

Incentives and means of control for long-term freight cooperation systems in urban areas

‘Decouple transportation work from traffic work’

- doing more with less -

A Thesis Work

by

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PREFACE

Transportation and infrastructure issues have been of interest to me all my life. Over the years I have had great deal of experience in the transportation business carried out in urban areas. I have seen and studied the positive effects of transportation but also the negative consequences it brings with it. During my extensive travels to different cities around the world it has occurred to me that the traffic situation is of crucial importance to both the efficiency of transportation to the pleasency of urban life. It has been a privilige to be able to gain deeper knowledge and a better understanding of the obstacles and possibilities at stake for the distribution of freight in urban areas.

For a long period of time I have been particularly interested in the development in what is usually refered to as coordinated freight distribution systems. That is why this thesis work was carried out with a great deal of optimism during the autumn and winter 2002/2003.

A few lines is not enough to express how thankful I am to the persons and organisations that have made this thesis work possible. Thousand thanks to Jakob Lagercrantz at the consultant company Ecoplan in Gothenburg, Anders Roth at the Traffic and Public Transport Authority in Gothenburg, and to my supervisor Lars Mossfeldt at the Department of City and Mobility at Chalmers University of Technology. Your theoretical and practical assistance and guidance have been indespensible and a source of inspiration to continue and complete this report.

A special thanks to AB Volvo, Department of society and environment, for all the resources that were made available for me at short notice. I would also like to take the opportunity to thank all other persons, in Sweden and Denmark, that have contributed with information, facts and ideas during the field work. I address my gratitude to the sponsors that have contributed with financial assistance for the completion of this report.

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SUMMARY

At Norra Älvstranden in Gothenburg there is a project going on in coordinated freight distribution concerning supplies of office material for the newly established companies there. During this introductory phase of the project, transport solutions have mainly consisted in reduced frequency of deliveries. With an expansion of the project it will be possible to develop other transport solutions, that are efficient and customer oriented, at the same time as being less environmentally disturbing.

The transportation of office material to the district of Norra Älvstranden is carried out by various transportation companies, wholesaler distributors, company owned cars, and privately owned cars. Apart from office material, the companies are getting deliveries with many other products as well. The distribution system can be said to be characterised by a high number of sub-optimisations where every distributor try to optimise their own vehicles in accordance to given conditions and customer demand. The optimisations done by every distributor on their own is not enough and a solution to the problem is needed. A growing demand of transportation work will have to be handled with less traffic work.

Main purpose of this study is to identify and analyse which incentives and means of control that needs to be used in order to get a sustainable freight cooperation in the long-term at Norra Älvstranden and furthermore to give recommendations to the city of Gothenburg in how to go ahead with the project.

The research carried out shows that to reduce the anticipated problems of congestion and accompanying resource use following increasing traffic work being carried out at Norra Älvstranden, a reloading terminal will have to be established at the entrance to the district. It is not possible to separate and optimise one product group from the others to get the desired results, the problem has to be handled in its entirety.

The incentives available today are not enough to bring about a change in the present distribution system. Stronger incentives have to be created were the market get to choose between compliance with the desirable development or getting increasing costs for non compliance. Using economical means of control seems to be the best way to make changes and accomplish efficiency when doing so. The provision of infrastructure has a crucial impact on the quality and effectiveness by which the transportation is performed.

The proposed solution incorporate a public/private partnership, where the public authorities provide the infrastructure needed while the market continue to handle operations, which is accompanied with means of control to create the incentives needed for the actors on the distribution market to form constellations for the establishment of a sustainable coordinated freight distribution.

As for office material, there are few incentives for the companies to reduce the frequency of ordering since the transport costs are included in the price of the products. To get any substantial change in ordering behaviour, the transport cost have to be separated from the product cost and made progressive according to the frequency of ordering or size of order. Only then can there be any long lasting results. The public authority can continue and intensify its work in trying to influence the businesses in this direction. It is also possible to widen the venture to cover also other product groups with the same objective of visualising the transport cost in order to make it negotiable.

TABLE OF CONTENTS

1	INTRODUCTION.....	3
1.1	BACKGROUND.....	3
1.2	PROBLEM AREA.....	4
1.3	PURPOSE.....	4
1.4	RESEARCH QUESTIONS.....	4
1.5	METHOD.....	5
1.6	LIMITATIONS.....	5
2	NORRA ÄLVSTRANDEN.....	6
2.1	DESCRIPTION OF THE GEOGRAPHICAL AREA.....	6
2.2	COORDINATED FREIGHT DISTRIBUTION AT NORRA ÄLVSTRANDEN.....	7
2.3	FREIGHT DELIVERIES TODAY.....	7
2.4	PROBLEM FIELD (THEORY).....	9
2.5	VIEWS FROM THE TRANSPORTATION SECTOR.....	11
2.6	AVAILABLE MEANS TO COPE WITH THE SITUATION.....	13
3	LITERATURE REVIEW.....	16
3.1	SUMMARY OF LITERATURE REVIEW.....	18
4	OTHER COORDINATED FREIGHT DISTRIBUTION PROJECTS.....	19
4.1	INTRODUCTION.....	19
4.2	BORLÄNGE.....	19
4.3	ÖREBRO AND KIRSEBERG.....	20
4.4	UPPSALA.....	21
4.5	LINNÉSTADEN.....	21
4.6	COPENHAGEN.....	22
4.7	COOP SWEDEN AB AND PRESSBYRÅN AB.....	22
4.8	HAMMARBY SJÖSTAD.....	24
4.9	SUMMARY.....	24
5	INTERVIEWS WITH CONSIGNORS AND CONSIGNEES.....	27
5.1	CONSIGNEE'S ACTIVITIES.....	27
5.2	COMMENTS AND SUMMARY.....	28
5.3	CONSIGNOR'S ACTIVITIES.....	29
5.4	COMMENTS AND SUMMARY.....	30
6	INCENTIVES AND MEANS OF CONTROL.....	32
6.1	INCENTIVES.....	32
6.1.1	<i>Introduction.....</i>	32
6.1.2	<i>Means of knowledge.....</i>	32
6.1.3	<i>Economical means.....</i>	32
6.1.4	<i>Administrative means.....</i>	33
6.1.5	<i>Increasing the service.....</i>	33
6.1.6	<i>Time-saving means.....</i>	34
6.1.7	<i>Information Technology.....</i>	34
6.1.8	<i>Infrastructure.....</i>	35
6.1.9	<i>Summary.....</i>	35

6.2	MEANS OF CONTROL	35
6.2.1	<i>Introduction</i>	35
6.2.2	<i>Economical</i>	36
6.2.3	<i>Examples of economical means of control</i>	36
6.2.4	<i>Administrative</i>	37
6.2.5	<i>Examples of administrative means of control</i>	37
6.2.6	<i>Juridical</i>	37
6.2.7	<i>Examples of juridical means of control</i>	38
6.2.8	<i>Infrastructure</i>	39
6.2.9	<i>Summary</i>	39
7	ANALYSIS	41
8	CHOICE OF SOLUTION FOR NORRA ÄLVSTRANDEN	43
9	CONSEQUENCE ANALYSIS	46
9.1	NORRA ÄLVSTRANDEN	46
9.2	THE TRANSPORT SECTOR.....	46
9.3	GÖTEBORG.....	48
10	CONCLUSION AND RECOMMENDATIONS.....	50
11	REFERENCES.....	51
12	APPENDICES.....	54

FIGURES

<i>Figure 1. Map of Norra Älvstranden.</i>	6
<i>Figure 2. Different distribution loops to supply a certain geographical area.</i>	8
<i>Figure 3. Present situation. Each distributor coordinates his own transports.</i>	8
<i>Figure 4. Typical distribution vehicle (redrawn from Lumsden, 1998).</i>	9
<i>Figure 5. Uncoordinated distributionsystem.</i>	10
<i>Figure 6. Coordinated freight distribution using a reloading point.</i>	12
<i>Figure 7. Sub-optimised transportation system using dedicated vehicle.</i>	14
<i>Figure 8. Coordinated freight distribution using a terminal.</i>	14
<i>Figure 9. Principle for restricted passage into the district.</i>	44
<i>Figure 10. Distribution with a reloading point en route.</i>	44
<i>Figure 11. Increasing size of a distribution vehicle.</i>	47
<i>Figure 12. Principle to render efficiency on a road.</i>	47
<i>Figure 13. Six modules on a full sized feeder truck is equivalent to six distribution vehicles.</i>	48
<i>Figure 14. Public transport system with trains, subway, and buses.</i>	49
<i>Figure 15. The different system layers needed in the distribution chain.</i>	49
<i>Table 1. Evaluation of the different projects investigated.</i>	26

1 Introduction

1.1 Background

Transportation is important for society and its economy. Access to a flexible, customer oriented transportmarket is a prerequisite for a competitive industry in growth. Distribution of goods within built up areas constitute a large part of the total transportation and traffic work carried out in the society. During the past years we have experienced a change in the industrial structure, towards more service oriented businesses, with smaller and more frequent deliveries as a result.

A continuously growing transportation demand in the cities and their surroundings has led to an increasingly alarming problem with congestion on the streets, emissions from the vehicles, disturbing noise and vibrations, as well as a non desirable development concerning resource use from the society's point of view. The distribution vehicles often have a low loading factor and constitute a risk for the safety on the streets. A more environmentally adapted distribution system is desirable if the city is to be the safe, healthy, and pleasant place its inhabitants wish to live in.

The long-term sustainability of society and its resource use is high up on the agenda today. Politicians and scientists talk about 'decoupling economic growth from material growth (growth in resource use)'. Future progress in development should aim at 'doing more with less'. For the transport sector this means 'decoupling transport work from traffic work'. A growing transport demand will have to be handled with less traffic work. Consequently, there is a need to use smarter and more efficient transportsolutions in the future.

Progress to render a more efficient distributionsystem is necessary to overcome, or at least mitigate, the problems mentioned above, in order to create city environments that are pleasant to live and work in. Coordinated freight distribution systems are currently under discussion in many parts of Sweden and elsewhere. A range of different projects have recently been tried out with various results. Some of the successful projects have been turned into continuous operation.

The city of Gothenburg is part of an EU funded project called TELLUS (Transport and environment alliance for urban sustainability), where six different cities cooperate in managing transportation issues. Gothenburg Traffic and Public Transport Authority has initiated a project, within the TELLUS framework, for a coordinated freight distribution system at Norra Älvstranden, a rapidly growing industrial area. The environmental manager needed accurate information and trustworthy recommendations on how to go ahead with the project to make it sustainable in the long-term.

1.2 Problem area

Heavy traffic is causing negative impact in urban areas. It contributes to:

1. Environmental pollution
2. Noise and vibrations
3. Congestion on the roads
4. Resource use (by its very nature)
5. Risks for safety in traffic

Everyday there are hundreds of heavy vehicles on the roads in and around Gothenburg, driving for different companies and distributing goods to different customers. There are seldom any coordination between the vehicles and their cargo. Although a coordination takes place to some degree, it is not enough to counteract the problems brought about. This lack of coordination leaves us with a lot of vehicles with a low loading factor on the roads, contributing to the above mentioned problems.

Transport is cheap, the manufacturers see quick and frequent deliveries as a competitive advantage. The incentives at stake are not sufficient enough for the companies to reduce their transportation work or their traffic work. The local authorities are trying to use different means of control to mitigate the problem, but so far with limited success.

1.3 Purpose

The main purpose is to identify and analyse which incentives and means of control that needs to be used in order to get a sustainable freight cooperation in the long-term at Norra Älvstranden. The attempt is to show the driving forces of the different stakeholders involved and how to use these to reach a desirable development.

Further more is the purpose to give recommendations to the city of Gothenburg in how to go ahead with the project in order to make the freight cooperation at Norra Älvstranden sustainable in a long-term perspective.

1.4 Research questions

A number of questions are needed in order to fulfill the purpose of the study. Similar questions posed to the different stakeholders involved are used to get a varied angle of approach, in order to get a more balanced picture of the conflicting interests. The questions are divided into one main question and a number of sub-questions.

Main question:

What incentives and means of control are needed at Norra Älvstranden to make the freight cooperation last in a long-term perspective?

Sub-questions:

What are the driving forces for the consignees?

What are the driving forces for the consignors?

What are the driving forces for the transportation companies?

1.5 Method

The report is based on inductive methodology, where the case was assumed and the data was collected in the literature, by experience and, most importantly, through fieldwork. The investigation was carried out unprejudicefully and the information gathered has played a decisive role for the conclusions and recommendations that the report has resulted in.

The work started with gathering all relevant literature on the subject and getting in touch with people that has knowledge or experience in coordinated freight distribution. This phase also included a study trip to Copenhagen, where the 'citygodssekretariatet' gave details about their ongoing work. Two local companies were visited and their experiences with the new arrangement were explained. The literature along with telephone interviews with a range of people involved in the coordination of freight distribution in Sweden gave me the full picture of the present status of knowledge in the subject. The intrinsic case study of conditions at Norra Älvstranden and the different stakeholders there could begin.

The method used during the field work was mainly semi-structured interviews with open ended answers, the questions asked were used as a basis for discussion. This information was supplemented with my own observations and previous experiences. Interviews were carried out with one person at the time as it was considered to be the best way to get as many different views as possible on the same subject. The interviews were prepared with a number of relevant questions that were transmitted to the person a day in advance (see appendices). This was done in order to present myself and my research study and to prepare him or her on what issues I wanted to discuss. The interviews got a semi-structural character which created a more open discussion in comparison to using a standardised questionnaire.

I began the interviews by explaining the purpose of the study and why I thought it was important to get their view on the subject. It was easy to get a good discussion when talking to consignors, consignees as well as representatives from the transportation sector. It seemed that most people had an interest in the subject and the future of transportation activities.

1.6 Limitations

Focus of the study is a geographical area in Gothenburg, today usually referred to as Norra Älvstranden. The study covers transportation of office supplies to the companies located there today and the ones moving there in a close future. It is the short distance transport by road vehicles within the greater Gothenburg area that is of interest here, long distance vehicles and fully loaded vehicles are outside the scope of this study. The intention is not to investigate all transportation, but only the freight distribution with a recipient in the studied area. Passenger transportation are therefore not covered.

2 Norra Älvstranden

2.1 Description of the geographical area

Norra Älvstranden is a district of Gothenburg, which belongs to the southern part of Hisingen island and covers an area of 250 hectares. It is located by the water, on the north side of Trollhättekanal, that cut through the city of Gothenburg. The area is demarcated to the west by Älvsborgsbron and to the east by Götaälvbron. In the north there are main roads and a railway that runs in an east-west direction to mark the demarcation.



Figure 1. Map of Norra Älvstranden (source: www.aktnet.se/fel/ 2000-09-23)

The district used to be dominated by the wharf industry, with a lot of wharf and harbour business for a period of more than a hundred years up until the mid-1970s. Following changes in the industrial structure nationally and internationally the wharf and harbour business experienced a continuous decline and had to be discontinued. Over the years the city of Gothenburg has been working on a strategy in how to vitalise the district again and having new and modern industries to establish there. The Information Technology (IT) industry was seen as the most promising business sector to make the district prosper again. A lot of efforts has been carried out in order to attract the new businesses to establish there, creating a cluster of IT-industry. An important step was taken with the creation and opening of a new IT-university.

The district presently host some 400 companies with approximately 20 000 people working there. There are also living quarters for another 5000 people mixed in the same area. These figures are planned to be doubled in the coming years before the district is fully grown, business and population wise. It is a logistical challenge for the city to cope with the transportation demands of such large number of people and goods that needs to go in and out of the district every day. A range of projects are taking place in order to find solutions to the transportation demands of modern city life and business, such as car-pooling, environmental vehicles, business owned bicycles, transport- and travel planning, and considerable efforts are carried out in public transport provision.

When planning Norra Älvstranden the intention has been to create an example of ‘the good city’; a city environment that mix different functions like work, living, education, trade, culture, research and recreation in a fruitful way, where all aspects

are considered and interacts. For this purpose a cooperation project called 'Vision Lundby' was established to facilitate research and development for future traffic- and transport solutions, which are less environmentally disturbing but still comply with demands on accessibility and safety. It is within the framework of 'Vision Lundby' a project on coordinated freight distribution is taking place. It has been planned by the city of Gothenburg, Traffic and Public Transport Authority, and started off in the autumn 2001.

2.2 Coordinated freight distribution at Norra Älvstranden

At Norra Älvstranden in Gothenburg there is a project going on in coordinated freight distribution concerning supplies of office material for the newly established companies there. The goal with the project is to reduce the number of transports of office material to customers at Norra Älvstranden by 30%. The project focus on the supply of office material since it is one of the major commodities used by the companies in the district. Office material is easy to store, easy to distribute, and easy to plan the demand in advance, which makes it particularly suitable for a coordinated freight distribution.

