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WORLD MARITIME UNIVERSITY

Malmö, Sweden

**IMPACTS OF THE NEW FIXED LINK
BETWEEN SWEDEN AND DENMARK ON THE
TRANSPORT LOGISTICS SYSTEM IN SWEDEN**

By

LAMIA BENNOUNA
Morocco

A dissertation submitted to the World Maritime University in partial
fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

SHIPPING MANAGEMENT

1999

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Dissertation: **Impacts of the New Fixed Link between Sweden and Denmark on the Transport Logistics System in Sweden**

Degree: **MSc**

The dissertation is a study of the impacts of the new fixed link over the Oresund on the Swedish transport logistics system.

Sweden is separated from the continent by its peninsula situation. The advent of the Oresund link in the year 2000 is going to be a historic event that represents a major step in the integration of Scandinavia into the EU. For the first time, Sweden will be linked directly by land to the continental Europe. The new fixed link will have various effects in the region, including impacts on the transport logistics related to the carriage of goods from and to Sweden.

It would appear that one of the main beneficiaries of the fixed link would be the railway if efforts are made to develop the European railway network. In particular, this will comprise transport over medium and long-distance.

Besides rail transport, road transport on short distances is also expected to be the main user of the Oresund link, taking advantage of the 24-hour opening of the bridge.

On long distances to the continent, ferry lines via Trelleborg remain the most advantageous routes for road transport as the crossing time is taken as a rest period for the driver.

The main airports in the Oresund region, Kastrup and Sturup airports will benefit from the new fixed link which will connect these airports to the road and rail network on both sides of the Sound.

KEYWORDS: Oresund Fixed-link, Transport modes, Logistics, Efficiency, Economic impact.

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LIST OF ABBREVIATIONS

MAL:	MALMÖ
CPH:	COPENHAGEN
SWE:	SWEDEN
EUR:	EUROPE
EU:	EUROPEAN UNION
TEN:	TRANS-EUROPEAN NETWORK

CHAPTER 1

INTRODUCTION

It has been seen throughout the world history how infrastructure projects influence populations, and help shape their ways of living and their culture. Nowadays, coming to the 21st century, civilisations are very diverse, dragging ideas from each other, which enlarges the importance of undertakings that facilitate communication between places and groups of people.

Although communication has expanded into many spheres, such as electronic, digital, and wireless transfer of data, trade is paramount because it relates to tangible products that can be transferred and interchanged from one location to the other, giving to a country what other may produce better, increasing options of purchase, commercial interchange, flow of foreign currency, and by consequence, better standards of living.

An infrastructure of such importance is being built in Scandinavia, a fixed-link between Denmark and Sweden. This construction will connect the continental part of Europe with the northern part of Scandinavia. An enterprise as this, of such size and importance, will entitle a huge investment from both countries. Therefore, the taxpayers and the community have placed broad expectations on it.

It has to be seen to which extent the new fixed-link over the Oresund will have an impact on the region. The politicians have different forecasts, and the business community is divided. It remains to be known if the public has totally accept it. Although the expectancies start with the general public to the highest ranks, a large portion of the success of this link will depend on the international trade.

Is it really going to be a change in the patterns of trade in Scandinavia? Are Denmark and Sweden going to become more competitive upon its construction? A bridge means connecting land with land. In this case, several enterprises linked to water transport will be affected: ports, ferry companies. What will be the changes in transportation logistics?

The impact of this link on the transport business can be taken as a benchmark for the fixed-link that is being under study between Morocco and Spain, linking two continents over the Gibraltar Strait, one of the busiest waterways in the world.

1.1. Objective of the study

This study aims to present the new fixed link over the Oresund, which will connect the northern part of Scandinavia with Denmark, and therefore with the rest of the continent. This new fixed link will have several impacts on different fields, including the transport system. This paper examines the potential impacts of this new infrastructure on the transport logistics, browsing through the vital aspects of the study such as the current transport logistics system in Sweden and its main characteristics, and the general features of the fixed-link itself.

1.2. Research methodology

The study is based on several types of sources:

- Books give the general overview over a subject, and explain in more extensive detail the basic concepts of transport and logistics.
- Magazines give a specialised insight regarding an issue. Through magazines and periodicals, one can have access to the latest facts and figures that are necessary to make any research up to date with the latest facts.
- Internet is important in order to access in a timely manner information regarding any company or organisation in particular, and facts and figures as well.
- Personal interviews are a vital resource for any scrutiny. The opinion of experts and people from the field provides the readers with the view from different people over the same issue. Interviews can also influence the author in considering one direction or another in the focus of its work. Therefore, its contribution is essential.

1.3 Structure of the study

This study is structured as follows:

Chapter 2 exposes the current transport logistics system in the region. Transport network and infrastructures used by transport service providers when moving goods from and to Sweden are presented. An overview of the trade pattern in the region is given, allowing the reader to understand the importance of all transport modes described. Then the main

characteristics of the Swedish logistics transport system will be analysed in terms of the carriage of goods from and to Sweden and its peculiarities.

Chapter 3 presents the bridge itself and its characteristics regarding services provided to the user, capacity, and prices. The socio-economic and environmental impacts will be discussed as well.

The transport logistics impacts of the new fixed-link will be forecasted in Chapter 4. It intends to present how the present transport logistics system may change with the introduction of the Oresund link. The impacts will be analysed for each mode of transport after a browsing of the general opinion among the Swedish transport providers.

Finally, in its Chapter 5, the writer will draw conclusions related to this study

CHAPTER 2

CURRENT TRANSPORT LOGISTICS SYSTEM IN SWEDEN

This chapter aims at presenting the main characteristics of the Swedish transport logistic system nowadays when carrying cargoes to and from Sweden, through an overview of the existing structures and facilities used by logistics service providers. The basic concept of transport logistics will be introduced first, followed by a general outlook of the trade in the region, which is the driving factor for continuous improvement in transport logistics services.

2.1. Basic concept of transport logistics

Logistics is defined as “a process of the location, movement and storage of resources from the point of origin, through various economic activities, to the final consumer” (Ma, 1998).

Seen from a strategic and competitive point of view, it becomes more and more important to ensure “the right products of the right quality and at the right price, are at the right place at the right time and in the right quantity, for the right customer”. Customers have become more and more demanding, not only vis-à-vis price and quality

but also with regards to speedy and reliable product delivery. In that, transportation plays a fundamental role in the logistic management process.

2.1.1. Transport mode characteristics

Each means of transport has its specific attributes that the transport logistic provider has to be aware of when choosing it, alone or combined with others, to perform a voyage. The four major modes of transport, i.e. sea, road, rail, and air transport, are presented in the following sections.

2.1.1.1. Sea

Sea transport remains the cheapest way to carry goods. This particularly applies to bulk cargo and to large packaged consignments that are going long distances. Where time delivery is not a priority, then the cheapness of sea freight makes it very competitive.

Sea transport tends to be very slow for several reasons, such as the actual voyage time, the turn around time in port that is still quite slow, and delay problems that may occur at the loading port and/or discharging port, or due to bad weather for example.

Sea transport is flexible in terms of the number of alternatives that are open. There are many tramps and liners that operate quite frequently nowadays. However, flexibility is limited in terms of size of ships.

2.1.1.2. Road

In the context of national distribution, road freight is very important. It provides a quick service and all parts of countries can be reached nowadays with the extensive road

networks. Its high flexibility makes it an advantageous mode of transport regarding transit time. With the flourish of just-in-time concept and the requirements for regular, frequent deliveries and flexibility, road transport is adequate and the other modes of transport will have difficulties to compete.

In the context of international distribution, road transport is also important, particularly in terms of the use of roll-on/roll-off (RORO) ferry services. These services can provide a very quick service, if ferry schedules are carefully timed into the route plans. Saving time is great, as there is a reduced need to double-handle and tranship goods and packages. The system can provide regular, scheduled services due to frequent ferry sailings, and due to the flexibility of road vehicle scheduling.

2.1.1.3. Rail

Conventional rail freight is a relatively cheap way of transport, particularly for bulky and heavy consignments to move over medium and long distances and where time is not vital. It is also a relatively slow means of transport, between road and sea transport as far as transit time is concerned. For long distance movement, rail is able to compete with road transport.

Rail transport has been developed during the last decade with the introduction of containerized systems, using ISO containers as the basic unit load, and the swap body concept of transferable road-rail units (Oxley and Rushton, 1991).

2.1.1.4. Air

Air transport is the quickest means of transport, as well as the most expensive one. Its flexibility is high as any number of countries and markets can be reached quickly and

easily. The time advantage can be reduced with airport congestion, handling and paperwork delays.

It is very advantageous for commodities with high value to weight ratios, for which expensive freight cost is not significant. However, for the vast majority of goods, air transport is a very expensive form of transport.

Table 1 gives an assessment of the qualities of each mode of transport regarding the major factors that are traded-off when examining the alternatives available between the distribution factors and the different transport factors.

Table 1. . Comparison between different modes of transport

QUALITY OF TRANSPORT	SEA	ROAD	RAIL	AIR
Speed	Very low	High	Low	Very high
Reliability	High	High	Low	Very high
Flexibility	Low	Very high	Low	High
Time efficiency	Very low	High	Low	Very high
Cost	Very low	High	Low	Very high
Ecological friendly	Poor	Very poor	High	Very High

It should be noted that regarding cost, transit time, and flexibility, road transport provides the best balance.

2.1.2. Modal choices

Figure 1 summarises the process of choosing the mode of transport.

