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Transport Efficiency Increase For Axfood's Transport Carriers in Central Gothenburg

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Abstract

The purpose of this thesis is to analyse current transport problems of transport carriers of Axfood's retail stores in central Gothenburg, and find solutions to these problems so as to improve their transport efficiency.

This report first gives an overview of the Axfood Group, its retail stores and transport carriers, then states carriers' current transport situation in central Gothenburg. Furthermore, Axfood's carriers' current transport problems will be analysed, as well as factors resulting in these problems. As a result, I will propose some solutions to resolve these problems according to existing measures so as to improve the carriers' transport efficiency.

Also, the study gives two recommendations. The first important issue is for transport carriers to cooperate closely with the City Administration and retailers when improving their transport efficiency. The second significant issue is to set up new partnerships and styles of cooperation between different carriers and in delivering/receiving goods in city centres. Finally, I make some suggestions for further studies: identify the feasibility of these measures for Axfood's carriers, select the most suitable options, implement the options selected, and evaluate the selected options. An in-depth research study will be needed.

It is my wish that this thesis will give all transport carriers in Gothenburg good and creative ideas for solving their current transport problems so as to improve their transport efficiency.

Acknowledgements

This thesis is not only a result of my own efforts, but also an outcome of all the enthusiastic people involved, supporting my work. Therefore, here I would like to thank all the people involved.

First of all, I want to thank Göteborgs Köpmannaförbund for giving me the opportunity to research this project. Here I would especially like to thank Ms. Lena Larsen at this association for her constant help and support.

I am delighted to give my most sincere gratitude and appreciation to all the helpful and kind people that have been involved in the interviews. They are Anders Agerberg, Claes Eliasson, Peter Thureson, Björn Zetterström, Barbro Månsson, Krister Blom, ULF, Bozenna Gustafson, Lars Mossfeldt, and ULF Törnestrard. I also want to thank the rest of people who supported my work and helped me: Henrik Wahlström, Kenth Månsson, Anne Marie Hagerell, and Paul Borgesand.

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Göteborg, December 2003

Yan Tang

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1. Introduction

In this chapter, I introduce the background, limitation, purpose, and outline of the thesis. Also, Axfood Group and Göteborgs Köpmannaförbund are presented. The purpose of this chapter is to give readers background in order to familiarize them with the subject.

1.1 Background

Nowadays, cities are facing the global competition for investment and trade. It is well recognised that urban freight transport plays a vital role in the sustainable development of cities, and a highly efficient and environment friendly logistics system help cities become more competitive in terms of economic development. On the other hand, a high proportion of total goods movement occurs within cities, and this often leads to many problems, such as high levels of traffic congestion, negative environmental impacts, and high-energy consumption.

Gothenburg is known as the Scandinavian centre of transportation. In the region you will find not only the main part of the Swedish companies involved in the production of vehicles but also the largest port in Scandinavia, the Port of Gothenburg. Half of the Scandinavian industrial base is within 300 kilometers of the port, 70 percent within 500 kilometers. A huge portion of the exported industrial products produced in Scandinavia passes through the city of Gothenburg.[1] Simultaneously, many transport carriers regularly, often daily, deliver a great deal of goods for the citizens' consumption to retail stores in the city centre. These freight transports are also facing some problems, such as traffic congestion, broken packaging, and bad parking options. Also, freight transport to and from the city deteriorates the quality of life in the city, and has a negative impact on the environment with problems such as air pollution and noise.

A couple of months ago Göteborgs Köpmannaförbund asked Handelshögskolan if they had any studies concerning mixed carloads to stores, which could improve carriers' transport efficiency and the environment in the city centre. They found out that there were no such studies. This project originates from this idea of this association, and extends the idea to improve carriers' transport efficiency.

1.2 Limitation

Due to density of retail stores, service, offices, and banks, more transportation problems are produced in the city centre than suburban areas. Consequently, only transport to and from central Gothenburg will be examined in this study. Furthermore,

[1] Lars Mossfeldt, Senior Researcher, Department of Urban Land Use and Transport Planning, Chalmers University of Technology

in order to analyze freight transport deeply, the geographic scope is narrowed again. A specific area, which is marked in blue and with a thick line, in central Gothenburg is chosen. (See *Figure 1*)

A broad variety of goods are transported to and from the city centre. Compared to other kinds of goods, food transport is most common so that it could be seem as a typical example. In central Gothenburg, food is delivered to retail stores, restaurants, and hotels, etc. Transportation to and from retail stores constitutes the majority. Therefore, this thesis will focus on foods transport to and from retail stores.

There are four major retailers in Sweden – ICA, Axfood, Coop, and Bergendahls. All of them have their own wholesaling operations. In this specific area, most of retail stores belong to Axfood. Hence, the Axfood Group will be chosen as an example in this report.

There are three parties who deliver foods to Axfood's retail stores: some producers, several solely transport companies, and Axfood's wholesaler - Dagab. In this study, I will examine ways to improve the transport efficiency of the three parties. When a producer delivers its goods to retail stores, we can say the producer and transport carrier are identical. So, in this report I will give the three parties the same term: transport carrier.

There are four actors in urban freight transport: transport carriers, shippers, residents, and administrators. Each actor tends to behave in a different manner, and faces different problems. I will focus on transport carriers' problems because I am much more interested in transport carriers.

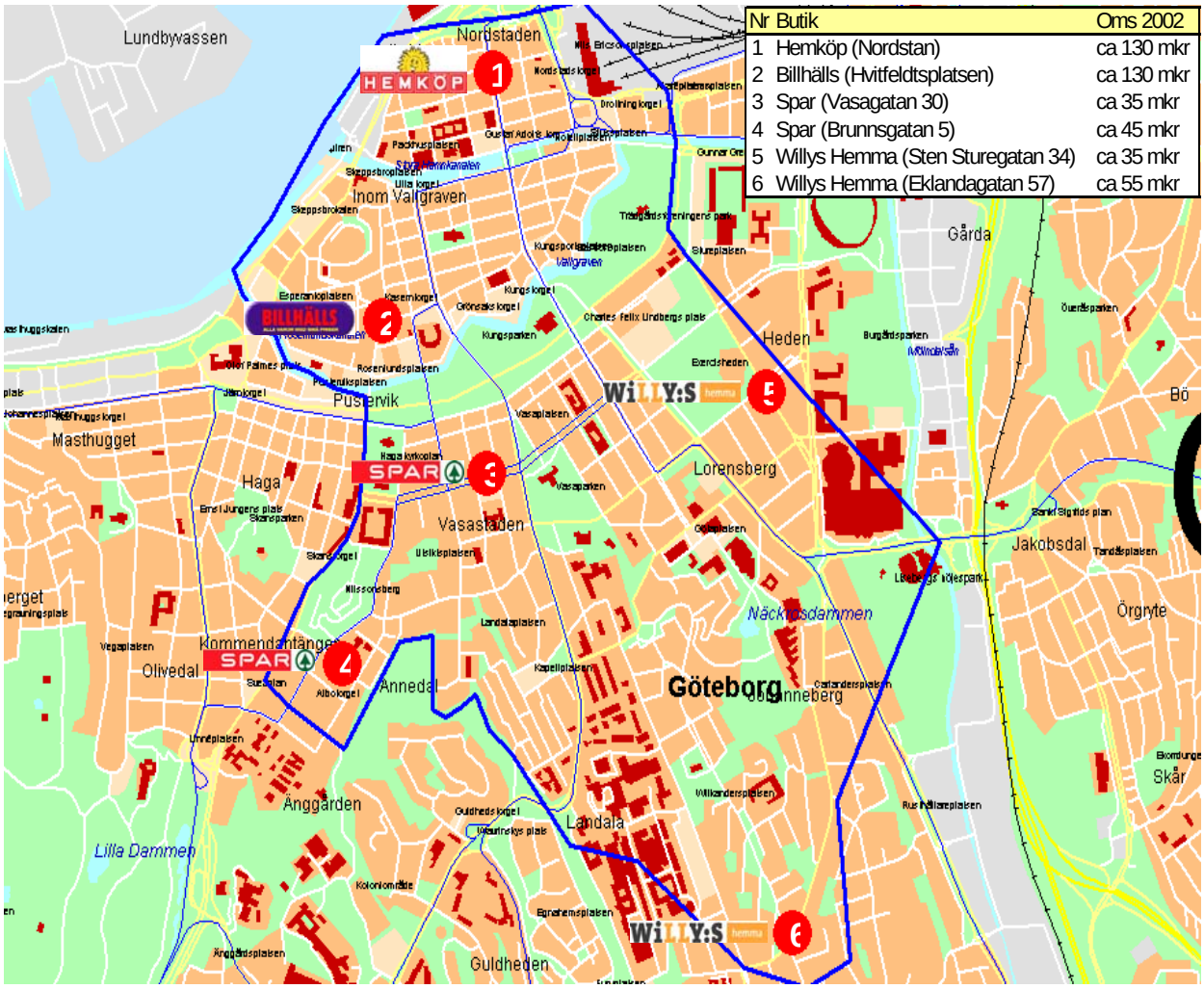


Figure 1: Map of a specific area in central Gothenburg and six Axfood's stores

1.3 Purpose

The overall aim of this thesis is to analyze current transport problems of transport carriers of Axfood's retail stores in central Gothenburg, and find solutions to these problems so as to improve their transport efficiency.

1.4 Axfood

In this section I shall present the Axfood Group.[2] In Sweden, Axfood has approximately 19% of the market (via wholly owned and collaborating stores). Axfood's wholly owned stores chains – Hemköp, Willys and Willys hemma – are intended to complement each other and cater to distinct customer needs. Axfood is the market leader in the strongly expanding discount segment. Willys, consisting of large

[2] The following part is based on information from Axfood Annual Report 2002.

stores with a relatively broad range of products, had 70 units at year-end. Willys hemma was launched during the year and has 42 stores. These stores are smaller and have a considerably narrower product range. At Hemköp's 96 stores, the focus is on food appreciation and culinary delight. Over the years Hemköp has built up a tradition distinguished by a commitment to quality, health and the environment.

Axfood has a long tradition of collaboration with private grocers. The Spar chain includes some 130 stores throughout Sweden. The Vivo Group is active in Stockholm and on Gotland, with some 80 stores. In addition, Axfood cooperates with a large number of small stores under the Tempo and Handlarn store profiles.

Two wholesale organizations are responsible for the Group's product supply. Dagab is the largest, with three distribution warehouses. Dagab delivers products to Axfood's wholly owned store chains and to the Spar and Vivo stores. Axfood Närlivs is an open wholesaling organization and supplies products to small retailers, contract customers in the service station segment, and restaurants and fast-food outlets. Axfood Närlivs also has 24 cash & carry outlets.

In the Finnish market Axfood is represented by its subsidiary Spar Finland, in which Axfood has 75.3% of the votes and 69.3% of the capital. Spar Finland has 79 wholly owned stores and collaborates with approximately 220 independent grocers. In total the Spar Group has 9% of the Finnish market.

The following diagram describes the Axfood Group:

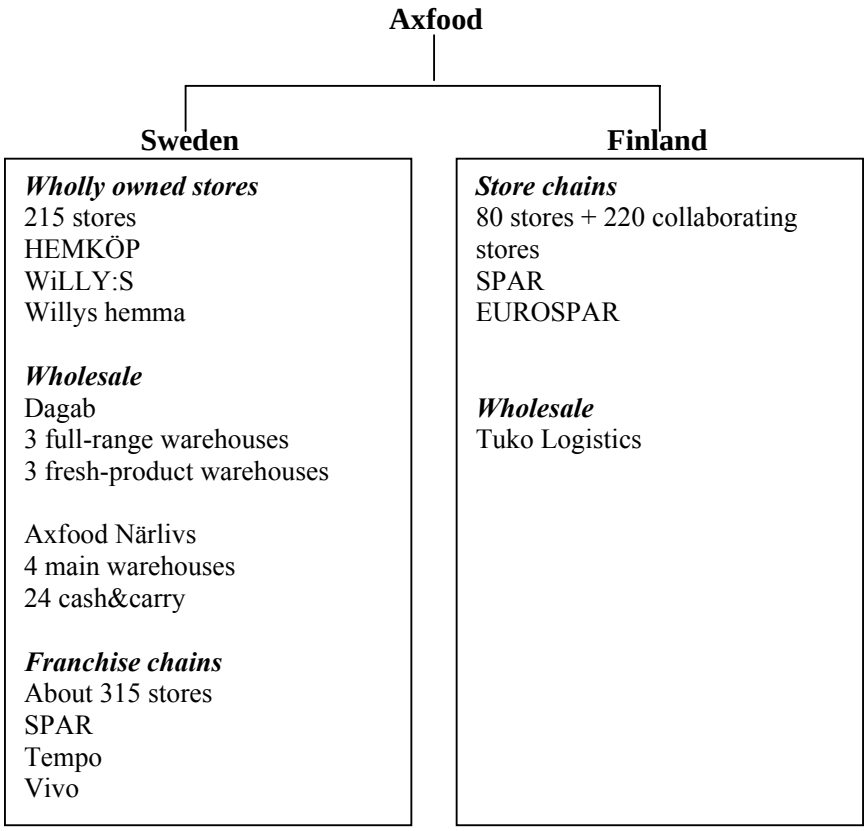


Figure 2: The Axfood Group

1.5 Göteborgs Köpmannaförbund

This project originated with an idea from *Göteborgs Köpmannaförbund.* During my study, this association provided important support and information, such as suitable persons who I should contact for surveys. These suitable persons can give me thorough and correct information on carriers' current problems. Based on these factors, it is necessary to introduce this association in my thesis.[3]

Nowadays, retail trade is an important part of trade and industry in Gothenburg. Göteborgs Köpmannaförbund, *Gothenburg Trade Association* in English, is the main organization to guard the interests of the retail trade. Its main task is to ensure that its region has best environment for this type of business. The Gothenburg region is its area of activity. This association possesses great trust, and has extensive connections in the region.

Gothenburg Trade Association started more than 80 years ago, and has much experience in dealing with the questions of the trade. It works as a link between

[3] The following part is based on information from Göteborgs Köpmannaförbund.

companies and political decision-makers to ensure that laws and regulations are adjusted to the companies' reality.

Gothenburg Trade Association helps its members to run their businesses effectively and with profit. Through it, members are able to influence the conditions that affect how they run their businesses. This association not only offers a network with great strength and widespread competence, but also provides an attractive range of services such as personal advice, personal information and personal assistance.

1.6 Outline of the thesis

Above I have given some basic information about this study. Now, I present the summary of other chapters so that readers have a clear outline of this thesis.

Chapter 2, "Problem Analysis"
This chapter introduces the main problem, six sub-problems, and information needed. Also, I will present how the main problem and six sub-problems are formed.

Chapter 3, "Theoretical study"
This chapter states the theories used in this study. These theories give readers a deeper understanding of this subject, and also help to resolve the sub-problems.

Chapter 4, "Methodology"
In this chapter, I explain how the research has been designed and how the work with the thesis has been performed. I also give my motivation for choosing to work in this way.

Chapter 5, "Empirical study"
This chapter discusses the relevant information received from the interviews and surveys.

Chapter 6, "Analysis"
In this chapter, I summarize and analyze Axfood's carriers' current problems, and the reasons for these problems. With the help of existing measures and the theories stated in chapter 3, I will propose some measures to solve these problems.

Chapter 7, "Conclusions and recommendations"
In this chapter, I will draw conclusions on the whole report, and give some recommendations, as well as suggestions for future work.

2. Problem analysis

In this chapter, the main problem and its sub-problems are identified. Also, I will explain how these problems are formed. These problems will be answered in the following chapters.

This chapter is an explorative study for specifying the questions that will be answered later.

2.1 Main problem

Gothenburg is the transportation centre of Scandanavia. A great deal of goods is delivered to and from the city centre. Some transport carriers deliver food regularly to Axfood's retail stores. Lead times, routes and vehicles are required to adapt the regulations and circumstances in urban areas. Currently, congestion, bad parking, restrictions in time and load, and the demand for more frequent delivery in smaller quantities are affecting Axfood's carriers' transport activities. Within these difficult conditions, Axfood's transport carries are still expected to increase their transport efficiency, and provide a higher level of service to retail stores. Based on the background, this forms the main problem in my thesis:

The need for improving the transport efficiency of transport carriers of Axfood's retail stores in central Gothenburg.

From this main problem spring a fan of sub-problems that have to be answered in the process of solving the main problem. The following are discussions leading to sub-problems and their information needs.

2.2 Problem analysis leading to sub-problems and information needs

In accordance with the main problem, Axfood's carriers' transportation activities will be analyzed. Transportation activity is the most important aspect of urban freight transport. In order to facilitate understanding of the activity of transportation, we must first know what urban freight transport is.

There are four actors involved in urban freight transport. They are transport carriers, shippers, residents, and administrators. The four actors have their own specific objectives, tend to behave in a different manner, and face different problems. This study focuses on the transport carriers' activities. Since we will discuss and analyze transport carriers' activities, it is necessary to know what a transport carrier stands for.