During this introductory phase of the project, transport solutions have mainly consisted in reduced frequency of deliveries. The concrete solutions are designed by the manufacturers (consignors) in cooperation with the customers (consignees). Some of the buyers in the testgroup have already reduced the number of deliveries of office material by up to 50 %. With an expansion of the project it will be possible to develop other transport solutions, that are efficient and customer oriented, at the same time as being less environmentally disturbing.

2.3 Freight deliveries today

The transportation of office material to the district of Norra Älvstranden is carried out by various transportation companies, wholesaler distributors, company owned cars, and privately owned cars. The major material flows of office material is being handled by professional transportation companies as part of their distribution loops, using medium sized trucks of conventional distribution model.

Minor flows are most often being handled by the same transportation companies in a parallel distribution chain for parcels, that are being conducted by smaller sized delivery vans. Added to these distribution structures are the wholesaler distributor vehicles, which are operated in much the same way and with similar sized vehicles. Some companies located at Norra Älvstranden are part of a group of companies located in different parts of the city, and therefore take care of their own distribution of office material using similar sized vehicles as mentioned above.

Lastly, there are a minor flow coming in to the district via privately owned vehicles, as the personnel stop by an office material shop on the way to work in the morning or passing by during lunch hours. All in all, apart from the last option, the office material are being transported to Norra Älvstranden as part of a distribution loop, where many

different companies get their supplies by the same vehicle. The distribution loop, as shown in figure 2, could be said to constitute a kind of coordination made by each distributor separately.

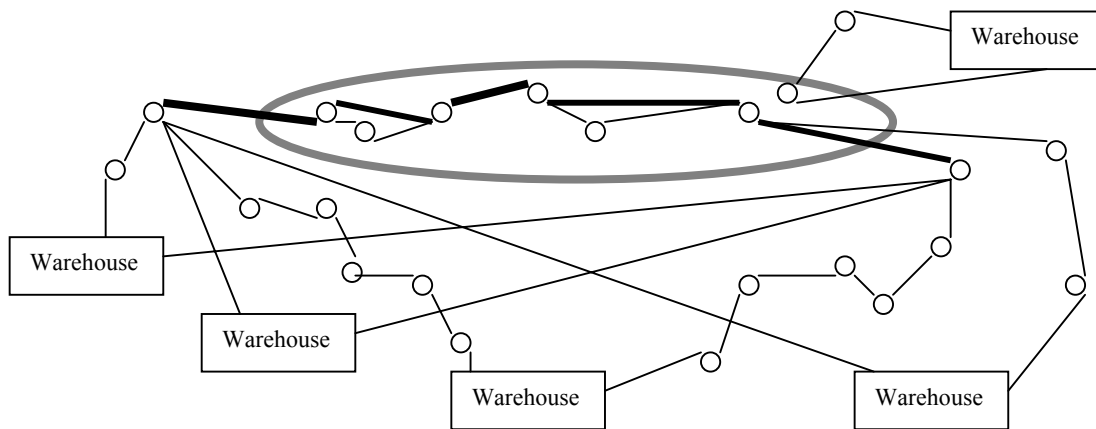


Figure 2. Different distribution loops to supply a certain geographical area.

These distribution loops are taking place in various frequency, in various speed, and at different times of the day and of the week. Most consignees wish to have the delivery during office hours to be able to receive and check the package as the driver is present. The distribution system can be said to be characterised by a high number of sub-optimisations where every distributor try to optimise their own vehicles in accordance to given conditions and customer demand. The result is a situation were each distributor has a long distance between each stop.

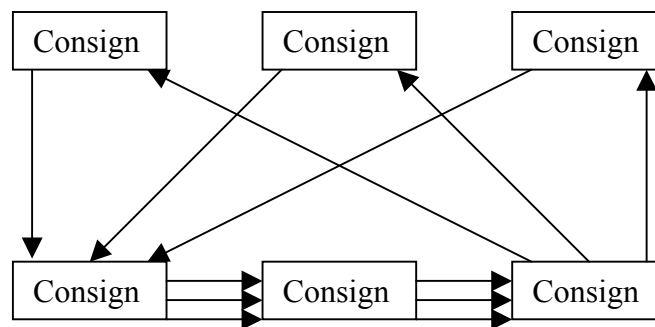


Figure 3. Present situation. Each distributor coordinates his own transports.

The sub-optimisation is further accentuated by each distributor by using many small vehicles instead of few big ones and using them at a similar time of the day, creating congestion at many of the delivery points. Size of the distribution vehicle is typically far smaller than the legal maximum limits concerning weight and size, since it is the number of stops the driver is able to do during the course of half a day (or a full day), that ultimately determines choice of size. Capacity on the distribution vehicles could increase as far as the space allows at the consignees, if the time for loading and unloading was reduced. The distribution vehicles usually have a greater amount of time standing still, for loading, unloading and handling, than actual driving time.

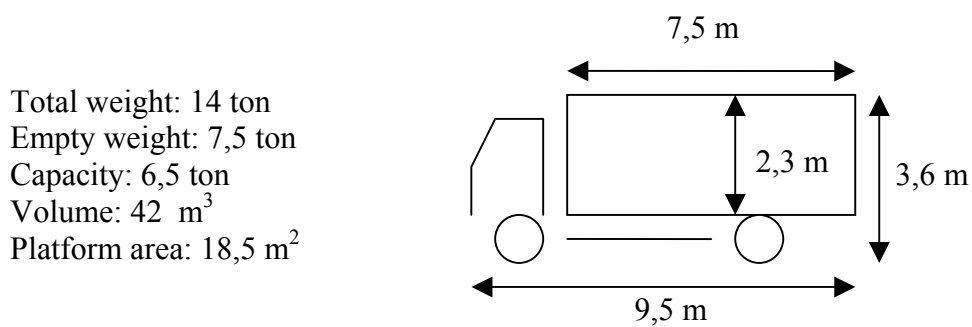


Figure 4. Typical distribution vehicle (redrawn from Lumsden, 1998).

Smaller parcels are normally being distributed by delivery vans, which typically have a total weight of 2,2 to 3,5 tons. They are quicker and smaller and thereby more smooth to handle in conditions of limited space. Delivery vans have already become a common sight within Norra Älvstranden and many of the companies are getting visits by these, several times a day. The delivery vans are being optimised in much the same way as the distribution trucks, where each operator optimise according to his own conditions.

It is feared, by the Traffic and Public Transport Authority, that this exceeding number of distribution vehicles will create a great deal of congestion on the roads within the Norra Älvstranden district and on the trunk roads leading there, in the future. The optimisations done by every distributor on their own is not enough and a solution to the problem is needed. A growing demand of transportation work will have to be handled with less traffic work. The solution have to incorporate the problems of congestion and resource use both within and outside the district of Norra Älvstranden.

2.4 Problem field (Theory)

An environmentally adapted freight distribution can be accomplished in various ways. So far focus has been mainly on a product level, where companies claim to actively work for a better environment by using modern vehicles with low emission engines and small noise generation. These measures can be seen in Gothenburg largely as a result of introducing an environmental zone with rules for the heavy traffic driving in the zone, alongside a growing costumer demand on low polluting transportation. By putting technical restrictions on the vehicles, the city, and the freight costumers, have been able to reduce emissions and noise to acceptable levels.

However, resource use and congestion are not dealt with by the environmental zone rules. Here, it is a matter of reducing the distance covered by each vehicle in the city and choice of vehicle size in order to reduce the number of vehicles used. Figure 5 show a distribution system without any coordination at all, with longest possible distance covered to meet costumer demand. Demands on frequency of deliveries and number of stops each vehicle manage to make during a workday are factors that put limitations on an optimum use of vehicles and infrastructure.

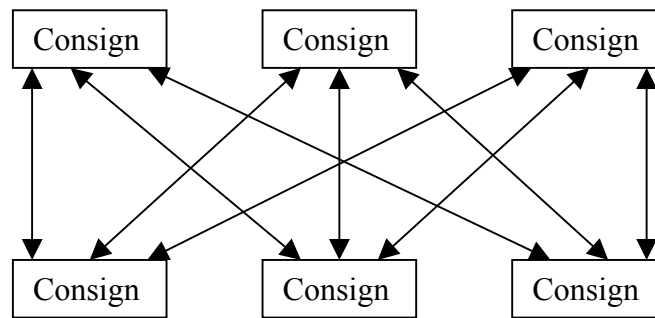


Figure 5. Uncoordinated distributionsystem.

To increase the efficiency of a transport it needs to be carried out with a minimum of traffic work per piece of freight. It is possible to perform present transportation work in the cities with a considerable reduction in traffic work. Efficient transportation in densely built up areas is achieved when they comply with the following criteria(Transportrådet, 1996):

- The transport is concentrated, so that the whole load is being turned over within a limited geographical area (a single receiver, a single street, a single neighbourhood). The ultimate solution is for each customer or each neighbourhood to be served by only one transport per day.
- The transport is carried out in large consignments with a high capacity utilisation of the vehicle and of the infrastructure, to reduce the number of vehicles used for each task.

An efficient freight distribution system to support a certain geographical area, can be accomplished using principally three different ways:

1. Full load – the transport is not being performed until there is a full load to carry from the consignor to the consignee.
2. Collecting – a designated vehicle is driving around collecting all products at various warehouses before delivering them at the consignee/consignees.
3. Reloading – different vehicles deliver their products to a certain place, where it is reloaded onto a fewer number of vehicles for further distribution.

This is already taking place in the transportation system to a certain extent but leads to sub-optimisations when each distributor optimises with regard to his own conditions. The interesting aspect out if a geographical point of view is at which level this is taking place and which environmental effects and congestion effects it brings about. To develop an efficient transportation system which is optimised as a whole, there is a need to raise ones vision, away from the sub-optimisations of each part of its own, to look at the system from a holistic point of view.

2.5 Views from the transportation sector

(following chapter is a synopsis of discussions held by the author with various representatives for the distribution of goods at different companies)

The professional freight forwarders conducting transport services are well aware of the problem with congestion on the roads and at the delivery points. It is, however, difficult for them to deal with it since it is their business concept to transport things no matter the circumstances. The freight forwarders have a task to fulfill and execute it using available means best possible way out of their own business perspective. Although some far-sighted freight forwarders realise that what they offer is a transport service, but how the production is carried out is of secondary interest to customer satisfaction.

The freight forwarders are usually better at optimising the loading factor on their vehicles than are the wholesale dealers, using their own company trucks/vans when distributing the goods (Wetterwik et al. 1998). The wholesale dealers usually have a longer distance between each delivery point, and have got accustomed to offering their consignees shorter lead times (between order and delivery) than the freight forwarders can offer in their organisation of transport services.

The transport services offered by the professional freight forwarders are usually organised in daily cycles where the pick-up service is conducted in the afternoon before a certain time of the day and delivered to its point of destination the following day before lunch time. These time restrictions are not always suitable for the wholesale dealers, why they use a transportation system of their own. The freight forwarders do not distinguish between demands on local transportation and long distance transportation, the goods are being handled in the same flow and taken to the terminal to be sorted out. The traffic work being carried out might well increase if a wholesale dealer choose to use a freight forwarder for its local distribution, since all the parcels will go first to a terminal, often in the outskirts of town, before being delivered the following day.

Although some of the freight forwarders give themselves out as being “public transport providers for goods”, that is not fully true. What they do is to collect the goods at a range of different customers and distributing them also to a range of different customers. Thereby they are able to get a high loading factor on the vehicles when leaving the terminal and a short distance between each delivering point in the designated distributing area. However, there are many exemptions to this rule. If, for instance, a truck load of goods comes to the terminal from some other town, then only smaller parcels are being unloaded while parcels exceeding a certain weight, for example 1000 kg, is being left on the truck. The heavier parcels are then being distributed on a direct route to the consignee. These routines are unfortunate out of an environmental point of view, as ineffective parallel systems adds substantially to the traffic work being carried out.

In the current distribution system there are areas where products by necessity are being coordinated on the same vehicle before delivery. It happens when the cost of individual distribution systems substantially exceed the cost of carrying out the transport jointly. It can be distribution of goods at long-distances in sparsely-populated areas, or when there is a physical barrier, such as water, too expensive to

overcome. In these cases the various distributors make a deal with one or a few companies to handle the distribution on behalf of themselves. A reloading point is agreed upon and some financial transactions takes place so as to satisfy all parties in the handling process(see appendix D). Freight distribution to smaller islands in the archipelagoes are often jointly conducted (fig 6).

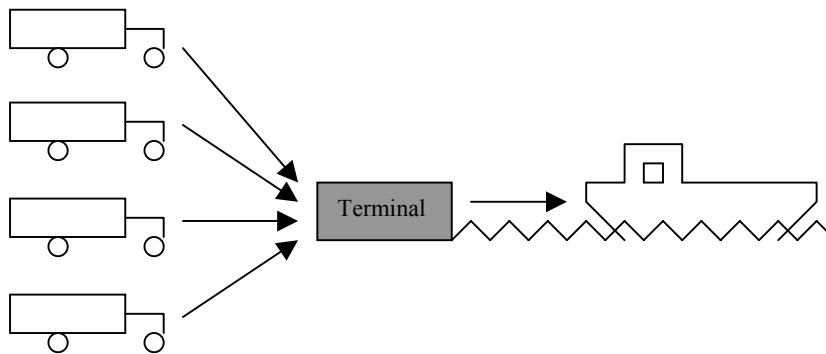


Figure 6. Coordinated freight distribution using a reloading point.

Environmental concern among the transportation costumers have increased during later years, often following the businesses certification to an Environmental Management System (EMS) like ISO 14000 and EMAS. Environmental aspects when purchasing a transport is now often an important part during a tender process and the freight forwarders compete to offer the best arrangements with least possible environmental drawbacks. Many costumers are willing to pay a little extra to reduce the environmental stress caused by their activities and some freight forwarders do offer the market “green” alternatives, such as bio-fuelled trucks, for customers interested.

Pricing for distribution services follows a range of different concepts but are usually based on some sort of tariff system, where prices stems out of a standardised cost coverage system. It can be perceived as somewhat unfair, as customers located at a short distance pay the same price as customers at a longer distance away. Accessibility and inconveniences at the delivery points rarely affect the price charged for distribution. It is believed that the development most likely goes towards an increasing differentiation of tariffs, where actual conditions are better reflected in the price.

When questioned about the possibilities of taking part or develop a coordinated freight distribution system, the freight forwarders are by no means strangers to the thought. They believe that a coordination in densely built-up areas will not develop by itself and that positive means to better facilitate a coordination is not enough. What is needed is for the public authorities to introduce restrictions so as to force a coordination into place. When requirements are put in force, the operators soon find solutions in how to comply with demands. Time restrictions when distributing in the city-center is one example of this and the environmental zone restrictions on technical standards of vehicles is another. Demands and restrictions from customers and authorities are the driving forces for development in the transportation business.

2.6 Available means to cope with the situation

There are a few different options to choose from when searching for a solution to the problem. The solution must be based on a reduction of traffic work being carried out. There are principally four ways of dealing with the problem:

Option 1. Reduce the frequency of deliveries – this is by all means an effective way of reducing traffic work. The freight coordination project at Norra Älvstranden has so far been focused on influencing the market in this direction. It is a matter of changing routines and making the stakeholders realise that it is enough to get deliveries less often. However, incentives for accepting what is often regarded as a deterioration in service are close to non-existent, as the cost of deliveries usually are paid for by the sender.

The freight being transported to Norra Älvstranden make up an extremely heterogenous mix of products, consisting of all imaginable things. To expect every consignor and consignee to accept a reduction in the frequency of deliveries is probably too much to ask for, although it may be possible to influence to some degree. The development goes on the contrary in the opposite direction with more and smaller consignments per delivery. It is not likely that the municipality of Gothenburg will be able to reverse this trend more than marginally, since it is influenced by macro- and micro economical factors of which the municipality have no control.

Option 2. All companies use the same distributor – in order to reduce the number of vehicles used for deliveries in a certain geographical area, and the distance between each delivery point, the companies could get together and form an association using one and the same distributor for all consignments. It is a possible solution if all and every consignee could make an agreement together and then make all purchasing using the same transportation company every time. They would most probably get a good discount in price when negotiating a general agreement. A prerequisite for this solution is for all the consignees to have power over the terms of delivery, which is seldom the case in reality. As for the supply of office material, the transport is usually included as part of the contract with the consignor who have already made a general agreement with a chosen transportation company. It is not likely that all material flow going in and out of Norra Älvstranden would become controlled by the consignees, as the development is going in the opposite direction with the transport included in the price when ordering a product. The consignors want to increase the service level for the customer by administer the transportation handling for them.