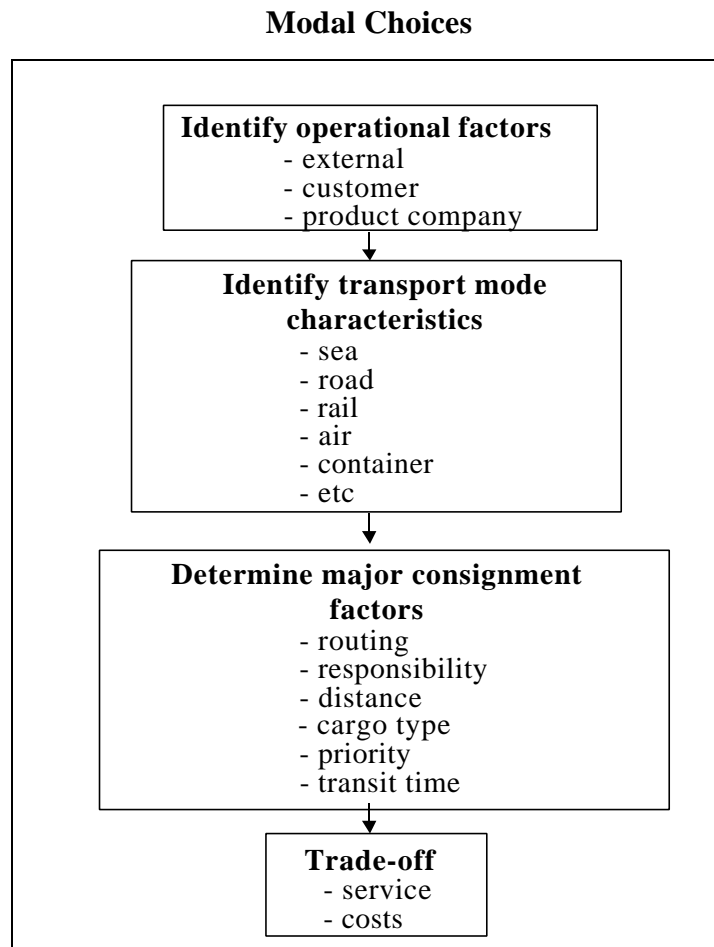


Figure 1.

Source: Oxley, J and Rushton, A (1991).

When selecting the adequate mode of transport and route, the transport provider determines the most cost and time efficient ones by trading off services and cost, taking into consideration all operational factors that may affect the transport, as well as the

customer's requirements. The choice is also driven by the value of the cargo to carry. He/she will first carry out a comprehensive study that shows the transport possibilities, the transport restrictions, the transit times, and the transport costs. Then, after investigating the various possibilities, the best alternative is chosen.

2.2. Trade and economic development

The last decade has been characterized by a high yearly increase in production all over the world and an expanding world trade. The Swedish increase in production, import and export has followed international developments.

Sweden is the largest economy in Scandinavia and located at the crossroads of the emerging Baltic markets and the European Union. Since January 1995, Sweden has been a member of the European Union with markets that reach more than 370 million consumers. Scandinavia provides access to a market of 25 millions of consumers, and the Baltic Sea region offers a market of some 100 millions consumers.

Many of the world's market leaders are Swedish: ABB, Ericsson, Volvo, Alfa Laval, SKF, and IKEA. With less than 0.2 % of the world's population, Sweden controls almost 10 % of the world's multinational companies (Why Sweden, 1999).

The total Swedish exports amounted to 15 million tons in 1997, comprising mainly machinery, motor vehicles, paper products, pulp and wood, iron and steel products, chemicals, petroleum and petroleum products. The total Swedish imports were about 13 millions tons at the same period, mainly composed of machinery, motor vehicles, iron and steel products, chemicals, petroleum and petroleum products, foodstuffs, and clothing (Swedfreight, 1999).

The major trade partners for Sweden are the EU countries, which account for 59.1 % of the total Swedish imports (Germany 13.2%, UK 10.2%, Denmark 6.9%, France 5.1%) and for 62.6 % of the total Swedish exports (Germany 18.4%, UK 9.5%, Denmark 6.6%, France 5.5%). Thus, the major flow of Swedish goods goes from Sweden to the continent (Sweden, 1999).

The flow of goods going to Denmark from Scandinavia or vice versa is shown partly by the Danish imports and exports with Sweden and Norway, its major Scandinavian trade partners. Sweden and Norway participate respectively for 9.7% and 5.9% of the total Danish exports and for 11.7 % and 4.9 % of the total Danish imports (Sweden, 1999).

Figure 2 shows the geographical distribution of the Swedish exports in 1997 based on reports of the freight forwarders (Swedfreight, 1999). It should be noted that more than 90 % of the total Swedish exports are from the southern part of the country.

Exports 1997.Geographical distribution

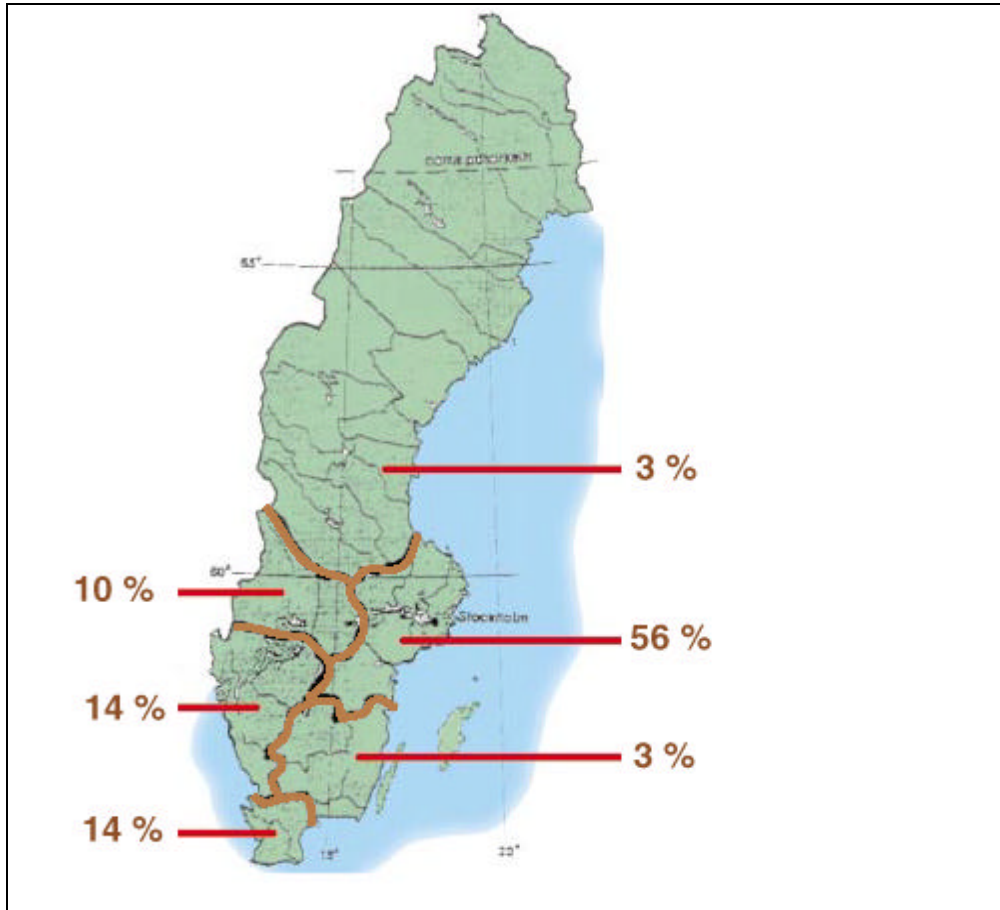


Figure 2.

Source: Swedfreight (1999)

The major distribution centers are Stockholm, Göteborg and Malmö. Stockholm is the business center of Sweden, with a population of more than 1,5 million. Göteborg, Sweden's second largest city (740 000 inhabitants) is a center of a fast growing industry of manufactured products ranging from motor vehicles to petrochemicals. Malmö is the third largest city (250 000 inhabitants) and an important distribution center for the southern part of the country.

From an economic point of view, the Oresund region, comprising Malmö as its hub, is one of Europe's strongest regions. A fifth of the combined GDP of Denmark and Sweden is produced here. The region is one of the eight largest in Europe, using the Gross National Product (GNP) as a yardstick (Oresundkonsortiet, 1999b).

The northern two thirds of Sweden are sparsely populated, but contain many large industrial sites for forest products, mining and hydroelectric power.

2.3 Characteristics of the Swedish transport logistics system

Each mode of transport has its own characteristics, regarding the infrastructure offered to its user, the type and amount of cargo it carries, the transit time it offers, as well as its cost. Those main features for each mode of transport used by logistic transport providers when exporting or importing goods to and from Sweden are analyzed in the following sections.

2.3.1. Transport infrastructure

The transport network in Europe is highly developed. Freight to and from Sweden is carried by road, sea, rail, air, or combined transport, according to the type of cargo, the distance and other factors that determine the most efficient way of transport.

- **Road**

The road structure is highly developed in Sweden. A total of 138,000 km of highways constitute a developed road network between all parts of Sweden, comprising 1,330 km of expressways.

On the Danish side, a total of 71,600 km of highway also forms a developed road network. The road link across the Great Belt connects the eastern and western Danish islands, Funen and Zealand.

- **Rail**

Sweden is investing heavily in rapid, environmentally safe rail transport. A total of 11,837 km constitutes the Swedish railways. Denmark has a total of 3,358 km of railways, which connect it to the rest of the Continent. Rail network between Scandinavia and the Continent is shown in Annex 1.

The combined transport rail/sea is illustrated by the longest train-ferries in the world which serve Danlink, the railway-ferry crossing between Copenhagen and Helsingborg in Sweden. Each of the two ferries has a capacity of 45-50 freight wagons, with 5 daily departures.

- **Air**

On the Swedish side of the Oresund, there is the Malmö Sturup Airport with commuter service to Stockholm and daily flights to London, Hamburg and Amsterdam.

On the Danish side, Copenhagen Airport is Denmark's major international air terminal. The airport can be reached by bus, ferry and by high-speed catamarans via Copenhagen.

- **Sea**

Scandlines is the main ferry line linking Sweden to Denmark and the Continent. Its main routes are shown in Figure 3.

Main ferry routes

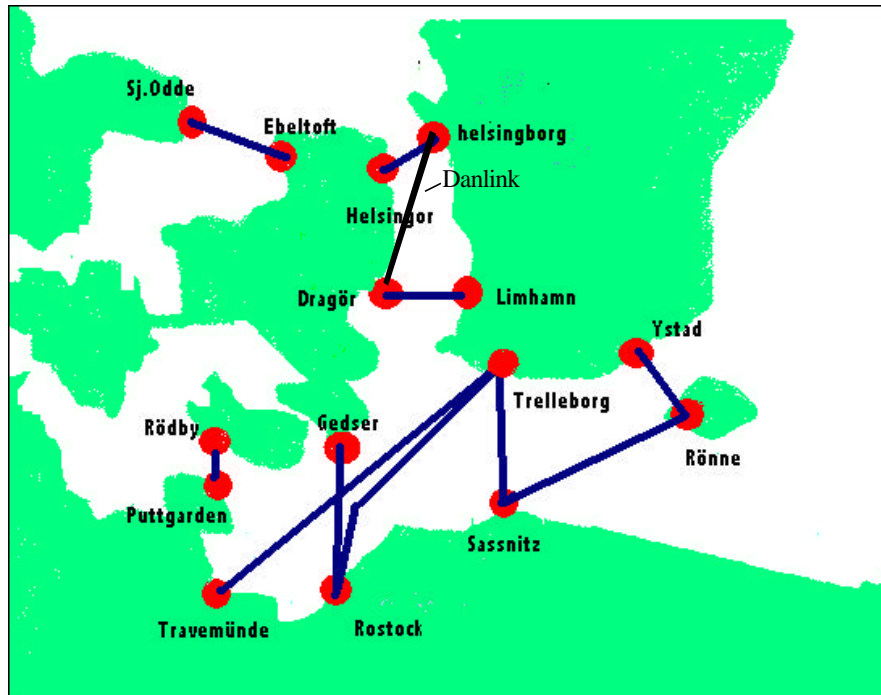


Figure 3.