The analysis above leads to the following two sub-problems:

► ***What is urban freight transport?***
► ***What is a transport carrier?***

The information required for answering the two sub-problems above is the following:

- *Definition of urban freight transport*
- *Structure of urban freight transport*
- *Definition of a transport carrier*

The purpose of this study is to improve the freight transport efficiency of transport carriers. One new question is produced: what is transport efficiency. Furthermore, since the transport system is a complicated, open and boundless system, the meaning of transport efficiency is not unique. Different group of interests, different system objectives and research perspectives will cause different definitions of transport efficiency. Generally, transport efficiency can be further categorized as macrocosmic or microcosmic, intercity or intracity, passenger or freight transport efficiency, etc. [4] Meanwhile, different categories are interrelated. If combined by certain means, more specific categories can be obtained such as efficiency of urban passenger transport system, and efficiency of intracity freight transport system. This thesis focuses on the freight transport efficiency of transport carriers. Hence, one important piece of the puzzle is an understanding of what the freight transport efficiency of transport carriers means. Another sub-problem is then formulated as:

► ***What does the freight transport efficiency of transport carriers mean?***

The information needed, in order to be able to answer this sub-problem, must also be identified. The information needs identified are:

- *The understanding of freight transport efficiency of transport carriers*

The information needs of the three sub-problems above will be explained in chapter 3, "Theoretical study".

Obviously, it is right to improve transport efficiency. I believe everybody within the transport carriers agrees with this point. However, when some new measures and actions are taken in order to achieve this goal, some change will occur and many people will be affected. Also, ingrained routines will be replaced by new tasks, and areas of responsibilities will change. A change is often met with resistance. Organizations are typically resistant to change and the resistance tends to be especially strong in situations when the change is radical, unexpected and has negative consequences for the persons involved (Bruzelius & Skärvad, 1995 p. 365). Hedberg & Sjöstrand (1979) use the word "organizational inertia" to explain the difficulties in establishing changes. They distinguish between two types of organizational inertia, maneuver-inertia and insight-inertia. Maneuver-inertia depends

[4] http://perso.wanadoo.fr/ville-en-mouvement/articles/lu_huapu04.pdf

on locked upped resources. Insight-inertia is due to forces that prevent or make it difficult for the members of the organization to observe or come to the radiation for the need for change. Lack of knowledge and education can make insight-inertia arise in organizations.

In order to avoid insight-inertia and facilitate the implementation of new measures so that transport efficiency can finally be improved, an explanation of the necessity for improving transport efficiency should therefore be paid some attention to in this study. Here, another sub-problem is identified:

►***Why it is necessary to improve the freight transport efficiency of transport carriers?***

In order to solve this sub-problem, the following information is needed:

- *What negative effects can low transport efficiency bring to carriers?*
- *What are the benefits of high transport efficiency?*

These information needs will be explained in chapter 6, "Analysis".

Recently, transport carriers of Axfood's retail stores realized they were facing some problems. It is these problems that are reducing their transportation efficiency. Consequently, the precondition of increasing transport efficiency is to solve these problems. How does one solve these problems? The Simplex Process can give us some directions. Below I will present the integrated problem-solving process. [5]

The Simplex Process is a powerful, sophisticated approach to innovation. It is suitable for projects and organizations of almost any scale. Rather than seeing creativity as a single straight-line process, Simplex sees it as the continuous cycle it should be. Completion and implementation of one cycle of creativity leads straight into the next cycle of creative improvement. Simplex uses the following eight stages:

[5]The following part is based on information from *http://www.mindtools.com/pages/article/newCT_10.htm*.

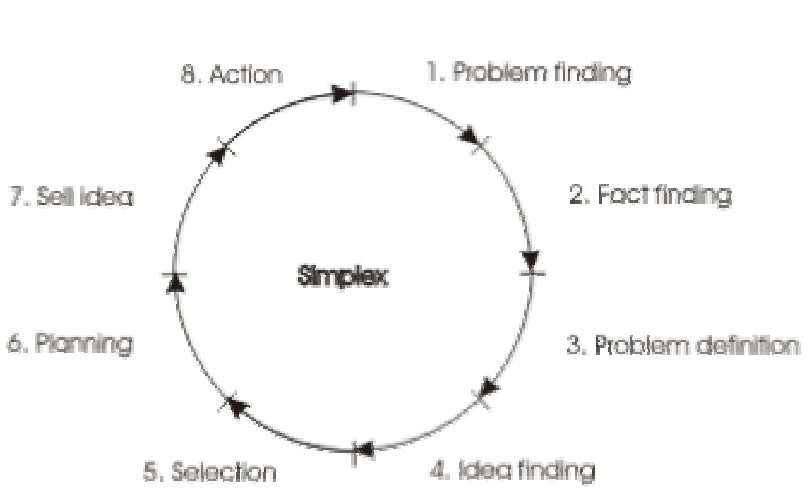


Figure 1: The Simplex Process

Figure 3: The simplex process
Source: http://www.mindtools.com/pages/article/newCT_10.htm

Each step of the process is explained below:

1. Problem finding

Often finding the right problem to solve is the most difficult part of the creative process. When using Simplex, you actively seek problems out. Wherever they exist you have opportunities for change and improvement. At this stage you may not have enough information to formulate your problem precisely.

2. Fact finding

The next stage is to find out as much information relating to the problem as possible. This stage also involves assessing the quality of the information that you have. Here it is worth listing your assumptions and checking that they are correct.

3. Problem definition

By the time you reach this stage, you should know roughly what the problem is and should have a good understanding of the facts relating to it. From here the thing to do is to crystallize the exact problem or problems you want to solve.

4. Idea finding

The next stage is to generate as many ideas as possible. Ways of doing this range from asking other people for their opinions, through programmed creativity tools, lateral thinking techniques, and brainstorming. Do not evaluate ideas during this stage. Instead, concentrate on generating as many ideas as possible. Bad ideas often trigger good ones.

5. Selection & Evaluation

Once you have a number of possible solutions to your problem, it is time to select the best one. The best solution may be obvious. If it is not, then it is important to think through the criteria you will use to select the best idea.

Once you have selected an idea, develop it as much as possible. It is then essential to evaluate it to see if it is good enough to be worth using. It is important not to let your ego get in the way of your common sense. If your idea does not result in much benefit, then either see if you can generate more ideas, or restart the whole process.

6. Planning

Once you have selected an idea, and are confident that your idea is worthwhile, and then it is time to plan its implementation. The best way of doing this is to create an Action Plan, which lays out who, what, when, where, why and how to do the work. For large projects it may be worth using more formal planning techniques.

7. Sell idea

Up until this stage you may have done all this work on your own or with a small committee. Now you will have to sell the idea to the people who must support it. This might be your boss, a bank manager or other people involved with the project. In selling the project you will have to address not only the practicality of the project, but also things such as internal politics, the hidden fear of change, etc.

8. Action

Finally, after all the creativity and preparation, comes action! This is where all the careful work and planning pays off. Once the action is firmly under way, return to stage 1, *Problem Finding*, and continue to improve your idea.

Above I introduced the Simplex process, an integrated problem-solving process. Now we clearly know the process of solving problems. We can adopt this process to resolve Axfood's carriers' current problems. According to the first three steps, *Problem Finding, Fact Finding, Problem Definition*, another sub-problem is formed:

►What are the current problems for transport carriers of Axfood's retail stores in central Gothenburg?

The information needed is as follows:

- *An overview of Axfood's retail stores and its transport carriers*
- *The current transport situation of Axfood's transport carries*
- *Current problems for transport carriers of Axfood's retail stores in central Gothenburg*

To be able to get this information, some interviews and surveys will be needed. They will be discussed in chapter 5, "Empirical study" and chapter 6, "Analysis".

Thereafter, according the fourth and the fifth steps of the Simplex process, *Idea finding, Selection & Evaluation*, the following sub-problem can be identified:

► ***How can we improve Axfood's transport carriers' transport efficiency in central Gothenburg?***

The information needed for answering this sub-problem is the following:

- *Reasons resulting in Axfood's carriers' current problems in central Gothenburg*
- *The process of solving Axfood's transport carriers' current problems*
- *Existing measures to improve carriers' transport efficiency*
- *Among existing measures, what measures can solve Axfood's carriers' current problems?*

The information required will be analyzed and discussed in chapter 6, "Analysis". Since implementation of measures is not in the scope of this thesis, the last three steps of the process will be skipped in this report.

2.3 Summary of problems and information needs

The main problem is formulated as:

The need for improving transport efficiency for transport carriers of Axfood's retail stores in central Gothenburg.

As discussed above, there exists a set of sub-problems and much information that needs to be collected to answer these sub-problems. After collecting the information needs, it will be possible to answer the sub-problems and thus solve the main problem. The sub-problems are presented below, as well as these their information needs.

1. What is urban freight transport?

- *Definition of urban freight transport*
- *Structure of urban freight transport*

2. What is a transport carrier?

- *Definition of a transport carrier*

3. What does freight transport efficiency of transport carriers mean?

- *Understanding the freight transport efficiency of transport carriers*

4. Why it is necessary to improve freight transport efficiency of transport carriers?

- *What negative effects can low transport efficiency have on carriers?*
- *What are the benefits of high transport efficiency?*

5. What are the current problems for transport carriers of Axfood's retail stores in central Gothenburg?

- *An overview of Axfood's retail stores and its transport carriers*
- *The current transport situation of Axfood's transport carries*
- *The current problems of transport carriers of Axfood's retail stores in central Gothenburg*

6. How can we improve Axfood's transport carriers' transport efficiency in central Gothenburg?

- *Reasons resulting in Axfood's carriers' current problems in central Gothenburg*
- *The process of solving Axfood's transport carriers' current problems*
- *Existing measures to improve carriers' transport efficiency*
- *Among the existing measures, what measures can solve Axfood's carriers' current problems?*

The first three sub-problems will be introduced in chapter 3, "Theoretical study". The fourth question and fifth sub-problem will be discussed in chapter 6 and chapter 5, respectively. The sixth sub-problem will be analyzed and answered in chapter 6, "Analysis". How these information needs are completed and what methods are used to collect information will be discussed in the "Methodology" chapter.

3. Theoretical study

This chapter will provide a broad theoretical framework relevant to the subject. Here, the first three sub-problems will be answered. I will begin with a presentation on urban freight transport.

3.1 Urban freight transport[6]

Traffic planning dealt solely with motorized private transport for a long time. The 70's brought about the first attempts to investigate urban freight traffic. Due to its heavy increase during the past few years, it has become the focus of traffic planners as well as catching the public's attention.

How much this area has been neglected becomes evident if one tries to define the subject. There is still no unique definition of urban freight traffic. An analysis of existing literature shows a broad variety of approaches. There is neither consent about the terms nor the hierarchical structure. A clear separation of terms is lacking as well as an allocation of types of transport.

Urban freight traffic is often equated with delivery traffic. Here it will be defined as one function of urban freight traffic. It covers the delivery of goods to the receiver. The change of position per time unit is considered mobility. The urban mobility will be divided into private transport and commercial transport. Private transport satisfies private needs alone. Commercial transport accounts for all activities associated with business, production and trade processes.

There is another distinction between commercial transport including goods traffic and commercial transport excluding goods traffic. Commercial traffic without goods flows is typical service trips, initiated by for example salesmen or craftsmen, authorities, emergencies or the police. Although some tools and goods might be transported the service itself is the focus.

Urban freight traffic is a complex part of the transport classification structure. The spatial separation of production and consumption results in transport and storage activities. Rarely is there a simple transport process from sender to receiver. The spatial and temporal transfer of goods is a multi-functional transport chain, accommodated by loading and transhipment activities, and information flows. Disposal and recycling make the transport chain cyclical. The definition for the process has been given as "an effect of technically and organizationally linked processes to move persons or goods from origin to destination. The transport chain is one system. The technical composite assumes system compatibility. The

[6] The following part is based on information from Susanne StrauB, *City Logistics-An Instrument to Decrease Urban Freight Traffic.*

organizational link is obtained by a coordination of information and control elements as well as legal and commercial prerequisites. The system transport chain is connected to adjacent systems such as goods production and consumption."[7]

The complex structure of urban freight traffic is displayed as a multi level structure in order to determine the individual functions and elements of the transport chain. The following Figure 4 describes structure of urban freight transport.

Functional

- Direct Delivery
- Shipment
- Storage/ Transhipment
- Pickup/ Recycling
- Disposal
- Through Goods Flow

Organizational

- Forwarding Companies
- Dedicated Transport Companies
- Parcel and Express Services
- Mail

Modal

- Truck
- Person Car/ Van
- Railway
- Public Transport
- Bike
- Walk

Customer Related

- Retail Trade
- Wholesale
- Private Customers
- Industry
- Craft
- Administration
- Banks/ Insurance
- Construction Sites

Goods Related

- Textiles
- Food
- Cooled Goods
- Beverages
- Piece Goods

Figure 4: Structure of Urban Freight Transport
Source: Susanne StrauB, City Logistics-An Instrument to Decrease Urban Freight Traffic

The classification described in Figure 4 can be explained as follows:

The ***functional structure*** separates according to the single pieces of the chain. Urban freight traffic deals mostly with deliveries, which means the transport of goods to the

[7] Heimes: Handlexikon des Guterkraftverkehrs. 1995.

location of the receiver. Besides this, there is goods transport to transhipment and distribution terminals, and to places of disposal and recycling.

The ***organizational structure*** distinguishes between the actors in urban freight transport such as forwarding companies or parcel services.

The ***customer related structure*** differentiates urban freight traffic according to the customers. Their function as sender and receiver is explained.

The ***goods related structure*** differentiates according to the commodities being transported and their specific demands. Because of the broad variety of goods and their numerous properties, such as weight, volume, perishableness, bulkiness, value or danger, this classification is important to evaluate the potential of consolidation.

The distribution of goods in cities is almost exclusively carried out by trucks. The goal to shift freight activities to more environmentally friendly vehicles made the ***model classification structure*** necessary.

The multi level structure of urban freight activities is appropriate to categorize every individual transport process in the city. The complex and abstract traffic is broken down into logic units. Furthermore, it is possible to analyze the obstacles and benefits for city logistics.

3.2 Actors in urban freight transport[8]

Above I presented urban freight transport. It is essential to introduce the actors related to urban freight transport because they play vital roles in urban freight transport. There are four key stakeholders: transport carriers, shippers, residents, and administrators (see *Figure 5*). Each of the key stakeholders related to urban freight transport has their own specific objectives and tends to behave in a different manner. This limits the likelihood of successful implementation of strategies suitable to make freight transport more efficient. The success of measures and strategies are very much dependent on the ability of the actors to negotiate satisfactory agreements. In the following section, I will present the four actors separately.

[8] The following part is based on information from Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems* and Susanne StrauB, *City Logistics-An Instrument to Decrease Urban Freight Traffic.*

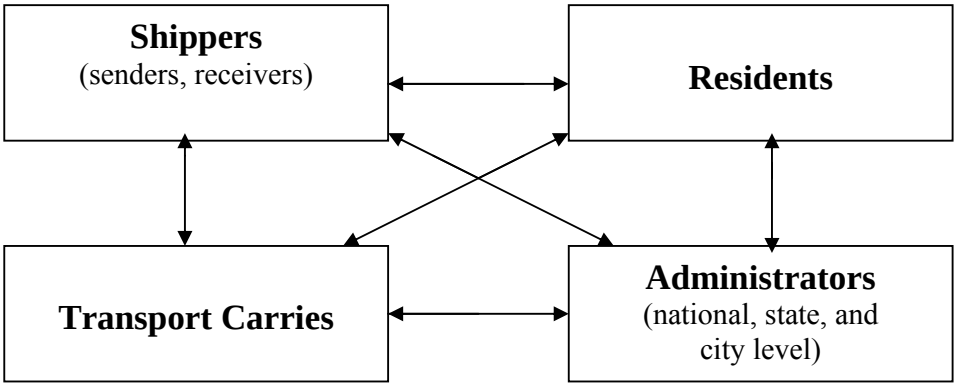


Figure 5: Key stakeholders in urban freight transport

Shippers

Shippers are the customers of freight carries who either send goods to other companies or persons, or receive goods from them. Shippers consist of senders and receivers.

The manufacturing industry as a ***sender*** of goods influences urban freight traffic by the organization of their transports. They are facing the demands of complete logistics services such as speed, reliability, flexibility, safety and low transport prices. The willingness of the industry to cooperate and to consolidate shipments to the same destination depends on the economic pressure and the transport cost. The manufactures can contribute to a more efficient urban freight transport by outsourcing. The price development on the transport market will support the decision against dedicated transport in the long run.

The biggest part of the ***receivers*** – in urban freight traffic is mainly retail trade – gets deliveries for free. The sender of goods pays the transport cost. Any logistics cost including those for delays caused by traffic jams or waiting queues are hidden in the price of the article. From the receiver's point of view there is no demand for improving the situation of delivery traffic.

An interrogation of the European Trade Institute (ETI) has proven that more than 40% of retail trade facilities consider the restriction of delivery tours by the city administration the biggest problem. The problems are furthermore increasing due to the narrow time windows of retailers. Many stores accept deliveries only until noon. The delivery before and after the opening hours is supposedly not being accepted because it requires additional, more expensive labour. Besides delivery on time, retailers expect more services from the driver. They have to carry the goods and articles into the storage room far away requiring extra time. Often load carriers destined to leave the store must be wrapped, checked for completeness and wastepaper returned.