Option 3. Dedicated vehicle for Norra Älvstranden – if focusing narrowly on the conditions at Norra Älvstranden only, it might well be comfortable thinking of how a dedicated vehicle would take care of all distribution activities for the companies within the district. If finding an acceptable way of financing the service, the vehicle could drive around to various warehouses in and around Gothenburg to pick up all the products and delivering them to each and every consignee at Norra Älvstranden. Though it would be a sub-optimisation in the extreme, as the distance covered by the dedicated vehicle would be much further than compared to the present system.

The distance (g) in figure 7 is the reason for why a dedicated vehicle, serving a particular geographical area, is not a good solution, on its own, out of an

environmental and economical point of view. With such solution you would get a very long distance between each and every warehouse but a short distance in the designated distribution area. With a too narrow focus in how to solve a congestion problem in one part of the transportation system, you might end up with a change for the worse when looking at the system as a whole. Figure 7 illustrates the problem.

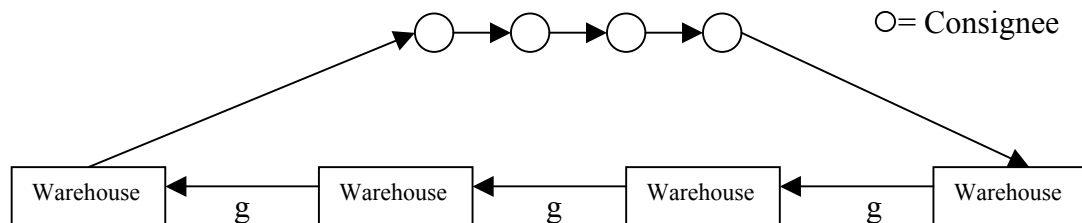


Figure 7. Sub-optimised transportation system using dedicated vehicle.

Since various consignees located in a particular geographical area is ordering very many different products, the ordering stock is so diversified that it would be practically impossible to have a dedicated vehicle going to all the different warehouses needed to satisfy the demand. An option could then be to choose certain product groups or certain consignees with similar ordering stocks to optimise the deliveries for the chosen group. Concerning the supply of office material there are presently some seven different suppliers, using different warehouses in and around Gothenburg for their logistical chain. It will, however, have a negative impact on traffic work and resource use in the total system, since there would have to be many parallel distribution systems side by side.

Option 4. Reloading terminal – remains the option of using a different point for delivery than the physical address of the consignee, where the packages can be consolidated on a fewer number of vehicles before reaching the final delivery address. If using a terminal to coordinate the distribution in a densely built-up setting, it should preferably be located in close proximity to the geographical area in question. If, on the other hand, the area is located on the countryside, it can with advantage be located at some distance away from the actual distribution area.

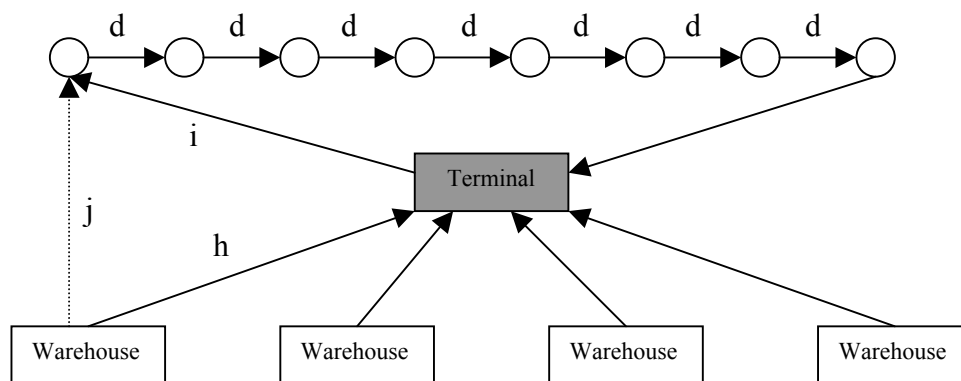


Figure 8. Coordinated freight distribution using a terminal.

The combined distance (h)+(i) should preferably not exceed the distance (j) as it might be counterproductive to the total distance covered. The risk is especially prevalent if the distances (d) are short. However, the distance (d) will in this example be up to four times shorter with a coordinated transport loop using only one vehicle instead of four. In the case of Norra Älvstranden, which is located in a densely built-up area, the most proper location of a terminal would be at the edge of the district, in order to reduce unnecessary driving distance for the affected distributors.

If the terminal is located at some distance away from the district, a situation arises where, for some of the distributors, the distance (h)+(i) will exceed the distance (j) and a situation of sub-optimisation has been created. What is being gained in reduced amount of traffic work within the district, is lost in increased amount of traffic work outside the district. Apart from a proper location, the terminal has to be equipped to be able to handle a whole range of different kind of products on different times of the day. Space and equipment have to be made available for a smooth handling process and some basic routines should preferably be organised for a satisfactory performance.

It can be argued that a terminal would lower the efficiency for each distributor that are affected since the vehicle fleet is dimensioned to do their respective loops in a certain amount of time. It is not a thoroughly thought out argument in a market economy where customers and their material flow are added or withdrawn continuously as the market change and new tenders are being conducted.

3 Literature review

In recent years a number of reports, essays and articles have been produced dealing with the subject, and associated subjects, of concern for this thesis. It shows that freight distribution problems are a burning issue and a source of unrest for authorities and decisionmakers in their search for environmentally friendly solutions to present day problems, nationally and internationally. Literature and evaluation of different projects can now be found in many parts of Sweden as well as all over Europe. However, a Scandinavian perspective was chosen for this literature review as the thesis deals with a project taking place in the Swedish city of Gothenburg.

Problems associated with the coordination of freight distribution has been exhaustively investigated by Pettersson (1999) with a focus on the conditions necessary to implement a coordinated city distribution and with an emphasis on the foodstuff provision sector. An evaluation can be found in chapter 4.5. There is also a comprehensive survey of the different means of control available to influence the cooperation process. The report was a successor to a previous report by Kristiansson and Pettersson (1996) where obstacles and possibilities of a coordination were analysed.

The environmental influence of transportation is dealt with in a lifecycle perspective in Blinge et al. (1995) and is also discussed on a more particular level in Roth (2000), where it is shown what environmental influence a product have in different transport relations. Andersson (1997) cover a wide range of different research in the transport and environmental field. It deals with politics, change in attitudes and communications, technical aspects, town planning, and possible means of control in the transport area and their effects.

An interesting angle in how to facilitate the coordination of freight distribution is presented by Vägverket (1997), when they investigate the advantages of using information technology in the freight transportation sector. Wetterwik and Backman (2002) cover the same subject as they recognise the potential benefits in using IT applications for an increased coordination in the freight sector but at the same time point out that so far the experiences indicate that most IT applications in this field have been failures, causing more damage than benefits.

A range of projects in coordinated freight distribution systems have been conducted during later years. Wetterwik (1999) has made a compilation of some 20 projects in Sweden and internationally with an evaluation of their result and the experiences that can be drawn. A thesis work from Helsingborg by Bjurhult and Stansgård (1999) describes the distribution patterns in the inner-city in order to reveal what the possibilities are for a coordinated distribution system in Helsingborg, and ending with a proposal in how to go ahead implementing these ideas.

Gebresenbet and Wetterwik (1999) conducted a serie of seminars involving the different stakeholders in the distribution chain. They conclude that companies are generally positive about coordination of distribution but have difficulties in finding feasible solutions based on each company's requirements. The main difficulty seemed to be how to find a practical way to coordinate the freight distribution without a

deteriorated service degree to the costumers. A contiued dialogue between researchers, decision-makers and distribution/transport companies was seen as necessary and required in order to find feasible solutions.

Inregio made a survey, at the request of Naturvårdsverket, recently to examine what different means of control are available to use in the transportation sector in order to meet the requirements set by the Government to frame the future transportation system (Engström et al. 2001). The study is concentrated on analysing the potential of the different tools at stake, and to show some international experiences. Economical means of control, according to this report, include taxes and charges, GST, and subsidies of different kinds that affect the transportation sector directly or indirectly. The focus is mainly on a national level, local conditions are not covered.

Restrictions on the loading factor for each vehicle entering a certain area has been investigated by Leu and Ottosson (2002) on behalf of the Traffic and Public Transport Authority in Gothenburg. They have drawn parallels to an ongoing project taking place in Copenhagen, further outlined in chapter 4.6, and give recommendations in how to introduce a similar system for the inner-city of Gothenburg. It can be noticed that the transportation businesses in Gothenburg, when asked, believe that such a system would be counterproductive in that it would create more and smaller vehicles, further worsening the congestion and traffic work being carried out on the streets.

Lumsden (1998) has made a coherent and comprehensive introduction to the technical, economical and theoretical foundation of the subject field logistics. The book covers most aspects of transportation and distribution systems as well as the different components it contains and the framework they all function under. Managing the material flows efficiently is the focus of discussion and it is shown how products often are stored at different locations through the transport system for days and weeks before finally being processed and brought to the final customer. Lumsden make a special point in the importance of being able to manage the information flows alongside the material flows in order to render effectiveness in the total system.

Various inception reports from TFK (Institutet för transportforskning), as well as Pettersson (1999), discuss the different incentives and means of control available for society to influence the process in order to increase the interest among stakeholders to coordinate the freight distribution. TFK has also identified some of the underlying factors for the increasing demand of transportation and, consequently, the reasons for lack of consideration to the negative external effects it contributes to.

Aspects covering the use of a company car/truck and its implications for a coordinated freight distribution system is dealt with in Wetterwik et al. (1998). Included in the report is an evaluation of different kinds of coordinations in the freight distribution field and an explanation of key factors to consider when dealing with these issues. The report conclude that knowledge, innovation and motivation is needed for a successful freight coordination and that there are no universal (general) solutions. It is a matter of finding innovative and individual solutions for every business and sector.

3.1 Summary of literature review

The existing knowledge in this field points towards a growing awareness of the complexity in the issues covered. Materials and substances move through the society in a large number of different flows. The transportation sector is already using available means to render efficiency and to optimise the business solutions. Freight distribution in densely built-up areas is a complex issue where you hardly can find any general solutions to the width of problems dealt with. The new information science do not seem to offer much help to optimise the system as a whole, since it is not enough with voluntariness to make the companies to cooperate with each other.

The companies are generally favourably disposed to a coordinated freight distribution since it can result in reduced transportation costs but have difficulties in finding practically viable solutions that works, without a deteriorated service level for the customer. Each business have different requirements and act in an economically rational manner out of their own perspective. Changes in business conditions are needed to create better opportunities for a coordination in the freight distribution. The new conditions should aim at rewarding cooperation and resource efficiency, while making selfishness and resource extravagance unpracticable.

4 Other coordinated freight distribution projects

4.1 Introduction

A range of projects concerning coordinated freight distribution systems have been carried out lately. A few of them are shortly presented here to give the interested reader an idea of some different possibilities at stake when dealing with the coordination of freight in a defined system. The first example is from Borlänge and covers a public effort in handling the drawbacks of transportation demand. Second comes two examples based on a similar approach but carried out in smaller geographical areas. Next follows two examples of private business involvement, where participation in a coordinated freight distribution was based on voluntary grounds by independent shop owners and suppliers. Then comes an example from Copenhagen, using a totally different approach, by restricting the loading factor, that apply for all freight vehicles within the inner-city. Next follows two examples of private sector initiatives, where the decision of introducing a coordinated freight distribution system was based on a quality control demand. An example from the building business with a different way of managing the material flows, ends the survey of coordinated freight distribution systems and the driving forces behind these ventures.

4.2 Borlänge

A well known coordinated freight distribution system is taking place in Borlänge, Gagnef and Sätters municipalities in the middle of Sweden. It was initiated by the municipalities on economical grounds, wanting to increase competition among the consignors by handling the distribution themselves. The municipalities are working together in making yearly contracts with the consignors to buy their products for a lower price, excluding the transportation costs. The different consignors deliver their products to a terminal where a neutral transportation company takes care of the reloading and distribution of all products to each consignee. Previously, the consignors included the transportation costs in the price of the product and had a service of 'free delivered', unless it was a small order, then there was a minor fee. There has been no added costs for any stakeholder using the new system.

A coordination central was used in the beginning to handle the communication between consignee, consignor and the transportation company. After an introductory period, there was no longer a need for this function since the new arrangement became routine. Contracts for the next coming year can be specified according to what the municipality feels important and prices, technical standards and service level can be agreed upon. The long term commitment on behalf of the municipalities was seen as a prerequisite to be able to reap the fruits of the efforts. The result has showed to be an increased traffic safety in and around schools, day care centers and retirement homes and better working conditions for the consignee. The number of deliveries to each consignee has been reduced dramatically, leaving the personnel free to take care of the daily work in a continuous manner instead of being interrupted by frequent deliveries. The amount of traffic work carried out have not changed much with the

new arrangement. Low loading factor and restrictions in delivery times are factors delimiting the effectiveness of the system.

Apart from a better control of the costs, the new system has also resulted in a wider range of consignors being able to compete for contracts. When there is no need for the consignors to have their own distribution capacity, it increases the smaller businesses competitiveness. Local production are strengthened and the consignees get access to a wider selection. Another positive aspect is that small consignees now can enjoy the same service level and frequency of deliveries as the bigger ones, since they use the same system and there are no 'punishment fee' for small orders. The transportation company are getting paid per delivery, regardless of the amount of goods ordered by the consignee that day. Even though the municipality initiated the new routines by force, the consignees soon realised the benefits of the new system (Backman, 2001 and discussions with Catherine Säll-Franzén).

4.3 Örebro and Kirseberg

Another project was carried out in Örebro during 1999/2000 as a practical attempt to coordinate foodstuff distribution to the public daycare centers. Like in Borlänge it was the municipality that initiated the project, this time on environmental grounds, wanting to reduce the number of deliveries carried out and the total amount of traffic work in the built-up area. Åslund (2000) explain that four suppliers and 68 receivers were involved during a period of six months. The main benefit from this project was the traffic safety for the children at daycare centres, when number of deliveries were reduced by 5700 on a yearly basis. The expected environmental benefits did not materialise.

The freight forwarders that used to deliver to the public daycare centers continued distributing their products to other costumers, only skipping the daycare centers while passing by on their distribution loop. A parallel distribution system was added by the municipality, reducing the number of deliveries but increasing the traffic work carried out. Cost recovery for the extra distribution system was covered by public funds and therefore discontinued after some six months. The project managers draw the conclusion that for a coordinated freight distribution system to be successful, it must exceed a certain size and cover many costumers within a defined geographical area in order to become cost efficient and environmentally beneficial.

A district in Malmö, Kirseberg, was chosen for a demonstration project within the IDIOMA (Innovative Distribution with Intermodal freight Operation in Metropolitan Areas) framework and had a similar approach to the project in Örebro. Only this time the project was carried out in a defined smaller district within a bigger city. Environmental benefits are uncertain so far as the project have not been evaluated properly yet. Here, the public purchasing company has been involved, in a similar way as in Borlänge, aiming to transfer the financing of distribution from being the suppliers responsibility to public concern. The new coordinated distribution system is now part of the continuous operations.

The experience indicate that regarding technical measures the private sector is confident in finding suitable solutions for their purposes. The organisational aspects

where several actors are influenced to change process is much more difficult. The tasks where the project aimed at implementing more efficient solutions by bundling the goods before the district distribution, show that some kind of public engagement is an advantage. One reason for this is that the transport companies are reluctant to cooperate with each other when the financial gain is uncertain. In the final remarks it is stated that “when trying to implement new concepts it is very important to understand the operations and organisational structures of the involved organisations. A solution can be very well adapted to the situation in one company but not at all relevant in another. This must be understood before promoting new solutions. Each case must be analysed separately (IDIOMA, 2001).”

4.4 Uppsala

An activity study was conducted in Uppsala, based on previous research and experiences, and is described in Eriksson (2002). It is stated that the main difficulty to carry out the project was the unwillingness of shop owners to participate. Therefore, the project involved only nine shops, located in the central part of Uppsala, and lasted for about six months. When questioned about improvements of present conditions in the distribution services, shop owners had wishes on rapidity, fixed times, short delivery times, and fewer number of deliveries.

There were no environmental benefits derived from this demonstration project. It was a too small number of stakeholders involved to actually make a difference. The project was all based on voluntariness from the shop owners and there were few incentives for them to participate. The goal was to build up a system for coordinated freight distribution that in the long run, after these kind of pilot projects with economical support, would become economically viable and long-lasting.

Findings from the study show that a coordination of freight distribution is not a technical problem but an organisational. Communication and dialogue was identified as key factors. The authors conclude that the determining factor for a successful coordinated freight distribution is to find a solution, in an open and active dialogue, that can be accepted or gain acceptance by the stakeholders involved.