Source: Adapted from Scandlines map (1999)

The ferry line between Trelleborg and Germany offers one connection with Germany almost every hour, between 00.30 and 23.00, weekdays and weekends. That creates an efficient link to the Continent.

- **Main ports as links**

The main southern ports in Sweden are Helsingborg, Trelleborg and Malmö, in terms of cargo throughput in 1997.

Port of Malmö

The port of Malmö has a strategic position as the gateway to the Baltic, close to the region's extensive network of motorways and railways. It is composed of 7 docks which provide a wide range of services. Among those docks, the New Dock is the base and the terminal for the German and Polish traffic. The Free Port allows rapid handling of containers, Ro/Ro and car transport ships. Large storage rooms are also available. The Container Terminal is a storage area for a great number of containers. The Swede Harbour is the largest transport harbour on the west coast, capable of accepting Panamax ships (13,5 meters of water depth).(Port of Malmö, 1999).

The port of Malmö is Sweden's import harbor for Mitsubishi, Honda, Daihatsu and Kia. It also manages the distribution within Nordic countries, Baltic States and Russia of Spanish Stainless steel, which is unloaded and stored in the port (about 45,000 tons per year). (Port of Malmö, 1999).

There is an extensive feeder traffic from the port to Hamburg and Brementhafen. 27,000 containers passing the docks at the Port of Malmö are nearly always transported by feeder-ships to and from those transatlantic ports (Port of Malmö, 1999).

The port of Malmö also provides forwarding services. 500,000 tons of goods are distributed and forwarded per year. Truck and rail forward them to receivers. The greater part is bound for Denmark, Norway, Finland, Baltic States and Russia (Port of Malmö, 1999).

Table 2 shows the goods traffic in tons in the port of Malmö in 1997 and 1998, considering both imports and exports flows.

Table 2. Goods traffic in tons in the port of Malmö in 1997 and 1998

KIND OF GOODS	1997	1998	Increase %
Mineral oil	1,237,430	1,512,596	22
Dry bulk	967,514	3,348,439	39
Ferry cargo	3,044,483	3,173,784	4
Nordö-Germany	2,720,302	2,850,369	5
Polferries-Poland	137,944	124,436	-10
Dragör-Denmark	186,237	198,979	7
Others	282,425	640,253	127
TOTAL	5,531,852	6,675,071	21

Source: Adapted from Malmö hamn (1999)

Port of Helsingborg

The port of Helsingborg is the major competitor of the port of Malmö in the region. It is the second port in Sweden in terms of goods traffic volume. It is one of the busiest ferry ports in the world. Besides the ferry traffic, the port of Helsingborg has modern terminals for breakbulk, containers and all kinds of bulkcargo. It has excellent intermodal rail, truck and air connections. It is also served by 5 direct ferry services, six direct container services and frequent feeder connections (Port of Helsingborg, 1999).

The total cargo throughput in 1997 is shown in Table 3.

Table 3. Total cargo throughput in 1997 in the port of Helsingborg

Foreign goods traffic (Tons)		Domestic goods traffic (Tons)		Total
Arrivals	Departures	Arrivals	Departures	
4,317,000	4,774,000	320,000	52,000	9,463,000

Source: Port of Helsingborg (1999)

In 1998, the total port cargo tonnage was 10,112,471 tons with the following distribution: bulk 18%, break bulk 3%, containers 7%, carferry 46%, and transferry 26% (Port of Helsingborg, 1999).

Port of Trelleborg

The port of Trelleborg is Sweden's most southern port, only 85 km from the German border. This creates excellent conditions for time table and high frequency. It is a ferry port working with rail and road, which intends to meet the industry's demands on high frequency and good regularity for freight transport.

The port of Trelleborg is the third largest port in Sweden, measured in number of handled tons. The total cargo throughput in 1997 (Table 4) shows that more than 99% of handled freight is from international traffic. The port of Trelleborg yearly handles 17-18% of the Swedish foreign trade (Port of Trelleborg, 1999).

Table 4. Total cargo throughput in 1997 in the port of Trelleborg

Foreign goods traffic (Tons)		Domestic goods traffic (Tons)		Total
Arrivals	Departures	Arrivals	Departures	
3,648,000	5,052,000	0	25,000	8,725,000

Source: Port of Trelleborg (1999)

2.3.2. Transport of goods

2.3.2.1. Distribution per mode of transport

The total freight transport mileage in Sweden amounted to 87.2 billion ton-kms in 1997. (Swedfreight, 1999). It is distributed among different modes of transport as shown in Figure 4, which represents the evolution of the freight transport mileage in Sweden since 1960 to 1997 (latest data).

Overseas shipping is defined as traffic over seas whereas coastal shipping concerns all domestic traffic, including passages through canals.

Short distance road haulage is for distances below 100 km whereas long distance road haulage concerns the distances over 100 km.

The trend is a significant increase of all the transport mileage during this last decade, except for the short distance road haulage.

Evolution of the freight transport mileage in Sweden (1960-1997)

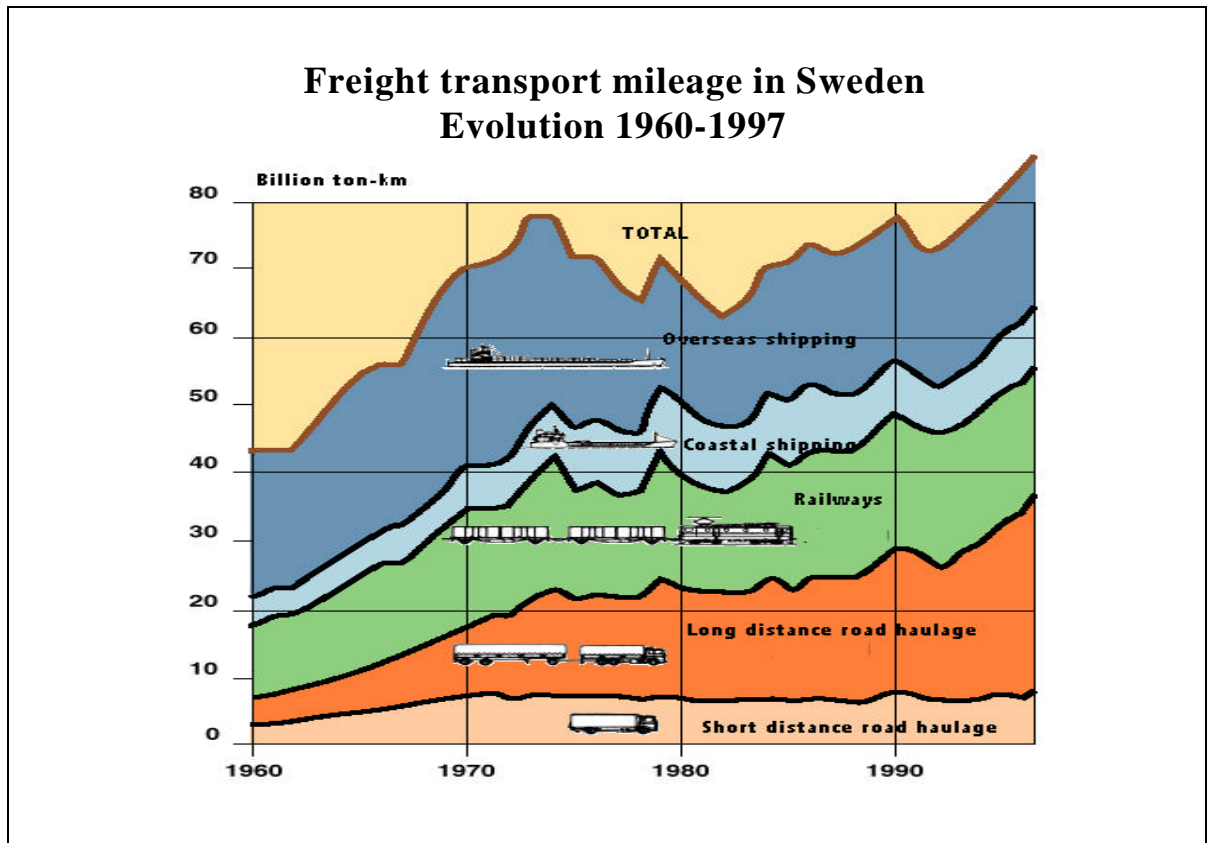


Figure 4.

Source: Adapted from Swedfreight (1999).

It is supposed that the ton-miles unit related to coastal and overseas shipping has been converted into ton-kms.

Sea transport is the major mode of transport used to carry goods to and from Sweden. Whether the cargo is going to Denmark or to the Continent, the mode of transport used is different. Goods carried by road or rail use the ferries whether they are destined to

Denmark or to the Continent. Those modes of transport are then combined with sea transport as trailers, trucks or wagons use the ferry lines to reach the Continent.

Road vehicles are of different types. One should distinguish the road vehicles in accompanied trailers and unaccompanied trailers. Accompanied movements are where the tractive unit pulling the trailer stays with the semi-trailer for the entire journey, while unaccompanied units are detached from the tractor for the sea journey at the port of departure, or as may be the case, between rail heads when being transported by rail (Wild, 1994).

Rail transport has the lowest share of the total transport. As the Group Marketing General Manager of Schenker-BTL said, the main obstacle for an extended use of that mode of transport that could offer services that are quicker, safer, less polluting and more energy saving on transport over medium and long distances, is the heavy bureaucracy that characterizes it.

2.3.2.2. Distribution per type of cargo

Figure 5 shows the distribution among the three modes of transport, long distance road haulage, sea and rail, of different types of goods.

