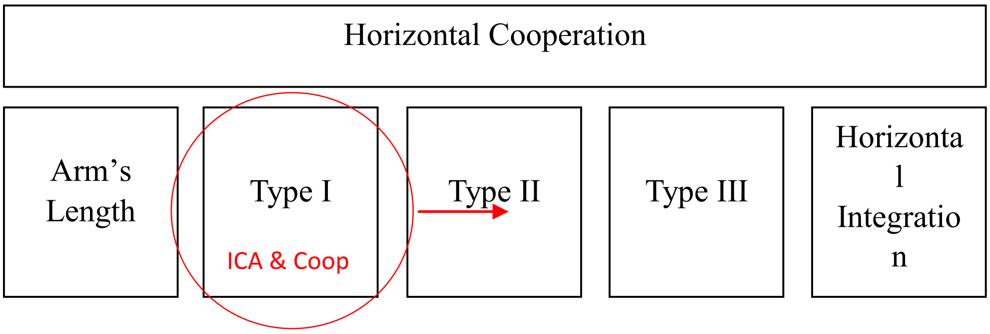


Figure 17 ICA and Coop classified as type 1 cooperation

5.1.1 Company comments

The contacts with ICA and Coop confirms the picture that an independent part that executes the analysis increases the potential to start horizontal cooperation. ICA and Coop have not been in contact with each other, all contact has been through the project team. There is no doubt that this cooperation is of a horizontal nature and can be classified as coopetition due to the competing relationship. At the beginning the cooperation is classified as a "Type I".

This type of company is similar to the UK study (Palmer and McKinnon, 2011) who also investigate the potential in the grocery sector. However they included 27 companies making the analysis general and not company specific. In that sense this study is more similar to the one executed in The Netherlands (Cruijssen et al., 2007a) where joint route planning for three Dutch catering companies is studied but also implemented.

5.2 Horizontal analysis in the constructed case

The horizontal analysis is a combination of the two models of ICA and Coop, presented in chapter 4, and will show the potential CO_2 emission reduction and cost savings as stated in the purpose. The potential is hidden in the combination of networks and the horizontal analysis is the final step before the potential can be presented. For this master thesis the analysis is limited to only include Coop's distribution terminals and ICA's distribution points in a common distribution network. The pooling principle is described in section 2.8.

Adding both companies' networks in the same model makes it possible to use all distribution terminals and points as joint facilities. Both ICA and Coop have terminals in Växjö and Umeå which mean that the only difference if adding them as joint facilities will be the cost structure. These terminals have therefore been excluded and kept separate as specific for each company. However there is a possibility that a merge of the two distribution terminals in the same city could lead to a decrease in cost. Figure 18 shows the principle of joint terminals. The Coop terminal in Luleå shorten the distribution distance to a lot of ICA stores in the north. ICA is distributing longer distances from their terminal in Borlänge. The trade-off between expensive distribution cost and extra handling in a distribution terminal decides the transport path. The horizontal analysis confirms that the cost can be reduced for many stores, when using closer, already existing distribution terminals.

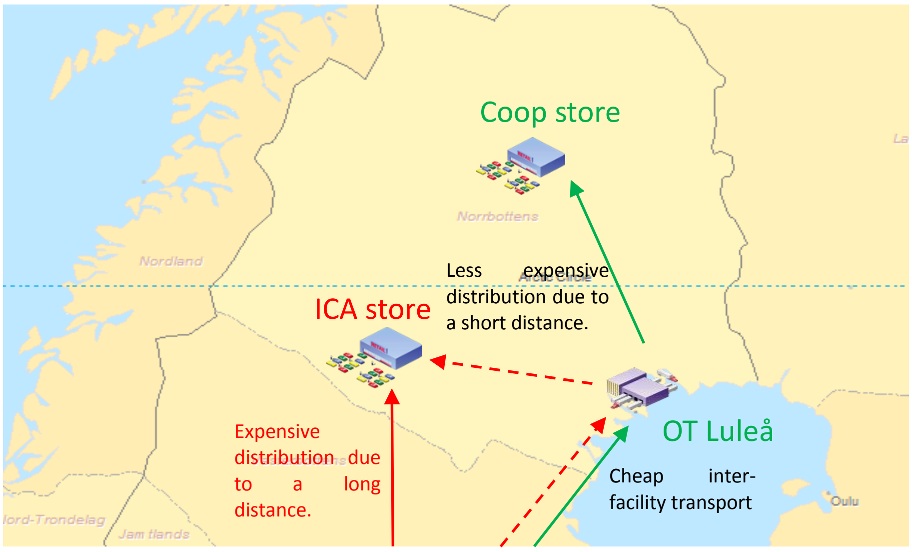


Figure 18 Joint distribution terminal in Luleå

Emissions can also be reduced through the horizontal analysis due to more direct paths with more available distribution terminals. The chance to combine a more direct path increases which lower the total driven kilometres. If adding joint route planning as illustrated in figure 19 the potential to reduce emissions is probably even higher because of increased fill rate due to larger volumes and planning possibilities. However, this has not been executed.