4.5 Linnéstaden

A well known project was carried out in Gothenburg during 1996-98. It was based on voluntary participation by the suppliers. Interest to participate proved to be low and it turned out to be only four suppliers involved in the project. It was carried out without using a terminal, instead the products were collected at the suppliers' and driven straight to the receivers'. A neutral freight forwarder was called upon to carry out the transport services. The project is exhaustively described and evaluated in Pettersson (1999). A range of difficulties were encountered along the way, mainly because the venture was initiated on academic grounds without sufficient knowledge and experience from the realities of the distribution system. The scale of the project turned out to be too small to draw any general conclusions concerning freight cooperation systems. Nevertheless, it appears clearly that the suppliers involved in the project were satisfied with its function.

4.6 Copenhagen

A different approach are being used in Copenhagen to reduce congestion, emissions and uncomfortness caused by the freight vehicles, within an 'environmental zone', in the city centre. The city of Copenhagen has focused on the loading factor as the decisive parameter. The city demands a minimum of 60% loading factor for all vehicles, with a total weight of more than 2,5 tonnes, entering the zone. It started with a voluntary trial period for a limited amount of participants for the system to be tried out and improved but are now obligatory for all vehicles who wants to stop in the zone.

There are three kinds of certificates – green, yellow and red. Green is for the normal distribution vehicles and they have to report to the city of Copenhagen every third month that they comply with the rules of 60% loading factor, on average during the period. Yellow is for vehicles that for some reason are unable to comply with the rules immediately and are therefore granted an exemption for the time being. It also gives exemption from the rules to others, such as refuse collection trucks and fire engines, on a permanently basis. Red is a temporary permit, valid only one day. Vehicles using a red certificate are not covered by the loading factor rules. If a vehicle without a certificate stop somewhere within the zone, they can get a parking fine from the car-park attendant or the police.

The distributors reports manually whether they comply with the rules for green certificate. The city of Copenhagen make spot tests by checking the consignment notes for a certain period, once in a while. The intention is to avoid bureaucracy as far possible. The 'environmental zone' in the city center, covered by the rules, is a geographically well defined area and has had problems with congestion for a long period of time. The zone with its rules has been worked out in cooperation between the transport business and the city of Copenhagen, since all agreed that congestion in the inner city was a problem. The city of Copenhagen hope by these means to avoid a continously chaotic situation with freight distribution, in a socially and culturally important and sensitive part of town. (Leu et al. 2001 and Forumforcitylogistik)

It is still too early to make a full evaluation of the results from the new system, but preliminary results show a significant increase of loading factor in the vehicles. There is an obvious risk of getting many more, smaller vehicles, instead of consolidation of goods on the current ones. It is also a matter of dispute weather the figure 60% is the best (Maria Ottosson). It will be interesting to see how the control function of consignment notes will work out in reality. Without a proper control function, the vehicles may have 40% loading factor left when leaving the zone and there will be nothing gained.

4.7 COOP Sweden AB and Pressbyrå AB

As a step in their quality control of the supply chain, COOP Sweden has, as the first foodstuff wholesaler in Sweden, started to coordinate the flow of perishables to the shops via dedicated perishable terminals. In an effort to safeguard the cold-storage and ethical handling of food products COOP Sweden decided to take charge of the

transports to the stores. Previously, a range of suppliers were delivering their own products to the stores, using company cars or trucks. With the new guidelines everyone delivers to the terminal, or gets their products picked up by COOP Sweden, where all products for each store are being reloaded together on COOP Sweden's own trucks. The store then gets all products delivered in one go and at a set time of the day, previously agreed upon according to local conditions. A prerequisite to introduce the new system was for all the stores to start using a computerised ordering system. They had to be forced into using a new technique and new routines for ordering and follow up of deliveries. Every store are now using a portable computer in their daily routines when ordering and handling the material flows.

The rearrangement of distribution patterns has resulted in a 75% decrease in the number of deliveries to each store. At the stores they have experienced a reduced work load, fresher products, and more smooth flow of products delivered. In the beginning there was a slight increase in costs for COOP Sweden, but after negotiations with the suppliers on the benefits of reduced transportation work for them, the company was able to make both ends meet. The big suppliers made some complaints in the beginning about not being able to deliver themselves, but soon realised the benefits in focusing the company efforts on manufacturing instead of distributing the products. Small suppliers have been very positive from the beginning, since they now can compete on equal terms with the bigger ones. COOP Sweden has been able to diversify the selection and can now offer their costumers a wider range of products in each and every shop.

The change into a coordinated freight distribution system was a strategic decision, taken by COOP Sweden headquarters, after having made a business environment analysis in different countries. It was seen as necessary in order to increase the competitiveness and safeguard the quality of the supply chain, in line with the trademark ambitions of high quality standards. The suppliers realised that it was a permanent change and adapted their organisations to the new conditions of deliveries to the terminal instead of driving around themselves.

Similar arguments and results can be seen at Pressbyrå AB – Stockholm. What used to be 15 deliveries per day to each of their stores, is now limited to only one per day. After having made a business environment analysis in how to increase the company's competition capabilities, a decision was taken centrally for a coordinated freight distribution system. The suppliers had the choice to continue the cooperation, under the new conditions with deliveries to a terminal, or to loose a big costumers. Since the supplier got reduced transportation costs, Pressbyrå AB could claim a reduced price for the products, to cover the costs of reloading and distribution. This was solved through successful negotiations.

Pressbyrå AB points out that a certain number of stores within a defined geographical area is needed for such a venture to be economically viable. Pressbyrå AB supply 170 stores within the greater Stockholm area. A certain volume of goods in the distribution flow is needed to maintain the frequency of deliveries and thereby guarantee the success of the concept. Both of these two examples outlined here, has meant an improved service for the costumers without higher costs and have resulted in a considerable reduction in traffic work (Wetterwik, 1999 and discussions with Jonas Regnér and Marie Avander).

4.8 Hammarby Sjöstad

A unique project covering the coordination of material flows to a major building site is taking place at Hammarby Sjöstad in Stockholm during 2000-2003. To reduce the drawbacks of increased traffic work on the building site, the City of Stockholm decided to set up a logistics center to handle the distribution of smaller quantities within the defined area. Experiences from a major building site in Malmö, Bo01, showed the importance of coordinating deliveries to reduce the traffic work with a devastating clarity. The decision was taken in cooperation with the building commissioners, and other stakeholders involved, to win acceptance and understanding for the changes of routines that was needed for a successful outcome.

A reloading terminal was set up at the entrance point for the building site where all small deliveries were directed to and either stored for a while or reloaded onto dedicated vehicles taking all deliveries at one go to each site respectively, at a suitable time of the day. This reduced the traffic work considerably and made this building site much less congested than they usually are. Working- and living conditions were improved and the building contractors could stay within the specified time frame and thereby reach the production goals.

Looking at the venture from a holistic point of view, it can be considered economically successful. However, prices and costs are not always allocated where most optimal from a system point of view. It may be pointed out that a coordination of the freight distribution would not have taken place unless the City of Stockholm decided so and also covered for the direct costs of managing it. Indirectly, all stakeholders did gain, economically and production wise, but not all have realised yet. Logistic costs that today are invisible for the stakeholders must be made visible if the building contractors are to realise the benefits of a coordinated distribution system. The logistic centre at Hammarby Sjöstad must in this perspective be seen as an important demonstration project, for future changes of the material flows in the building sector (Albinsson et al. 2002 and discussions with Jonas Brisvall).

4.9 Summary

It can now be stated, that coordinated freight distribution is, beyond doubt, not a technical problem but an organisational. The problems in making the coordination long-lasting, have mainly been focused on cost recovery for the changed patterns. The cost recovery has been possible when the businesses have had control of the material flows and it has been fixed flows. All the public examples have been based on external funds in the initial phase, for the final distribution from the terminal to the end customer. Once the structure is there, it has been possible to negotiate with the supplier about reduced prices on the articles, since the supplier has got reduced transportation costs with the new arrangement. Cost recovery in the examples from COOP and Pressbyrån has been arranged in a similar way, though the basic reason for initiating a coordination for these businesses were increased quality control. Experiences show that power over the material flow is needed to be able to reach economical balance with the new arrangement, which is a prerequisite for long-lasting viability.

Other projects, Örebro and Hammarby sjöstad, have not been able to reach economical balance with the new arrangements. The suppliers have been given an economical advantage in delivering to a terminal but the costs for further distribution has been covered by external funding. These kind of ventures should be looked upon, not as failiures but, as local demonstration projects, which are important for the future development of coordinated freight distribution systems. It is difficult to carry through a change in transportation patterns when the economical advantages are unclear. The examples from Uppsala and Göteborg, where the stakeholders could participate in a freight coordination project on purely voluntary basis, have failed or been discontinued. In Copenhagen, where many different shop owners and suppliers are covered by the rules by force, the costs and handling problems were transferred to the 'market' to solve best way they can. The rules have gained acceptance and the stakeholders use different means, according to their unique prerequisites, to comply with the rules.

A reasonable assumption to make, is that, on an unstructured market with various owner constellations and conflicting interests, an outside force is needed, to set the rules on a change in the distribution patterns for the benefit of all. The changes needs to be worked out in an active dialogue among the affected parties to win a wide support and thereby gain acceptance by the various stakeholders and include some sort of control function for compliance with the rules. The proposed coordinated freight distribution system can derive advantage from being designed in such way as to be economically beneficial, and thereby have a chance of being sustainable in the long-term.

Project	Motive	Measure	Pos. effect	Neg. effect
Borlänge	Increasing competition among the consignors delivering to the municipality	Dividing transport cost from product cost. Using a terminal for reloading and further distribution	Fewer number of deliveries Wider selection in the sortiment	Minor cost increase More traffic work
Örebro and Kirseberg	Reduce the traffic work Reduce number of deliveries	Using a terminal for reloading and further distribution	Fewer number of deliveries	Minor cost increase More traffic work
Uppsala	Demonstration project	Voluntary participation	No benefits apart from demonstration	Unwillingness to participate Cost increase
Linnéstaden	Demonstration project	Dedicated vehicle	No general conclusions	Unwillingness to participate
Copenhagen	Congestion	Demands on loading factor fulfillment Differentiated certificates	Not evaluated yet	
COOP and Pressbyrån	Quality control of the supply chain	Dividing transport cost from product cost Computerised ordering system Consignors deliver to terminal only	Quality control Cost neutral Less traffic work Fewer number of deliveries Wider selection in the sortiment	
Hammarby sjöstad	Congestion during building process	Reloading terminal	Reduced congestion Less traffic work	Cost increase for the municipality

Table 1. Evaluation of the different projects investigated.

5 Interviews with consignors and consignees

5.1 Consignee's activities

Interviews have been carried out with the person responsible for the office material supply at 12 companies. Most of the companies are already located at Norra Älvstranden while some are about to move there in a close future. Half of the companies are taking part in the ongoing project with office material supply, accepting reduced frequency of deliveries. Size of the companies varies from 14 employees to 550 employees. Following discussion builds upon statements made during the interviews.

Stock: Stocks are updated at different intervals in different companies. Most companies update their stocks on a regular basis, while some update ad hoc as they run out. Companies who have developed routines for updating stocks, seldom run out and appreciate getting accurate information on how long time the delivery will take. Companies who often run out of material appreciate short lead time from order to delivery. A growing number of companies have started using "cupboard service", where a representative from the material supplier take care of the updating and filling up of stocks at a regular basis.

Orders: Orders are usually made by sending a fax to the supplier. A few uses telephone and a few make the orders via Internet. The majority feel most comfortable with sending a fax with the specified requirements. Some companies carry out their ordering at a special day of the week, while others feel it more convenient to do it when time allows. The ones using "cupboard service" do not have to worry about ordering, as the supplier representative takes care of it. Participation in the ongoing project described in chapter 2.2, has reduced the frequency of ordering by some of the companies. Ordering of office material are typically made about ones a week by most companies but it varies a lot according to business structure and perceived needs.

Deliveries: Deliveries are carried out by professional freight forwarders in most cases, while company trucks also are being used along with privately owned vehicles. Lead time from ordering to delivery varies from 1-3 days depending on company and agreement. The package or parcel are most often being delivered to the reception where the receiver sign a receipt confirming the delivery. Drivers with parcels can show up at any time of the day and of the week, the receiver never, with few exceptions, notice at which company the driver belongs. If there is a reminder to deliver it usually comes the day after, which often are considered unnecessary as it would have been of no inconvenience to instead receive it with the next regular delivery.

Costs: Transportation costs are almost always included in the price when making an order. The companies seldom reflect on the cost of

transportation as they feel it is a service the supplier provide for them. Most companies feel that they have made such a good deal with the supplier and that it is the supplier that are paying for the transport! There are no cases where the transport costs have been up to negotiation. Since the transport cost is made invisible for the buyer, there are few incentives for reducing it.

- Debit: The customers have a wish of getting as few bills as possible, as it is time consuming to administer every bill. There is a conflict since the supplier wants to get paid as soon as possible.
- Contacts: Contacts between buyer and supplier occur most frequently at the time of ordering (usually via fax, see above) or by telephone contact with a personal salesman at the 'customer service', handling their particular company's needs. A salesman seldom comes out on personal visits, it can happen ones or twice a year at the most. Customers using 'cupboard service' have a greater amount of contacts, but the staff picking up the material on to the shelves should not be regarded as sales people but rather as a messenger (*sv. vaktmästare*). None of the companies see the driver coming with the delivery as being part of the sales function.
- Supplier: Choice of supplier is either a well thought out decision or just a coincidence. Some companies declare traditions or old habits as reason for choice while others are changing supplier according to best offer of the day. Many companies are part of a business group with a centrally negotiated general agreement for supply of office material. Almost all companies believe that the different suppliers are offering almost the same kind of products and have the same range of assortment.
- Future: Just about all companies have a desire for making the ordering, handling and administration process as smooth and quick as possible. They want to save time in every process, as time is what they are short of. It is becoming more and more common with companies to introduce an Environmental Management System (EMS) in their organisation structure, whereby present routines for ordering and delivery may be questioned.

5.2 Comments and summary

None of the companies indulge any expectations of getting fewer number of deliveries a day in the future. Presently they are getting deliveries a day or two after ordering, often also the following day for remaining (missing) products. Emergency deliveries are being ordered and delivered now and then when a situation occur, and printed matter are being sent seperately. Concerning office material some companies often get a problem with the pallet used, since that is being left over when the material have been put into shelves. The pallet constitute a cost and an inconvenience since the driver is leaving it at the reciever's.

Apart from office material a range of other products are being transported and delivered to the various companies examined on a daily or weekly basis. Often companies find it disturbing with many small deliveries several times of the day. Many of the companies mention a wish of having the same driver coming everyday, doing all the deliveries as it would render possibilities of getting a personal connection with him which would feel more convenient. Lastly, the EMS work increase the will and understanding of changing routines to reduce the environmental drawbacks a company's activities are causing.

5.3 Consignor's activities

Interviews have been carried out with four of the major office material suppliers for the companies located at Norra Älvstranden. Three of the suppliers have contracted freight forwarders to take care of the transportation services for them. One supplier takes care of their own local distribution with dedicated vehicles, while using freight forwarders for longer distances. All four suppliers offer similar range of selection and compete on the same areas. Three of the suppliers have a national coverage in their sales network, while one supplier is a local establishment with the Gothenburg region as their principal market.

- Location: The central warehouses are located at various places as follows; Mölndal, Borås, Jönköping and Växjö. With the current distribution system, products starts their final journey, the distribution journey, from a warehouse located in the outskirts of Gothenburg.
- Orders: Orders are being processed during office hours and customers can choose to use telephone, fax or the Internet to make the orders. A growing number of companies are using the Internet when ordering. Some of the suppliers are offering a dedicated homepage for each company who shows interest, where they can make orders continuously but where the orders are transmitted to the supplier only when the customer wants to send the order. Number of orders are reduced dramatically.
- Deliveries: The customers are offered 24- or 48 hours deliveries from the day of ordering. The suppliers have made a general agreement with a freight forwarder to deliver their products to the customers. The agreements are usually set up on a three year basis for the suppliers to get the best deal and consequently can the choice of freight forwarder change over time. The agreement usually includes for the freight forwarder to deliver all the way in to the reception at the receiver's. As transport buying companies, they have no power to control the friendliness and courtesy of the drivers making the delivery. The supplier using their own dedicated vehicles believe that the drivers are representatives for the company at the point of delivery, while customers seldom notice the difference in behaviour. A driver is doing a drivers job, while the personality of the driver can make a major difference in how the customer percieve the service.