Residents

Residents are the people who live, work and shop in the city. They influence urban freight traffic quantitatively and structurally. They do not welcome large trucks coming into local streets although these vehicles carry commodities that are necessary for them. They would like to minimize traffic congestion, noise, air pollution and traffic accidents near their residential and retail areas. Within the commercial zones of urban areas, retailers want to receive their commodities at a convenient time for them. However, this sometimes conflicts with residents who desire quiet and safe conditions on local roads.

City administrators

City administrators attempt to enhance the economic development of the city and increase employment opportunities. They also aim to alleviate traffic congestion, improve the environment and increase road safety within the city. They should be neutral and should play a major role in resolving any conflicts among the other key stakeholders who are involved in urban freight transport. Hence, it is the administrators who should co-ordinate and facilitate City Logistics initiatives.

Freight carries

Freight carries typically attempt to minimize the costs associated with collecting and delivering goods to customers to maximize their profits. There is much pressure to provide high levels of service to customers at a lower total cost. The following *transport carriers* are known to take part in transport activities:

· Forwarding and Transport Companies
· Dedicated Transports
· Express and Parcel Services

Forwarding and Transport Companies
Forwarding companies usually do not transport the cargo physically. They procure a transport for another carrier. The forwarder is in charge of the organization of the shipment of cargo, its reception, the necessary documents, the transhipment, insurance and storage; A mere transport company is limited to carrying out the physical transport of cargo.

Forwarding and transport companies do not only fight with decreasing turnovers but also they must react to changing market conditions. Besides the physical transport they are confronted with additionally required services such as labelling and storage.

The growing demands of speed and punctuality have lead to a service that is almost comparable to parcel services like 24 hour distribution, country-wide delivery, etc.

Dedicated Transport

Dedicated transport companies are committed to a single supplier. One can say that the transport company and the sender of goods are identical. The reasons are plentiful, for instance special vehicles, individual customer support, and flexible and continuous availability of trucks.

The biggest market for dedicated transport is the building industry. This accounts for almost two thirds of the transport volume and 50% of all trips. Another typical market is the transport of food. Here are almost three times as many trips as are carried out by forwarding companies. Wholesalers employ about 44% of all vehicles in use. This is dedicated transport for consumer goods (food and pharmacy), brewery and press releases and, for instance, building material, hygenics and electric household devices.

Here I skip Express and Parcel Services because it is not in the scope of this report. There are three parties who deliver foods to Axfood's retail stores: producers, transport companies, and Axfood's wholesaler - Dagab. In *"Limitation*" in chapter 1, I gave the three parties the same name: transport carrier. According to the discussion above, producers are senders, and transport companies are those companies who are limited to carrying out the physical transport of cargo. Dagab belongs to Dedicated Transport Company. This is what a transport carrier stands for in this thesis.

3.3 Freight transport efficiency of transport carriers

The basic definition of efficiency[9] is the relationship between input and output, or between costs and benefits in a certain system. In economics, the general meaning of efficiency is the extent to which a certain amount of productive resources can meet the demand of human beings. The relationship between efficiency, input and output in a system can be explained by the following equation:

$$O = I \_ E \qquad \_1\_$$

Where:

O – the capacity of satisfying certain demands, or the output of a certain input;

I – the quantity of productive resources input in the system;

E – the efficiency of the system.

From equation (1), it can be seen that efficiency is the key parameter, which determines the total supply of a system. Given the same amount of input, different efficiency will lead to quite different output.

[9] http://perso.wanadoo.fr/ville-en-mouvement/articles/lu_huapu04.pdf

Now we know the basic definition of efficiency and the general meaning of efficiency in economics. What is the freight transport efficiency of a transport carrier? So far, there has not been much investigation into urban freight transport, so I could not find an exact definition from the limited materials. According to information I got and my understanding, I myself give it a definition.

The relationship between input and output in a freight transport system also satisfies the basic definition of efficiency. In this paper, the *freight transport efficiency of transport carriers* is defined as: the relationship between a transport carrier's resources inputs and its service in a freight transport system. The following Figure 6 describes this relationship. Here, a transport carrier's resources inputs include financial, physical or human, and a carrier's services for retail stores are output. Given the same transport carrier's inputs, the higher the transport efficiency, the higher level of services.

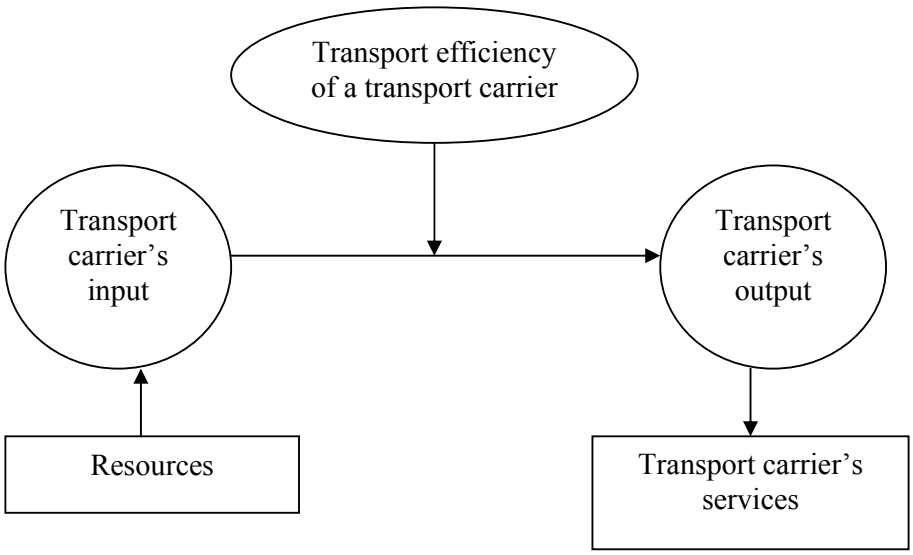


Figure 6: The relationship between the transport efficiency of a transport carrier, transport carrier's input and transport carrier's output

Based on this definition, whether transport efficiency of carriers can be evaluated as "high efficiency", is determined by whether carriers can provide the best transport services for their customers with the lowest resource inputs. From the receivers' point of view, what they are most concerned with is the extent to which carriers can satisfy their demands of flexibility, low transport prices, Just-In-Time, and reliability. There are two types of reliability: delivery without any damage to the goods, and delivery without any delay with respect to designated time at customers.

3.4 City Logistics

In chapter 6, I will state the measures that can improve carriers' transport efficiency. Here, I introduce theories related to the measures. An important theory should be presented, and that is: ***City Logistics***.

In response to transportation problems, a new area of transport planning has emerged called City Logistics. The term *logistics* came originally from the military and meant support activities. Since the 60's logistics has become popular in the field of economics. Logistics is the interaction of temporal, spatial, functional, quantitative and qualitative dimensions of the flow of goods, whereas transport bridges the gap in distance between places of production, consumption and disposal. Logistics plans, controls and realizes the goods flow. An optimization of the entire logistics chain is the declared goal.[10]

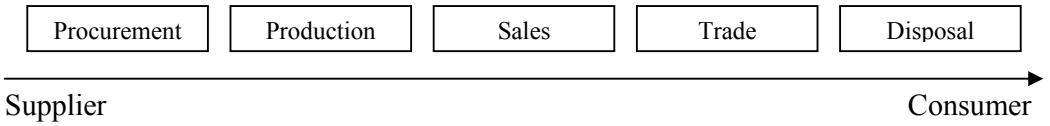


Figure 7: The logistics process
Source: Susanne StrauB, City Logistics-An Instrument to Decrease Urban Freight Traffic

The term City logistics is related to urban goods flows. Many of the projects currently in progress are limited to forwarding companies in terms of organization and to inner cities in terms of its spatial extension. The following statements are attempts to cope with the term. Until now there has been no unique and widely accepted definition of City Logistics.

City Logistics is the attempt to organize freight trips directed to the city centre in order to achieve a transition from a spatially separated distribution of individual commodities (the same kind of goods is sent to several receivers) to a spatially coordinated distribution of several commodities (several kinds of goods/articles are sent to the same receiver).[11]

City Logistics is a new organization of urban freight activities comparable to vehicle routing procedures of express or parcel services: the delivery of goods to certain parts of the city centre is coordinated and carried out with smaller, specially adapted, environmentally friendly city trucks instead of badly utilized heavy trucks. Another aspect is the implementation of storage facilities in inner cities and to include disposal.[12]

[10] Susanne StrauB, *City Logistics-An Instrument to Decrease Urban Freight Traffic*
[11] Hesse: City-Logistik et cetera. 1992.
[12] Wurdemann: ExWoSt-Informationen zum Forschungsfeld "Städtebau und Verkehr". 1992.

City Logistics is the efficient organization of urban freight traffic in order to meet ecological and economical standards. This refers not only to the city centre but the total vicinity including private, public and commercial activities. The aim is an integrated goods transport concept for the entire city.[13]

For the scope of this study the following definition shall be applied:

Taniguchi *et al.* (1999a) defined City Logistics as "the process for totally optimising the logistics and transport activity by private companies in urban areas while considering the traffic environment, the traffic congestion and energy consumption within the framework of a market economy."

Typical City Logistics objectives are to[14]:

(a) Reduce operation costs
(b) Increase efficiency
(c) Reduce environmental impact

City Logistics usually includes one or more of the following initiatives[15]:

(a) Advanced information systems
(b) Co-operative freight transport systems
(c) Public logistics terminals
(d) Load factor controls
(e) Underground freight transport systems

It is common for these initiatives to be combined and varied to be compatible with local transport planning policies. In the following section, I will make a detailed description of these initiatives and also introduce their functions, and note successful examples in some countries.

Advanced Information System

Advanced information systems have become important in rationalizing existing logistics operations. In general, advanced information systems for pickup/delivery trucks operations have three important functions:

(a) To allow communication between drivers and the control centre
(b) To provide real time information on traffic conditions

[13] Stabenau: Bedarfsgerechte Gestaltung einer leistungsfähigen City-Logistik. 1993.
[14] Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*
[15] The following part is based on information from Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*

(c) To store detailed historical pickup/delivery truck operations data

The third function is very important for rationalizing logistics operations. A Japanese milk producing company experienced one successful application of historical operations data. After introducing a satellite based information system for one year, the company was able to reduce the number of pickup/delivery trucks by 13.5% (from 37 to 32 vehicles) and increase their average load factor by 10 percent (from 60% to 70%). A computer based system was used to store detailed historical data on pickup/delivery trucks operations, including starting/arriving times at the depot and customers as well as the waiting times, travelling speeds and routes travelled. The company was able to analyze this data and change their routes and schedules to substantially increase the efficiency of their vehicle fleet. This type of system can reduce both freight transport and environmental costs within a city.

Cooperative Freight Transport Systems

Several researchers have investigated cooperative freight transport systems (Ruske, 1994; Taniguchi *et al*., 1995, 2000c; Kohler, 1997) that allow a reduced number of trucks to be used for collecting or delivering the same amount of goods. Also, this system reduces queues of trucks waiting to deliver goods on streets.

In Germany, these partnerships (known as *City Logistik* companies in Germany) are in operation in Berlin, Bremen, Ulm, Kassel and Freiburg. The Freiburg example has several pointers to the future shape of freight transport in urban areas. There are currently 12 partners in the scheme. Three of the partners leave city centre deliveries at the premises of a fourth. The latter then delivers all the goods involved in the city centre area. A second group of five partners delivers all its goods to one depot located near the city centre. An independent contractor (*City Logistik*) delivers them to city centre customers. A third group, this time with only two service providers, specialises in refrigerated fresh products. These partners form an unbroken relay chain, one partner collecting the goods from the other for delivery to the city centre.[16]

The Freiburg scheme has reduced total journey times from 566 hours to 168 hours (per month), the monthly number of truck operations from 440 to 295 (a 33 % reduction) and the time spent by lorries in the city from 612 hours to 317 hours (per month). The number of customers supplied or shipments made has remained the same. The Kassel scheme showed a reduction of vehicle kilometres travelled by 70 % and the number of delivering trucks by 11 %. This has reduced the costs of all the companies involved and increased the amount of work that can be done by each vehicle/driver combination. [17]

[16] http://europa.eu.int/comm/environment/trans/freight/booklet_en.pdf
[17] http://europa.eu.int/comm/environment/trans/freight/booklet_en.pdf

Another outstanding case is the cooperative delivering system among 11 department stores in Osaka, Japan. In this system, basically two department stores with depots adjacent each other, exchange their goods to be delivered in the neighbourhood of the depot. This led to the considerable reduction of travel time for trucks, working hours and total costs. As observed in these cases, cooperative freight systems can substantially reduce transport costs as well as environmental impact.

Public Logistics Terminals

Public logistics terminals located in areas surrounding a city can be helpful in promoting cooperative freight transport systems (Janssen *et al.* 1991, Taniguchi *et al.* 1999b, Duin 1997).

Goods movement involves several functions relating to nodes and links in a network. The functions of links are transportation and pickup/delivery; node functions include storage, deposit, handling, processing, assembling, packaging, wrapping and loading/unloading. Logistical terminals are required to fulfil these node functions and to make both functions interact with each other. Such public logistics terminals are multi-company distribution centres and also complex facilities with multiple functions involving advanced information systems, which can facilitate the implementation of co-operative freight transport systems. These terminals can also meet various needs in supply chain management systems.

A good example of this platform for city distribution can be seen in Monaco (Dablanc, 1998). This platform is provided by the government and operated by a private freight carrier for delivering goods to city areas. This company is subsidized by the government to provide a delivery service with cheaper prices then normal. This system helps reduce the required number of trucks used for deliveries. In Japan the first multi-functional logistics terminal is to be built in Seki near Nagoya. This logistics terminal is referred to as a “logistics town” and has various functions such as the transhipment of goods, assembling products during distribution, warehouses and wholesale markets. This project is being planned and executed by a group of companies from various kinds of industries with the support of the national, prefecture and municipal governments.

Load Factor Controls

Controlling the loads of pickup/delivery trucks is a relatively new initiative compared with conventional regulations such as vehicle weight limits, designated times for trucks to enter city centres and the control of vehicle emissions. Two European cities (Copenhagen and Amsterdam) introduced a certificate system for freight carriers who deliver or collect goods within the city centre in 1998. In Copenhagen, only vehicles with a certificate (green sticker) are allowed to use public loading/unloading terminals

in the inner city. This certificate can only be issued to vehicles satisfying the following two conditions:

(a) Load factor over 60 percent
(b) Vehicle age less than 8 years old

Companies owning vehicles are required to produce a report on the load factors of their vehicles every month. To maintain certification, a company must have an average load factor during the previous month above 60 percent. In Amsterdam vehicles weighing over 7.5 tons are not permitted to use streets other than main streets. However, vehicles weighing over 7.5 tons are able to obtain a special certificate to enter these streets, if they satisfy the following three conditions:

(a) Load factor over 80 percent
(b) Length less than 9m
(c) Engine must satisfy Euro II emission standards

The police inspect the load factor of specific vehicles on the road. This initiative assumes that higher load factors lower the environmental impacts.

Underground Freight Transport Systems

A technology, which could play a big role in future City Logistics systems, is underground transportation. Underground transportation is already common technology in passenger transportation systems such as subways. In freight transportation systems the industrial application of this technology is mainly restricted to transport by pipelines for some chemical products, oils, etc. Underground logistics distribution systems seem to be a sustainable solution for environmental, congestion and space problems.

In highly congested areas initiatives for underground projects have been studied as an alternative. Initially Japan started with the study of underground distribution systems (Koshi *et al.,* 1992; Ooishi and Taniguchi, 1999). Koshi *et al.* (1992) estimated the impacts of building an underground freight transport system in the central area of Tokyo, Japan. The results of this study indicate that NO_x and CO_2 emissions would be reduced by 10 percent and 18 percent respectively and that energy consumption would be reduced by 18 percent and the average travel speed would be increased by 24 percent. Ooishi and Taniguchi (1999) studied the economic feasibility of the underground freight transport system in Tokyo and concluded that this project has an internal income rate of 10 percent when the infrastructure is constructed by the public sector. The Dual Mode Truck (DMT) was developed and tested by Public Works Research Institute of the Ministry of Construction in Japan. This new type of automated electric truck can travel through an exclusive guided lane in underground

tunnels with an external supply of electricity and also travel on normal streets operated by a driver with batteries. In the Netherlands a similar idea was proposed (Visser 1997, Duin 1998) and the feasibility of underground freight transport system between Aalsmeer and Schiphol airport for carrying flowers was investigated. An automated guided truck named the "Combi-road" system was also developed and tested by a group of private companies.

These systems are, however, innovative systems with automation that requires a huge initial investment, although cost benefit analyses showed positive results. Consequently, underground freight transport systems are included as a future development for City Logistics. At the city level, some municipalities have already adopted this idea and have started to work on a feasibility study for this new technology. At the regional level some companies located in different industrial zones could become connected by an underground distribution system. Companies with an especially strong supplier-customer relationship in terms of volumes and pieces are potential users of these systems. Due to the flexible, continuous and reliable underground transport system Just-In-Time deliveries become possible, thus reducing stock positions at suppliers' as well as at the customers' end. At a national level, huge economic centres with underground distributions networks will be interconnected by high-speed rail connections.