Processed goods are transported by road whereas, raw material and heavy goods are mainly carried by rail and sea.

The transport mileage varies for different sectors. Forest products (round timber, pulp, paper and timber products) are big consumers of transport. Round timber is generating an important transport mileage due to transport from the felling places. The main parts of this transport are carried out by road haulage, often as feeder transport to other modes

(Swedfreight, 1999). Long distance transport mileage for forest sectors account for around 18 billion tonne-km. Transport mileage for the energy sector accounts for more than 16 billion tonne-km.

Long distance transport mileage in 1997.

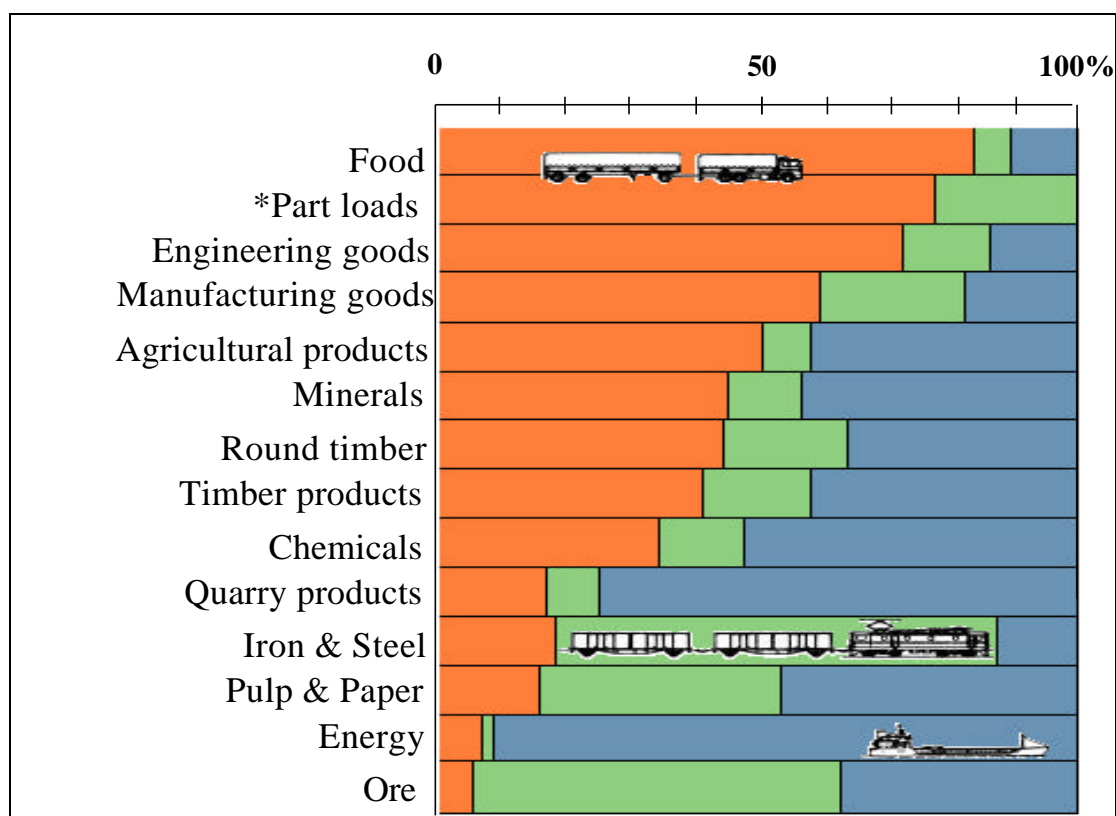


Figure 5.

Source: Adapted from Swedfreight (1999)

*Part load: translated from "handel" in Swedish

2.3.2.3. Main routes to Denmark and the Continent covered by ferry services

The main routes taken for the carriage of goods coming from the southern part of Sweden, and destined to Denmark and the Continent are shown in Table 5. The number

of trailers and wagons that has been carried through those routes in 1998 are also presented. It shows that the ocean leg is unavoidable, whether rail or road is the initial mode of transport.

Table 5. Main ferry routes to the Continent and their characteristics

	Distance (Nautical miles)	Number of TRAILERS	Number of WAGONS	Crossing Time (Kappelin, 1999)
From Sweden to Denmark				
➤ Helsingborg-Copenhagen (Danlink*)	20	-	123000	1h17
➤ Helsingborg - Helsingör	2	273600	12600	20min
➤ Limhamn- Dragör	9	29400	-	25min or (55min)
From Sweden to the Continent				
➤ Malmö - Travemünde	120	164400	-	9h
➤ Trelleborg - Travemünde	90	186000	-	7h
➤ Trelleborg - Sassnitz	63	25200	84000	4h45
➤ Trelleborg - Rostock	80	70200	53520	2h45 or 5h

Sources: Oresundbron (1999), Cappelin (1999)

*Danlink is a rail ferry service between Helsingborg and Helsingör, which explains the absence of trailers in this ferry line.

2.3.3. Factors affecting the transport and route choices

2.3.3.1. Driver's working hours

Drivers of goods are subject to many regulations that rule the exercise of their profession. The Transport Act of 1968, with other supporting regulations addressed the problem of driver's hours. This concerns the observance of proper working and driving hours by drivers. Drivers' hours of work are governed by the EC Council Regulation 3820/85 which cover working hours (Oxley and Rushton, 1991). These regulations apply to the drivers of vehicles with a permissible maximum weight over 3,5 tonnes, operating within the margins of the EC.

The major requirements are as follows:

- A maximum daily driving of nine hours, which may be extended to ten hours maximum, but not more than twice a week.
- A total of 4.5 hours driving time after which a break must be taken.
- Breaks of 45 minutes must be taken. The break can be split into three breaks of fifteen minutes spread over the driving period or immediately following it.

Therefore, when choosing the road transport, these requirements are of great importance for time and cost considerations. For example, if time is of prime importance, it may be necessary to have two conductors in order to remain in legal driving conditions, a matter that increases the cost of transportation considerably.

2.3.3.2. Transit time

Transit time differs according to the mode of transport used. For each route used, transit time will also vary. It will depend on the time spent in waiting for the ferry, on traffic congestion, and other unpredictable factors.

Road transport transit times differ whether it is an accompanied or unaccompanied service when using the ferry services. Accompanied services offer the fastest transit time to the freight user.

In the case of large transport provider companies, such as Schenker-BTL, timetables are available, giving the time of delivery in door-to-door services, from and to each part of Europe. Annex 1 shows an example of a timetable. When choosing the route, time of delivery is determined according to the timetable.

2.3.3.3. Cost of transport

The cost of transport varies according to the mode of transport used and the route taken.

The trucking cost is around SEK15 per kilometer including fuel and road charges. The ferry charges are approximately SEK3500 for a standard trailer (13,65m) (LeNormand, 1999). The part of the ferry cost compared to the total transport cost will vary according to the total transport distance.

A case in point is the example of transport of goods between Halmstad and Hambourg by a standard truck: The total cost is as follows:

- Road transport Halmstad - Trelleborg : $200 \text{ km} \times \text{SEK}15 = \text{SEK}3000$

- Ferry charges Trelleborg - Travemunde SEK3500
- Road transport Travemunde - Hambourg 100 km x SEK15 = SEK1500

The values taken are approximate. The total cost is SEK8000. The ferry charges account for 43,7% of the total cost (Fig.6).

Cost share (%) of each transport leg between Halmstad and Hamburg

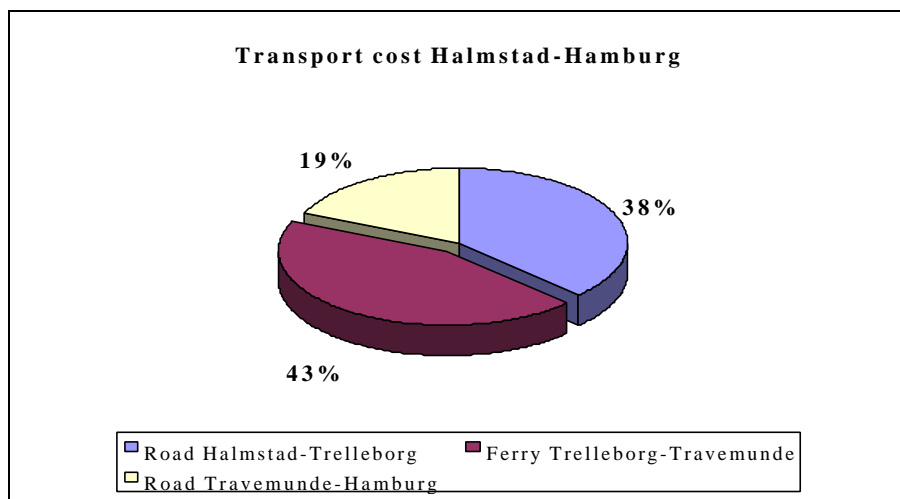


Figure 6

If the example of a transport between Stockholm and Paris is taken, the total cost will be as follows:

- Road transport Stockholm - Trelleborg : 700 km x SEK15 = SEK10,500
- Ferry charges Trelleborg - Travemunde : SEK3500
- Road transport Travemunde - Paris 1100 km x SEK15 = SEK16,500

The total cost is SEK30,500; the ferry cost accounts for 11.5% of the total transport cost (Fig.7).

Cost share (%) of each transport leg between Stockholm and Paris

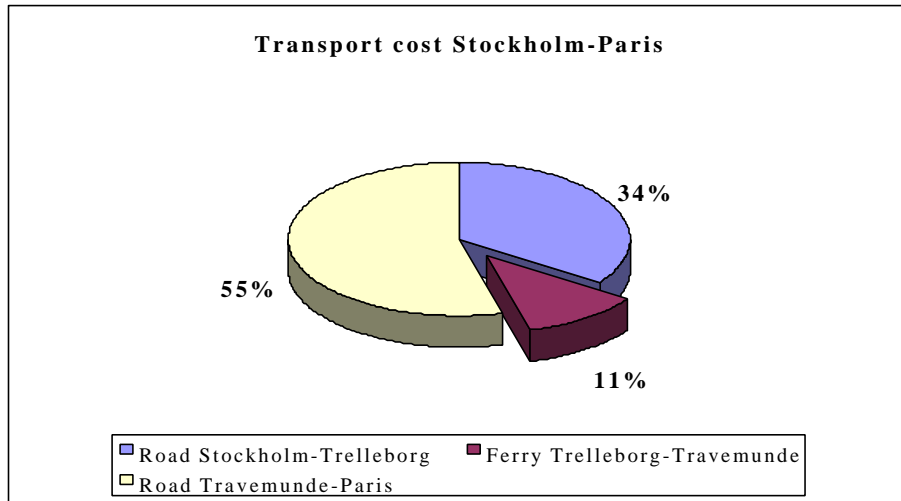


Figure 7

These two examples show that according to the total distance of the transport, the part of each item composing the total cost will vary: the longer the transport distance, the greater the share of the ferry cost compared to the total transport cost.