- Lead-time:** The suppliers always want to shorten the lead-time between getting the order to the time of delivery. However, when using a certain freight forwarder, activities have to be adopted to their transport cycles. The locally established supplier has an advantage of being able to shorten the lead-time by using their own dedicated vehicles for the distribution. It so happens sometimes that the supplier runs out of stock for a product ordered. This product is then usually delivered the day after, thereby increasing the traffic work being carried out considerably.
- Costs:** Transportation costs for the distribution of office material generally constitute some 8-10% of the product price the customer is paying. This share of the cost has been growing continuously as the customers are making their orders more frequently. For small orders, the transportation cost can constitute such a large share of the total that the supplier does not make any profit on them. There is an administration and handling cost for every order, which does not differ much either it is a big or a small order.
- Debit:** Customers are usually being charged once a month. There are many exceptions to the rule though and it can also be once a week, every second week or after every order made.
- Competition:** The suppliers compete on the same market and with similar products. Even though the products can differ a little, lowest price is what the customers generally ask for. Offering a high standard of service is then one of the few tools the suppliers can use in order to get an advantage in front of the others. Fast and frequent deliveries is one of the services provided. However, some suppliers have realised the negative aspects of such development and are working actively to convince the customers in making orders less frequently for their own good. The "Cupboard service" is a means to tighten the relation to the customer and thereby introducing routines to reduce the frequency of deliveries.
- Future:** All suppliers are aware of the increasing environmental concern the customers are showing. Even though the price is the most decisive factor, many customers expect environmentally friendly products when making an order and some are willing to pay extra for it. So far, demands have been focused mainly on a product level, while not on a system level. As companies join the trend of introducing an EMS to monitor their daily activities, environmental concern will be incorporated in the discussions when competing for a tender.

5.4 Comments and summary

The different actors in the office material supply business are working under conditions of very tough competition. They have made it difficult for themselves by surpassing each other in offering such a high service degree as to pull the legs from themselves. To have deliveries where the transportation cost exceeds the product cost are clearly not economically sustainable in the long run, since the development are

going towards smaller and more frequent orders. The suppliers are painfully aware of the dramatic increase in transportation costs during later years but see few ways out of it. They perceive the situation as to have few options to turn the trend, since it is the wishes of the customers that govern the business.

The “Cupboard service” is a way to tighten up the relation with the customer but also a way to reduce the frequency of deliveries. Stock levels are then dimensioned according to a certain degree of consumption, which allows an agreed low frequency of deliveries. Not all customers appreciate “cupboard service” as it increase stock levels and therefore constitute a cost for them. Some suppliers are working actively to make the customers realise the benefits in time consumption in making orders less frequently. But the economic incentives of doing so are unclear.

The most far-seeing suppliers are offering the customers a dedicated homepage to gather up all orders during the week before actually making an order. Others leave it to the customers to take notes on a piece of paper during the week, before sending the order by fax when it is convenient. However, nothing stops the customer from making small orders continuously during the week. None of the suppliers have developed any progressive routines in how to handle remainders in a smooth way, in order to reduce the traffic work being carried out.

In order to increase the incentives of making orders less frequently, the transportation cost must be made visible for the customer. Only then will it be possible to negotiate with the customer about it. Since the transport cost is included in the price of the product, a possible solution could be for the suppliers to offer two different options for the customers to choose from. One of the options could then be to get a slightly lower price of the products if ordering less frequently (and accepting to get remainders with the next delivery). Only with clear economic incentives will lasting results be archived.

6 Incentives and Means of control

6.1 Incentives

6.1.1 Introduction

For the different stakeholders to be interested in a coordinated freight distribution there need to be a clear advantage of participating or, alternatively, a clear disadvantage of not participating. When wanting to setup a coordinated freight distribution it is possible to derive advantage from using different kinds of incentives.

6.1.2 Means of knowledge

- Information - by arranging meetings where different stakeholders are brought together, it may be possible to increase the interest.
- Demonstration- carrying out real life projects to show others the practical solutions and how it is possible to do.
- Legitimacy - knowledge and information spreading by the public authorities gives legitimacy to the concept.
- Policy - preparing a municipal long-term policy concerning freight transportation.
- Uncertainty - reducing the uncertainties in a changing process.

Knowledge is a weak kind of incentive that are not likely to change anything quickly. Although it is an important means and can be used with advantage together with other means, it can not be neglected. Demonstration projects are being used as “the good example” and reduce the uncertainties around a coordination. The authorities have an important part to play here as there are no other organisation that feel a responsibility in initiating a coordination between different companies. Public policy documents for future development do not have an immediate impact but does have an effect on all parts of society in the long run.

6.1.3 Economical means

- Reducing the costs
- Sharing the costs
- Tax relief
- Subsidies
- Discount on the transport services
- Making the transport cost visible to make it negotiable
- Devide the purchase of product from the purchase of transport
- Discount for infrequent ordering
- Increasing the speed of delivery
- Cheaper insurance premium

According to the interviews made in the transportation business, economical means are the most effective means to use to get desired results. Business understand

business, so to say. A transportation company's business idea is to solve the customers transportation needs best possible way at lowest cost and according to specified requirements. If something on the market is changing, the transportation company adopts to it by finding or developing a solution in the most cost effective way.

Economical means can be an effective way to reduce the frequency of deliveries. When there is an economical advantage in making few big orders instead of many small orders, the market will adopt to those conditions (compare to the supermarkets offers of buying '3 for the price of 2', and similar offers). For this to happen the transportation cost have to be clearly stated and open for negotiation.

6.1.4 Administrative means

- Certify - give benefits to the ones that comply with certain demands.
- Database - using a national/local freight database for control.

Setting up goals for certain requirements to comply to might be an effective way to increase the interest for a coordinated freight distribution, if the certified companies get some major benefit compared to the uncertified. Some kind of control function is needed in order to monitor the compliance. The risk when using administrative means is to get an expensive bureaucratic system along with it. Bureaucracies have a tendency to grow over time and therefore require more and more resources for its maintenance. A common reporting system have to be developed and jointly accepted by the stakeholders involved. It can be assumed that bigger companies get an advantage when using certification as an incentive, since they have the time and resources to administer it. Ideas of a national or local freight database have been put forward but is not likely to come true because of the complexity of the issue.

6.1.5 Increasing the service

- Few deliveries per day
- Take care of packing/wrapping/pallets, etc
- Recievers perspective
- fixed time of the day for delivery
- SMS-message – “we are on our way”
- Monitoring – distribution vehicles on a GPS-map
- Control (tracking goods)

Most companies wants to increase the service towards their customers. Many try to find ways in how to increase the service without increasing the costs when doing so. There is sometimes a confusion among the service providers about what it is the customer really wants. Is it short lead-times or a complete consignment? In the transportation sector the confusion is further accentuated by the fact that the sender is most often the one paying for the service, and therefore percieved as customer by the transportation company. The reciver have only to accept the way the products are delivered.

According to the investigation made at Norra Älvstranden, the receivers would appreciate having less number of deliveries per day and preferably carried out by the same driver. Many receivers expressed a wish for the driver to take care of the packing that is used for transportation purposes, since it constituted inconveniences for them. It was also perceived an inconvenience not knowing when, during the day, the drivers would show up.

The transportation companies have developed a service of 'track-and-trace' where the customer can log in to a homepage and find out how far in the transportation chain the package have come. It is the sender who gets an identification number for the package when sending it and so have to give the number to the receiver for them to be able to trace their delivery. They can see if the package has been loaded onto the distribution vehicle and, if so, they know that it will be delivered sometime during the day. Some receivers need more accurate information and have therefore established a personal contact with a driver and call his mobile phone to find out where he is and when he is coming.

To increase the service from the receivers point of view, possibilities of monitoring in real-time would be appreciated. A map on a homepage can show the area with the daily distribution route outlined and with a GPS transmitter on the distribution vehicle the receiver will be able to see in real-time where the vehicle is located at present. It is of no value if the distribution route is changed daily or very often.

6.1.6 Time-saving means

- quicker deliveries
- shorter lead-times
- shorter time cycles in the logistic chain

In an era of 'time efficiency' most time savings are appreciated. Shorter distances and shorter lead-times opens up opportunities for time savings. Many of the conventional freight forwarders unfortunately have a system of long time cycles in the logistic system they offer. Local transportation from one part of town to the other is carried out in a time consuming manner as it is today. The package is picked up sometime during the afternoon, taken to a terminal somewhere outside town and stored overnight. The next morning it is taken by another vehicle on its distribution route to the receiver, which will have it delivered sometime during the day.

6.1.7 Information Technology

- Offering a homepage for collecting of orders
- Connect the computer systems between the consignee and the transportation companies.

To help customers reduce the frequency of deliveries, the suppliers could offer each company a dedicated homepage where orders can be made during many days but where the order is not transmitted until the customer do so. If properly set up and used, it can also help the supplier with the logistics.

A more 'high tech' kind of use of the IT systems is to connect the systems used all through the logistic chain by using a facility for translation to and from relevant standards. Control of the material flow increase when the receiver and sender is in contact with each other and with all the transportation companies used all through the supply chain.

6.1.8 Infrastructure

- Available loading zones
- Using bus lanes for freight distribution vehicles
- New infrastructure disposed in public/private partnerships
- Subsidized infrastructure

Infrastructure is needed to perform transportation. The provision of infrastructure has a crucial impact on the quality and effectiveness by which the transportation is performed. It is the society that provide infrastructure and therefore largely control the effectiveness of transportation. Cost covering for infrastructure building and maintenance is under continuous debate and it is largely a question of economical and societal values in the society that determines the cost allocations.

Infrastructure provision is a strong incentive for the society to use in order to steer the development in desired direction. It has a decisive effect on operations and functions. For example, the provision of a designated loading zone for trucks can constitute a major difference for the transport service and for other traffic using the street. During later years it has become more and more common with public/private joint ventures in both building and in the management of infrastructure, as a way to lower the costs and increase the efficiency in operations.

6.1.9 Summary

The existing incentives are not enough to bring about a coordination of the freight distribution. Even though there are benefits to be made, these seem not to be valued high enough to outweigh status quo in the distribution system. Stronger incentives have to be created in order to increase the interest in a coordination.

6.2 Means of control

6.2.1 Introduction

Various means of control can be used in order to create the incentives needed for a coordination of freight distribution. In an open democratic society with a market economy, it can be difficult to get acceptance in using means of control. It is, however, easier to get acceptance when the affected stakeholders can see the benefits in introducing them. Means of control are often in the power of society to handle.

6.2.2 *Economical*

Economical means of control can be used to make the distribution more expensive so as to increase the interest of a coordinated freight distribution. They can also be used to lower the cost of distribution for the companies that cooperate, while increasing the cost of not cooperating. An advantage with economical means of control is the possibilities to direct them towards a particular aim. There can be a cost allocation problem as some stakeholders perceive the changes to be particularly disadvantageous to them but not for others. It is on the other hand exactly what the economical means of control are used for, to give advantages to the ones that best comply with the desired development. Economical means of control is an effective tool to use in a market economy, as the market always try to find the most cost effective way to carry out an activity. The society is in charge of these means but it takes political will and courage to implement them.

6.2.3 *Examples of economical means of control*

Taxes – are most effectively used on a national level when trying to deal with the total system. Taxes on fuel is a well known example. Taxes are difficult to use in a local context as they are adapted to national issues. Products or services usually get more expensive when putting a tax on them. The extra cost is added to the price and the final consumer is the one eventually paying for it.

Charges – can be used in both a national and a local context. Road charging is an example of this. There can be a price for every kilometre driven or there can be a price for driving on a particular road. Road barriers are common in for example Norway, where the driver has to pay to use the national highways. An advantage with charging is the possibility to direct the charges to the particular problem that needs to be dealt with. The logic of introducing a charge can with advantage be communicated by giving it a conformable name. Charges can have a negative impact on prices of goods and services, since the extra cost have to be added somewhere to get cost recovery. A possibility is then to have a differentiated charging system where the ones who comply most with the desired results gets a the lowest charge or no charge at all.

Subsidies – have to be paid for by someone. Subsidies are often used to give microeconomic benefits to reach macroeconomic goals. It usually follows the logic of a cost-benefit analyses of the macroeconomy. Investments in road building and most other kind of infrastructure is based on these premises, as is grant-aided terminals for inter modal exchange between different modes of transport. There can arise demarcation problems when introducing subsidies and it is therefore important to consider possible effects of a proposed subsidy. It has to be clearly stated what performance is needed to comply with demand and thereby access to the subsidy. It may be possible to derive benefits from cross-payment between charges and subsidies to reach a cost neutral solution.

6.2.4 Administrative

All administration brings costs with it. Demands can be put in place by some authority and the companies have to prove that they comply with the rules by showing the figures. The cost for the transport itself may be the same but there will be an administrative cost increase. The companies will get more administration to handle, which is probably easier for a bigger company than smaller ones. A control function has to be put in place to check the figures with the authority to judge if compliance is reached or not.

6.2.5 Examples of administrative means of control

Certificates – can increase the interest in a coordination if the certified companies get some kind of advantage in having a certificate or disadvantage in not having one. Depending on what rules are set up as a prerequisite to get a certificate, there will be a high or low cost for the affected parties to comply. One can assume that since the certified companies are getting an advantage, the uncertified will most probably get a disadvantage. Meaning that the uncertified companies will get a cost increase by not participating. The gist of this reasoning is that the certified companies get a cost increase in administration, the uncertified companies are getting a cost increase by not participating and the control authority are getting a cost increase by checking the compliance.

The benefits of introducing the system of certificates must compensate for these costs. There is a difficulty in cost allocation in relation to benefits gained for the different stakeholders. The certificate can be intended for either the consignors, or the consignees, or to the distributors directly. Either way it should be designed in such way as to gain acceptance by the stakeholders by having an active dialog before its introduction. When using certificates, demarcation problems similar to those of subsidies can arise.

If using certificates for demands on the level of loading-factor in the vehicles, the effect might be a combination of ‘Option 1-4’ in chapter 2.6. Option 1 leads to less traffic work being carried out, while ‘Option 2’, if not fully implemented, leads to the same effects as ‘Option 3’; meaning more traffic work being carried out in the total system. ‘Option 4’ might lead to less traffic work but only if the terminal is located in close proximity to the affected area, otherwise the effect might be the same as for ‘Options 3’. The consequences of introducing a loading-factor certificate are hard to determine and will have to be evaluated from practical experiences. There are also a risk of getting many small vehicles instead of few big ones, which is counterproductive to the goals of reducing congestion and resource use.

6.2.6 Juridical

A change of the distribution system can also be brought about by force. The society has the power to institute laws and to control that they are followed. When using legal means there has to be a clear reason for using them. The society has to be able to show that restricting the freedom is for the benefit of all. The cost to carry out a

service can often become more expensive when there is legislation surrounding it. There is a risk of increasing the costs when using legal means to accomplish a goal. The transportation sector is used to carry out their services within the framework of what the legislation permits. Legal restrictions has always been part of the freight distribution activities and has had a strong effect on its design and efficiency.

6.2.7 Examples of juridical means of control

Time windows – are mainly used for inner-city distribution where it is prohibited to distribute after 11 am. The transportation sector is used to handle time restrictions since the consignees also have restrictions in when they can receive the delivery. Time restrictions are widely accepted and the distributors adopt to the demands.

By moving the traffic from one part of the day to another it is possible to reduce congestion, for example by nightly deliveries, but it does not necessarily reduce the amount of traffic work carried out. The problem of recourse use stays largely unaffected. Early or late deliveries can also cause problems for the residents living there with disturbing noise and vibrations.

If time restrictions are very narrow it can make the situation so difficult for the distributor that a cooperation between the distributors arise, alternatively that each distributor use an increasing amount of vehicles to carry out the distribution in a short time, which would be counterproductive. If some kind of freight cooperation arise, there is a risk that the effects would be similar to them outlined in ‘Option 3’ in chapter 2.6. Since the reloading have to take place somewhere, it might lead to longer distances driven in the total system.

Environmental zone – require that the companies renew their vehicle fleet. Pollution and noise disturbance are effectively managed by the society when introducing these rules. The rules strikes hardest against the small companies, since they get problems in coping with it economically. The introduction of an environmental zone has not led to a substantially increasing cooperation because of the cost increase, but the problem of congestion and resource use are still evident.

Technical standards – generally prohibit all kinds of vehicles that do not comply with certain specified standards, it is possible to force a cooperation into action. It gives an advantage to the ones that can afford investing in the special vehicle. Reloading have to be carried out somewhere, if the reloading terminal is located far away from the distribution area there is a risk of getting results similar to them outlined in ‘Option 3’ in chapter 2.6.

Certain vehicle – or certain company, will be the only one allowed to carry out the distribution if forbidding everyone else to use the streets. It can be put in place via a yearly tendering process, whereby ‘the winner takes it all’. From an efficiency point of view it might be regarded as optimal at first thought, while on the second thought a monopoly situation should be avoided. Competition is the driving force for efficiency and cost reductions in a market economy and a limitation to the market forces will implacably lead to undesirable consequences.