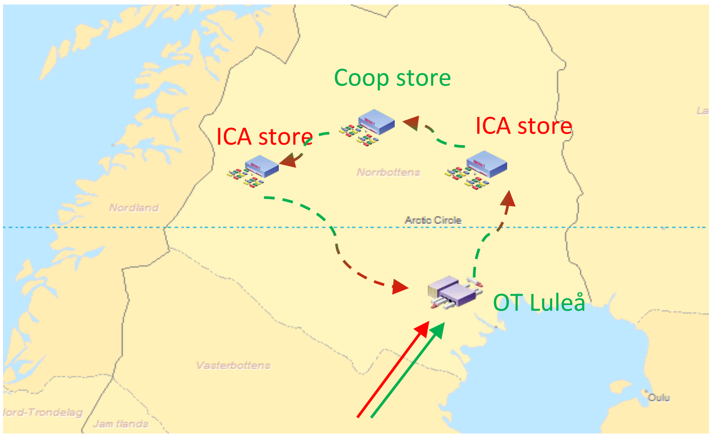


Figure 19 Principle with joint route planning for ICA and Coop

In the reference model the stores are forced to source from the terminal or distribution terminal according to the delivery plans but in the horizontal analysis this constraint has been opened and all ICA's and Coop's stores can source from other closer terminals.

The flows in the models are steered by cost per pallet as direct shipments. This is a simplification of the reality and is a consequence of the limited scope of the master thesis but still enough for this first analysis. However, to model joint routes a deeper analysis would be necessary and also claim a lot more detailed information about flexibility of delivery times, frequency, transportation times, fill rate etc. The principle of joint route planning is illustrated in figure 19 and could further increase the reduction of emissions and costs.

5.2.1 Horizontal analysis result

The combination model of ICA and Coop has included the companies' distribution points as joint facilities and Supply Chain Guru has optimized the flow according to lowest cost, the result is shown in table 4 below. The cost for both ICA and Coop combined decreases by 6.2% and the CO_2 emissions decrease by 1%.

Table 4 Result of the combined model

	Cost	CO_2
Combined result	-6.2%	-1.0%

Looking at the costs separately for each company shows that ICA can realize a bigger cost saving and reduce their CO_2 emissions more than Coop. Table 5 shows that the inter-facility flows have an increase in both cost and CO_2 emissions. This is due to that prior long distance distribution in the new model gets transported between facilities and thereafter have shorter distance to be distributed.

Table 5 The change in cost and CO2 emissions for each company and flows

	Flow	Cost	CO2
Coop	Distribution	-4.2%	-2.8%
	Inter-facility	2.5%	1.2%
	Total	-1.1%	-0.4%
ICA	Distribution	-18.5%	-22.2%
	Inter-facility	4.6%	4.6%
	Total	-8.6%	-1.2%

5.2.2 Result comparison with other studies

The existing research from the densely populated countries in Europe has with this study been complemented with another Swedish study where the population is widely spread over longer distances. Figure 1 on page 3 is indicating that larger distribution areas increase the cost reduction. It is impossible to compare the result between different studies because of unique conditions for each case but this master thesis show a great potential for horizontal cooperation for Swedish grocery retailing companies where the distribution area is large. The result also complement the other Swedish studies from Pajala (Hageback and Segerstedt, 2004) and the research on the Swedish forest industry (Frisk et al., 2010) with a result supporting horizontal cooperation. The reduction of CO_2 emission by 14.2% and cost savings of 17.6% reported from the study in the UK (Palmer and McKinnon, 2011) is not reached in this study but it includes many aspects such as out of hour deliveries, back hauling and bundling. The result from this study is only due to joint distribution terminals and can also be expanded. The major difference between the study in the UK and Starfish is that Palmer and McKinnon combine all companies and analyse a huge theoretical maximum while Starfish is more focused on matching companies and to present activities to implement. A cost structure based on real events is a major difference from the UK study which has used standard flat rates.

5.3 Supply chain design software

Funaki (2009) argues that supply chain design as well as product design and operation set-up determines 80% of the total supply chain costs. The remaining 20% refers to operational efforts such as production scheduling and transaction handling. An optimal design of the supply chain can therefore be a good way to increase profitability and show the importance of a correct choice of software for such analysis.

5.3.1 Software analysis

The evaluation of available software on the market was made based on an article of Funaki (2009), where he presents 13 available software. Information collected on each of the software can be found in appendix B. From these 13 software six were identified as possible candidates and two were chosen for thoroughly testing; the IBM LogicNet and the Supply Chain Guru.