3.5 City Logistics with ITS[18]

Above I introduced City Logistics and its initiatives. Recent developments in the field of Intelligent Transport Systems (ITS) can facilitate the implementation of many City Logistics initiatives. Currently, advanced telecommunication systems provide powerful tools for efficiently operating vehicle fleets. Sophisticated logistics systems can now be developed by integrating Global Positioning Systems (GPS) and Geographical Information Systems (GIS) in conjunction with application software. Now, ITS based City Logistics has become more realistic in many industrialized countries. Consequently, it is necessary to introduce Intelligent Transport Systems here.

Intelligent Transport Systems (ITS) involve the application of advanced technologies to help reduce the costs of transport systems. ITS makes, "skilful use of advanced electronic and communications technologies to merge people, vehicles and roads into integrated, intelligent systems" (Nissan, 1998). Using advances in electronic and communication technology, ITS have the following potentials:

(a) To reduce freight distribution costs
- Increase productivity of local deliver vehicles

[18] The following part is based on information from Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*

- Increase reliability of commercial vehicle operations
- To increase safety

(b) Increase the capacity of urban freight systems (without providing additional traffic infrastructure)

ITS have two key elements, intelligence and integration. Intelligence involves gaining knowledge through data collection and information processing. Integration relates to connecting and coordinating the key elements of the system. Gains in efficiency through reduced delay and congestion costs can be achieved by developing integrated information systems.

ITS provide a wide range of opportunities for developing effective City Logistics schemes. With limited funds and space available for new roads in many cities, there is a real need for more sophisticated procedures for efficiently using existing transport systems. With the growing use of "Just-In-Time" transportation there are increased requirements on carriers to increase performance as well as flexibility (OECD, 1992).

There are a number of ITS based City Logistics schemes that have already been implemented in cities through the world:

- Electronic tolling
- Matching systems for back-loads
- Booking systems for access to terminals
- Real time vehicle tracking and monitoring
- Performance monitoring (e.g. travel times, speeds and weights)
- Computerized vehicle routing and scheduling systems
- Route guidance

City Logistics based ITS relies heavily on horizontal data integration that involves the exchange of data and information between organizations. This requires a high degree of co-ordination and commitment. Computer systems must be compatible across organizations.

ITS generally consists of the following three elements:

(a) Data acquisition
(b) Data processing
(c) Information dissemination

The *collection of data* provides input for management and operating procedures. Currently, mobile telephones and CB radio are generally used to communicate between drivers and control or customers. Various technologies now exist for the automatic collection of truck data. Sophisticated measuring devices can measure a range of attributes of trucks, including length, weight (Bergan *et al*, 1995; Karuo and

Koyasu, 1995) and speed. These recordings can be linked to monitoring centres and used for planning, enforcement or fleet management purposes.

Data processing is an essential component of a City logistics ITS. Data must be converted into information. "Information becomes information only when it is communicated in forms and at times suitable for use in a particular decision", (Bowyer and Taylor, 1985). Thus, information needs to be provided to decision makers at the appropriate time and in an understandable form. Data processing generally includes one or more of the procedures: Verification, Summarization, Integration, and Prediction. Often specialized procedures need to be developed to perform these tasks. Their nature will depend on the specific functions of the system.

The *dissemination of information* to facilitate efficient movement of goods in urban areas is an important component of ITS based City Logistics schemes. This involves understanding the decision-making environment of the users of the information. Consideration of the information needs of potential users will influence the form and timing of its dissemination. There are a variety of ways of disseminating information for decision makers. A number of issues need to be considered:

- Who are the decision makers (or users of information)?
  - drivers
  - dispatchers
  - fleet managers

- Why the information is required (application)?
  (a) fleet management
    - vehicle routing & scheduling
    - vehicle tracking
    - driver communication
  (b) vehicle management
    - route guidance
    - vehicle operation
    - emergency information

- How can the information be presented (i.e. what medium)?
  - Internet
  - Phone
  - Fax
  - Truck stops
  - TV
  - Radio

Two-way communication is often needed to satisfy user's information needs. Due to recent technological advances, there are a number of methods available for transmitting information to commercial vehicle operators, e.g. commercial vehicle radio broadcasting, mobile telephone, ISDN or Internet. Radio frequency (RF) communication, including truck radio, civil band (CB) radio and mobile telephones, are the main means of two-way information transmission between vehicle fleets and depots. For information exchange between other sectors, such as those with road authority or customers, a variety of facilities, such as standard telephone, teletext, leased lines or Internet, can be employed.

3.6 Facility Location Models[19]

In chapter 6, some measures that I will propose to solve Axfood's carriers' problems include Public Logistics Terminals. Since optimal location of logistics terminals are considered within the framework of facility location problems, it is necessary to introduce theories about the facility location problems.

Facility location problems have been studied in many fields such as operations research, economies, mathematics, and geography and computer science. Facility location models (e.g. Hansen *et al*., 1987; Drezner, 1995; Daskin, 1995) involve determining the location of one or more facilities in such a way that optimizes a certain objective.

Facility location models have some common basic elements:

(a) Space (defining the distribution of demand points and candidate sites of facilities)
(b) Number of facilities to be located
(c) Size of individual facilities
(d) Number of existing facilities
(e) Objective of decision maker
(f) Demand (distribution, actual demand, variation)
(g) Candidate sites for facilities (distribution, number)
(h) Facility user behavior
(i) Capacity limits on facilities

These elements can be used to classify facility location models into three types: continuous location models, network location models and discrete location models. With *continuous location models*, any point on the plane is available for candidate sites; theoretically, there are infinite numbers of candidate sites. Most continuous location models can be formulated as a non-linear programming problem with the assumption that facility users move straight to the facilities available. *Network*

[19] The following part is based on information from Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*

location models have an infinite number of candidate sites as well, but these are only on nodes or links and facility users can only move within the network. This model is more realistic because facility users are actually unable to move straight on the plane but are able to move along links (the road network). *Discrete location models* consider a finite number of candidate sites and determine the optimal location using the location of candidate sites and predetermined costs incurred from demand nodes to the candidate sites.

4. Methodology

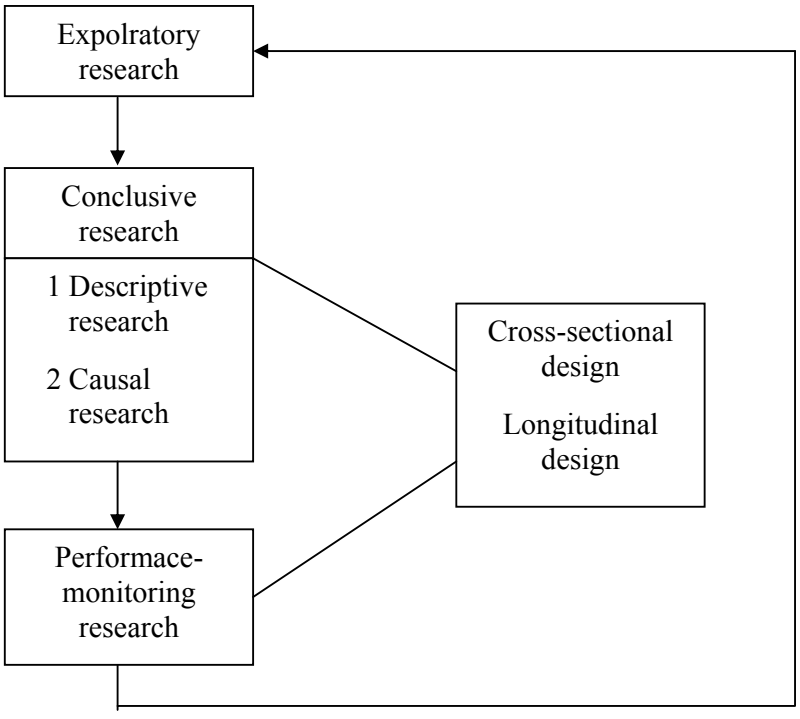
In this chapter, I will introduce research design, the research methods I used, and the research process. Also, I will evaluate my research.

The methodology is discussed in this chapter. This makes it possible for you as a reader to understand and shape your view and perspective of how transport carriers' transport efficiency is improved, and to what extent the conclusions are reliable. The methodology gives you advice on how to interpret the information provided.

4.1 Research design[20]

A research design is the basic plan that guides the data collection and analysis phases of the research project. It is the framework that specifies the type of information to be collected, the sources of data, and the data collection procedure. A good design will make sure that the information gathered is consistent with the study objectives and that the data is collected by accurate and economical procedures.

The objective of the research project logically determines the characteristics desired in the research design. Research objectives are dependent upon the stages of the decision-making process for which information is needed. Three types of research have been identified in this regard: exploratory, conclusive, and performance-monitoring research (see *Figure 8: Research Design*).



[20] The following part is based on information from Kinnear and Taylor (1996), *Marketing Research*, Mc Graw-Hill.

Figure 8: Research design
Source: Kinnear and Taylor (1996), Marketing Research, Mc Graw-Hill

Exploratory Research is appropriate for the early stages of the decision-making process. This research is usually designed to obtain a preliminary investigation of the situation with a minimum expenditure of cost and time. The research design is characterized by flexibility in order to be sensitive to the unexpected and to discover insights not previously recognized. These include secondary data sources, observation, interviews with experts, group interviews with knowledgeable persons, and case histories; *Conclusive Research* is designed to provide information for the evaluation of alternative courses of action. The research design is characterized by formal research procedures. This involves clearly defined research objectives and information needs. Often a detailed questionnaire is drawn up, along with a formal sampling plan. Possible research approaches include surveys, experiments, observations, and simulation. Conclusive research can be subclassified into descriptive research and causal research. In this report, exploratory research and conclusive research are adopted to collect data needed. In detail, I use secondary data sources, interviews, observations and surveys. Below is a more detailed description of the four methods.

4.2 Research methods

In this section, I will explain why I chose the following four methods, and how I used these methods to collect data needed.

4.2.1 Secondary data sources[21]

There are two general types of marketing data - primary and secondary. *Primary data* is collected specifically for the research needs at hand. *Secondary data* is already published data collected for purposes other than the specific research needs at hand.[22]

In basic and mature research fields, there is normally a well-trodden path made up of textbooks and articles in scientific journals to follow for a comparatively fast advance for the research conductor. But, in a young and multi-disciplinary research field such as urban freight transport, there is normally no much literature to consult while approaching the research problem. In order to resolve those sub-problems mentioned in chapter 2, I consulted a wide variety of secondary data sources such as textbooks, annual reports, articles in academic journals, and investigation reports. Some materials were found to provide information for the following areas:

[21] Concerning all the articles, see reference list.
[22] Kinnear and Taylor (1996), *Marketing Research*, Mc Graw-Hill.

▪ *Definition and structure of urban freight transport*
▪ *Definition of transport carrier*
▪ *Understanding of freight transport efficiency of transport carrier*
▪ *An overview of Axfood's retail stores and its transport carriers*
▪ *The process of solving transport carriers' current problems*
▪ *Existing measures to improve carriers' transport efficiency*

It was not difficult for me to find most of the information in the areas above. When I tried to find the definition of freight transport efficiency of transport carriers, I found more investigations on transport efficiency focus on the social perspective, so I could not find an exact definition from the transport carriers' perspective. Through my understanding on some materials, I gave it a definition by myself.

4.2.2 Interview

In order to get information on the retail stores' current situation, a list of their transport carriers, and their transport carriers' problems from the retailers' perspective, interviews with several retail stores were conducted.

In central Gothenburg, there are six retail stores, which are Axfood's wholly owned chain stores or franchise chains. They are one *Hemköp*, one *Billhälls*, two *Spar*, and two *Willys hemma.* Because the population is small, I planned to visit the six stores and interview their shop managers in August 2003. Since the manager of one *Willys hemma* was on vacation and the manager of one *Spar* was too busy, I interviewed the shop managers coming from the other four retail stores. I prepared several questions (Appendix 3). The four shop managers introduced their retail stores, their transport carriers, and current problems when receiving goods to me.

Also, I interviewed Lars Mossfeldt, Senior Researcher at Department of Urban Land Use and Transport Planning, Chalmers University of Technology. He has conducted studies on urban freight transport for several years. He gave me some ideas on retail stores' transport carriers' current transport problems in urban areas.

All of these interviews gave me primary knowledge on these stores, their carriers, and some current transport problems of transport carriers.

4.2.3 Observation

When I visited the six retail stores, I also observed the types of foods, location of stores, trucks that deliver food to the stores, and how they receive food from trucks. These observations helped me understand more about the retail stores and their current transport problems.

4.2.4 Survey

The fourth research method is a descriptive survey. A descriptive survey is concerned primarily with addressing the particular characteristics of a specific population of subjects, either at a fixed point in time or at varying times for comparative purposes (Gill & Johnson, 1997 p.81). The purpose for doing this survey is to get information on Axfood's transport carriers' current transport situation, their current problems, and reasons resulting in these problems.

The subject of this survey is Axfood's transport carriers. There are three parties who deliver foods to Axfood's stores. Dagab, which is wholesaler of Axfoods, delivers approximately 60-70% of the volume of each store. Besides Dagab, some producers and several mere transport companies also deliver foods to these stores. I did not make a total survey. There are four reasons: 1. Dagab delivers most of the volume of each store, thus, it is a main carrier. 2. The aggregation of producers and mere transport companies is not small. 3. Not enough time to make a total survey. 4. Actual effect of selecting several typical companies to study is better. Considering the four reasons, I chose five typical companies to make a survey.

In order to explain how I chose the five companies, it is necessary to introduce sampling[23] here. Sampling is used very frequency in marketing research. Steps in selecting a sample are described in the following Figure 9.

[23] The following part is based on information from Kinnear and Taylor (1996), *Marketing Research*, Mc Graw-Hill.

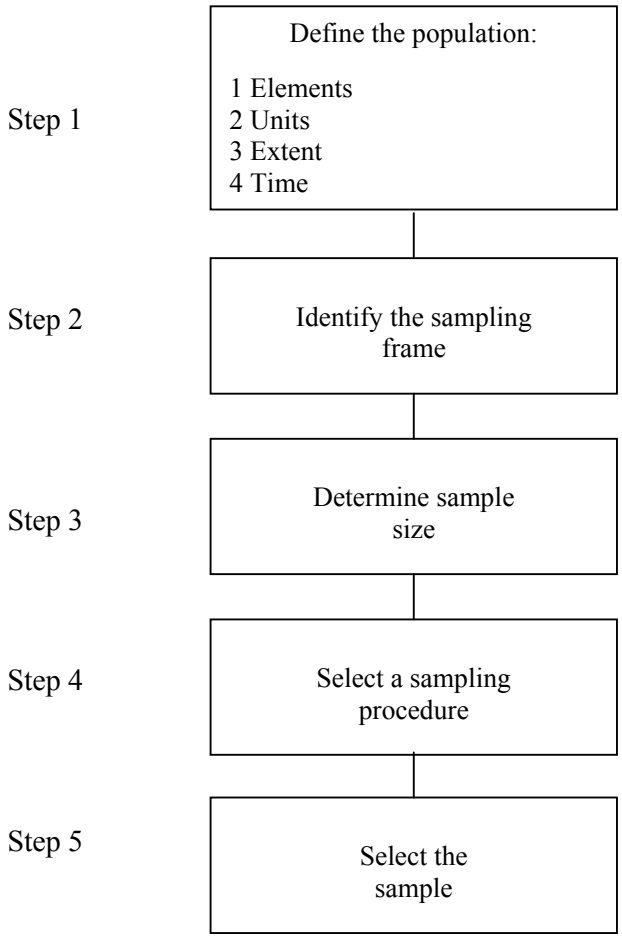


Figure 9: Steps in selecting a sample
Source: Kinnear and Taylor (1996), Marketing Research, Mc Graw-Hill

Step 1: Define the population. A *population* is the aggregate of all the elements defined prior to selection of the sample. A properly designated population must be defined in terms of (1) elements, (2) sampling units, (3) extent, and (4) time. An *element* is the unit about which information is sought. A *sampling unit* is the element or elements available for selection at some stage of the sampling process.

Step 2: Identify the sampling frame from which the sample will be selected. A *sampling frame* is a list of all the sampling units available for selection at a stage of the sampling process.

Step 3: Decide on a sample size. Here we determine how many elements to include in the sample.

Step 4: Select a specific procedure by which the sample will be determined. Exactly how will the decision be made on which population elements to include in the sample?

Step 5: Physically select the sample based upon the procedure previously described in step 4.

Now we know how to select a sample. According to the process, I can choose the sample in my thesis. The sampling frame in my survey is the five companies: Dagab, Arla, Spendrups, Pågens, and Scan. Obviously, Dagab was chosen because it is the main transport carrier. I skip mere transport companies because there are only a few mere transport companies, and Dagab's problems can represent theirs. When selecting producers, a method was employed. Different foods have different characteristics. These different characteristics will cause different transport situations and problems. If I want to get broad and more accurate information, the transport situation of different foods with different characteristics should be studied. Therefore, the transportations of milk, beverages, bread, and meat are selected. The four kinds of foods have the following different typical characteristic respectively: heavy and high frequency delivery; heavy and low frequency; light and high frequency; light and low frequency. Furthermore, the four kinds of foods have several producers, respectively. Their main producers are chosen, and they are *Arla, Spendrups, Pågens*, and *Scan*.