6.2.8 *Infrastructure*

The infrastructure is provided for by the society. The infrastructural restrictions determines the maximum weight, size and length of vehicles used in the traffic. The speed by which a vehicle is driven is ultimately determined by speed restrictions on the infrastructure used. The infrastructure can also be the factor determining the total distance a vehicle have to drive to get from one location to another. By putting limitations to the usage it is possible for the society to control the transport system and its function. It can be regarded as somewhat surprising that this tool is not used more effectively, considering the enormous costs infrastructure provision has on the society.

There are no set rules for what should be regarded as infrastructure and what should be a matter of private concern. It is largely determined by the economic and social values prevailing in the society at a certain time in history. In Sweden there has been some kind of consensus regarding what should be included as infrastructure for the different means of transport and what they handle. Following is examples:

Railways	(tracks, signals, communication, signs, rolling stock, reloading terminals, chunting terminals, stations, garages, workshops, bridges, tunnels, etc, etc)
Aviation	(landingstrips, terminals, parkingspace, communication, snow clearing, etc, etc)
Marine	(harbours, terminals, warehouses, signs, signals, channels, locks, cranes, pumps, etc, etc)
Road	(roads, signals, parkingspace, intermodal reloading terminals, signs, bridges, tunnels, snow clearing, etc, etc)
Passenger	(roads, buses, trams, tracks, subways, rolling stock, bus stops, bus stations, subway stations, garages, workshops, signals, signs, information, snow clearing, etc, etc)

To get efficiency in the usage of road infrastructure regarding freight transports, the means of control should steer in the direction of using:

1. Big units
2. Fully loaded units
3. Units driven shortest possible distance to carry out the service needed

High utilization of vehicles and infrastructure should be rewarded in the tax and charging system to create incentives for the companies to choose what is desired from the society's point of view.

6.2.9 *Summary*

It is the society that has the power of the means of control available to cope with the present situation of an inefficient freight distribution. There are different means of control to use to cope with the situation. Economical means can be used to render efficiency when making a change in the present distribution system but have to be careful not to create a monopoly situation, since that would lead to inefficiency.

Business knows business and if making a change the market will incorporate the new situation in their balance sheets, finding the most cost effective solution to the problem. Administrative means leads to increasing bureaucracy by its very nature and it is hard to predict if their consequences will give the desired result. Measuring and reporting for compliance with the rules are not part of the companies normal daily routines and will constitute a burden for the smaller companies with limited resources.

The transport sector are used to juridical means and adopt their business to the restrictions they imply. Time windows and environmental zone restrictions are largely accepted among the distributors. Juridical means often imply a cost increase when operations are made more complicated in order to comply with the rules. The infrastructure is owned, controlled and monitored by the society and is provided for according to prevalent values and traditions. Infrastructural changes is an excellent means of control for the society to use when steering the development in desired direction. Infrastructural means of control are being used all the time. For every road built or bridge built or roundabout built, a new status quo is created and the transport sector and the transport prices are adopted accordingly.

7 Analysis

The literature shows a growing awareness of the complexity of the issues dealt with. It shows that the transportation sector is already using available means, best possible way out of their own perspective, to render efficiency and to optimise the business solutions. The new information science does not seem to offer much help to further optimise the distribution system. It is changes in the business conditions that are needed to create opportunities for a coordination in the freight distribution.

Other projects carried out show that a coordinated freight distribution is not a technical problem but an organisational. Main problem in making the coordination long-lasting have mainly been on cost recovery for the changed patterns. This problem has been possible to overcome when the receiver's, through their common owner, have had power to control the material flow. A range of projects have been carried out lately with few of them showing any environmental benefits. It has been very difficult to bring about a coordination on purely voluntary basis, especially since the economical advantages in participating have been unclear. A reasonable assumption to make is that on an unstructured market with various owner constellations and conflicting interests, an outside force is needed to set the rules on a change in the distribution patterns for the benefit of all.

The freight forwarders are well aware of the problem with congestion on the roads and at the delivery points. They have a task to fulfill and execute it using available means best possible way out of their own perspective, as mentioned above. In their distribution and pickup loops they do not distinguish between demands on local transportation and long distance transportation, the goods are being handled in the same flow and taken to the terminals to be sorted out. Coordinated freight distribution already exist on a daily basis at some places where the cost of individual distribution systems substantially exceed the cost of carrying out the transport jointly, for example freight distribution to the archipelagoes.

The freight forwarders do not believe that a coordinated freight distribution in densely built-up areas will develop by itself. A balanced formula of opportunities and restrictions are needed so as to force a coordination into place. The operators soon find solutions in how to adapt to the new situation. Apart from competition, demands and restrictions from customers and authorities are the driving forces for development in the transportation business.

Office material is ordered when and as often as is convenient for the consignee. The frequency varies a great deal between the different companies investigated. The transport cost for office material supply is included in the price of the product and therefore invisible for the consignee. Some consignee's request rapidity in deliveries while others rather want to know at what time of the day the delivery will come, to be able to plan ahead. Apart from office material, the companies are getting deliveries with many other products as well. Fewer number of deliveries per day or per week is what many of the consignee's request when asked about improvements in present situation. The packing often constitute an inconvenience as the driver is leaving it there, instead of taking it with him. Wishes to have the same driver coming everytime has been stated, as it would render possibilities in getting a personal connection with the person carrying out the services.

There is a very tough competition in the office material supply business. The actors have made it difficult for themselves in offering such high service degree that profit marginals have become tight. The transportation costs have escalated during later years, as the development is going towards smaller and more frequent orders. By offering a dedicated homepage to all customers where orders can be gathered, some unnecessary deliveries can be avoided. Better routines for handling remainders could also help reducing the amount of traffic work being carried out. The transport cost have to be made visible to become negotiable. By offering progressive pricing of the products according to the transport costs caused, there will be a clear incentive in making orders less frequently.

The incentives available today are not enough to make a change in the present distribution system, no matter the information campaigns and demonstration projects carried out by the public authorities. Stronger incentives have to be created in order to make a change. There is a risk when using administrative means to get an expensive bureaucratic system along with it. Using economical means seems to be the best way to make changes and accomplish efficiency when doing so. The provision of infrastructure has a crucial impact on the quality and effectiveness by which the transportation is performed. It is the society that provide infrastructure and therefore largely control the effectiveness of transportation.

Means of control can be used to lower the cost of distribution for the companies that cooperate in the freight distribution, while increasing the cost for the companies not willing to do so. The transport sector is used to juridical means of control and adapt their business to the existing restrictions. Time windows and environmental zone restrictions are largely accepted. Infrastructural changes are an excellent means of control for the society to use when steering the development in desired direction.

8 Choice of solution for Norra Älvstranden

The incentives and means of control to be used should steer the development towards less traffic work being carried out but without deteriorating the service level or increasing the costs. There are two ways of dealing with this, which complement each other in both content and focus. To further improve the service level for the businesses located at Norra Älvstranden, the physical distribution can be complemented with a handy monitoring system based on IT applications.

1. Reduced frequency of deliveries.

The investigation show that there are no clear or strong incentives for ordering office material less frequently. To make orders more seldom there need to be some kind of an economic incentive in doing so. The transport cost is included in the price of the product and is therefore invisible for the customer. The transport cost have to be made visible by dividing the transport cost from the product cost. When the transport cost is clearly stated it can also be negotiated. The office suppliers can offer different price alternatives on their products according to the frequency in ordering (or the value of each order). Only then will any substantial results be achieved. This reasoning is valid for other products groups as well, not only office material.

2. Reloading terminal

To reduce the anticipated problems of congestion and accompanying resource use following increasing traffic work being carried out at Norra Älvstranden, a reloading terminal will have to be established at the entrance to the district. It is not possible to separate and optimise one product group from the others to get the desired results, the problem has to be handled in its entirety.

Usage of the reloading terminal will not happen by itself but an incentive, preferably economic, will have to be introduced. Coordinated freight distribution does not happen voluntarily, some kind of force is needed. The society can be regarded as responsible to provide the infrastructure needed for a good location, function and design of such terminal, while the daily operations can be carried out and financed by user charges. Parallels to the provision of airports or subway stations and their function can easily be drawn. Such major change will of course have to be accompanied with a great deal of information and education for the affected parties.

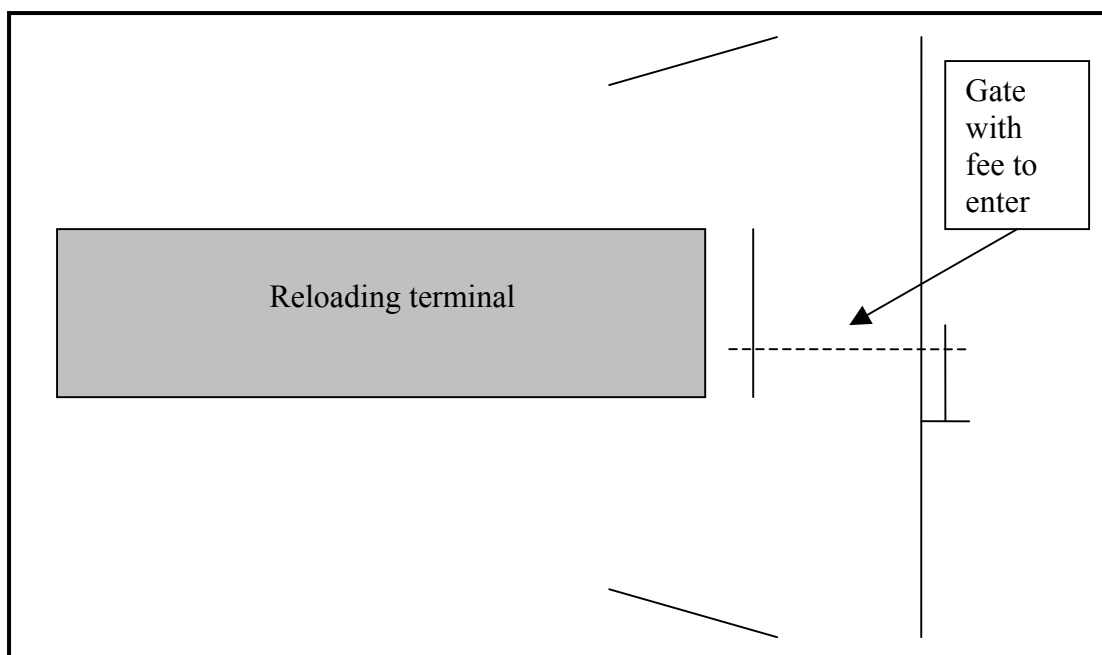


Figure 9. Principle for restricted passage into the district.

It should be the distributors responsibility to take care of the whole distribution also under the new conditions. It is the transport sector that has the knowledge and the possibilities to find effective solutions to a changed condition. There have to be a cost to not use the reloading terminal if desired results are to be achieved. Properly designed the new distribution system will not have to mean increasing costs for the distributors, but a cost neutral solution can be found. Synergy effects of coordinating the freight distribution can make up for the extra cost of reloading.

During present conditions, if there are no obstacles such as water or long distance, the delivery goes from the warehouse to the consignee without reloading. When using a terminal for reloading of the goods (fig 9), a cost increase can be expected. Results from international experiences indicate a cost increase of somewhere around 20%, if no synergy effects are made (Transportrådet, 1996).

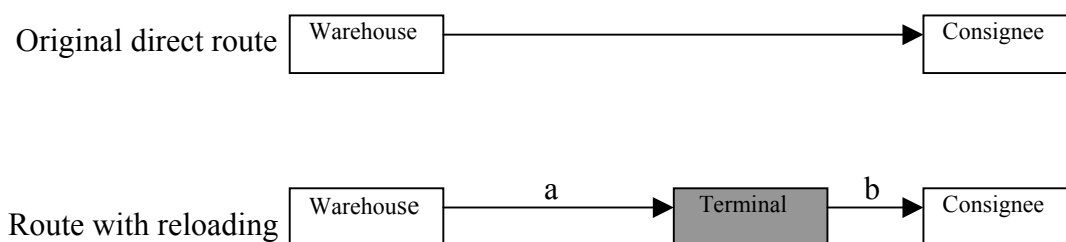


Figure 10. Distribution with a reloading point en route.

A fee to enter Norra Älvstranden by distribution vehicles have to be introduced, with an exemption of a short time in the early morning and a short time in the evening. This is to let some vehicles to get a free passage if staying inside the district the whole day (and to accommodate for trailers and other detachable platforms to get through

free of charge). The fee should be applicable for all freight vehicles exceeding 2,2 tonnes total weight and be high enough so as to make the distributors choose to unload their cargo at the terminal instead of driving to the delivery address themselves. Exemptions should be given to already fully loaded big vehicles, according to specified regulations and to special vehicles such as mobile cranes and concrete deliveries. To avoid a cost increase by using a terminal, synergy effects of more than 20% is needed. A simple example illustrate how this can be made:

A distributor (a) delivers on average 1 pallet to each consignee en route. When using a terminal for reloading many different kind of products from many different vehicles to only one vehicle, chances are good that distributor (b) will have on average more than 1 pallet to each consignee. If the distributor (b) gets on average 1,25 pallets per consignee, the cost of reloading will be regained. If the distributor gets on average more than 1,25 pallets per costumer, there will be a profit made. The profit could be used to cover the cost of running the terminal.

It is up to the actors on the transportation market to organise themselves in constellations so as to find the synergy effects needed to make profits out of a reorganisation of the distribution. The most successful constellation will reap the highest profits. An example of how this can work out in reality, for a small demonstration project, is given in Appendix E.

3. Monitoring

For the businesses to be able to plan their work during the day it is not only good to have less number of deliveries, but also to get to know approximately when, during the day, the delivery will arrive. By providing the distribution vehicles used within Norra Älvstranden with GPS-transmitting equipment, the present location of the vehicles and the daily distribution route can be shown on a map on a homepage in real-time 24 hours a day.

9 Consequence analysis

9.1 Norra Älvstranden

Following less traffic work being carried out by heavy vehicles in the district, both businesses and residents will, most likely, find it a more attractive area to reside in. If nothing is done to curb the traffic increase by distributors, the situation might well escalate into something similar to the city centre extravagance of congestion, noise and mix-up caused by uncoordinated deliveries to various businesses and residents.

With restrictions covering only vehicles of more than 2,2 tonnes total weight, normal residents and express deliveries of small consignments will largely stay unaffected. A more pleasant atmosphere will arise when businesses get fewer amount of deliveries per day. The businesses will be able to get a personal connection to the few drivers active in the district and thereby getting to know their routines and daily time schedule.

The drawbacks include higher risk of damaged cargo following an extra reloading and possibly delayed deliveries once in a while compared to status quo. Some businesses may experience a reduced freedom of operations when the transport flow is interrupted by an extra reloading. These businesses should be subject to exemptions from the rules during an intermediate stage until operations have been adjusted to prevalent circumstances.

9.2 The transport sector

When introducing a reloading terminal at Norra Älvstranden, as outlined in chapter 8, the distributors have a choice of either pay the fee to enter or to establish cooperation agreements in various constellations and appointing one or a few transportation companies to execute the transportation task on their behalf within the district. The agreement can be something similar as is used today for the distribution of freight to the islands of the south archipelago outside Gothenburg. An agreement like that can be found in the appendix.

A coordinated freight distribution system is about loading different products on the same vehicle and thereby reaping the environmental and economical benefits from doing so. The environment will gain when having less amount of vehicles driving on the streets within the Norra Älvstranden district and with a common point of unloading the cargo, vehicles used on the feeder roads coming to Norra Älvstranden can be made bigger with a higher capacity and thus reducing the number of vehicles on the streets also outside the district. Thereby it may be possible to reduce congestion(see example in appendix E).

The size of the distribution vehicle (a) can be made bigger if unloading many pallets at the terminal, since, as mentioned in chapter 2.3, it is the number of delivery points the driver is able to do in one day that determines the size of the vehicle. *Figure 11*

illustrates what would happen to the size of a distribution vehicle if going from an average of 15 pallets a day to an average of 20 pallets a day.

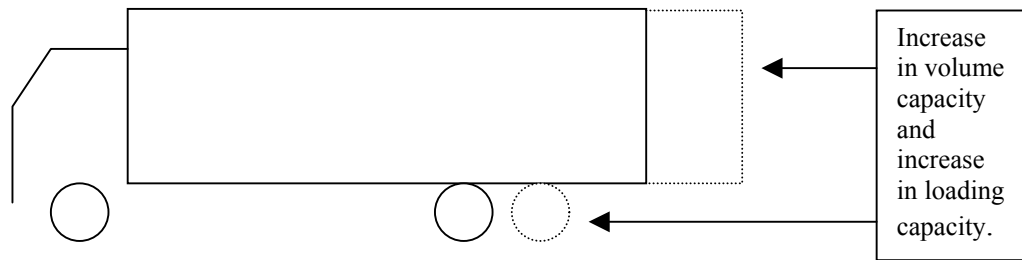


Figure 11. Increasing size of a distribution vehicle.