5.3.1.1 IBM LogicNet

The IBM software LogicNet, presented in section 4.3.1, was mainly chosen based on a recommendation from an experienced and proficient academic researcher and consultant, who stated that the software matched all our requirements regarding the analyses. In order to evaluate the software a visit to a consultancy firm in the Netherlands, which uses the software, was made. The software was also fairly easy to access and the consultancy firm is a potential cooperation partner. Concerns about the software's capability to solve the tactical analysis were discussed and dismissed.

5.3.1.2 LLamasoft's Supply Chain Guru

The Supply Chain Guru, presented in section 4.3.2, was taken into consideration and discussed in a meeting with Optilon, a Swedish partner of LLamasoft that provides the software. The software offers a powerful mix of network optimization in combination with route optimization in Transportation Guru, which is fully integrated in the Supply Chain Guru. Supply Chain Guru offers a unique possibility to combine strategic network design and tactical route planning issues in one software package.

5.3.1.3 Software output comparison

In order to compare the two software an early version of the Coop model was built up in both LogicNet and Supply Chain Guru. The result showed that both software gave similar results suggesting that no difference in performance could be drawn.

5.3.1.4 Computing power

When performing the initial horizontal analysis, the validation of the model took between 6-9 hours to complete. In order to bring down the computing time to a more manageable level, a high performing server was used. In addition, the model was more streamlined and some unnecessary settings in the model was removed. This has brought down the validation of the model to 30-60 minutes.

5.3.1.5 Results

Both LogicNet and Supply Chain Guru are capable of solving the problems addressed in this master thesis, but there are some differences. The tactical analysis in LogicNet needs an extra external program while Supply Chain Guru has an integrated solution. The support partner for Supply Chain Guru is located in Sweden closer to the analysis team which facilitates when support is needed. Also, the support received from Optilon/LLamasoft is considered better than the support from IBM.

6 Discussion and Future Research

In this chapter a discussion and a suggestion for future research will be presented.

6.1 Discussion

The most interesting part of the result concerns the effects of horizontal cooperation for Coop and ICA. The result shows that Coop and ICA combined has a potential to reduce CO_2 emissions by 1% and costs by 6.2%. This analysis gives a first indication of the effects but needs to be expanded and more detailed. Furthermore the found potential will probably increase when adding the opportunity for joint distribution to stores, i.e. one truck delivering to both Coop and ICA in one trip. Route planning would also add the option to collect goods from a supplier on the way back.

The results are also important to further motivate companies to act and join cooperation to decrease costs and, not to forget, decrease the environmental impact. The potential to reduce the environmental impact and at the same time cut costs should hopefully make companies more willing to start own cooperation initiatives or to join projects like Starfish.

Different opportunities resulting from cooperation is what motivate companies to join a collaboration and the two most relevant opportunities for the participating companies in this master thesis has been to reduce CO_2 emissions and, of course, the possibility of reducing their logistic costs. This is not surprising since costs is what drive all companies in a competitive market and environmental aspects is growing in importance to stay competitive. The opportunity about service has not been mentioned by either Coop or ICA even if they both point out that the service to the stores and customers need to be preserved and also improved if possible. Even if the main focus of Starfish is to lower the environmental impact by horizontal cooperation it is important to highlight the cost benefits in order to encourage companies to participate.

Both Coop and ICA have expressed a willingness to collaborate with distribution which shows that even fierce competitors can and are willing to cooperate in order to gain synergies. However, other impediments mentioned in previous research are soft aspects such as conflicts, relationship, and trust.

One such impediment with cooperation is the sharing of gains and profit. As presented in the analysis, the savings are unequal between Coop and ICA which additionally increase the importance of a fair sharing of the savings. The gain sharing issue is therefore even more important and it can be difficult to find a long term solution. Other implementation aspects are size of the terminals, operational costs, etc.

Due to the trust issue and the unwillingness to share data it can be hard for companies to evaluate suitable partners in order to see the true potential of a cooperation. Therefore it is essential to have a third-party that can collect and analyse the data, and thus take away the trust issue. This leads to a new problem - who is a suitable third-party? In some areas, products of both Coop and ICA are already transported by the same truck. In that case, a transport from ICA and a transport from Coop are separately outsourced to a LSP that act as the third-party. This means that ICA and Coop are buying transports of a number of pallets and are not involved in the route planning. This is mostly done in rural areas such as in the northern part of Sweden and not in the control of either ICA or Coop. The LSP is not an independent partner since they do not have any incentive to find the best solution for ICA and Coop but to maximize their own profit.