Thus, the companies I will research are selected. Since Dagab delivers food to all of the six stores, and each of the four producers only deliver food to some of the six stores, I made two sets of questionnaire. One is for Dagab (Appendix 1), the other for producers (Appendix 2). Furthermore, the questionnaire for each of four producers is a little different. There are four different stores among the six stores: *Billhälls*, *Willys hemma, Hemköp,* and *Spar*. These stores have different locations and occupied areas, which cause different transport problems. Hence, questions for four producers are same, and their destinations are different (see Figure 10). I mentioned this point when I sent questionnaire to different producer. The two sets of questionnaires are sent to the five companies through e-mail. The respondents are their Transport Leaders.

Product	**Producer**	**Retail Store**	**Location**
Milk	Arla	Billhälls	Hvitfeldtsplatsen
Beverage	Spendrups	Willys hemma	Eklandagatan 57
Bread	Pågens	Hemköp	Nordstan
Meat	Scan	Spar	Brunnsgatan 5

Figure 10: Transportation destinations of different producers

Thus, the objects for study and respondents are chosen, and questionnaires are made. This survey can provide me information on Axfood's carriers' transport situation and problems in central Gothenburg.

4.3 Research Evaluation

Validity and Reliability are central issues when discussing the credibility of a study. To make sure the results of a study are trustworthy, one has to take the validity and reliability of the study into account.

The *validity of measure* refers to the extent to which the measurement process is free from both systematic and random error. The *reliability of a measure* refers to the extent to which the measurement process is free from random errors. Reliability is concerned with the consistency, accuracy, and predictability of the research findings. Validity is concerned with the question: Are we measuring what we think we are measuring? Validity is a broader and more difficult issue then reliability. [24]

In the following section I will discuss the validity and reliability of the four methods mentioned above.

4.3.1 Secondary data sources

I read a wide variety of secondary data sources such as textbooks, annual reports, articles in academic journals, and investigation reports. They provide enough theories related to this subject. Most of books and articles used in this thesis are written by well-known authors, and I have tried to use the most recent articles. One problem I encountered was that very little was written about freight transport efficiency from the transport carriers' perspective. I found one article, *Evaluation and Analysis of Urban Transportation Efficiency in China*, where *Transport Efficiency* and *Efficiency of Urban Transportation System* were defined. According to this material and my understanding, I defined it.

4.3.2 Interview and Observation

There are six stores in this area. Among the six stores, there are four different retail stores. I interviewed all of the four different stores so that transport problems resulting from different kinds of stores could be included. All shop managers were co-operative in the interviews, which made the thesis easier to conduct. These shop managers are very familiar with their stores, their goods, their transport carriers, and problems when receiving goods. They can provide me much useful information on these areas, and provide me with a strong support to my thesis from a real business perspective. Furthermore, I interviewed Lars Mossfeldt, who is a senior researcher at the Department of Urban Land Use and Transport Planning, Chalmers University of Technology. Since he made some studies on urban freight transport for several years, he can provide me some useful and interesting information on carriers' problems.

[24] Kinnear and Taylor (1996), *Marketing Research*, Mc Graw-Hill.

I carefully observed the six retail stores and how they receive goods from trucks. This also helped me deepen my understanding of retail stores and their current transport problems.

4.3.3 Survey

There are three broad sources of errors: sample error, frame error, and dropout error, which can arise when undertaking a survey.

A number of transport carriers deliver food to Axfood's retail stores. Five typical companies are selected to research Axfood's carriers' transport situation and problems. Dagab delivers about 60-70% of the volume of each store, and a variety of foods to all of the six stores so that this company can be considered as the main carrier. Consequently, Dagab can be taken as a typical example while analyzing the transport situation of mere transport companies; each producer delivers its own goods to some of the six stores. Transportations of foods with different characteristics have different transport problems. I chose to study the transportation activities of four typical kinds of foods, and selected their main producers. Thus, the transport problems of the four producers, *Arla, Spendrups, Pågens,* and *Scan*, can stand for transport problems of producers. As analyzed above, the issues of sample error do not exist in this survey.

The second source of error, frame error, refers to bias of the results that depend on a mismatch between the frame of sample and the target population. A frame error can, for instance, arise when the telephone directory is used as a register population. The problem with a telephone directory as a register population is that all people don't have a phone, some people have unlisted numbers and others have just moved in (Lekvall & Wahlbin, 1993 p. 155). The shop managers of retail stores I interviewed provided me a list of their transport carriers, including the main carriers. In chapter 1, I introduced Göteborgs Köpmannaförbund, which possesses great trust, and has extensive connections in its region. This association provided me with the contacted persons for the five carriers, their e-mail addresses and telephone numbers. Hence, the risk of a frame error was avoided.

The Third source of error, dropout error, is more relevant in my survey. Dropout means a failure in getting all data that is needed for the survey. Some data falls off in the data collection process. The most significant measure to restrict the dropout is to have a clear and not too extensive questionnaire. Long and complicated questionnaires are in general devastating for the willingness to answer. There are only 9-12 questions in my questionnaires. These questions are clear, easy to understand and answer. Another very important aspect is that the persons who answer the questionnaire really have knowledge. The questionnaires were sent to transport leaders who have the most knowledge of the transport activities taking placing in their

companies. All of them are experienced and know every aspect of their business clearly. Moreover, in order to control the information, the respondents are required to list their names and titles.

As analyzed above, the three sources of errors do not exist in my survey. Furthermore, managers of the five companies are co-operative, and answered my questions clearly so that I could get enough information on Axfood's carriers' transport situation and problems.

4.4 The research process

To conclude this chapter, I constructed a model; see *Figure 11*, *The Research Process.* Also, this model shows how the work with the thesis is structured and what parts are based on others.

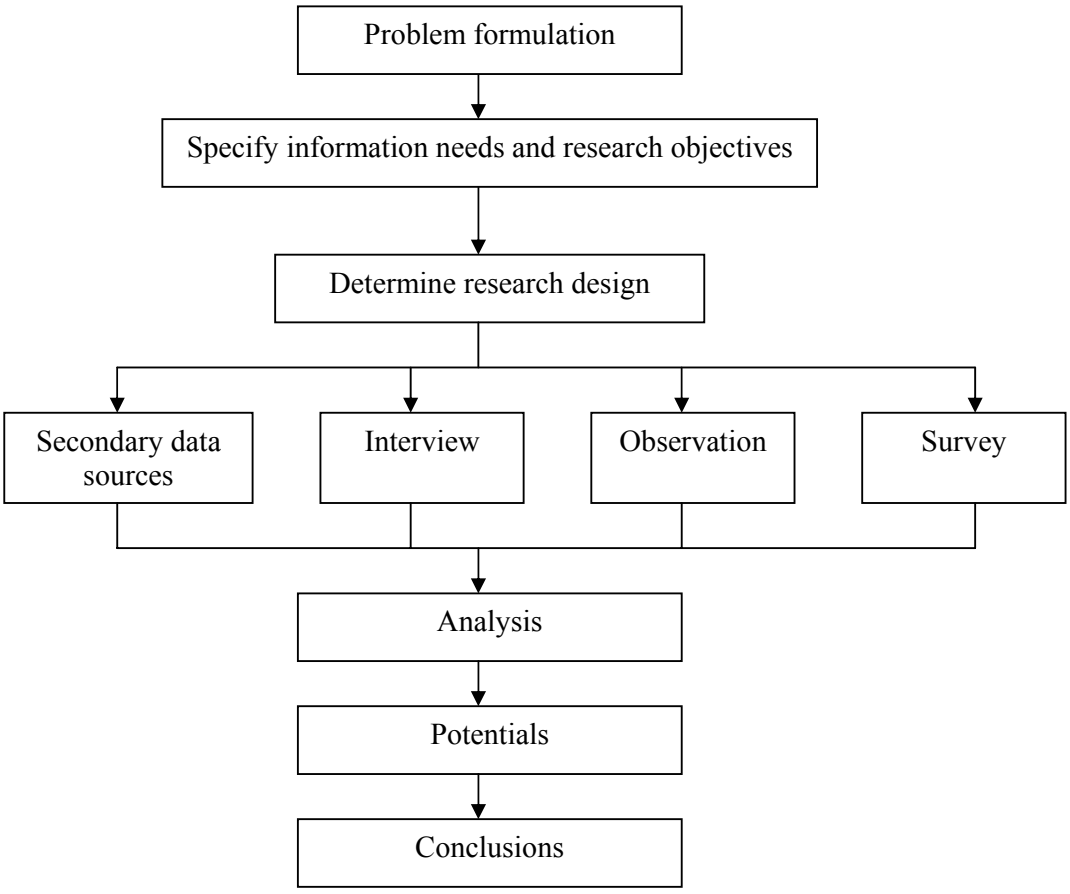


Figure 11: The Research Process

5. Empirical study

In this chapter, I present the information gathered from the interviews and surveys.

From the interviews with shop managers and surveys from the five companies I mentioned in chapter 4, I got a lot of information. Here I will introduce this information. Firstly, there is a general presentation of the four retail stores - *Hemköp*, *Billhälls*, *Willys hemma,* and *Spar*. Thereafter, I will generally state the five transport carriers - *Dagab, Arla, Spendrups, Pågens*, and *Scan*. Finally, the current transport situation and problems of carriers will be introduced.

5.1 Retail stores

In chapter 1, I introduced Axfood Group in general terms. Axfood has wholly owned stores: *Hemköp, Willys* and *Willys hemma*. Also, Axfood collaborates with some private grocers, including *Spar, Vivo, Tempo*, and *Handlarn*. In this specific area, only *Hemköp*, *Willys hemma*, and the *Spar* chain have stores. Hence, here I only present the three different retail stores in the following section.[25]

Hemköp

Hemköp's business concept is to be the obvious choice of store for people with an interest in food. Toward this end, Hemköp attaches a premium to the breadth and depth of its product offering, with a focus on fresh products and knowledgeable, personal service.

Hemköp is a nationwide chain with 90 stores. The Hemköp chain continued to modify its store structure in 2002 and now has three store formats: centrally located stores with less than 1,000 sq.m. in retail space, neighborhood stores with 900-1,800 sq.m. of space, and stores on the outskirts of cities – semi-external locations – with over 1,800 sq.m. of retail space. These three formats cater to different customer needs. The long-term strategy is to start up new stores that fit in to any of the three concepts.

Hemköp stores offer roughly 12,000 items, where local products play an important role. The chain has also built up an extensive range of private label products over the years, which account for 8.7% of total sales.

The type of traditional retailing that Hemköp is engaged in is subject to competition from many directions. This is requiring Hemköp to make its customer offering even more clear than in the past and to reduce the gap between the competing segments.

[25] Some information of the following part is based on Axfood Annual Report 2002.

Hemköp's aim is to compete through quality and its offerings, not through price. However, its prices must nevertheless be competitive, which explains the price cut initiative taken by the chain.

Hemköp has had weak sales and earnings development in recent years. Extensive work was devoted to breaking this trend during the year and included an overview of the product selection, the changeover to central purchasing, a general reduction in prices, the introduction of longer business hours and a revitalizing of the concept. The next step will be to more effectively manage store space by displaying products according to a pre-drawn blueprint, or planogram.

Hemköp has one store at Nordstan, with 2,400 sq.m. of retail space and 1,700 sq.m. of storage space. This store is a centrally located store. The categories, about 30% of this store's volume that is delivered directly from producers, is bread, vegetables, milk, and newspaper, etc. Dagab delivers approximately 70% of this store's volume, mainly frozen foods, cold stuff, and some dairy products. Delivery times of the various categories are different. For example, frozen foods, cold stuff, and mineral water, are delivered twice, three and four times per week, respectively.

Billhälls belongs to Hemköp now. Billhälls is an old chain, exclusively in the Gothenburg area. Some years ago, Dagab bought Billhälls from its founder. A couple of years ago Axfood took it over entirely. Axfood's main chain was Hemköp. The Hemköp-chain now includes Billhälls stores in the Gothenburg area. Axfood doesn't change the name Billhälls to Hemköp because Billhälls as a brand name is very important for the Gothenburg people. If the name is taken away, its identity will be gone, and for the Gothenburg people Hemköp is not the same kind of store. If the Billhälls identity is taken away, a customer might turn to another store outside Axfood. Consequently, so far the name Billhälls has been kept.[26]

From Figure 1, the map of this area, we can find Billhälls has one store at Hviteldtspatsen. Its main transport carrier is Dagab. Other carriers involve Bilspedition, ASG, THL, Arla, and Lngemar Johansson. This store usually receives goods from 7 AM to 7 PM. Freight volume is different on weekdays and weekends. About 22-24 trucks deliver goods to this store per day on weekdays. However, only 10 trucks and 2 trucks deliver goods to the store on Saturday and Sunday, respectively.

Willys hemma

Willys hemma's business concept is to offer a limited range of food products in neighbourhood stores with prices in the lowest tier of the market. Willys hemma works in the hard discount segment. This international concept is based on small

[26] Göteborgs Köpmannaförbund

stores, a very lean product offering (about 1,000 items), an almost exclusive offering of private label products and a limited offering of fresh products.

Willys hemma was launched in February 2002 and opened 42 stores during the year. The stores are located near residential areas and have 400-1,100 sq.m. of retail space. The chain was established to satisfy the needs of people who don't have the means or desire to drive to the more remote discount supermarkets. Another reason for establishing the chain was to head off new competition.

The Willys hemma store structure was derived from the HP Billigt&Nära discount chain, which Axfood acquired at the end of 2001. The 29 HP stores have been converted and the product offering has been changed.

Compared with its main competitors in its segment, Willys hemma has a slightly broader product range and considerably more fresh products. Willys hemma stores offer approximately 2,000 items, which is about twice as much as that offered by comparable competitors. An extensive offering of private label products makes it possible to keep prices low despite low annual sales volume, which is approximately SEK 30 m per store and year. The target group is small households, for whom the stores can serve as a primary source of groceries, and families in need of complementary shopping.

Willys hemma has two stores in this area. They are located at Eklandagatan 57 and Sten Sturegatan 34. I interviewed the shop manager of a store at Eklandagatan. This store has 350 sq.m. of retail space and 50 sq.m. of storage space. The store receives goods between 16:00 and 18:00 on weekdays. Only on Thursday and Friday do they receive cold foods. Dagab delivers approximately 85% of this store's volume. Another 15% is delivered directly from producers, including meats, cookies, beverages, and tobacco. These producers include *Spendrups, Geniko, Tobahsbolaget*, and *Mergos*, etc.

Spar

The Axfood Group cooperates across a broad spectrum in the private retailer segment. The important store brands are Spar, Tempo, and Vivo. Spar and Tempo owners cooperate more closely with Axfood. This means that they are included in the Group's joint purchasing arrangements and thereby benefit from the same favourable purchasing terms. These stores also receive support from Axfood on matters such as marketing, concept development and category management. Axfood Franchise AB is responsible for the Spar chain and since 2002 for the Tempo chain. In this area there are two Spar's stores. Below I will present Spar in detail.

The Spar chain consists of former Vivo stores outside Stockholm. The stores are tied to Axfood through franchise agreements and pay an annual fee of 1.3% of net sales. The Spar concept comprises two store profiles: Spar and Eurospar. The Spar stores are traditional grocery stores with 500-2,000 sq.m. of retail space and sales ranging from roughly SEK 20-60 m. Eurospar stores have over SEK 40 m in annual sales and between 1,000 and 3,000 sq.m. of retail space.

The concept centres around the theme of "festive food stores," with a distinct focus on fresh products. The chain profiles itself through initiative such as in-store food demonstrations performed by store employees in an effort to inspire innovative meal ideas. The stores have a product range of some 7,000 items. The introduction of Spar's own private label – which today includes over 40 Spar products – is also an important part of the chain's customer offering and a significant factor for the chain's profitability.

Spar stores are typically the main store in small towns or regional stores in larger cities. This type of store is exposed to fierce competition. Dynamic stores with attractive prices are essential to ward off the call of hypermarkets and discount stores.

The Spar chain has two stores in the specific area, which are located at Brunnsgatan 5 and Vasagatan 30. I interviewed the shop manager of one store at Brunnsgatan. This store has approximately 700 sq.m. of retail space, and 300 sq.m. of storage space. This store receives most of its goods from 7:00 to 16:00, and bread before 9:00. Dagab delivers approximately 50% of the volume on Monday and Thursday, including dry goods and frozen goods. Another 50% is delivered directly from producers to the store, such as bread, dairy, beverages, ice cream, and newspapers. There are numerous of producers, including Pågens, Shogaholms, Dahls, Arla, Carslberg, and Spendrups, etc. Delivery times of different goods are different. For example, dairy, vegetable, and bread are delivered six, five, and seven times per week, respectively.