The traffic flow on a road is determined by the number of vehicles using it. Each vehicle with a pulling unit (p) and a carrying unit (c) needs in addition to its own length a stopping distance, breaking distance (b), to the nearest following vehicle. If many vehicles are coupled together it will reduce the amount of necessary breaking distances needed, since the number of vehicle combinations are reduced (Lumsden, 1998). Consequently, a potential for an increased traffic flow, or reduced congestion, appear.

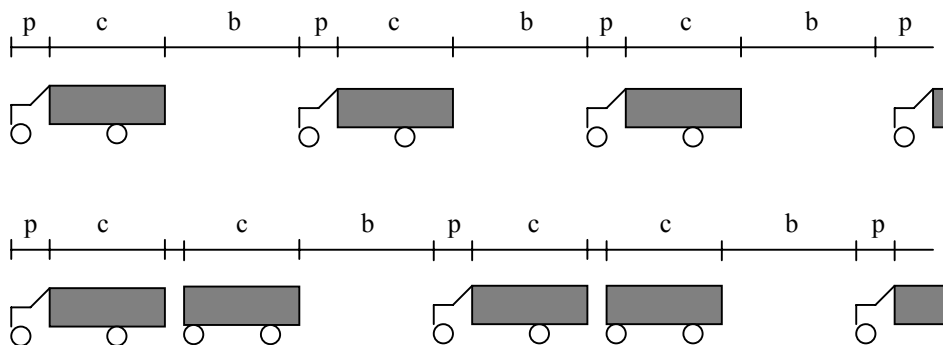


Figure 12. Principle to render efficiency on a road following increased capacity for every vehicle combination (redrawn from Lumsden, 1998).

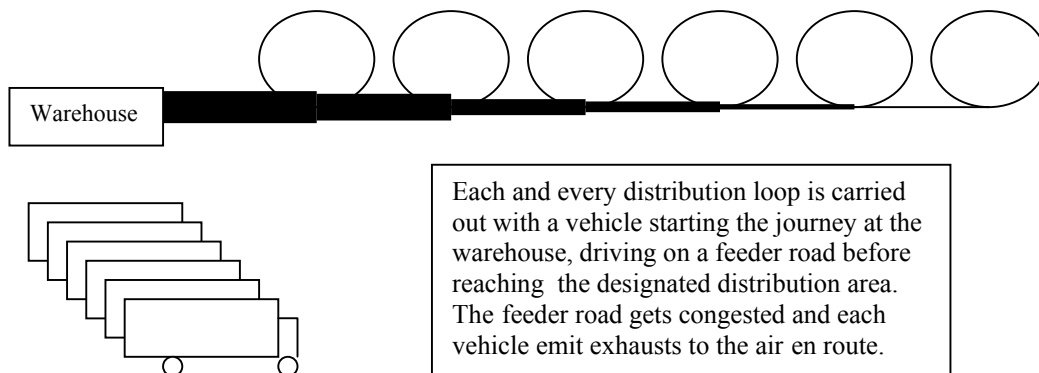
These possible environmental gains have to be balanced against the possible environmental drawbacks the construction and operation of a reloading terminal will involve. It is by no means a matter of course that this solution is the best in all different circumstances. As often with environmental work, it is a matter of comparing apples and pears and deciding on what it is one want to bring about.

9.3 Göteborg

Reloading terminals as proposed above can be applied in many parts of the city, providing for coordinated distribution in various districts. Introducing the same logic of choosing between paying a fee for passing the gate or unloading the cargo and letting someone else take care of the final distance and delivering at the recipient.

A distribution system in the city as it functions today is characterised by many small units, driving long distances with few products. It constitutes an unnecessary resource consumption, creates congestion on the roads and negative environmental stress. There are savings to be made, economically, environmentally, and congestion wise. In *figure 13* it is shown the principle of how the system can be made less resource intensive.

The system today:



The optimised system:

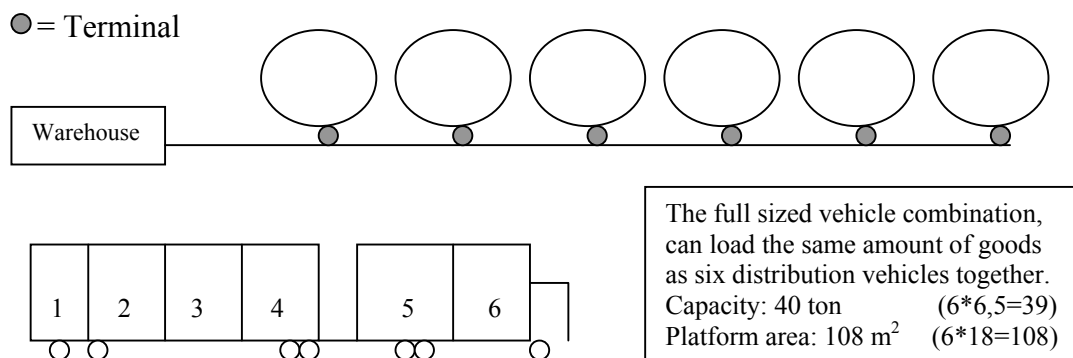


Figure 13. Six modules on a full sized feeder truck is equivalent to six distribution vehicles.

A feeder truck can carry the modules to each terminal, where a smaller distribution vehicle can take over. It would increase the capacity on the road substantially according to the logic shown in *figure 12* (Principle to render efficiency on a road). What we get by introducing reloading points at strategic places in the city along the feeder routes, is a more efficient distribution system. The character of the system will look similar to a subway system used for passenger traffic.

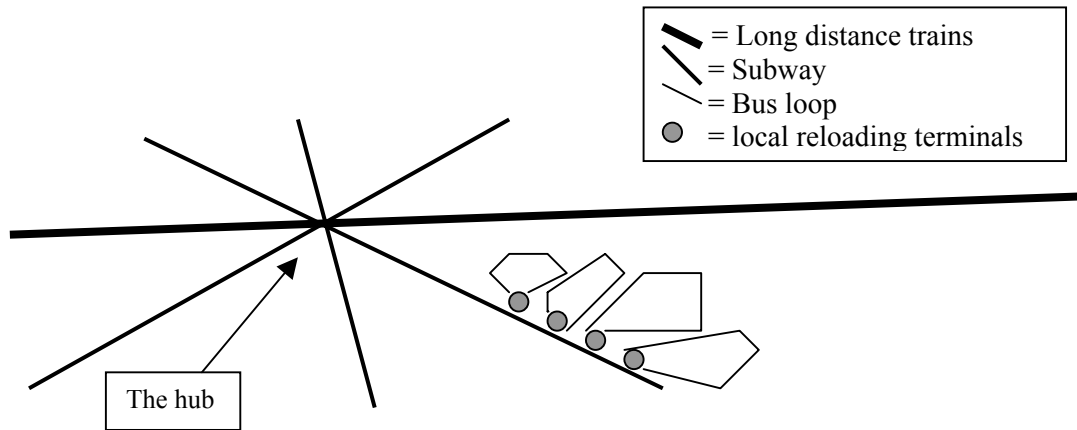


Figure 14. Public transport system with trains, subway, and buses.

Concerning the freight distribution in cities, there are no equivalent to the subway system. There are only the long distance vehicles (equivalent to long distance trains) and the distribution vehicles (equivalent to local buses). Without the equivalence to a subway system, the distribution vehicles have to start their distribution loop at the terminal for the long distance vehicles and drive one by one to their respective designated distribution area. There are today only two layers in the distribution system, no matter the size of the city. While in big cities, a third layer would be needed (fig 15).

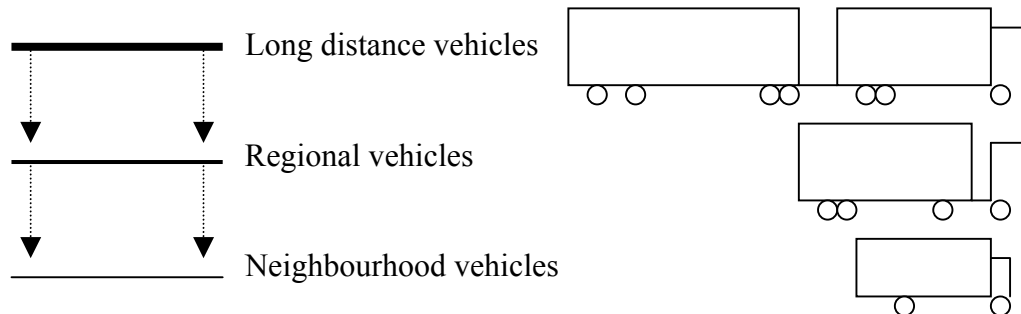


Figure 15. The different system layers needed in the distribution chain.

In the freight transportation market, there are not only one center where all long distance vehicles arrive and depart. Each warehouse where a distribution vehicle starts its distribution route from, resembles the “hub” in figure 14. A range of different hubs of various sizes are located in various places in and around the city. All of these businesses with their own hub, build up a distribution system to be able to reach their customers using their own distribution vehicles. With the proposed system the distributors will need, when distributing within Gothenburg, only a few big vehicles instead of many small ones.

10 Conclusion and recommendations

The incentives available today are not sufficient enough to bring about a change in the present distribution system. A coordinated freight distribution system based on pure voluntariness from the distributors is not likely. Means of control have to be used in order to create the incentives needed to bring about a change to status quo. There are no individual stakeholder on the market who feel responsible for changing the routines for the better of all. Each business optimise their own distribution system according to economic rational choice, according to prevalent conditions and the different options at stake.

The proposed solution resembles a public/private partnership similar to how an airport is setup, managed and financed. A great deal of the responsibility comes on the public authorities who has got to put the infrastructure in place at the markets disposal and will also have a major financial obligation. Responsibility for management and efficiency of operations should preferably be taken cared of by the transportation sector, same as it is under present circumstances.

For the public authorities not to take on more than they can manage it may be advisable to first execute a smaller demonstration project with a number of voluntary stakeholders covering only small and medium-sized consignments, usually distributed by delivery vans. A number of consignees located at Norra Älvstranden can participate in a project with a mutual delivery address separated from the physical address and thereby getting only one delivery per day with these kind of consignments(see example in appendix E).

Financing the final distance in the transport chain will be a matter of negotiation between the public authorities and the distributors involved. Examples from cost recovery in the distribution to the islands in the archipelago can be used with advantage. Measurements for a statistical foundation before, during, and after the project are of crucial importance for a continuation and widening of operations directed towards establishing a coordinated distribution system as proposed above.

As for office material, there are few incentives for the companies to reduce the frequency of ordering since the transport costs are included in the price of the products. To get any substantial change in ordering behaviour, the transport cost have to be separated from the product cost and made progressive according to the frequency of ordering or size of order. Only then can there be any long lasting results. The public authority can continue and intensify its work in trying to influence the businesses in this direction. It is also possible to widen the venture to cover also other product groups with the same objective of visualising the transport cost in order to make it negotiable

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12 Appendices

Appendix A

Företagets namn

Gbg 2002-XX-XX

Hej – Namn på ansvarig beställare av kontorsmaterial--

Jag heter Magnus Larsson och studerar Transportekonomi- och Hållbar Infrastruktur på Chalmers Tekniska Högskola. Avslutande delmoment i studierna är ett examensarbete som ska utföras under en termin. Jag har fått i uppdrag av Trafikkontoret, Göteborgs stad, att göra en undersökning gällande **samordnad varudistribution av kontorsmaterial på Norra Älvstranden**.

Titel: *Incitament och styrmedel för en långsiktig hållbar samordnad varudistribution i tätort.*

Syftet är att identifiera och analysera vilka drivkrafter som ligger bakom rådande förhållanden för att på så sätt avgöra hur man på lämpligt sätt kan underlätta en samordning av varudistributionen. Målet är att minska trafikarbetet, trängseln på vägarna och miljöbelastningen, genom effektivare flöden och smarta lösningar.

Min uppgift är att hitta en lösning som kan vara till godo för samtliga parter.

DISKUSSIONSUNDERLAG (OBS: ENDAST KONTORSMATERIAL)

1. Företagets namn, storlek, antal anställda, affärsidé.
2. Nulägesbeskrivning (hur gör ni i verkligheten)

A. Leveranserna:

Vad är bra och vad är dåligt med dagens leveranssystem?

B. Lagret:

Hur uppdateras lagret?

Hur fungerar beställningsrutinerna?

C. Kostnader:

Uppfattning om transportkostnaden?

Faktureringsrutiner?

D. Konkurrensen:

Hur sker kontakterna mellan er och er leverantör?

3. Hur kan ovanstående förbättras / hur skulle ni vilja ha det?

Magnus Larsson, e-mail: pellefant69@hotmail.com tel: 031-66 44 36 fax: 031-66 10 44

Appendix B

Hej –Namn på representant för leverantören-- Gbg 2002-XX-XX
Jag heter Magnus Larsson och studerar Transportekonomi- och Hållbar Infrastruktur på Chalmers Tekniska Högskola. Avslutande delmoment i studierna är ett examensarbete som ska utföras under en termin. Jag har fått i uppdrag av Trafikkontoret, Göteborgs stad, att göra en undersökning gällande **samordnad varudistribution av kontorsmaterial på Norra Älvstranden**.

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Syftet är att identifiera och analysera vilka drivkrafter som ligger bakom rådande förhållanden för att på så sätt avgöra hur man på lämpligt sätt kan underlätta en samordning av varudistributionen. Målet är att minska trafikarbetet, trängseln på vägarna och miljöbelastningen, genom effektivare flöden och smarta lösningar.

Min uppgift är att hitta en lösning som kan vara till godo för samtliga parter.

DISKUSSIONSUNDERLAG (OBS: ENDAST KONTORSMATERIAL)

1. Nulägesbeskrivning (hur gör ni i verkligheten)

A. Leveranserna:

Vad är bra och vad är dåligt med dagens leveranssystem?

B. Lagret:

Hur uppdateras kundens lager?

Hur fungerar beställningsrutinerna?

C. Kostnader:

Uppfattning om transportkostnaden för leveranserna?

Hur stor del av priset utgör transportkostnaden?

Faktureringsrutiner?

D. Konkurrensen:

Vilka är era konkurrensmedel?

2. Hur kan ovanstående förbättras / hur skulle ni vilja ha det?

E. Samordnad varudistribution

Hinder och möjligheter för er verksamhet?

Vilka krav måste kunderna ställa för att en förändring ska komma till stånd?

Magnus Larsson, e-mail: pellefant69@hotmail.com tel: 031-66 44 36 fax: 031-66 10 44

Appendix C Möte med representanter inom transportsektorn.

Jag heter Magnus Larsson och studerar Transportekonomi- och Hållbar Infrastruktur på Chalmers Tekniska Högskola. Avslutande delmoment i studierna är ett examensarbete som ska utföras under en termin. Jag har fått i uppdrag av Trafikkontoret, Göteborgs stad, att göra en undersökning gällande **samordnad varudistribution av kontorsmaterial på Norra Älvstranden**.

Titel: *Incitament och styrmedel för en långsiktigt hållbar samordnad varudistribution i tätort.*

Syftet är att identifiera och analysera vilka drivkrafter som ligger bakom rådande förhållanden för att på så sätt avgöra hur man på lämpligt sätt kan underlätta en samordning av varudistributionen. Målet är att minska trafikarbetet, trängseln på vägarna och miljöbelastningen, genom effektivare flöden och smarta lösningar.

Min uppgift är att hitta en lösning som kan vara till godo för samtliga parter.

DISKUSSIONSUNDERLAG (OBS: ENDAST KONTORSMATERIAL)

1. Nulägesbeskrivning (hur gör ni i verkligheten)

A. Leveranserna:

Kommer leveransen vid lämplig tidpunkt till mottagaren?

Hur viktig är rätt-tidigheten kontra snabbheten av leveransen?

Placeras leveransen på lämplig plats?

Vilken typ av fordon används?

B. Beställningen:

Hur fungerar beställningsrutinerna?

Vilken framförhållning krävs av beställaren?

C. Kostnader:

Vilken är kundens uppfattning om transportkostnaden?

Lönsamhet i er distributionskörning?

Kostnad per stopp?

Faktureringsrutiner?

D. Konkurrensen:

Vilka är era konkurrensmedel?

2. Hur kan ovanstående förbättras / hur skulle ni vilja ha det?

E. Samordnad varudistribution

Hinder och möjligheter. Hur ska man få till stånd en samordning?