This type of arrangement, where the LSP is taking care of the route planning of products from both Coop and ICA in the same trucks, could be a sort of insinking. Arguably, the LSPs should be able to lower the cost thanks to larger networks and flows and therefore offer a lower cost than if the products of Coop and ICA had to be separated. But since they are not buying the transports together the LSPs will charge extra for the risk of not filling the truck and for parts of the empty return trip. Also, the willingness to let a LSP handle the analysis and present the cost savings can be questioned and opens doubts about fairness and trustworthiness. Could the companies trust that the gains are shared in a fair way? And if the analysis is operated by a LSP, the companies are forced to use that LSP.

Instead it is better to have a third-party that is independent and that can see to the good of the involved companies without taking other interests in consideration. Therefore the Starfish initiative is a great opportunity for joining companies to evaluate the potential in transportation cooperation without having any trust issues. Insinking builds on the same principle as Starfish, to identify network synergies, but Starfish gives the companies the power to operate or choose operator of the cooperation.

The choice of software has been a critical issue in this master thesis. The whole analysis depends on the software and the relevance of using the most proper software on the market cannot be stressed enough. In order to be able to perform a software analysis, to test if the software fulfils the requirements, it is important that the choice of software does not entail any issues with reliability or availability of cooperation partners. The importance of proper support and availability of potential partners is also worth mentioning. All these factors were a part in the choice of the Supply Chain Guru.

The costs are critical in this kind of analysis. The trustworthiness of the result is based on the accuracy of the input costs. Transportation contracts are secret and sensitive information since companies easily could be abused by competitors if disclosed. The authors appreciate ICA's and Coop's willingness to share costs. The combined model uses both ICA's and Coop's cost structure which means that the flow in the combined network has an alternative to choose the cheapest cost. A region where the cost differs greatly can therefore show great potential but it is just due to cost difference between ICA and Coop. This means that no conclusion should be drawn for specific regions, without further investigation, but the holistic view in the combined model is trustful.

The average structure of the costs used in the model also contributes to that some stores still source from their original terminal and not through a closer distribution terminal in spite of long distribution distances. This could be due to the cost structure in that specific region.

6.2 Future research

A deeper analysis that includes route planning and collections from suppliers are aspects to include in the future and that analysis can start already with ICA and Coop. A joint route planning analysis will require the software Transportation Guru. However, it is not an issue since it is a fully integrated part of Supply Chain Guru but will require more detailed data regarding delivery times, working hours etc. Transportation Guru adds opportunities to analyse fill rates and optimize distribution in large networks.

A critical part for a successful continuation of Starfish is to involve more companies with unbalanced networks. This first study including influential companies and presenting promising results will hopefully motivate more companies to join. New companies have to share proper data such as cost structure, transportation data, and facilities but that has not been an issue so far. The potential of Starfish is vast and the changing logistics structures are continuously affecting the Starfish analysis.

Other aspects like gain sharing, relational issues and sharing facilities and transportation fleet are also important research areas for a successful implementation. This thesis has just been focused on theoretical possibilities. Therefore, the authors of this master thesis encourage more research on how horizontal cooperation is to be converted from theory to reality and how to implement this in practice.

7 Conclusion

The market sets higher demands on environmentally friendly operations and it gets increasingly more important to lower the total amount of driven kilometres. Therefore, companies have to find new ways to meet these demands. This master thesis has examined if horizontal cooperation could be one way to addressing these issues.

Previous research has investigated horizontal cooperation for third-party operations, mainly in the Benelux area. The UK study has also studied retailing companies but only used flat-rate costs in their analyses. This master thesis has taken the concept of horizontal cooperation and investigated the effects it has on Swedish market conditions. The cost that has been used are sharp cost delivered directly from the case companies. The results in this master thesis are in line with the previous research, both in in Sweden (Frisk et al., 2010, Hageback and Segerstedt, 2004) and in Europe (Cruijssen et al., 2007a, Cruijssen et al., 2007b, Palmer and McKinnon, 2011).

Horizontal cooperation has been proven to be a valid solution in different industries and other countries but no former studies found by the authors has addressed this issue in Sweden. This master thesis has tested the concept in the grocery industry and the results show that ICA and Coop have a potential to lower the CO_2 emissions by 1% and reduce costs by 6.2%.

ICA and Coop have been the participating companies and the result is completely based on their conditions and are not to be generalized. Other companies considering horizontal cooperation need to be analysed in order to investigate if they could gain the potential positive effects of horizontal cooperation. However, since ICA and Coop together represent nearly 70% of the Swedish market, the results indicates that horizontal cooperation is a good solution for companies with similar operations and conditions as ICA and Coop.

In order to build up the transport networks of ICA and Coop and to perform the horizontal analysis, there was need of a software capable of this. In this master thesis 13 software was briefly studied and out of those were 2 software chosen to be more thoroughly examined. The chosen software were the IBM LogicNet and LLamasoft's Supply Chain Guru. Since the case and result is based on the performance of the software, it is critical that the output is reliable. Both software were proven to be reliable and matching the set requirements. In the end, the Supply Chain Guru was determined as the more suitable for Starfish due to a better support, cooperation partner in Sweden, and an integrated solution for tactical issues.