The total cost will also vary whether the transport is accompanied or unaccompanied when using ferry services. Accompanied transport is the most expensive to operate. This is because the driver stays with the vehicle at all times and the fact that it is more expensive to ship both the trailer and tractor than the trailer on its own. The tractor unit adds about 2-3 m to the overall length of the vehicle and since charges are based on length, truck costs can increase. Unaccompanied trailers become the most economic option on the longer routes.

2.3.4. Examples of export of goods from Sweden to the Continent

Two concrete examples are presented in this section, provided by the transport provider Schenker-BTL.

Example 1 illustrates the classical way to export goods from Sweden to the Continent. Example 2 shows a specific case or marginal transport where time is of prime importance, thus the route taken is not the cheapest one. These examples will be used further in Chapter 4 when analyzing the impact of the future link on the transport logistics system.

- **Example 1**

Electrolux refrigerators have been exported from Arvika to Duesseldorf in Germany (door-to-door service). The route taken is presented in Annex 2. Figure 8 summarizes the entire process.

Export of refrigerators between Sweden and Germany

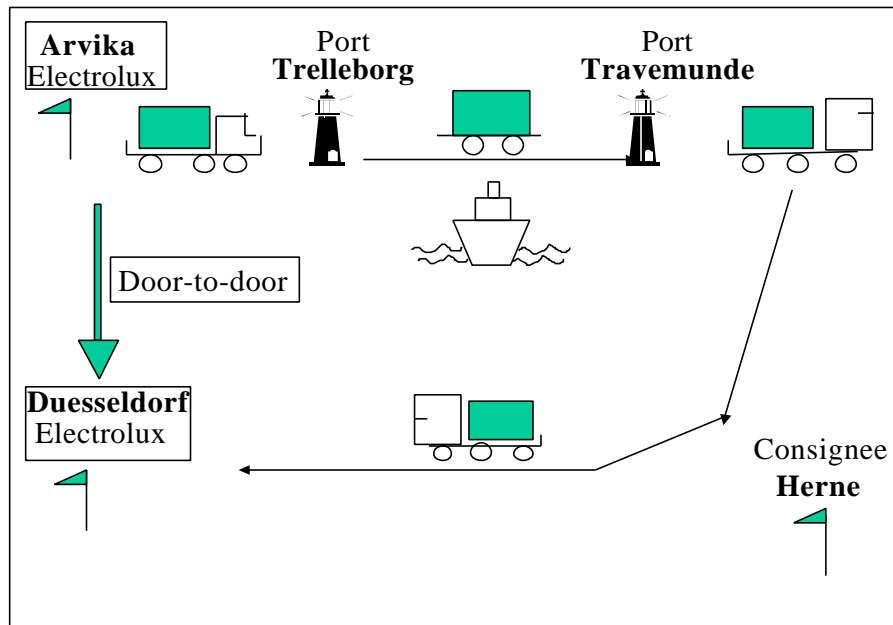


Figure 8

The route via Trelleborg is the shortest way to reach the Continent. It is also the cheapest one. The transport is unaccompanied, thus less expensive

- **Example 2**

It is a specific transport of paper where time is of prime importance. Paper has to be delivered on the 8th of April at 10.00 am in Wrexham (UK) (door-to-door services), leaving from Klippan on the 6th of April. The consignee is in London. The route taken is shown in Annex 3.

Figure 9 summarises the steps taken.

Export of paper between Sweden and UK

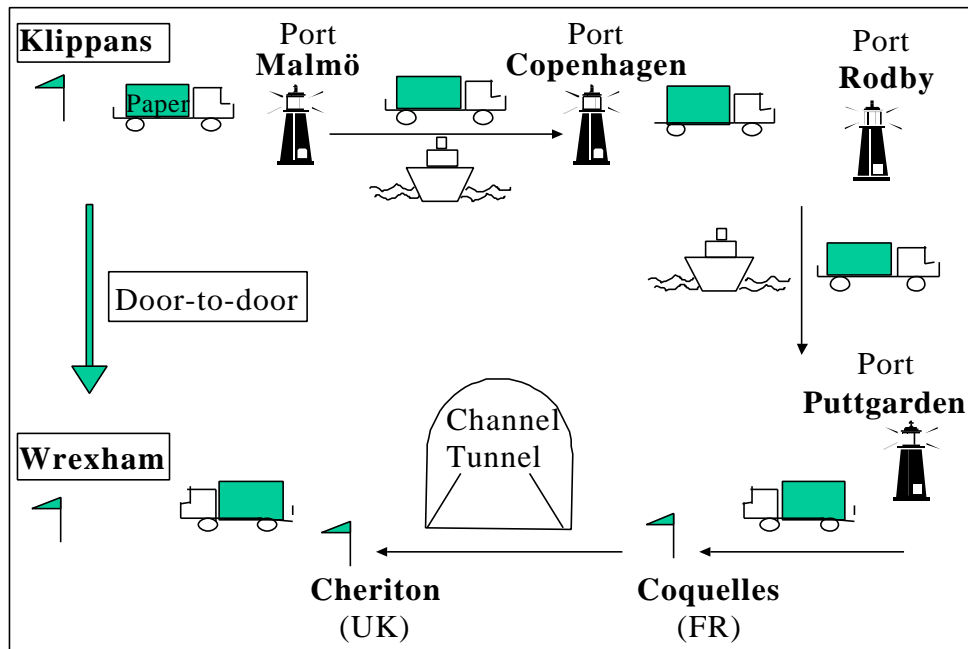


Figure 9.

The route taken is not the shortest one and is very expensive. In fact, the total cost comprises:

- the price of two ferries: Malmö - Copenhagen, and Rodby - Puttgarden, in accompanied transport
- the price of the road kilometres between klippans and Malmö and Puttgarden - Coquelles (terminal of the Channel tunnel on the french side), Cheriton (terminal of the Channel tunnel on the British side) and Wrexham, the final place of delivery.
- the price of crossing the Channel tunnel between France and UK

The cheapest way would have been to ship the goods between Malmö and England. The cost would comprise the freight and port charges. However, as said before, time limit has directed the choice of the route. The transport is accompanied for a gain of time, thus more expensive.

2.4. Conclusion

The chapter has discussed the main characteristics of each transport mode used to move goods from and to Sweden.

Given the level of trade in Sweden plus its main commercial partners in the rest of Scandinavia and the European Union, it is evident to conclude that the Swedish transport system holds a key role in the logistics picture.

Then, this role is bound to increase with a new fixed link between Sweden and Denmark, which will reduce the need for sea transport, but will add more possibilities for combination of modes. Some permutations can reduce transit time, but increase the overall costs, as shown in the examples above. Some commodities benefit due to their sensitivity to time and high value, others can not accept the additional expenditure. This is part of the spectrum of possibilities available, which at the end contributes to the facilitation of the commercial interchange, and keeps the transportation business active and changing.

CHAPTER 3

THE NEW FIXED LINK OVER THE ORESUND

The Swedish government considers the southern part of the country as the area where development and economic growth is expected in the next years. A major reason for this consideration is its proximity to the Continent, and the influence that the neighbouring countries place in the patterns of trade and culture. The fixed-link over the Oresund is a key element on this scheme, where Swedes and Danes are placing big expectations for the upcoming 21st century.

This chapter provides an overview of the future Oresund Link, in terms of infrastructures and services provided. It also browses through the expected socio-economic and environmental impacts that will affect the region.

3.1. Background

In June 1994, after numerous environmental measures, the Swedish government gave the final go-ahead for a fixed link over the Oresund, the mass of water in the middle of the Baltic and the North Sea that divides Sweden and Denmark. That was the final stage of a process that begun in March 1991 with the signing of an agreement to construct a

fixed link between both countries. This agreement was ratified by both parliaments, but subject to environmental consent in Sweden.

The fixed link is expected to be completed in the summer of the year 2000. From then, it will be possible to use rail or road transport to cross the Oresund. The fixed link will consist of a 16 km long road and railway link between the Danish and Swedish coasts plus landworks on both sides of the Sound.

The Oresund Link consists of an artificial peninsula at Kastrup, a long tunnel under Drogden, an artificial island, the high bridge, and a toll station on the Swedish side. The Fixed Link comprises a four lane motorway and a dual-track electrified railway (Oresund Konsortiet, 1999a).

Figure 10 shows the general view of the entire infrastructure.

The Oresund link.

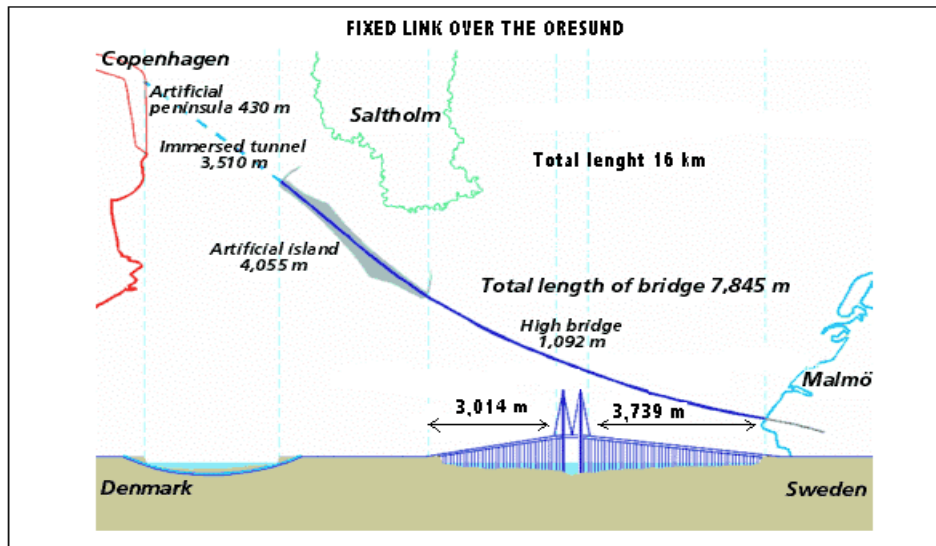


Figure 10.