5.2 Transport carriers

After I described the four different retail stores, I will present the five companies, which deliver foods to these retail stores. I start the following section by describing the main transport carrier for Axfood's stores, Dagab.

Dagab[27]

Dagab's business concept is to convey goods and information between retailers and suppliers on commercial terms.

[27] Some information of the following part is based on Axfood Annual Report 2002.

Dagab's operations are conducted from three major distribution centers: Borlänge, Jordlbro (outside Stockholm), and Backa (Gothenburg). Fresh product warehouses operate out of Jönköping, Kristianstad and Backa. The current organization is the product of several years work on efficiency improvement. In addition, during 2002, geographic distribution was initiated, entailing that stores always receive goods from the warehouse closest to them. About 170 stores have been affected by this change.

Dagab delivers approximately 60% of its volume to Axfood's wholly owned stores, mainly groceries, meat and processed meats, and some dairy products. Also, Dagab supplies large stores owned by collaborating grocers. Volume for Axfood-owned stores is being concentrated more and more to Dagab. Agreements have been reached with Scan, under which Dagab is taking over all meat and processed meat distribution to wholly owned stores within the Axfood Group.

From its roots as a traditional wholesaler, Dagab is undergoing a major transformation in order to become a more integrated sourcing system within the Axfood Group. Through the increase in the number of wholly owned stores the conditions are in place for an entirely new way of working and new routines. During the next three years a newly started project within Axfood will develop this newly integrated product sourcing system within the Group, with opportunities for substantial cost reduction and greater availability on store shelves.

Most of the savings will be made at stores through the adaptation of integrated supplier-wholesaler work processes. Examples include packing deliveries by category, delivering according to set time frames, simplifying ordering routines, and so on. The objective of all these initiatives is to optimize the work in the stores, which is the most time-consuming link in the entire chain from supplier to customer.

Arla[28]

Arla Foods is one of the world's leading and most innovative dairy companies. It trades in 120 countries worldwide, with production facilities in Denmark, the UK, Brazil, Saudi Arabia, Sweden, Poland and Norway. Established in the spring of 2000 through the merger between the Danish MD Foods and the Swedish Arla, Arla Foods is a co-operative owned by approx. 7,200 Swedish and 8,300 Danish milk producers.

Between them they supply 6.2 billion kg of milk to the Group, the equivalent of almost 80% of all milk production in Sweden and Denmark. Since Arla Foods also purchases approx. 0.9 billion kg of milk per year in the UK, this means that Arla Foods sources a total of 7.1 billion kg of milk, making the Group the largest dairy company in Europe. Through its network of subsidiaries in 22 countries, Arla Foods maintains a direct presence in key export markets.

[28] http://www.arlafoods.com

Arla Foods has an annual turnover of about 5.1 billion euro, half of which is accounted for by Sweden and Denmark, a third by other EU countries (with the UK as the most important followed by Germany) and the rest by markets outside the EU, i.e. the Middle East followed by Asia and America.

Arla Foods' objective is to be the consumers' and customers' preferred dairy. Arla Foods wishes to provide consumers with healthy, tasty, inspiring and valuable products made with the greatest consideration for the surrounding environment. Only in this way can Arla Foods meet consumer expectations for innovative dairy products produced in a way that inspires consumer confidence. Furthermore, Arla Foods constantly develops new products in keeping with consumers' requirements.

Arla Foods' aim is to be Europe's leading supplier of high-class dairy products to national and international retailers. Moreover, Arla Foods intends to maintain and develop its position as an innovative global supplier of added value, milk-based ingredients for leading food producers throughout the world.

Spendrups[29]

Spendrups Bryggeri AB is a subsidiary company to Spendrups Invest AB. It was founded in 1897. Based in Stockholm, Spendrups is Sweden's second-biggest national brewery. Product areas are beer, soft drinks, water, and wine. Its trademarks include Spendrups, Norrlands Guld, Mariestads, Loka Jaffa m.fl. and Heineken. As an independent family owned brewery, Spendrups combines strong traditions and new ideas. Today, Spendrups has 1,100 employees and a turnover of 1.8 billion kronor.

Pågens[30]

Pågen is the leading bakery company in Sweden. Ever since 1878, when the founders Anders and Matilda Påhlsson first opened a little bakery shop in Malmö, Pågen has had a passion for baking.

Today, Pågen employs some 1,600 people, and most of them work at bakeries in Malmö and Göteborg. The product range includes various kinds of bread, toasts, pastries and cookies. Pågen JätteFranska, Pågen Roast 'n Toast Vallmo, and Pågen Lingongrova are the 3 top-selling items on the Swedish bread market.

5,000 supermarkets and grocery stores in Sweden receive fresh bread every day through Pågen's 425 direct delivery distributors. Due to this Company's effective national distribution system, consumers all over Sweden can find fresh bread from

[29] http://www.waymaker.se
[30] http://www.pagen.com/

Pågen in their local supermarkets each day. This is becoming reality also for consumers in the Scandinavian neighbouring countries as Pågen now defines the entire Nordic Region as its home market.

Pågen is one of Sweden's leading food exporters. France, the United Kingdom and Belgium are the key export markets outside the Nordic region. In particular Krisprolls® - Original Swedish Toasts - has become popular in many countries, not the least in France where this well known brand is a regular source of "joie de vivre" for French consumers.

Scan[31]

Scan Foods has been producing meat products in Sweden for 75 years. The Scan brand name is one of the best known and respected brands in the Swedish food industry and is ultimately owned by the farmers who supply the meat products. Scan Foods is a part of the Swedish Meats Group, one of the biggest provision groups in Sweden and Northern Europe. Swedish Meats Group is owned by 4,5000 Swedish farmers.

Scan Foods in Sweden markets fresh Swedish meat cuts, frozen meat products and cooked meats to wholesalers, retailers, restaurants and the food service sector. Sales amount to around SEK 4,000 million and Scan Foods accounts for one third of all cut and cooked meat production in Sweden.

Being a part of Swedish Meats Group, Scan Foods has a great advantage: they have fully controlled over the production chain, from raw materials to finished products. Scan Foods works with selected farms so that all meat sold under the Scan brand name is produced safely and to the highest quality.

5.3 Current transportation situation and problems of carriers

Above I presented these retail stores and the five transport carriers. In the following section, I will introduce the current transport situation and problems of carriers when the five carriers deliver food to these stores. Here I only state the information gathered. Summary and analysis of the information will be provided in the next chapter.

5.3.1 Current transport situation

[31] http://secureshop.ebizz.co.uk/scan/about/team.asp

In chapter 4 I mentioned I made two sets of questionnaires for Dagab and producers, respectively. From the surveys, the current transport situation of these carriers is collected. First, the present situation of Dagab is introduced, then producers.

In this area, Dagab's operations are conducted from the two distribution centres: Backa and Ingemrjohansson. Since storage of meat needs controlled temperature, meat is only stored at Ingemrjohansson. About 1-2 trucks deliver meat to the six stores per day. There are around 40 trucks at Backs. Among these trucks, 2-3 trucks are responsible for delivery to this area each day. The main categories delivered consist of frozen foods, dry goods, grocery, cheese and butter. Some goods are combined for delivery, such as cheese and dry goods. Frozen foods and other foods are delivered separately. Dagab adopts the Routing Planning System to plan its route. Dagab does not set up partnerships with suppliers and other transport companies. However, a few external transport companies, GLC, Bilbeställning, and Danzas, work for it. Furthermore, Anders Agerberg, Logistics Manager at Dagab, told me they do not have enough trucks to deliver all the goods so that they have to buy a lot of trucks. Other information on delivery to the six stores is described in the following Figure 12.

Retail Store	**Location**	**Frequency (per week)**	**Time Windows (minutes)**	**Arriving Time (am)**	
				Frozen Goods	**Other Goods**
Hemköp	Nordstan	5	45	8	6-8
Billhälls	Hvitfeldtsplatsen	5	60	7-8	9-11 (*meat and cheese*) 11 (*grocery*)
Willys Hemma	Eklandagatan 57, Sten Sturegatan 34	3	45	11-13	14-17
Spar	Brunnsgatan 5, Vasagatan 30	3	120	9-12	10-12

Figure 12: Current transportation situation from Dagab to the six stores

Now we know Dagab's transportation situation. In the following Figure 13 I describe the four producers' transport situation.

Company	**Product**	**Characteristic of Product**	**Trucks (per time)**	**Frequency (per week)**	**Arriving time**
Arla	Milk	Heavy	1	7	7:00 (Mon.-Sat.) 12.00 (Sun.)
Spendrups	Beverages	Heavy	1	1	12:30
Pågen	Bread	Light	1	10	7:00
Scan	Meat	Light	1	3	10:30-12:00

Figure 13: Transport situation of each producer

From the table above, we can see that the four companies deliver four goods with different characteristics. Delivery quantities per time of the four goods are almost same. However, delivery frequency of milk and bread are higher than for beverages and meat, and the arrival time of milk and bread are earlier than for beverages and meat.

5.3.2 Current problems

While researching Axfood's carriers' transport problems, I not only consulted Axfood's carriers but also asked shop managers about current problems when they receive goods from carriers. Thus, I can understand the overall transport problems from the two different perspectives.

Moreover, I also consulted Lars Mossfeldt, Senior Researcher at Department of Urban Land Use and Transport Planning, Chalmers University of Technology. He has conducted some studies on urban freight transport for several years, and gave me some ideas on carriers' current problems such as the following:

- Congestion in the city centre
- Bad parking options when arriving at stores
- Backrooms of stores are incorrect height for receiving goods.
- When trucks from different carriers arrive at a store at the same time, they have to wait.

Now, let us have a look at the current transport problems as Axfood's carriers and retail stores believe them to be.

5.3.2.1 Problems from stores' perspective

When I asked shop managers of the four different retail stores, I found they face different problems while receiving goods. Below I described these problems, separately.

<u>Hemköp</u>

- Packaging is broken
- some goods are omitted to deliver

<u>Billhälls</u>

- Packaging is broken
- wrong goods are delivered
- sometimes carriers are late

Willys hemma

Due to its little storage space, different deliveries cannot arrive at the same time. Cold goods have to come first, then non-cold goods. No problems with producers because their freight volume is low.

Spar

On the one hand, they have no problems from small companies. Usually these small companies can adjust themselves to adapt to Spar's requirements. On the other hand, Spar has to adjust itself to adapt to Dagab.

The above-mentioned are existing problems when retail stores receive goods from carriers. Below I will state current problems that carriers are facing.

5.3.2.2 Problems from transport carriers' perspective

When I made surveys on different carriers, I found different carriers' problems are not same. In the following section I will introduce each carrier's problems, respectively. In chapter 6, I will analyze what factors result in these problems.

Dagab

- congestion in the city centre
- bad parking options when arriving at stores
- Some requirements and limitations for trucks at the city centre. For example, environmentally sound trucks less than 8 years old with a clean engine are required.
- Stores have incorrect heights for unloading in their backrooms so that Dagab has to use some trucks with less volume.

Arla

- late delivery
- some goods are omitted to deliver
- Packaging is broken
- wrong goods are delivered
- Wrong temperature for milk during transportation

Spendrups

- congestion in the city centre
- Bad parking options when arriving at stores
- Some requirements and limitations for trucks at the city centre

Pågens

Björn Zetterström, Regional Manager of Pågens, told me they have no any problem with any of stores in the city centre.

Scan

- some goods are omitted to deliver
- wrong temperature for meat during transportation

Scan's main problem: wrong temperature for meat during transportation, especially in the summer.

Above I simply stated information collected from interviews and surveys. In the next chapter, I will summarize and analyse this information.

6. Analysis

In this chapter, I will explain the necessity to improve carriers' efficiency, and introduce the process of solving Axfood's carriers' problems. Thereafter, I will analyze the empirical facts I have collected, and present the conclusions of my research on Axfood's carriers' current problems, as well as reasons resulting in these problems. Finally, some measures will be proposed to solve these problems so as to improve their transport efficiency.

6.1 The necessity to improve carriers' transport efficiency

In chapter 3, I mentioned that whether transport efficiency of carriers can be evaluated as "highly efficient", is determined by whether carriers can provide the best transport services for their customers with the lowest resource inputs. Receivers wish that carriers could satisfy their demands of accessibility, Just-In-Time, and reliability. However, freight carriers often face difficulty and do not provide best transport services due to reasons such as traffic congestion. Low-level services will generate the following five negative effects:

(a) Carriers' costs will be increased, resulting from low-level services such as inefficient use of trucks or broken packaging.
(b) Retailer's business will be affected if carriers deliver wrong goods or omit some goods.
(c) Inefficient use of human resource
(d) Retailer's dissatisfaction will weaken business relation so that retailer may change carrier.
(e) It will weaken carriers' competition and reputation.

It is, thus, clear that low transport efficiency has a serious impact on carriers. Consequently, it is necessary to improve carriers' transport efficiency so as to diminish these negative effects. Furthermore, high transport efficiency of carriers can reduce the occupation of resources and negative impacts on environment. At the same time, it can promote the economic development and land-use pattern of a city.

From the analysis above, we have known it is essential to improve carriers' transport efficiency. Because it is carriers' current problems that reduce their transport efficiency, the precondition of increasing efficiency is to solve those problems. Below I will explain how to solve current problems.

6.2 Process of solving Axfood's transport carriers' problems

Firstly, I would like to introduce the process of solving Axfood's transport carriers' problems, which consists of thirteen steps. (See *Figure 14*)

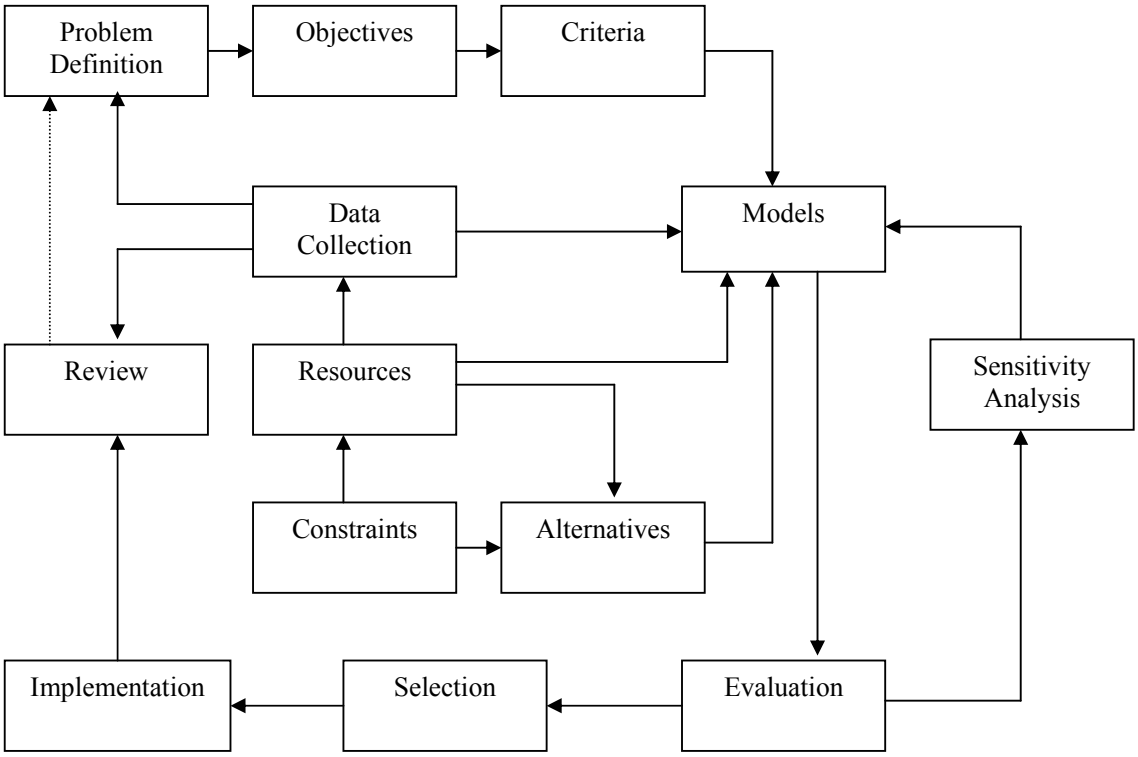


Figure 14: Process of solving Axfood's transport carriers' problems
Source: City Logistics: Network modelling and intelligent transport systems

During the process, *Objectives* are established to provide a direction relating to the outcome of the proposed scheme; *Criteria* measures effectiveness of solutions; *Resources* are the inputs of carriers and are usually financial, physical and human; *Constraints* may restrict the level of resources available or unacceptable outputs; *Alternatives* are the options having the potential to solve the problem; The performance of the existing system often requires an extensive number of surveys to be conducted. A range of *data* is often required to provide a rational basis for decision-making; *Models* are used to provide a simplified representation of urban freight systems. Computer based procedures based on mathematical relationships are typically used to predict the performance of schemes; *Evaluation* involves the methodical comparison of the alternatives, based on economic, social, financial, energy consumption and environmental grounds. The predicted consequences for each alternative are compared; *Sensitivity analysis* involves investigating the variability of the predicted effects of the alternatives; After evaluation, an alternative is selected by someone having the power and jurisdiction to make decisions; *Implementing* the selected scheme often involves a range of tasks that have to be managed; After implementing the selected scheme it is necessary to check how it is performing. It is

particularly important to determine if the initial problem has been solved and whether or not the objectives have been attained.[32]

The process initially focuses on defining the problem, then specifying objectives and determining criteria. The next stage involves consideration of any constraints and available resources that allows the range of alternatives to be generated and an appropriate level of data collection and modelling to be determined. Models have a central role within the process. They are used to predict the performance of the alternatives. Here, estimates of future demand, supply and impacts are produced. The sensitivity of these effects to any assumptions should next be investigated. Alternatives are then evaluated on the basis of their consequences. The selection procedure determines which alternative is chosen for implementation. After implementation the chosen alternative its performance is reviewed. This feedback link involves checking whether the initial problem has been solved and objectives attained. If the initial problem has not been solved it may need to be redefined or the original objectives modified. In either case, the process continues until the initial problem has been solved and objectives achieved. [33]

Above I explained every step of the process, and relationship among steps. Since the whole process needs a thorough and large number of studies, the limitation of time, funds, and other conditions, this thesis will only analyse and discuss four steps of the process, including *Problem Definition, Objectives, Data Collection, and Alternatives.* In previous chapters, I stated the purpose (*Objectives)* and carriers' current problems, and analysed the performance of the existing transport system *(Data Collection)*. Next I will summarize the current problems (*Problem Definition)* and give some advice on solutions *(Alternatives)*.