Validating models in these software can be very time consuming and demand much computing power. Therefore, a high-speed server was used in order to facilitate the validation of the models. This helped bringing down the computing time to a more manageable level.

Transport models are very complex and this master thesis has presented that horizontal cooperation between large retailers in Sweden have a large potential to reduced CO_2 emissions and logistics cost. However, more analysis is encouraged to further investigate the opportunities and impediments and to determine how these cooperation are to be executed in practice. To facilitate this, this master thesis has contributed with ideas of possible future research in the field of horizontal cooperation.

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APPENDIX

Appendix A – Data collection framework

Supplier details

Name of the supplier	City	Zip Code	Delivery warehouse 1	Delivery warehouse 2	Delivery warehouse 3	Type of goods
	If more locations than one, use several rows		To which warehouse/terminal does the supplier normaly deliver			What tpye of sku the supplier normally distribute (EUR, wagon, etc)

Customer details

Store Name	City	Zip Code	Sourcing warehouse 1	Sourcing warehouse 2	Sourcing warehouse 3
			From which warehouse the store receives goods		

Terminal details

Name of the terminal/warehouse	City	Zip Code	Product	Warehouse capacity
			If it only handles a certain type of goods (Frozen, dry, etc.)	Number of pallets the warehouse can contain

Inbound transports

Supplier	City	Zip Code	Destination	Type of Transportation	Type of goods (SKU)	Number of Skus	Volume (M3)	Weight (Kg)	Distance (Km)	Price	Date
Supplier 1			Termnial/Warehouse/Store	Which type of truck and/or trailer	EUR/Wagon/Etc.					The cost of the specific transportation	

Distribution

Trip	Date	Origin (Terminal/Warehouse)	Type of Transportation	Type of goods 1	Type of goods 2 (SKU)	Number of Skus	Volume (M3)	Weight (Kg)	Distance (Km)	Price (SEK)	Number of stops	Destination
The unique number for a specific number of stores that are distributed on the same trip			Which type of truck and/or trailer	Frozen, dry, Noon-food, etc.	EUR/Waggon/Etc.					The cost of the specific transportation		Name of store

Inter-Facility transports

Date	Origin (Terminal/Warehouse)	Type of Transportation	Type of goods (SKU)	Number of SKUs	Volume (M3)	Weight (Kg)	Distance (Km)	Price (SEK)	Destination
		Which type of truck and/or trailer	EUR/Waggon/Etc.					The cost of the specific transportation	

Appendix B – Software evaluation

Funaki (2009) presents the currently available supply chain design software tools. He presents 13 software tools available at least in the US market and they all generate supply chain models as a network with nodes of supply chain facilities and arcs of movements of goods. This list has been the basis of the evaluation conducted in this master thesis but the IBM LogicNet and LLamasoft Supply Chain Guru, that are used, are described in section 4.3.2.

CAST

This software helps to support decisions for supply chain modelling, strategic network design and optimisation. Supply chain network optimisation identifies the optimal supply chain configuration by calculating the trade-off between costs, such as warehousing and transportation. The software enables optimising the supply chain in weekly, monthly and yearly time horizons and means that you can identify in time when changes should be executed. CAST also has the capability to optimise seasonal businesses with a high variability due to holiday peaks or harvest periods. There is also an application to evaluate the cost and service impact of moving manufacturing to low cost countries. For retailing companies CAST is useful to identify optimal distribution infrastructures for their national supply chain networks if developing new product ranges, change store configurations or market channels (Barloworld, 2013).

This software could possibly fulfil the requirements for the Starfish project.

4flow vista

The 4flow vista software offers application such as:

- Planning of the complete logistics network inbound and outbound, including production site allocation.
- Continuous transportation planning to reduce transportation costs
- Evaluation of total cost to select the most competitive suppliers.

The 4flow vista can be combined with a transport planning module as a complement to add tactical transportation optimization (4FlowVista, 2013).

The information is scarce and it has been difficult to get a good picture of the software but it could maybe be an alternative.

LOPTIS

The information about the LOPTIS software is scarce but the provided information indicates that the software not fulfils the requirements. It offers guidance for facilities location studies and for logistics operations planning (Ketron, 2013).

NETWORK

Professor Ballou presents a report (Ballou) about the features of Network and the purpose of this software program is to assist managers in planning, auditing, and budgeting an organisation's supply chain. It is designed to be user friendly and have desktop availability so supply chain managers can use it routinely to support decisions. Network has the ability to analyse large multi-product distribution networks containing many levels all the way from source points (manufacturer, ports) through intermediate facilities (warehouses, terminals) and finally to the customer (retailers, other plants). The program will search for the most economical solution out from a pre-defined list of facilities with upper and lower capacity limits but also customer service requirements. The simulation of alternative network configurations and/or evaluation of selected combinations of facilities are executed in just a few minutes.