Source: Oresund web site (1999)

The Swedish landworks carry the motorway and rail track from Malmö to the bridge. There will be 10 km of motorway and 20 km of railway line including 10 km of existing one-track railway, which will be upgraded to a two-track high-speed line. The construction is scheduled to finish in line with the completion of the link in the year 2000.

On the Danish side, landworks consist of roughly 18 kilometres of rail track and around 9 kilometres of motorway. These land-based facilities are intended to link the existing traffic arteries to the Oresund fixed link between Denmark and Sweden, and to provide a railway link between the centre of Copenhagen and Copenhagen International Airport at Kastrup.

3.2. General features

The customer groups are identified by the Oresundskonsortiet (1998) as:

- Long distance commercial traffic between Scandinavia and the continent
- Holiday traffic between Scandinavia and the continent
- Freight traffic between Norway/Sweden and Denmark
- Holiday traffic between Norway/Sweden and Denmark
- Commuter traffic in the Oresund Region

- **Capacity**

Preliminary studies forecast a daily average of 8,500 automobiles and 1,500 lorries and buses crossing the Oresund Link for the year 2000 (Oresundskonsortiet, 1999b). However, this road traffic will vary according to the seasons, but is expected to reach 25,000 cars a day during holidays and weekends.

The estimated distribution of the Oresund link traffic by category of vehicle is shown in Figure 11. The percentages represented for the year 2000 correspond to an estimated traffic of 10000 vehicles per annual average day (Oresundkonsortiet, 1992).

The estimated distribution of the Oresund link traffic by category of vehicle

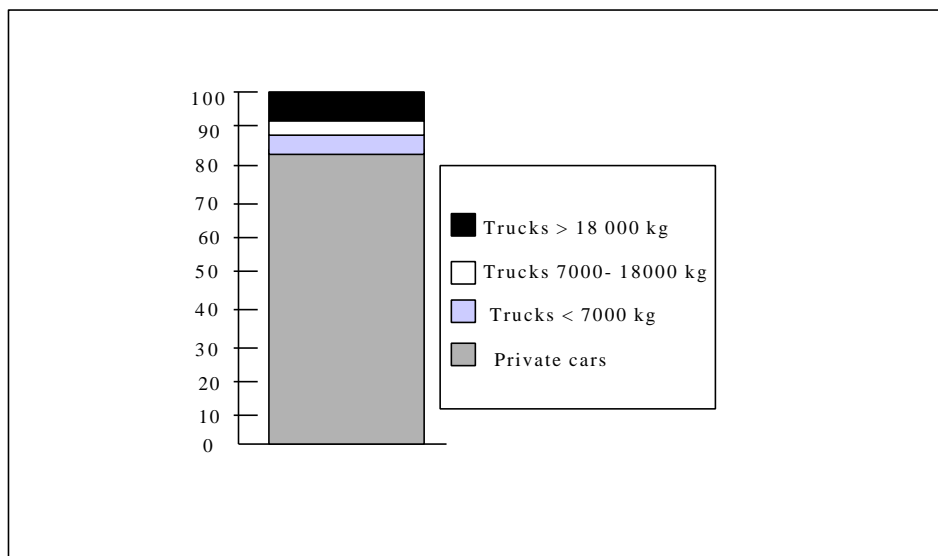


Figure 11.

Source: adapted from Oresundkonsortiet (1992).

Freight traffic accounts for about 17% of the total traffic.

The rail traffic on the fixed link is estimated to about 118 passenger trains and 20 cargo trains in a normal weekday in the year 2000 (Oresundkonsorsiet, 1992), that is an average of around 5 passengers trains and 0.8 cargo trains per hour. The dual-track railway will be a high-speed link capable of sustaining speeds of up to 250km/h. Then, freight traffic will cross the bridge at 120 km/h, while passenger trains will touch 200 km/h (Lloyd's list, 1999).

- **Services**

The Fixed Link is open 24 hours a day, allowing continuous road traffic.

Toll Station

The toll station located at Lernacken on the Swedish side consists of eleven lanes in each direction (Oresundskonsortiet, 1999c):

- Nine lanes will be equipped with card automats and/or manned by service personnel depending on traffic volume. Each lane will have a capacity of around 200 cards per hour, which means that each car will spend roughly 18 seconds to pay its fee.
- Two lanes will be reserved for electronic payment. One lane is reserved for Heavy Goods Vehicles which are required to maintain lower speeds for safety measures.

Customs checkpoint

It will be based in the toll station, and it is set to become the most important customs clearance point in Sweden. Between 8 and 12 Swedish customs officials will be on duty 24 hours a day, for customers services and anti-smuggling measures. No Danish customs officials will be based in Lernacken (Sund&Bro, 1999).

The first stop for the trains coming from Denmark will be in Svågertrop Station, which is 5 km away from the toll station, until the City tunnel, the train tunnel under Malmö, which is to be completed in the year 2005.

- **Price**

Road toll fees are set by the Oresundskonsortiet. They are yet to be decided but road users are expected to pay a toll fee based on the ferry fares between Helsingborg and Helsingborg, which is at the moment SEK160 (one way) for passenger car (Moulding, 1999) and approximately SEK1200 for standard trailer (Lenormand, 1999).

Danish and Swedish rail operators will each pay DKR150m annually for the use of the link (Lloyd's list, 1999).

According to the Market Manager of the Oresundskonsortiet, Thomas Kristofferson (1998), the link's pricing structure will consider the disparate customer groups as well as the competitive situation. It will be differentiated in order to meet the demands of the market and the objective of long-term profitability at the same time. That means that the price for crossing the link will be relatively inexpensive for long distance travellers but more costly for short distance ones, for instance those who travel from Malmö to Copenhagen.

- **Potential traffic problems related to the weather**

The users may face some problems when using the bridge, which can have an impact on the crossing time.

- Strong lateral winds exceeding 20 m/s, may be a limit to the use of the bridge by trucks and lorries. Advice for not using the bridge will be provided when the case occurs. They may experience problems even at slightly lower wind speeds than 20m/s.
- Snow drifting can also occur along the connections, a problem that can be limited by an adequate and suitable road profile.
- Icing of some parts of the bridge can represent a danger if some pieces of ice fall.

However, the availability of the bridge is of great advantage in the case of the frozen water, which has led to the closure for some days each winter of the ferries between Limhamn and Dragör.

Therefore, the traffic problems which are likely to occur on the bridge may be caused weather conditions, are foreseeable, and controllable down to a minimum with constant preventive maintenance and good management of resources.

3.3 Socio-economic impact

Whenever a major transport infrastructure is introduced, the economic and social activity in the region concerned is affected.

Rietveld (1992) illustrates in Figure 12 the relationships between transport infrastructures and spatial development.

Relationships between transport infrastructures and spatial development

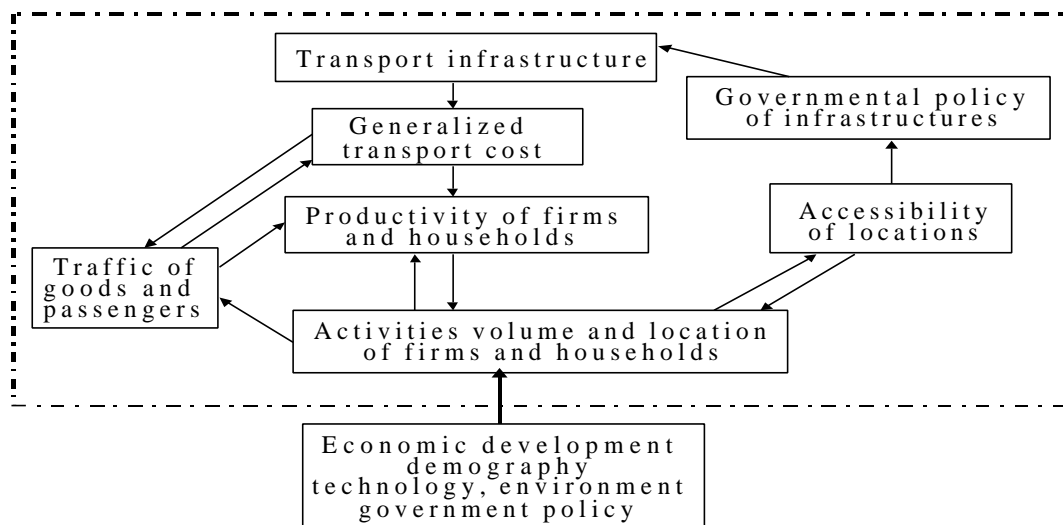


Figure 12

The parallel can be drawn with the introduction of the Oresund link and the addition of road and rail connections between Sweden and Denmark. In fact, this diagram shows that an improvement in the transport network can lead to a decrease in transport costs. This means an increase in the productivity of firms, either directly by savings on fuel,

maintenance and repair, improved transit time, or due to growth in the transport flow and greater accessibility, encouraging commerce with new locations, or increasing trade in places where there is already some freight being moved.

The greatest beneficiary of an adequate transport infrastructure serving the bridge will be the Swedish public. This is because the bridge is only one link with the efficient transport network which Swedish manufacturers and consumers need if they are to play their part fully in the Single European market.

The fixed link will also provide a foundation for stronger and more extensive cooperation regarding economy, education, research and culture in the Oresund region. It will unite the entire region, and create prerequisites for a joint housing and labour market, where geographical, political, or tributary barriers will not exist. However, there are still differences in legislation between Sweden and Denmark with regard to labour law and taxes, which are still barriers for development (The Oresund region, 1999). Thus, Swedish and Danish governments have to remove those barriers in order to achieve the expected development.

3.4. Environmental impact

When giving its approval for the commencement of the construction of the bridge, the Swedish government stipulated a number of conditions that had to be implemented in order to eliminate up to a high percentage all negative environmental effects.

An environmental impact assessment has been produced by the Oresund Consortium to illustrate the effects of the fixed-link between Malmö and Copenhagen. (Oresundkonsortiet, 1992). The main conclusions of this report are presented in this section.

A wide-ranging analytical work has been in progress, covering the main elements of environmental impacts such as, marine ecology, traffic and congestion, atmospheric emissions, and noise.