6.3 Summary of Axfood's carriers' current problems and reasons resulting in current problems

In chapter 5, I stated Axfood's carriers' current transport problems from various perspectives. I summarize these problems and list them as follow:

1. Late delivery
2. Packaging is broken so that contents could fall out.
3. Some goods are omitted to deliver.
4. Wrong goods are delivered.
5. Bad parking options when arriving at stores
6. Unsuitable temperature for goods during transportation

[32] Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*
[33] Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*

7. Backrooms of stores have incorrect height for receiving goods.
8. High cost resulting from some requirements and limitations for trucks
9. When trucks from different carriers arrive at a store at the same time, they have to wait.

In order to find solutions to the problems above, we should first know what causes these problems. The following is an analysis of possible reasons for each problem:

Problem 1: Late delivery
· Traffic congestion results in delay.
· Unreasonable routes arrangement
· Some personal factors of truck drivers
· Bad communication between drivers and the control centre
· Accidents during transportation

Problem 2: Broken packaging
Packaging mentioned here refers to bottles filled with milk or beverages. Possible reasons resulting in their breakage are the following:
· Wrong procedure during unloading so that packags could fall
· Hits during transportation so that the packaging could fall
· Low quality of packaging

Problem 3 and 4: Incorrect goods delivered
· Bad communication between carrier and retailer
· Bad communication between dispatchers and drivers
· Some personal factors of truck drivers

Problem 5: Bad parking options when arriving at stores
· Unsuitable design of parking areas
· Lack of space for parking when planning a store

Problem 6: Unsuitable temperature for goods during transportation
Some foods require a suitable temperature to stay fresh, such as meat and milk. If the temperature increases, food is destroyed or freshness is destroyed. Hence, a suitable temperature is important. A few factors will cause unsuitable temperatures:
· No advanced technology for keeping a suitable temperature during transportation
· If the door of a truck is open for unloading for a long time, it is not easy to keep the temperature right during the warmer season.
· Some personal factors of truck drivers

Problem 7: Incorrect heights for receiving goods in the backrooms of stores
· Unreasonable design of platform for receiving goods

· Some old buildings are adopted to be stores. Since these old buildings were not planned to be stores from the beginning, it is impossible to change the building-construction.

Problem 8: High cost because of some requirements and limitations for trucks

· Environmentally sound trucks are required to run in the city centre. They should have a clean engine, and are less than 8 years old.

· Since some stores have incorrect heights to receive goods in their backrooms, trucks with less volume are used in order to adapt to heights. This leads to smaller loads and more frequent delivery.

Problem 9: Queues of trucks waiting to unload goods to stores

Transport carriers are requested to arrive at customers within a designated time period set up by shop owners based on labor costs (resource allocation) and on customer needs. Trucks often have to wait near the location of customers when they arrive earlier than the designated time, or different trucks arrive at stores at the same time.

The above-mentioned is a detailed analysis of the reasons for each problem. We can summarize these reasons in the following categories:

- Transport planning, technology and management of carriers
- Some factors resulting from retail stores
- Cooperation between carriers and retailer
- Some factors from City Administration

Now, we clearly know the current problems and the reasons for these problems. Thus, we can understand how to solve these problems. In the next section I will provide solutions.

6.4 Solutions to the current problems of Axfood's carriers

Before I supply solutions for Axfood's carriers, I would first like to introduce existing measures that could improve carriers' transport efficiency. We will find some of these measures can solve Axfood's carriers' problems.

6.4.1 Existing measures to improve carriers' transport efficiency[34]

To gain an overview of the available measures, it is useful to summarize them in a catalogue. Frequently used is the following classification system:

• Organizational measures

[34] The following part is based on information from Susanne StrauB, *City Logistics-An Instrument to Decrease Urban Freight Traffic.*

- Administrative measures
- Location theory
- Road design
- Measures aimed at the industry

Organizational measures do directly influence the transport chain or transport process. They are the introduction of freight distribution centers, city terminals, information technology for vehicle routing and hazardous goods. City Logistics belongs to these measures.

Administrative measures deal with municipal commands and prohibitions. The most frequently used instruments are temporal and spatial restrictions and speed limits. A dedicated road network for trucks and the access to bus lanes for trucks are possibilities.

Location theory aims at the attraction and relocation of industry and commerce to certain areas that should be linked to the transport industry. The steering instruments are local land use codes and planning regulations. In the long run the separation of urban functions should be decreased and integration should be the aim.

Road design is often connected to an adapted road layout that becomes possible with a redesign of streets. Disturbances arising from road freight traffic shall be reduced and loading and delivery processes be eased. Restrictive measures are narrower cross sections, traffic reduced spaces or even pedestrian malls. A promoting measure is the introduction of loading areas.

Measures aimed at the industry shall improve the organization of their transport planning. They include measures of preparation and performance of the transport, communication between companies and vehicles or the delivery trucks themselves. Their base is mostly the introduction of expensive technologies, such as vehicle routing planning information technology or environmentally friendly, adapted city trucks.

Another important issue is which actor is responsible for implementing these measures. For urban freight transport the following actors are identified:

- Receivers
- Transport Carriers
- Senders
- Public administrations

6.4.2 Measures for Axfood's carriers

So far, we know the current problems of Axfood's carriers, the reasons for these problems, and present measures to solve carriers' problems. Thus, solutions can be identified to solve Axfood's carriers' problems. I will propose some solutions according to existing measures mentioned above. These alternatives below are only some ideas, actions points, or directions. Detailed measures and actions will need more intensive investigation.

6.4.2.1 Organizational measures

In chapter 3, I mentioned five initiatives of City Logistics, which belongs to organizational measures. They are: Advanced Information Systems, Co-operative Freight Transport Systems, Public Logistics Terminals, Load Factor Controls, and Underground Freight Transport Systems. Except Load Factor Controls, another four measures are helpful to solve the problems of Axfood's carriers. In the following Figure 15, I described ***what*** problems could be solved by the four measures:

Measures	**Problems**
Advanced Information Systems	Problem 1
Co-operative Freight Transport Systems	Problem 8 and 9
Public Logistics Terminals	Problem 8 and 9
Underground Freight Transport Systems	Problem 1

Figure 15: Appropriate measures for problems of Axfood's carriers

Here I would like to explain ***why*** the four measures could solve the three problems. The first problem is carriers' late delivery. In order to resolve this problem, we must solve the factors that cause it. In chapter 3, I described functions of *Advanced Information Systems* and *Underground Freight Transport Systems*. In the following Figure 16, I listed these functions, as well as the reasons resulting in late delivery. From this Figure, we can find the functions of the two systems correspond to solve these factors. Therefore, we can say the two systems are helpful to realize Just-In-Time delivery.

Reasons Resulting in Late Delivery	Functions of Advanced Information Systems	Functions of Underground Freight Transport Systems
1. Traffic congestion	To provide real time information on traffic conditions so that drivers could avoid congestion	Reduce traffic congestion
2. Unreasonable routes arrangement	A company can adopt the systems to store and analyze detailed historical pickup/delivery truck operations data so as to arrange more suitable routes.	
3. Some personal factors of truck drivers		
4. Communication between drivers and the control centre	To allow and improve communication between drivers and the control centre	
5. Accidents during transportation		

Figure 16: Functions of the two systems and factors resulting in late

The eighth problem is high cost due to some requirements and limitations for trucks. Environmentally sound trucks are required in the city centre, and smaller loads and more frequent delivery are needed. According to the logistics Manager of Dagab, Dagab doesn't have enough trucks to deliver all goods so that they have to buy a lot of trucks. All of these factors increase the carriers' cost. One solution is to reduce trucks to be used for delivering goods. In chapter 3, I mentioned Co-operative Freight Transport Systems and Public Logistics Terminals could lead to fewer vehicles and deliveries, and better vehicle capacity utilization, and, thus could substantially reduce costs. Meanwhile, since the two systems decrease utilization of trucks, queues of trucks waiting to unload goods to stores could be reduced. Consequently, the ninth problem is also resolved.

So far, we know what measures could solve these problems, and why these measures can solve them. Below I will describe ***how*** to implement these measures one by one.

Advanced Information Systems[35]

[35] Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*

Here I will introduce some advanced information technology that can be used to help to improve efficiency.

ITS have been already developed to automatically collect vehicle travel times (Kurosaki *et al*, 1993). Technology incorporating vehicle license plate recognition using image processing techniques has also been developed to collect and predict vehicle travel times in real time (Takahashi *et al*, 1996)

Multiple electro-magnetic loop sensors imbedded within the road pavement can be used to automatically classify trucks into standard configurations based on length and number of axles (Vincent, 1986).

Real time vehicle location or position data allows the dynamic assignment of jobs as well as customers to be advised on the current location of their goods and updated arrival times. There are several methods that can be used to automatically collect travel time information for trucks, including using specialized equipment within vehicles, such as Global Positioning Systems (GPS) or electronic tags. GPS is an object tracking system developed by the US Department of Defence. It is satellite based and available world wide, at all times and at a low cost. It is widely used in many areas of transportation, including aviation and shipping. GPS allow the dynamic location of a vehicle to be determined using satellite technology. The co-ordinates of the location of a vehicle are provided in real time. Other alternative methods of Automatic Vehicle Location (AVL) include roadside beacons, specialized mobile radio towers and geo-synchronous satellite networks for both communication and tracking purposes.

In-vehicle computer systems have a number of benefits for commercial vehicle operators and have potential for being an effective tool for City Logistics (Hellaker, 1996; Suzuki, 1999). They can automate many of the administrative tasks undertaken by drivers, leading to increased efficiency. In-vehicle computer systems can calculate fees, monitor performance and generate reports. Processing of documentation and invoicing can also be done. In vehicle computers can automatically log information relating to vehicle and driver performance, including, monitoring operational efficiency fuel consumption, vehicle speeds, drivers work time, feedback into maintenance and scheduling systems. They can aid the efficiency of vehicle control and goods by monitoring waiting times for customers and depots for loading/unloading goods. Navigational systems can be used to predict arrival times. In-vehicle navigation systems have a number of benefits, including savings in time and costs, reduction in driver workload, more reliable scheduling and simpler co-ordination.

Geographic Information Systems (GIS) are computer-based procedures for storing, manipulating and mapping spatial data. Attributes of spatial objects (e.g. streets) can be stored in a common database. Various tools allow analysis to be undertaken of spatial networks. GIS provides a framework for integrating traffic networks and performance data, allowing a realistic representation of the traffic network to be constructed. Road network information (e.g. turn restrictions, clearways, parking, speed limits, designated routes, number of lanes and gradients) can be managed within a GIS and integrated with models. GIS provides an integrated spatial referencing system that has potential to perform many of the tasks required to successfully operate a Computerized Vehicle Routing and Scheduling (CVRS) system (Calogero, 1994; Keenan, 1998).

Above I presented some advanced information technology and their functions. Axfood's carriers can adopt some or all of them to improve their efficiency according to their own capital, conditions, and necessity.

Co-operative Freight Transport Systems

Since the City Administration has more power than private associations and initiatives initiated by them can lead to real improvements, they play an important role in the coordinated distribution, and discussions concerning the subject can be arranged by the City Administration acting as a mediator. The transport carriers are very interested in this system because it can bring them many benefits such as fixed capital reduction resulting from cooperation to jointly purchase delivery vehicles. The shop owner may be not interested in it, however.

In order to reach an agreement on a coordinated distribution, first, it is necessary to survey the current pattern of deliveries in a city center, and decide if it is feasible to unload at an edge-of-town depot for onward delivery in smaller vehicles at early times. Second, the local administration and the transport carriers should select suitable goods and geographical area. Third, the local administration should try to negotiate and organize discussions with the actors concerning the coordinated distribution, try to make individual actors find benefits from the coordinated distribution for themselves. Fourth, it is necessary to specify responsibilities of different actors in distributions. Meanwhile, a control policy, such as licenses for city distribution, can be applied to create pre-conditions for coordinated distribution. Finally, an agreement can be reached as to when individual actors would like to join the coordinated distribution.

Public Logistics Terminals[36]

[36] Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*

Since Public logistics terminals are required to satisfy node functions and to make node functions and link functions interact with each other, the location and/or relocation of logistics terminals should be incorporated into re-established urban logistics systems.

Moreover, the concept of public logistics terminals needs more intensive investigation in several areas, such as their function, size, location, management as well as the role of the public sector. The location of logistics terminals is influenced by their *size*. Often regression models have been used to determine the size of logistics terminals within urban areas. It must be recognized that these models may be good for calculating the required size of logistics terminals of a company because they can easily represent the relationship between the required facility size of a logistics terminal and the amount of goods handled within it. However, they cannot represent the overall impact on urban logistics systems, especially on traffic conditions on the road network. Thus, the behavior of freight vehicles within and outside logistics terminals should be incorporated into optimal size models of logistics terminals when modeling City Logistics schemes; optimal *location* of logistics terminals can be considered within the framework of facility location problems[37]. Since the aim of constructing logistics terminal in terms of City Logistics is to help establish more efficient urban logistics systems, traffic conditions on the road network in a study area play a key role in assessing establishing such logistics systems. Traffic assignment techniques, which are usually applied within the field of Traffic Engineering, will be incorporated into the optimal location model of logistics terminals.

Considering the purpose of City Logistics schemes, the effect of constructing logistics terminals should be evaluated using a variety of performance measures, such as transportation costs, traffic congestion and environmental impact. Such public logistics terminals are multi-company distribution centers and also complex facilities with multiple functions involving advanced information systems, which can facilitate the implementation of co-operative freight transport systems. Hence, public logistics terminals need major investment, cooperation among a group of companies, as well as support of national, prefecture and municipal governments.

Underground Freight Transport Systems[38]

The feasibility of these projects will be examined for logistical aspects, technical specifications of infrastructure and means of transport, financial aspects, and environmental conditions. To give an idea of some of the critical design issues:

- Layout of the network

[37] Theories about facility location problems are introduced in chapter 3.
[38] Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*

Which kind of layout can serve most locations? What kind of traffic control system do we need at the junctions in the network under all kinds of circumstances?

- Tubes

What are the influences of gradients in the performance of the system? Should the tube be used for one-way traffic or two-way traffic? What should the diameter of the tube be?

- Energy supply

What is the influence of power supply systems, such as wire conduction, or loadable batteries with power loading stations on the layout of the system?

- Terminals

How many terminals should be available in the system to meet customers' requirements? What should be the layout of terminal in terms of docking stations, driving lines and parking facilities?

- Vehicles

What are the relationships between the physical characteristics (like speed, acceleration, braking distance, sizes, and loading capacity) and the requirements derived from the infrastructure (e.g. safety and guidance)?

- Dock stations

What is the influence of top, rear, one-sided or two-sided loading?

- Freight flows

Can we define the maximum handling capacity of these systems? Can the system facilitate loads?

- Disturbances and recovery

What are the effects of physical disturbances (for instance a defective vehicle in a tube)? How can the system be reactivated again?

To answer these types of design questions it is very useful to use simulation modeling as a technique. Most design issues are interrelated and therefore simulation can deal with these dynamic characteristics. For setting up dynamically several simulation experiments the simulation approach is based on the development of a library of components (objects). As a consequence of this approach all kind of configurations can be built and evaluated quickly. The chosen language is SIMPLE ++, an object-oriented simulation language allowing hierarchical building blocks (Aesop, 1997). However, there are still a lot more questions concerning underground distribution networks that cannot be resolved using simulation modeling, including:

Is it public infrastructure? Should the company be responsible for the total freight transportation or are other transport agencies also allowed to use the network? Should it be regulated to access to the network by the municipality? Should an access place to the network be accompanied by a city distribution center? How about legal regulations – existing laws are mainly specified until 20 meters below the surface? Should the government provide subsidies for underground technology?

These questions above should be brought into the discussion on the implementation of Underground Freight Transport Systems.