The network software offers network design optimization but seem to miss the distribution aspect in the optimization features which makes it unsuitable for the Starfish project.

Opti-Net Supply Chain Optimization Service

Opti-Net offers a powerful software for supply chain optimization and in combination with the transportation management software FreightMaster, the software can be the tool for many supply chain questions and scenarios such as (Nextgeneration, 2013):

- Minimum overall cost calculation utilizing manufacturing, warehousing, and transportation costs.
- Optimal number, size, and location of warehouses.
- Appropriate allocation of products to different plants and warehouses.

Opti-Net seems to be a possible software for the Starfish project with the combination of strategic network analysis and transportation optimization. The question is how well integrated the transportation module Freightaster is?

PowerChain Network Design and SAILS -> Logility voyager solutions

Logility introduced its first solutions in the market in 1996, and in March of 2010, Logility acquired Optiant and Insight, creator of advanced supply chain software (SAILS and Supply Chain Network). The Logility Voyager Solutions offers a lot of different software where *Supply Chain Collaboration* and *Transport and Logistic Optimization* are two of the modules.

With Voyager it is possible to implement and benefit from supply chain transformation by targeting the areas of greatest importance for the company in question. There are six different parts: Performance management, Value Chain Collaboration, Demand Optimization, Inventory Optimization, Supply Optimization, and Transportation and Logistics Optimization. The Supply Optimization module uses costs and capacity constraints and provides supply chain planning solutions to help dynamically source materials, optimize production and manufacturing plans, and reduce distribution costs. The Transportation and Logistics Optimization focus on the warehouse and transportation system to reduce costs and increase profitability. In addition, it enables effective collaboration with customers, suppliers and transportation providers to increase efficiency (Logility, 2013).

The focus of this software is fairly wide and distribution networks are not in the centre of attention. However it could possibly be an alternative for the Starfish project.

PRODISI SCO

PRODISI SCO evaluates existing and new supply chains with costs and provides a quantitative basis for strategic decisions. They also offer a routing and scheduling system called PROTOUR for optimizing the delivery tours and minimize the transport costs with a remaining high level of service in daily operations (Prologs, 2013).

PRODISIS SCO in combination with PROTOUR could possibly fulfil the requirement for the Starfish project.

SITELINK

The Sitelink was investigated by e-mail contact with Robert Rice at CGR Management Consultants, this was his respond (Rice, 2013):

Sitelink was developed in the 1990s and has been used in over 50 strategic planning assignments for networks ranging from distribution, to production plus distribution decisions to full scale supply chain strategies. It was sold in the 1900s to third parties, but we made a decision not to convert it to Windows and thus it has only been used internally since that time.

The SITELINK software is obviously not an option.

i2 Supply Chain Strategist

i2 Supply chain strategist provides a modelling and optimization software that is capable of handling the entire supply chain from raw materials to finished products and their customers (Laurenbossers, 2013).

i2 Supply Chain Strategist seem to offer a Software for strategic supply chain decisions but miss the tactical parts regarding the transportation and delivery route aspect.

Appendix C– Structuring data

Coop

The data received from Coop contained all data for 2012 and November was cut out for the analysis. Each terminal or distribution terminal has its own data file containing all goods transported out from that terminal. There is a destination number that indicates where the goods are transported, it could be to a store or to a distribution terminal.

The data was then stripped from irrelevant information in the following steps:

1. Rows with no information regarding load unit or floor space was deleted.
2. Rows in the terminal files with destination numbers to distribution terminals were checked that it existed in the appropriate demand file and thereafter removed.
3. Rows with load units that do not take any floor space are deleted except lifted pallets (EUX/PAX).
4. Some store names are not stores but suppliers or others. These have been double-checked with Coop and then removed.

Appendix D - Structure of literature review

A total of 44 articles have been extracted from the searches and the base of the theoretical framework. In combination an ancestry approach has been used.