Magnus Larsson, e-mail: pellefant69@hotmail.com tel: 031-66 44 36 fax: 031-66 10 44

Varför kan man ge rabatt om alla på Norra Älvstranden går ihop och gör en gemensam upphandling av transporterna?

Vilka incitament står till buds?

Ekonomiska – lägre kostnader – hinna med fler ställen på en dag.

Tidsmässiga – snabbare leverans – bättre framkomlighet

Ökad servicegrad till kunden

Underlätta för de som är duktiga???

Skattelättnader?

Billigare försäkring på vissa transporter?

Lediga lastzoner

Utnyttjande av Kollektivtrafikkörfält

Synliggöra transportkostnaden för varje leverans

Synliggöra miljöpåverkan för varje leverans

SMS meddelande – “nu kommer vi inom en timme!”

Nationell godsdatatabas – inrapportering om vad som finns på flaken – rabatt till de duktigaste.

Monitoring – GPS sändare i bilen som visar exakt var han befinner sig på en karta så att mottagarna kan gå in och kolla det. Funkar bättre om endast en bil kommer per dag. Bättre än dagens track-and-trace. Detta kan vara i realtid.

Upphandling av transporterna kan ge rabatt. Många kan gå ihop och därigenom få ner priset. Krävs att mottagaren har “makten över frakten”.

Styrmedel som står till buds?

Kunskapsmedel – “det goda exemplet”

Ekonomiska styrmedel – Avgifter eller subventioner.

Administrativa styrmedel- Certifiering (auktoriseras av lämplig organisation)

Rättsliga styrmedel - någon sorts tvång

- tidsrestiktioner

- miljözon

- förbjuda distribution/tillåta endast

vissa(samlastade) fordon

Appendix D

FRAKTVILLKOR

För godsbefordran med fartyg tillhöriga AB Göteborg-Styrsö Skärgårdstrafik gäller följande villkor:

1. Gods skall avlämnas till fartyg direkt vid kaj och avlämnas vid kaj vid fartygets framkomst. Rederiets ansvar för godset inträder vid lastningens början och upphör efter lossningens slut. För gods som i avvaktan på befordran har kajlagts svaras således icke. Om gods icke mottages, när det lossas, skall det kajläggas av rederiet på varuägarens risk och utan skyldighet för rederiet att anordna bevakning. Då lastning eller lossning företas av varuägaren själv, eller av dennes ombud eller avlastare, står han också för risken härför. Allt gods fraktas på däck.
2. Rederiet svarar icke för uppgifterna i fraktsedel vad beträffar innehåll, vikt, mått, värde eller kvalitet, ej heller för bristande eller felaktig märkning eller adressering av godset, ej heller för skada på godset eller dåligt emballage.
3. Rederiets ansvar är under varje förhållande begränsat i enlighet med gällande svensk sjölag. Allt gods fraktas normalt på däck. I mån av tillgång på skyddade utrymmen äger rederiet rätt att därstädes placera som däckslast angivet gods. Rederiet svarar ej för dröjsmålsskada eller indirekt skada.
4. Om is eller annat hindrar fartyget att uppnå destinationsorten, lossas godset på lastägarens risk och bekostnad på annan plats mot betalning av full frakt.
5. Skriftlig underrättelse om förlust eller skada skall tillställas rederiet genast, dock senast inom 3 dagar efter det att lossningen ägt rum eller skulle ha ägt rum.
6. Tvister under dessa fraktvillkor skall avgöras vid Göteborgs Tingsrätt.

STYRSÖBOLAGET

Short in english: *Terms of conditions for freight*

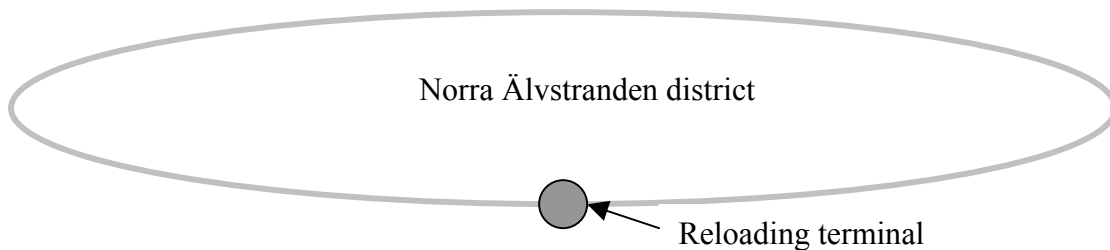
For freight forwarding with ships belonging to Gothenburg-Styrsö Archipelago traffic following conditions apply:

1. *Freight are to be delivered to the ship at the wharf and is delivered at the wharf when the ship arrives. The shipping company is responsible for the freight from the time of loading until it has been unloaded. Responsibilities do not cover freight stored at the wharf after unloading. Etc, etc....*
2. *The shipping company are not responsible for statements in consignment notes in regard to content, weight, measurement, value or quality, not for inadequate marking or labelling of the freight, and not for damaging caused by poor wrapping.*
3. *The shipping company's responsibility is limited to act according to swedish law. Etc, etc....*

Etc, etc, etc.....

Appendix E

On the following pages a calculation example shows possible effects and results of a smaller practical attempt to coordinate the distribution of parcels to Norra Älvstranden. In the example it is assumed that four major freight forwarders are included in the project and that the reloading takes place at a suitable place at the entrance to Norra Älvstranden district.



Delivery vans from the four companies comes to the terminal to unload all packages with a delivery address within Norra Älvstranden district, as part of their normal distribution loop. It is assumed that to unload some 15 parcels at the terminal, takes approximately the same amount of time as to deliver to two different addresses (25 parcels equals 4 different addresses). The packages are being reloaded into only one delivery van (company E) for further distribution to the final recipient.

It is further assumed that there will be a small synergy effect of 25% on the final distribution loop. This means that; in the original scenario the four delivery vans had on average only one package to deliver per stop made, while after reloading there will be on average 1,25 packages to deliver per stop. After the reloading is done, some of the packages will have a common recipient. The cost of reloading is being regained on the reduced cost of distribution.

The gist of the reasoning is that for the distributors to avoid cost increases under the new circumstances as proposed in chapter 8, consortias need to be formed. The most successful consortium gets the highest synergy effect and can thereby reap the highest profits. Cooperation is rewarded, while unwillingness to cooperate becomes unpractical.

Note:

A successful consortium with an attractive arrangement may attract many smaller participants wanting to join the syndicate. The so called 'company car' distributors can with advantage delegate their final distribution to the consortium.

These organisational changes makes it possible to gradually transfer deliveries now made by company car distributors to become part of a syndicate managed by professional freight forwarders. Deliveries made by the company cars makes up a substantial part of the total traffic work carried out in the distribution system and adds to the congestion on the roads and at the delivery points (for further information about company car distribution see Wetterwik et al., 1998 and Pettersson, 1999).

Starting position

Company A

Delivery van

Total number of packages		75 cll
Number of packages for NÄ		15 cll
Total distance driven	(7,5*2+75)	90 Km
Distance driven within NÄ		10 Km
Km / package outside NÄ	(90km/75cll)	1,2 km
Km / package within NÄ	(90km/75cll)	1,2 km
Total time used	(8 tim*60)	480 min
Time / package outside NÄ	(480/75cll)	6,40 min
Time / package within NÄ	(480/75cll)	6,40 min
Total cost	360 kr/tim = 6 kr/min	2880 kr
Cost / package	(6kr*6,4min)	38,40 kr

Off loading at terminal for deliveries within Norra Älvstranden district

Company A

Delivery van

Total number of packages	(73 + 15)	88 cll
Number of packages for NÄ		15 cll
Total distance driven		85 km
Distance driven within NÄ		0 km
Km / package outside NÄ	(85km/88cll)	0,97 km/cll
Km / package within NÄ	(transferred)	0 km/cll
Kilometre saving		5 km
Total time used	(8 tim*60)	480 min
Time / package outside NÄ	(467,5/73cll)	6,4 min
Time / package within NÄ	(12.8/15cll)	0,85 min
Time saving (transferable to third part NÄ)		83,25 min
(6,40-0,85=5,55)	(5,55*15=83,25)	
Total cost		2880 kr
Cost / package outside NÄ		38,40 kr
Cost / package within NÄ	(0,85*6kr)	5,10 kr
Cost saving (transferable to third part NÄ)		500 kr
(88cll*38,40kr)	=	3379,20
((73cll*38,40)+(15*5,10))	=	2803,20+76.50 = 2879,70
		3379,2-2879,7 = 500 kr

Starting position

Company B

Delivery van

Total number of packages		80 cll
Number of packages for NÄ		20 cll
Total distance driven	(3,5*2+75)	82 Km
Distance driven within NÄ		10 Km
Km / package outside NÄ	(82km/80cll)	1,03 km
Km / package within NÄ	(82km/80cll)	1,03km
Total time used	(8 tim*60)	480 min
Time / package outside NÄ	(480/80cll)	6,0 min
Time / package within NÄ	(480/80cll)	6,0 min
Total cost	360 kr/tim = 6 kr/min	(480 á 6kr) 2880 kr
Cost / package		(6kr*6,0min) 36,0 kr

Off loading at terminal for deliveries within Norra Älvstranden district

Company B

Delivery van

Total number of packages	(77 + 20)	97 cll
Number of packages for NÄ		20 cll
Total distance driven		77 km
Distance driven within NÄ		0 km
Km / package outside NÄ	(77km/97cll)	0,79 km/cll
Km / package within NÄ	(transferred)	0 km/cll
Kilometre saving		5 km
Total time used	(8 tim*60)	480 min
Time / package outside NÄ	(468/77cll)	6,08 min
Time / package within NÄ	(18,24/20cll)	0,91 min
Time saving (transferable to third part NÄ)		103,40 min
(6,08-0,91=5,17)	(5,17*20=103,40)	
Total cost		2880 kr
Cost / package outside NÄ		36,48 kr
Cost / package within NÄ	(0,91*6kr)	5,46 kr
Cost saving (transferable to third part NÄ)		620,40 kr
(97cll*36,48kr)	=	3538,56
((77cll*36,48)+(20*5,46))	=	2808,96+109,20 = 2918,16
		3538,56-2918,16 = 620,40 kr

Starting position

Company C

Delivery van

Total number of packages		75 cll
Number of packages for NÄ		25 cll
Total distance driven	(10*2+75)	95 Km
Distance driven within NÄ		10 Km
Km / package outside NÄ	(95km/75cll)	1,27 km
Km / package within NÄ	(95km/75cll)	1,27 km
Total time used	(8 tim*60)	480 min
Time / package outside NÄ	(480/75cll)	6,4 min
Time / package within NÄ	(480/75cll)	6,4 min
Total cost	360 kr/tim = 6 kr/min	(480 á 6kr) 2880 kr
Cost / package		(6kr*6,4min) 38,4 kr

Off loading at terminal for deliveries within Norra Älvstranden district

Company C

Delivery van

Total number of packages	(71 + 25)	96 cll
Number of packages for NÄ		25 cll
Total distance driven		90 km
Distance driven within NÄ		0 km
Km / package outside NÄ	(90km/96cll)	0,94 km/cll
Km / package within NÄ	(transferred)	0 km/cll
Kilometre saving		5 km
Total time used	(8 tim*60)	480 min
Time / package outside NÄ	(454,4/71cll)	6,4 min
Time / package within NÄ	(25,6/25cll)	1,02 min
Time saving (transferable to third part NÄ)		134,50 min
(6,4-1,02=5,38)	(5,38*25=134,50)	
Total cost		2880 kr
Cost / package outside NÄ		38,4 kr
Cost / package within NÄ	(1,02*6kr)	6,12 kr
Cost saving (transferable to third part NÄ)		818,40 kr
(96cll*38,4kr)	=	3686,4
((71cll*38,4)+(25*5,38))	=	2733,5+134,5 = 2868
		3686,4-2868 = 818,40 kr

Starting position

Company D

Delivery van

Total number of packages		60 cll
Number of packages for NÄ		15 cll
Total distance driven	(10*2+75)	95 Km
Distance driven within NÄ		10 Km
Km / package outside NÄ	(95km/60cll)	1,58 km
Km / package within NÄ	(95km/60cll)	1,58 km
Total time used	(8 tim*60)	480 min
Time / package outside NÄ	(480/60cll)	8 min
Time / package within NÄ	(480/60cll)	8 min
Total cost	360 kr/tim = 6 kr/min	2880 kr
Cost / package	(6kr*8min)	48 kr

Off loading at terminal for deliveries within Norra Älvstranden district

Company D

Delivery van

Total number of packages	(58 + 15)	73 cll
Number of packages for NÄ		15 cll
Total distance driven		85 km
Distance driven within NÄ		0 km
Km / package outside NÄ	(95km/73cll)	1,3 km/cll
Km / package within NÄ	(transferred)	0 km/cll
Kilometre saving		5 km
Total time used	(8 tim*60)	480 min
Time / package outside NÄ	(464/60cll)	7,72 min
Time / package within NÄ	(16/15cll)	1,07 min
Time saving (transferable to third part NÄ)		103,95 min
	(8,0-1,07=6,93)	(6,93*15=103,95)
Total cost		2880 kr
Cost / package outside NÄ		48 kr
Cost / package within NÄ	(1,07*6kr)	6,42 kr
Cost saving (transferable to third part NÄ)		719,70 kr
(75cll*48kr) =	3600 kr	
((58cll*48)+(15*6,42))	= 2784+96,3 = 2880,30	
	3600-2880,3 = 719,7 kr	

Savings made by the four companies:

Total distance saved	(A+B+C+D)	20 km
Total time saved	(83,25+103,40+134,50+103,95)	425 min
Total cost saved	(500+620,40+818,40+719,70)	2659 kr

New situation within Norra Älvstranden district

Loading at terminal and distribution within Norra Älvstranden district

Company E

Delivery van		
Number of packages for NÄ	(15+20+25+15)	75 cll
Distance driven within NÄ	(2,5*2+10)	15 km
Km/package within NÄ	(15km/75cll)	0,2 km
Time / package before synergy		6 min
Total time used	(75cll*6)	450 min
Synergy effect 1,25	(75cll/1,25)	60 stopp
Number of packages per stopp		1,25 cll
Time / package after synergy	(6 min/1,25)	4,8 min
Total time used	(60cll*4,8)	288 min
		4,8 tim
Total cost	(288*6kr)	1728 kr

Savings that can be used to cover the cost of reloading at a terminal

Time savings	(425-288)	<u>137 min</u>
		2,3 tim
Cost savings	(137*6)	<u>822 kr</u>

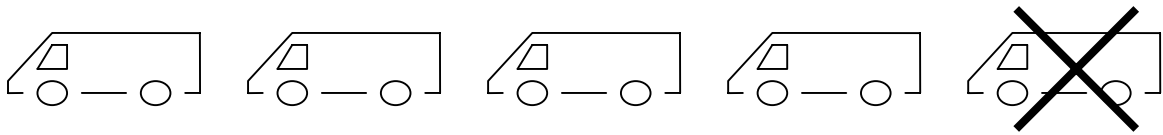
If synergy effect is 1,5 (a profit can be made)

<i>Time savings</i>	<i>(425-180)</i>	<i>245 min</i>
		<i>4 tim</i>
<i>Cost savings</i>	<i>(245*6)</i>	<i>1470 kr</i>

The cost of reloading the packages at a local terminal for further distribution within the Norra Älvstranden district can in this example come up to 20% without causing a net cost increase for the transportation companies involved.

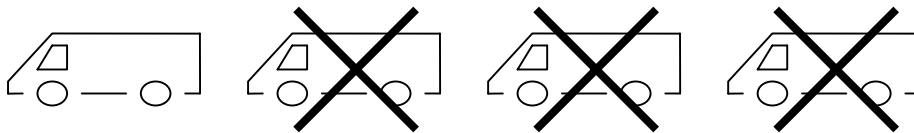
Positive effects include: *Reduction of the number of delivery vans on the trunk roads leading to the Norra Älvstranden district by 20%.*

Some 354 packages are brought to the district on the trunk roads using only four vans instead of five, increasing the average load of packages when beginning the distribution loop from 72,5 to 88,5. An increase by 22%.



Reduction of the number of delivery vans used for distribution within the Norra Älvstranden district by 75%.

The distribution work is carried out using only one vehicle instead of four.



As there are positive effects such as the above mentioned there are also other effects to take into consideration, of which a few can be mentioned. For this solution to function, it requires the disposal of a suitable place for reloading. It is noteworthy that a place for reloading can imply other drawbacks out of an environmental and resource use point of view and also that an extra reloading, as in this example, does not necessarily mean a time delay in the delivery but can, however, constitute a risk for damages and wastage on the goods.