- **Marine ecology**

The ecological system in the Baltic is highly sensitive to changes caused by a deficiency or insufficiency in the salt water supply. According to this study, the effects of the installations and constructions on the marine environment in the sound are expected to be smaller, by the use of adapted construction techniques that will not change the inflow of water to the Baltic Sea. That is called the 'zero solution'

- **Traffic and congestion**

The road traffic crossing the Oresund link will depend on the bridge toll, but it is estimated to amount 10000 vehicle per annual average day on the basis of the same rates as the ferry crossing between Helsingborg and Helsingör. With a lower toll the traffic flow is expected to increase.

The redistribution of an increase of the road traffic is forecasted in Southern Sweden. A net growth of 0.5 % is estimated for the traffic flow. The increase of the vehicle mileage covered in Skåne will coincide approximately to one year increase in traffic. The traffic flow is expected to diminish in certain areas, including Helsingborg, between Helsingör and Copenhagen on the Danish side , and in the Malmö urban area.

The rail traffic is closely linked to the bridge toll for motor traffic. With an increased toll bridge, the number of train journeys will increase and vice versa. It is estimated that the number of people travelling on regional trains will be around 15,000 a day, on the

current ferry traffic rate basis. This estimated number is expected to drop to 9000 a day, with a very low bridge toll.

- **Emission of gases**

As seen before, an increase in the road and rail traffic is predicted with the new fixed-link. As a result, an increase of the emissions of hydrocarbons is expected, coupled by a reduction of greenhouse gases connected to the fact that the increase in motorised traffic will be compensated by a simultaneous reduction in ferry traffic. However, the study shows that the emissions generated by the bridge are of the same order as those from the ferry traffic replaced by the bridge traffic, even taking into consideration the emission cleaning system from the ferries. Thus, the changes will be very small.

- **Noise**

The noise from road and rail traffic will marginally increase at the connection routes of the network existing today with the Oresund link. Nowadays, the areas to the south and east of Malmö that will be affected by the Oresund Link are a barely disturbed by sound from the main roads (E6, E65, 11, E22 European highways), by train noise from Trelleborg and Ystad railway, and also by the noise of air traffic from the Kastrup Airport.

However, necessary measures have been taken to keep the traffic noise below the relevant recommended value when the bridge is finished. Noise-abatement measures comprise window replacement, and noise barriers.

All necessary measures regarding environment protection have been taken by both Swedish and Danish government to reduce to its maximum extent the negative impact of the fixed-link on the environment. Regular surveys are made by the environmental authorities to monitor the consequences that a structure of this magnitude may cause.

CHAPTER 4

IMPACTS OF THE NEW FIXED LINK ON THE TRANSPORT LOGISTICS IN SWEDEN

This chapter intends to provide an analysis of the impact of the Oresund fixed link on the different modes of transport used by carriers in Sweden. It will first give a public opinion and forecasts in Sweden on how the new bridge can change trade and affect the transport patterns, as well as its effects on the main southern Swedish ports.

4.1. General opinion of the transport industry and forecasts on the potential impacts of the Oresund link

The general opinion is that the fixed link will bring significant changes in the region. As Sven Landelius (1994a), Managing Director of Oresundkonsortiet points out:

The link will in itself not lead to expansion but when its potential is exploited it can be a catalyst for development for the whole area. Not just for the infrastructure but also with respect to overall development. A new region can be formed and the link will facilitate its growth

With respect to the transport patterns, forecasts have concerned mainly the ferry business and its future after the Oresund link. A deficit in the ferry business in the Oresund region is forecasted.

Few forecasts have been found on the freight traffic future and the potential changes in transport patterns. The exact impact this link will have on the region's transport systems is not clear, depending, according to most people, on the tariffs charged for crossing it (PdI, 1997).

A questionnaire was addressed in April 1999 to the main transport providers in Malmö in order to have their opinion on the potential impacts of the Oresund link in the transport industry. Five companies out of 12, to whom the questionnaire was sent answered, which constitutes a return of 42%. These companies are Scanlink Transport & Logistics AB, Stella Transport AB, Wilson&Co AB, Transfargo AB, and Ingstad&Co AB.

The questions covered different aspects of the potential impact that the new fixed link will have on the region and its transport logistics. The most important questions, together with their results, are summarised as follows:

- What do you think will be the transport logistics changes resulting from the future fixed link over the Oresund?
 - ❑ Increase in the road freight for short distances (100%).
 - ❑ Transport over long distance would not be affected by the new fixed link (100%).
 - ❑ Increases in intermodal transport and in the Scandinavian port activities (60%).

- Who will be the winners resulting from it?
 - ❑ Logistics service providers / Freight forwarders (100%).
 - ❑ Airlines, airports, trucking companies (80%).

- Who will be the losers?
 - ❑ Ferry companies (100%).
 - ❑ Liner companies (60%).

- What will the changes in the patterns of trade be?
 - ❑ Increase in the trade between Scandinavia and the continent (80%).
 - ❑ Increase of intra-Scandinavian trade, Scandinavian integration with the EU (60%).

- In what sense will it impact the general population?
 - ❑ Additional jobs will be created (100%).
 - ❑ Swedish products will become more competitive (60%).

- There is a considerable competition among the Scandinavian ports and the big north European ports regarding freight moved to and from the region. When the bridge is built, who do you foresee as winners and losers?
 - ❑ Winners: Malmo, Copenhagen (100%).
 - ❑ Losers: ports in the 'Antwerp to Hamburg' range (60%).

Concerning the use of the bridge on short distances, more than 90% of the transport providers interviewed are going to use the bridge, whatever the bridge toll will be. The other 10 % will use it only if the bridge toll is under or equal to the ferry tariff paid for the crossing between Helsingör- Helsingborg.

On long distances, they are not willing to use the bridge, the ferry option remaining the most advantageous alternative to reach the continent. One of the reasons given by the transport providers for not using the bridge over long distance are driver regulations which rule their compulsory resting time. This point will be discussed in more details in further sections.

4.2. Changes in the transport network

The Oresund link is going to bring changes in the current transport network in the region.

Two ferries lines are going to close:

- Danlink between Helsingborg and Copenhagen on the 1st of July 2000
- Limhamn - Dragör link between Malmö and Copenhagen, on the 31st of October 1999

This means that the current freight traffic on those routes is going to move to other routes. Is the bridge going to take this traffic that was routed initially via these two ferry lines? The alternatives will be discussed further.

Railways will connect Scandinavia directly to the continent. Furthermore, Copenhagen Airport will be incorporated into the infrastructure, and there will be a direct rail link from Copenhagen to the airport. The fixed Oresund link will make Copenhagen Airport 20 km away from the City of Malmö, and is approachable via ferry and motorway from Helsingborg.

Malmö Central Station and freight yards are being modified to accommodate the traffic increase expected as a result of the fixed Oresund Link. New and extended arrival and departure tracks will be added to the freight yards.

An Outer Ring Road east of Malmö is currently under construction, and is coordinated with the opening of the Öresund Link in 2000.

4.3. Impact on road transport

Whether the road transport is short distance (less than 100 km) or long distance (more than 100 km), the impact of the new fixed link on these two types of road transport has to be differentiated.

4.3.1. Short distance transport

The type of journeys on which the bridge can offer time savings to road hauliers are the ones which involve short distances that do not require rest period for drivers. By its unlimited frequency, the bridge offers a great time advantage on short distance between Malmö and Copenhagen.

Road transport between Malmö and Copenhagen will without a doubt increase dramatically. All cargo moved initially via Dragör and Limhamn will be transferred to the link. Savings in time will be achieved due to the freight not having to wait for the arrival of the ferry, its berth, and its readiness to sail. Moreover, savings in costs will be achieved as well if the bridge toll is of the same amount as the ferry tariff between Helsingör and Helsingborg, that is cheaper than the former price of the ferry between Limhamn and Dragör.

4.3.2. Long distance transport

A case in point is given in Chapter 2 (p. 28) of the export of refrigerators between Arvika and Duesseldorf. In that example, the route by the ferry line Trelleborg-Travemunde was taken to reach the continent (Fig.8). The new route by road when taking the Oresund Bridge is shown in Figure 1. The route by ferry via Rodby - Puttgarden has been taken in that example to reach Germany; for traffic to go through the Oresund bridge and over the Great Belt, it would mean a detour of 170km (Hunt, 1994).

Export of refrigerators from Sweden to Germany using the Oresund Bridge

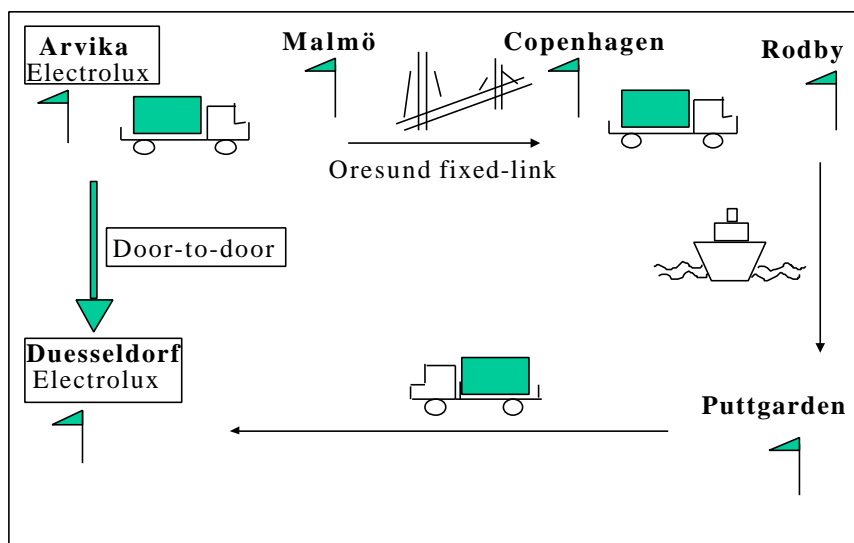


Figure 13

The transport cost will comprise the following items:

- Road transport Arvika - Malmö: $SEK15 \times 549 \text{ km} = SEK8235$
- Oresund Bridge toll $SEK1200$

- Road transport on the bridge $\text{SEK}15 \times 16 \text{ km} = \text{SEK}240$
- Road transport Copenhagen - Rodby $\text{SEK}15 \times 163 \text{ km} = \text{SEK}2445$
- Ferry Rodby- Puttgarden $\text{SEK}1200$
- Road transport Puttgarden - Duesseldorf $\text{SEK}15 \times 485 \text{ km} = \text{SEK}7275$

The bridge toll is considered as the same price as the ferry tariff between Helsingör and Helsingborg for a standard truck, that is SEK1200 (LeNormand, 1999).