Search	Key Words	Database	Nbr of Hits	Nbr of Articles	Date
1	Horizontal cooperation Transportation	LUBSearch	2 265 49	- 9	25/01/2013
2	Transport bundling cooperation	LUBSearch	662 14	- 2	25/01/2013
3	Horizontal collaboration Transportation Logistics	LUBSearch	1 204 24 6	- - 2	25/01/2013
4	cross-company cooperation	LUBSearch	823 28	- 3	30/01/2013
5	Horizontal collaboration supply chain	LUBSearch	1 203 61	- 6	30/01/2013
6	Horizontal cooperation supply chain	LUBSearch	2 246 41	- 2	31/01/2013
7	Road planning Horizontal cooperation	LUBSearch	50 688 4	- -	31/01/2013
8	Horizontal cooperation Distribution Network	LUBSearch	2 246 193 34	- - 1	31/01/2013
9	Horizontal cooperation Logistics	LUBSearch	2 246 44	- 4	31/01/2013
10	joint-route-planning distribution	LUBSearch	306 21	- 0	04/02/2013
11	joint-route-planning horizontal	LUBSearch	306 2	- 0	04/02/2013
12	joint-route-planning cooperation	LUBSearch	306 13	- 0	04/02/2013
13	supply networks horizontal cooperation	LUBSearch	119 401 486 23	- - 0	04/02/2013
14	coopetition horizontal	LUBSearch	530 10	- 0	04/02/2013
15	alliance horizontal cooperation logistics	LUBSearch	776 138 13	- - 1	04/02/2013
16	Joint ventures Logistics road transportation	LUBSearch	157 287 1 257 31	- - 1	04/02/2013
17	Truckload Transportation Efficiency Logistics	LUBSearch	44 642 37 505 1 043 213	- - - 8	21/02/2013
18	Maria Bengtsson	LUBSearch	81	4	18/02/2013
19	Sören Kock	LUBSearch	50	1	18/02/2013
20	Facilitators Logistics Cooperation	LUBSearch	36 398 417 13	- - 0	21/02/2013
21	Enablers Logistics Cooperation	LUBSearch	5	0	21/02/2013
22	Facilitators "Joint-route-planing"	LUBSearch	36 398 49	- 0	21/02/2013

Appendix E - Meetings & Interviews

The interviewees are below referred to their titles as stated in table 2.

Coop

The data collection from Coop has involved several managers with different roles within the company that have been interviewed in order to get the knowledge required of the network. In between these meetings several questions have been communicated by e-mail with project manager 1.

Skype interview, March 21
Interviewee	Project manager 1
Interviewers	Andreas Holmberg, Klas Örne

The first interview with Coop was with project manager 1 via Skype. A semi-structured interview with the aim to explain the documents and create a base for the first model.

Meeting at Coop, Bro, April 5
Interviewees	Project manager 1, facility manager
Interviewers	Andreas Holmberg, Klas Örne

This meeting was held when the first version of the Coop-model was finished. The aim was to clear up specific problems and giving Coop the opportunity to comment on the model. After this meeting the model was adjusted to the issues handled and the model was finished.

Meeting at Coop, Solna, May 6
Interviewee	Project manager 1
Interviewers	Andreas Holmberg, Klas Örne, Henrik Sternberg

The finished model was presented and validated by Coop. Some issues regarding the transportation cost were discussed and a meeting with the transport procurement manager was planned.

Meeting at Coop, Bro, May 31
Interviewee	Transport procurement manager
Interviewers	Andreas Holmberg, Klas Örne

This meeting aimed at clearing up the last issues regarding costs in the model. After the meeting the transport costs were adjusted in the model and by e-mail with project manager 1 the result of the Coop-model was confirmed as accurate.

ICA

The data collection from ICA was made through only one representative, project manager 2 working exclusively with transport development. Therefore there have been fewer meetings but the lead-time has been longer since project manager 2 handled the contact within ICA with the affected managers.

Meeting at ICA-terminal, Helsingborg, May 2
Interviewee	Project manager 2
Interviewers	Andreas Holmberg, Klas Örne, Henrik Sternberg

This meeting aimed at presenting documents of the network and going through the data files. After this meeting the ICA-model was constructed and no supplementary meeting was needed before the validation meeting, though some contact by email was needed to clear up some smaller issues regarding interpretation of the network and the data.

Meeting at Campus Helsingborg, September 30
Interviewee	Project manager 2
Interviewers	Andreas Holmberg, Henrik Sternberg

At this meeting the finished model was presented to ICA and was confirmed as accurate.

IBM LogicNet

Skype interview, March 26
Interviewee	Optimization analyst 2
Interviewers	Andreas Holmberg, Klas Örne

This first contact was an unstructured interview aiming at discussing the basic functions of the software. The questions that were prepared were of a basic nature and covering low complexity issues such as:

- How to interpret specific error messages?
- How to model different carriers?
- How to model a flow transported both by truck and train?
- How are flow sizes constrained?

Meeting at ArgusI, Netherlands, April 29
Interviewees	Optimization analyst 2, Optimization analyst 3
Interviewers	Andreas Holmberg, Klas Örne, Henrik Sternberg

After the Skype interview, the model was further built up and issues that occurred during the building was documented. During the building of the model a more thorough interview guide was prepared, found in appendix F. The interview guide consisted of a brief introduction of our specific case and questions divided into different topics. This was used as a base for the workshop and from these several issues arose and were discussed.