6.4.2.2 Administrative measures

Sometimes, some of Axfood's carriers are late when they arrive at stores. One of the reasons results from traffic congestion. Pågens told me they do not have this problem because they usually deliver bread very early and arrive at stores at 7:00. But, according to the carriers' current situation mentioned above, we find some carriers arrive at stores at noon or later. During rush hour, carriers meet traffic congestion making them late. One option is to adopt administrative measures to reduce congestion.

Administrative measures handle municipal commands and prohibitions. The City Administration can make rules that can lead to a better flow of the traffic and to a more coordinated delivery system. Since the authorities have more power than private associations, initiatives undertaken by them can lead to real improvements. In the following section, I will present some administrative measures that can reduce traffic congestion.

The most frequently used instruments are temporal and spatial restrictions and speed limits. Some measures for temporal restrictions of road freight traffic are:

- Equalization of deliveries periods
- Restriction for deliveries periods
- Temporal restriction of roads
- Temporal restriction for trucks
- Temporal speed limits
- Regulation of periods for hazardous goods traffic

Some measures for spatial restrictions of road freight traffic are:

- Hierarchical road network for freight traffic
- Decentralization of freight activities
- Conversion into one-way streets
- Prohibition of through traffic
- Access restriction
- Routing for hazardous goods traffic

A dedicated road network for trucks and the access to bus lanes for trucks are possible. Good planning for road repair work so that the same road section need not to be repeatedly dug up. This also helps to reduce traffic congestion.

To give out permission cards to enter the city centre would be a way to reduce the traffic amount. Only a few permission cards would be handed out and given to a central authority who could decide who can get a permission card.

A good idea would be to implement a kind of an intersection control, which improves the capacity at junctions, and is based on allocation of safe and efficient priorities to different road user categories. Another possibility is to have a road control system that controls speed limits and gives direction recommendations.

Other options available to city planners would be to allow certain deliveries to be made during the night. This would relieve some of the daytime traffic, but strict controls would have to be imposed so that local residents were not disturbed – perhaps new generation hybrid trucks that use electric power in town could be used.

Furthermore, some other measures that can influence road freight traffic include:

- Better traffic accident management
- Permission for loading/unloading in certain zones of the road
- Promotions of storage areas in city centres
- Hazardous goods information technology
- Promotion of businesses less dependent on road freight traffic

Above I discussed how to use administrative measures to reduce traffic congestion. Here, I want to mention the administrative measures can also improve problem 5, bad parking options when carriers arrive at stores. The City Administration can introduce the Parking Permit System. For example, private cars are restricted from parking in some areas during weekdays between 8:00 and 16:00. This will solve the problem of cars that block the way to delivery areas, but will at the same time, still let the inhabitants of the area keep their cars on the street during the nights and weekends.

In order to reduce delays and improve parking problems, above I gave many suggestions. They can be regarded as a reference for the authorities in Gothenburg to make their administrative decisions.

6.4.2.3 Road design

Unreasonable road design will result in traffic congestion, one of reasons that cause delays for carriers. The following Figure 17 describes how road design causes truck disturbances.

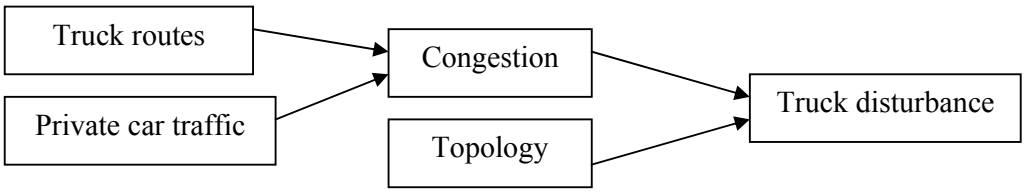


Figure 17: Factors resulting in truck disturbance

In order to reduce congestion, one option is to make a good road design. Road design is connected to an adapted road layout that becomes possible with redesign the streets.[39] An adapted road layout is able to reduce disturbances arising from road freight traffic and ease the loading and delivery process, and thus help to resolve problem 1.

In order to reduce congestion, some measures on road design can be adopted as follow:

- Narrower cross sections
- Suitable pavement width adapted to dimensions of delivery trucks
- Traffic calmed spaces or even pedestrian malls
- The introduction of loading areas
- Widen vehicle lanes
- Suitable designs of interchange layouts, temporary detours, and auxiliary lanes
- The introduction of direct freeway-to-freeway connectors
- The introduction of high-occupancy vehicle lanes
- The introduction of pedestrian bridges, and crosswalks to encourage pedestrians to use them
- Suitable designs of lanes for buses stop and through traffic escape from the bus lanes

6.4.2.4 Measures aimed at the industry

Let us review the factors that cause Axfood's carriers' problems. We find some of them result from the organizations themselves. We must make some steps to improve organizations for resolving current problems. In order to find solutions, firstly, I summarized the related factors in the following classification system:

1. Management problems of carriers

- Personnel management
  - Personal factors of truck drivers lead to some problems
  - Bad information communication between dispatchers and drivers due to personal factors
- Security management

[39] Susanne StrauB, *City Logistics-An Instrument to Decrease Urban Freight Traffic.*

- Accidents during transportation

2. Unreasonable transport planning
- Unsuitable routes arrangement

3. Technical problems
- Wrong information communication between dispatchers and drivers resulting from information systems
- Low quality of packaging
- No advanced technology for keeping a suitable temperature during transportation
- Unreasonable routes arrangement due to technical problems

4. Cooperation between carrier and retailer
- Wrong information communication between carrier and retailer

5. Retailer's factors
- Transport carriers are requested to arrive at customers within a designated time period set up by retailers.
- Unsuitable height of platforms for receiving goods
- Unsuitable design of parking areas

The classification system above can help us to find solutions. This system involves many factors. It is these factors that lead to problem 1, 2, 3, 4, 5, 6, 7 and 9. Some solutions could be found according to this classification system. Since carriers implement some measures and a retailer carry out some, below I propose solutions from the two actors' positions, respectively.

Transport Carriers
- Improve truck drivers' expertise and skills
- Improve communication between companies and vehicles or the delivery trucks themselves
- Better accident management so that carriers could deal with incidents immediately and rearrange other trucks to deliver goods
- Better transport planning
- Adopt more advanced technologies such as in-vehicle computer systems, high quality packaging with shockproof design, special design for keeping suitable temperatures during transportation, and vehicle route planning information technology
- Build up close cooperation with retailers, and reduce bad information communication

Retailer

- It is suggested that retailers should enlarge time windows, and prevent deliveries being carried out at the same time.
- In order to improve efficiency of unloading, potential solutions are reconstruction of platform for receiving goods, or the introduction of unloading instruments with special design.
- Reconstruct the old parking areas, or acquire additional parking spaces from the streets with the support of the City Administration

6.4.2.5 Summary of solutions

As mentioned above, Axfood's carriers have the following problems:

1. Late delivery
2. Packaging of goods is broken so that contents could fall out.
3. Some goods are omitted to deliver.
4. Wrong goods are delivered.
5. Bad parking options when arriving at stores
6. Unsuitable temperature for goods during transportation
7. Backrooms of stores have incorrect heights for receiving goods.
8. High cost because of some requirements and limitations for trucks
9. When trucks from different carriers arrive at a store at the same time, they have to wait.

Through my theoretical studies and analysis, I have found some ways to resolve the nine problems so as to improve Axfood's carriers' transport efficiency. In the following table, I make a summary on each problem's solutions.

Problems	Solutions
Problem 1	Organizational measures Administrative measures Road design Measures aimed at the industry
Problem 2	Measures aimed at the industry
Problem 3	Measures aimed at the industry
Problem 4	Measures aimed at the industry
Problem 5	Administrative measures Measures aimed at the industry
Problem 6	Measures aimed at the industry
Problem 7	Measures aimed at the industry
Problem 8	Organizational measures
Problem 9	Organizational measures Measures aimed at the industry

Figure 18: Solutions of Axfood's carriers' current problems

Furthermore, from Figure 18 we find that most of problems come from the organizations themselves. Consequently, it is very important and necessary to improve the organizations themselves in order to improve carriers' transport efficiency.

The measures I proposed above are only some ideas, directions, and action points, and are not very precise or detailed. More detailed directions to improve Axfood's carriers' transport efficiency will need in-depth research and thorough study.

7. Conclusions and recommendations

In this chapter, my goal is to draw conclusions and recommendations based on the findings from my theoretical study, empirical study and analysis.

7.1 Conclusions

Firstly, I will return to chapter 1, and tie together the problems and purpose of this report with the outcome of the study. Have I found answers to the main problem and sub-problems? Is the purpose fulfilled? The two questions will now be given answers.

In order to refresh our memory, I shall state the problems and the purpose of this report and, thereafter, state the conclusions I have been able to make.

Main Problem:
The need for improving transport efficiency of transport carriers of Axfood's retail stores in central Gothenburg.

Sub-problems:
1. What is urban freight transport?
2. What is a transport carrier?
3. What does the freight transport efficiency of transport carriers means?
4. Why it is necessary to improve the freight transport efficiency of transport carriers?
5. What are the current problems of transport carriers of Axfood's retail stores in central Gothenburg?
6. How can we improve transport efficiency of transport carriers of Axfood's retail stores in central Gothenburg?

Answers to sub-problems:
In chapter 3, *Theoretical study,* I discussed theories related to this subject. Some of these theories have provided answers and understanding on *Urban Freight Transport*, *Transport Carrier,* and *Freight Transport Efficiency of Transport Carriers.* Hence, the first three questions have been answered.

At the beginning of chapter 6, *Analysis*, I analyzed five negative effects generated by low level services of transport carriers during delivery to retail stores. Consequently, in order to reduce these negative effects, it is necessary to improve freight transport efficiency of carriers. Thus, the fourth sub-problem was answered.

In chapter 5*, Empirical study,* I noted carriers' current problems from the carriers' and retail stores' perspectives so that I could get an overview of the transport problems of carriers. Thereafter, I summarized these problems in chapter 6. Therefore, the fifth question has been answered.

Since current problems influence carriers' transport efficiency, the precondition of improving carries' transport efficiency is to resolve carriers' problems. In chapter 6, I made a detailed analysis of reasons that cause these problems and, thereafter, proposed solutions for these problems from the four aspects: organizational measures, administrative measures, road design, and measures aimed at the industry. Thus, the last sub-problem was resolved.

As was stated above, this thesis has provided answers to all of the sub-problems, and thus solves the main problem. Since I have been able to deal with all problems, I also have fulfilled the purpose of this study "*The overall aim of this thesis is to analyse the current transport problems of transport carriers of Axfood's retail stores in central Gothenburg, and find solutions to solve these problems so as to improve their transport efficiency"*.

So far, all problems were resolved, and the purpose of this thesis has been accomplished. Furthermore, I would like to make some suggestions in the following section.

7.2 Recommendations

In this section, I will make some recommendations as the conclusion of this thesis.

The first important issue that should be highlighted is the cooperation with another two actors, the City Administration and retailer, is very important for improving carriers' efficiency. If we review those solutions, we find some of those measures need substantial support from the authority, and some have to be implemented by retailers. This raises the question whether or not the two parties are interested in improving transport efficiency. High transport efficiency of carriers can result in high-level services, which are what a retailer needs, and it can also bring about economic benefits for a city and improve the urban environment, which is what the City Administration is concerned with. Therefore, retailer and the City Administration must be interested in an improvement of the current situation besides carriers themselves. We can say these measures have taken transport operations into an area of development that builds links and emphasises cooperation between all players and interest groups.

Secondly, it is significant to set up new partnerships and styles of cooperation between different carriers and in delivering/receiving goods in city centres. These

partnerships offer significant reductions in vehicle kilometres, the time spent by lorries in the city, total journey times and truck numbers. This can reduce the costs for all the companies involved, increasing the amount of work that can be done by each vehicle/driver combination, and improve the urban environment.[40] Setting up partnerships between different carriers is a complicated process, and needs the City Administration as a mediator to coordinate this delivery system.

Finally, I would like to make some suggestions for further studies as follow:

Identify the feasibility of these measures for Axfood's carriers

- Identify carriers' current resources, including financial, physical, and human resources
- Identify the incurring costs
- Consider any constraints that may restrict the level of resources available or unacceptable output. Often financial, legal, social or political issues limit the range of alternatives[41]:
  - Availability of specific resources required
  - Relevant regulations and standards
  - Potentially unacceptable side effects
  - Legislation and regulations relating to competition and privacy

Select the most suitable options

- Comparison of alternatives, based on financial, availability, energy consumption, environmental and social grounds
- Analyze and predict effects of alternatives
- Select the most suitable options; the processes, including tender selection, contract negotiation, and independent review, often characterize how the selection procedure is structured. The decision making process is often quite complex, with a number of actors all influencing each other. The relationships between shipper, carrier and receiver are difficult to generalize. Organizational structures and management styles vary considerably between companies, often making it challenging to identify decision makers.[42]

Implement the options selected

- What resistance will occur while carrying out the selected measures? How do you deal with the resistance?
- Implementing the selected options include a range of tasks that have to be managed. Often new operating and organizational procedures have to be established.

[40] http://europa.eu.int/comm/environment/trans/freight/booklet_en.pdf
[41] Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*
[42] Eiichi Taniguchi, Russell G Thompson, *City Logistics: Network modelling and intelligent transport systems*

Evaluation of the selected options

- Establish criteria and approaches to evaluate effects and effectiveness of the solutions; are there likewise negative effects associated with these measures?
- Have the initial problems been solved? Are the benefits greater than the costs after the implementation period?

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Appendix 1: Transportation Activities Questionnaire 1 (for Dagab)

QUESTIONNAIRE

Please answer the following questions and send back to: ann_ty@yahoo.com

Company name: _____
Your name: _____
Job title: _____

There are six retail stores, which are Axfood's wholly owned stores chains or franchise chains, in the city centre. The following are their names and addresses:

1. Hemköp (Nordstan)
2. Billhälls (Hvitfeldtsplatsen)
3. Spar (Vasagatan 30)
4. Spar (Brunnsgatan 5)
5. Willys Hemma (Sten Sturegatan 34)
6. Willys Hemma (Eklandagatan 57)

The following questions are about your company's current transportation activities for the six stores above.

- How many depots do you have in Gothenburg?

- How often do you deliver foods to each store per week?

- What time do your trucks usually arrive at the six stores above?

- What are time windows for each store?

- What technologies do you adopt for your transportation?

- How do you plan your transport routes?

- How many trucks deliver goods to the six stores? How do you organize these trucks for the six stores?

- How do you arrange your trucks to deliver different kinds of goods?

- What companies do you set up partnership with to deliver goods?

- What problems do you have when you deliver goods to the six stores? Please read the following problems and choose answers representing your company's problems here _____

1. Late delivery
2. Some goods are omitted to deliver.
3. Packaging of some goods is broken.
4. Wrong goods are delivered
5. Unsuitable temperature for goods during transportation
6. Bad traffic in the city centre
7. Bad parking options when arriving at stores
8. Some requirements and limitations for trucks at the city centre
9. High transport cost
10. There are often some empty or half empty trucks running
11. There are not enough trucks to deliver goods
12. Backrooms of stores have incorrect heights for receiving goods.
13. If your company has other problems, please write them down here: _____

- What are your company's main problems? Can you describe them in details?

- What causes these problems? Do you think about how to solve them?

Appendix 2: Transportation Activities Questionnaire 2 (for Arla, Spendrups, Pågens, Scan)

QUESTIONNAIRE

This questionnaire is about your company's current transportation activities to XX store. Please answer the following questions and send back to: ann_ty@yahoo.com

Company name: _____
Your name: _____
Job title: _____

- How often do you deliver foods to the store per week?

- What time do your trucks usually arrive at the store?

- What technologies do you adopt for your transportation?

- How do you plan your transport routes?

- How many trucks deliver goods to the store each time?

- What companies do you set up partnerships with to deliver goods?

- What problems do you have when you deliver goods to the store? Please read the following problems and choose answers representing your company's problems here _____

1. Late delivery
2. Some goods are omitted to deliver.
3. Packaging of some goods is broken.
4. Wrong goods are delivered
5. Unsuitable temperature for goods during transportation
6. Bad traffic in the city centre
7. Bad parking options when arriving at stores
8. Some requirements and limitations for trucks at the city centre
9. High transport cost
10. There are often some empty or half empty trucks running
11. There are not enough trucks to deliver goods
12. Backrooms of stores have incorrect heights for receiving goods.
13. If your company has other problems, please write them down here: _____

- What are your company's main problems? Can you describe them in details?
- What causes these problems? Do you think about how to solve them?

Appendix 3: Interview Guide (Questions for retail stores)

1. Please tell me the classification of foods in your store.

2. How big is the retail space and storage space in your store?

3. What companies delivery foods to your store? What foods are delivered by different companies?

4. What companies are the main transport carriers?

5. How often are different foods delivered per week?

6. What period do you receive foods in each day?

7. How many trucks deliver goods to your stores each day?

8. What problems do you usually face when you receive foods from transport carriers? What are the main problems?

9. Do you think about what problems your transport carriers have during transportation? What are the main problems?

10. What measures can you propose to solve these problems?