LLamasoft's The Supply Chain Guru

Meeting in Malmö, May 24
Interviewee	Sales manager
Interviewers	Andreas Holmberg, Klas Örne, Henrik Sternberg

This was an introductory meeting where Starfish was presented by the authors and the Supply Chain Guru was presented by Optilon. After the meeting the Coop model was converted into the Supply Chain Guru.

Meeting in Malmö, May 29
Interviewees	Sales manager, Optimization analyst 1
Interviewers	Andreas Holmberg, Klas Örne, Henrik Sternberg

Thanks to the experience from modelling in LogicNet, the interview guide in appendix F was not needed to be sent to Optilon. Instead some more specific issues were addressed and discussed during this meeting.

Appendix F – Interview guide for the software

Background

Our model is a simulation of a large Swedish grocery retail company and their distribution network. They order goods from hundreds of suppliers that deliver pallets into three terminals depending on the type of goods. The goods are then packed at terminals on trolleys or pallets for specific stores. It is then distributed to the stores either directly or through a distribution terminal. The basis for the demand is made up of how many trolleys, or pallets of refrigerated, dry, and frozen goods that is delivered per day to each store. The power point briefly presents the company and an overview of the situation.

Questions

Time periods

- Each store has specific days for when they can receive any given product. E.g. one case could be that a store only receives dry goods on Mondays and Thursdays, frozen on Wednesdays and Fridays, and so on.
    - Should we use time spans to control which day the order is done? We will simulate a month, would that mean:
        - 30 time periods (one for each day) or
        - 7 time periods (simulating 1 week with average numbers each day)?
    - Most deliveries are executed during weekdays and just a few during weekends
        - How does this influence the choice of time periods?
- Is the shipment profile something for us to use?

Demand - supply

- Since the products are grouped (packaged) in an unsystematic manner in the terminals, we have had problems to follow a product through the chain. A delivered wagon to the store does not trigger a need from a supplier. Is there any way to solve this in LogicNet?
    - When ordering from the suppliers they make sure that they order full loads each time to avoid empty running. This means that the inbound is in big batches and then deliveries in much smaller volumes.
- The demand is higher than the supply since there are a number of local suppliers delivering directly to a distribution terminal. We do not have data on that kind of inbound flow.
    - How can we add goods along the flow?
- When a delivery is made out to the stores, one trip by one truck delivers to more than one store.
    - How can we model this in LogicNet?

Inventory

- Do we need inventory in the warehouses?
- Or does the demand trigger supply in advance?

Sourcing

- In the form, Customer Details, you can choose static source, product split or single source.

    - We have specific warehouses that deliver to specific customers and we therefore want to choose from where each customer gets their supplies.
        - There are also some "emergency" deliveries from other warehouses that are not from the scheduled one. If we steer the flow from a specific warehouse this flow causes problems.
        - Is the WarehouseToCustomerAssignment a good way to steer the flow?
        - Can the WarehouseToCustomerAssignment be combined with product split?
    - In the data we have deliveries of the same product in the same time period from two different warehouses.

Transportation times and costs

- How should we consider transportation times?
    - The train is just going X times in both directions with X trailers. How can we add this limit?
    - We do not have starting inventory in the warehouses. Maybe that's needed if we add transportation times?
- Where in LogicNet can we add the cost for extra handling that occurs when using a distribution terminal or other kind of transshipment costs?
- Carbon footprint is of high interest for us, but we haven't used that function.
    - Is it as simple as it looks like?

General questions

- Product details, how should we handle the size issue?
    - Does this only affect the transport constraints?
    - We will probably not have any weight constraints, but the floor space should be a problem.
    - Sometimes they can also have several pallets on top of each other leading to that the floor space can hold more than the normal case. How should we take this in to consideration?
- We have suppliers that deliver from different cities, to different terminals and by different transport types.
    - Worst Case Scenario: Supplier A has two productions sites, city A and city B. They deliver to two terminals, terminal A and terminal B. And from city A they deliver both by train and truck.
        - How should this be solved in LogicNet?
- How good is the program with calculating distances?
    - Do the arrows' distances represent the true distances?
    - Is there a geocode specific for Sweden that works better than the one in LogicNet?
- Process warning count: Your model is unable to carry inventory across time periods
    - There is a setting in the scenario preferences. Is it just to check the boxes there?
    - Discussion:
        - "Network design model"
        - "Combination model"
- In "Project Preferences"

        - Logging Level
            - This can be put to Low, Medium or High
                - What does this do?
- Customer Details: There is a column called Size. Is that relevant for our model?
- Advanced Carrier form
- Warehouse products
    - Should we prohibit products that are not allowed in the warehouse?
        - At the moment this has been constrained with lanes.
- Warehouse starting inventory
    - The tie to ending inventory function?