The total cost is therefore equal to SEK20,595.

By using the ferry Trelleborg - Travemunde, the total transport cost would have been as follows:

- Road transport Arvika - Trelleborg $\text{SEK}15 \times 579 \text{ km} = \text{SEK}8685$
- Ferry Trelleborg - Travemunde $\text{SEK}3500$
- Road transport Travemunde - Duesseldorf $\text{SEK}15 \times 438 \text{ km} = \text{SEK}6570$

Then the total cost would have been equal to SEK18,755.

It shows that using the bridge is more expensive than using the direct route to Germany via Trelleborg - Travemünde.

When considering the alternative of using the bridge, the bridge toll contributes to 5.8% of the total transport cost. Therefore, it can be said that the bridge toll has no relevance in the evaluation of using or not using the bridge over a long distance.

The evaluation of the transit time for the two alternatives, using the bridge or using the ferry line shows the following results:

Using the ferry		Using the bridge	
Road Arvika-Trelleborg (579 km)	7.5h	Road Arvika-Malmö (549km)	7h
1 break after 4.5h driving	45min	1 break after 4.5h driving	45min
Ferry Trelleborg-Travemunde	10h	Bridge Malmö- Copenhagen	15min
Road Travemunde-Duesseldorf (438 km)	6h	Road Copenhagen-Rodby (163km)	2h
1 break after 4.5h	45min	Break after 9 hours compulsory driving/day	9h
		Ferry Rodby-Puttgarden	1h15min
		Road Puttgarden-Duesseldorf (485km)	6h
		1 break after 4.5h driving	45min
TOTAL	25 hours	TOTAL	27 hours15 min

An average speed of 80km/h has been considered when calculating the transit time.

It appears that the determining factor that has an impact on the long distance transport is the time factor. Using road transport, as the unique mode of transport over a long distance has no advantage in that time is wasted due to the compulsory driver's resting time.

This analysis shows that the new fixed link will have little or no impact on the long distance transport from Sweden to the continent. Therefore, there is no doubt that longer distance traffic to and from Germany will continue to move much in the same manner as before, that is, via Trelleborg ferry lines to Travemünde or Rostock.

4.3.3. Marginal transport

The example of the export of paper between Klippans (Sweden) and Wrexham (UK) given in Chapter 2 (p.29) can be considered as marginal transport in that the time factor has directed the choice of route and the cost factor has not been taken into consideration. Two drivers have been assigned to this urgent transport. With the bridge, the new route is shown in Figure 14.

Export of paper from Sweden to UK using the Oresund Bridge

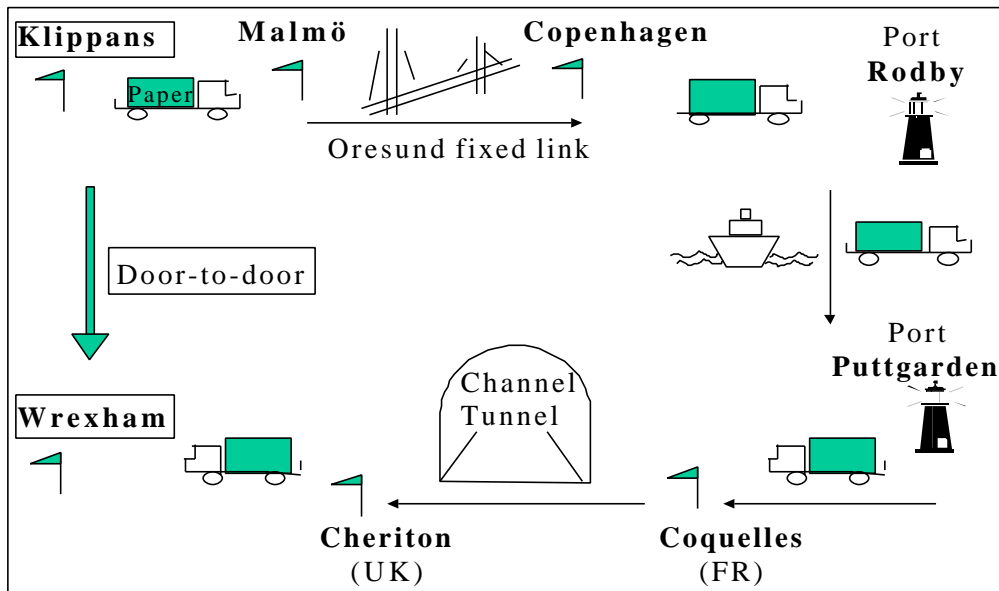


Figure 14

Using the bridge on this route is a gain of time only, in that there is no time wasted waiting for a ferry and the bridge is open 24 hours a day. It is clear that the bridge toll contributes a small percentage to the total transport cost. Therefore, using or not using the bridge in the portion of the route Malmö-Copenhagen is not a determining factor in terms of cost.

In case of urgent deliveries for Denmark or the continent, the use of the bridge may be advantageous because it is continuously open. In these types of transport, the cost factor does not enter into consideration as the time factor has priority. Therefore, whatever the bridge toll will be, using the bridge results in time gained.

In addition, the Swedish export industry works mainly with just-in-time production, which means, there are no large storage areas and as soon as a product has been produced, it must be transported. The transport criteria demanded by the export industry are frequent, regular and reliable transport. These requirements are closely met by the road transport and the new fixed link serves in this case the transport needs.

4.4. Impact on rail transport

With the closure on the 1st of July 2000 of the rail ferry service Danlink between Helsingborg and Copenhagen operated by Scandlines, the bridge will take the rail traffic that was routed via Helsingborg. The link will make it possible to run block trains directly through the rest of Europe, via the Great Belt.

A case in point is the example of transporting goods from Stockholm to Hamburg using the railway. Without the bridge, rail ferry lines to the continent (e.g. Trelleborg - Rostock) have to be used. With the new fixed link, goods can travel through a fixed rail link from Stockholm to Hamburg, passing by the Great Belt or taking the rail ferry Rodby - Puttgarden. The route via the Great Belt signifies a detour of 170 km and a bridge toll to pay. Moreover according to Erik Östergaard, Business Development Manager of Scand Lines AB (1999), there is a problem of slots allocation for freight trains in the rail link between the Great Belt and Germany. Therefore, according to him,

it is better to take the rail ferry Rodby - Puttgarden to join the German railway network instead of taking the Great Belt.

What is left to be seen is the allocation of slots per day to freight trains versus passenger trains. This can be a limiting factor for an efficient use of railways. At the moment, passenger trains are automatically given priority over freight trains (The Economist Conferences, 1998).

The freight rail is still not an efficient mode of transport as Erik Östergaard (1999) pointed out, due to the bureaucracy that characterises it, as well as the lack of coordination and harmony between each European country's railway system.

Therefore, it appears that the time advantage that the Oresund Link may offer to the railway is not fully exploited as problems of slot allocation for freight trains are still remaining.

4.5. Impact on air traffic

The motorway system in both Sweden and Denmark will have exits directly to the airport area. The railway will run through a tunnel under the landward side of the airport

Kastrup (Copenhagen Airport) has a position as a hub, which means that Copenhagen has a larger number of departures and flight connections than the population density of the city and region warrant.

Kastrup is located in the heart of the Öresund region which is expected to become an international growth center once Denmark and Sweden are connected by the bridge in

the year 2000. The construction of the Oresund link will reinforce the position of the Copenhagen airport as a hub for passenger and freight traffic to and from Scandinavia. Although on the Swedish side Sturup may attract some cargo, the tendency of today's transportation is to consolidate the routes between increasingly bigger transportation centers which from there will relay the shipments to its final destination. Kastrup has already a well-established structure, i.e. the benefit of a wider local market, and north and south connections.

In addition, it may be possible that goods that are initially destined to Kastrup, will be directed first to Sturup and then be carried by road from Sturup to Copenhagen. It may be a consequent gain in time, avoiding airport congestion at Kastrup. Then, although Kastrup will consolidate as the Scandinavian air hub, both airports will benefit from the Oresund link. In addition, the fixed link will provide opportunities for more efficient combinations of air-land transport, specially high value commodities coming from or going outside the continent.

4.6. Impact on the ferry business

The impact of the Oresund link on ferry lines is different whether the destination is Denmark or the continent.

4.6.1. Ferry lines between southern Sweden and Denmark

Ferry lines between southern Sweden and Denmark (short distance) are the most likely to be affected by the Oresund link. That is a general opinion, which has to be discussed. In fact, when comparing the alternatives of using or not using the bridge, the results

show that the use of the bridge is probably not the most cost effective alternative, but the most efficient in time.

If the example of the ferry line Helsingborg-Helsingör is taken, it appears that it is more expensive for a standard truck to use the bridge instead of using the ferry line Helsingborg-Helsingör.

The comparison of the two alternatives shows the following results:

Helsingborg-Copenhagen by using the ferry line:	Helsingborg-Copenhagen by using the Oresund link:
<ul style="list-style-type: none"> ➤ Ferry charges Helsingborg-Helsingör: SEK1200 for a standard truck (Le Normand, 1999) ➤ Helsingör-Copenhagen by road: 34 km x SEK15 = SEK510 	<ul style="list-style-type: none"> ➤ Helsingborg-Malmö by road: 65 km x SEK15 = SEK975 ➤ Oresund bridge: SEK1200 , considering the bridge toll equal to Helsingborg-helsingör ferry charges
Total cost: SEK1700	Total cost: SEK2175

A difference of approximately SEK500 per truck is significant when considering a fleet of trucks.

However, as mentioned before, there is a great advantage in time saving, which plays in favour of the use of the bridge on short distance.

It is also worth mentioning that the route between Helsingör-Copenhagen is known to be narrowed and subject to traffic congestion (Ingstad, 1999). This may be a factor to take into consideration when comparing the two alternatives.

Thus, it can be predicted according to the above analysis that the ferry links between Helsingborg and Helsingör may face a decrease that is due to the benefit in time that the bridge offers, and to the current traffic congestion between Helsingör and Copenhagen.

4.6.2. Ferry lines between southern Sweden and the continent

The effect of the Oresund link on the ferry lines from Trelleborg to the continent (long distance) will not be noticeable. As shown before, it is more expensive to use the bridge to reach the continent on long distance transport. In addition, the main advantage is that the crossing time can be used as a rest period for truck drivers. The importance of this factor has been underlined several times by the people interviewed.

To conclude, it appears that the impact of the new fixed link on the freight ferry business will be significant only for the lines serving Southern Sweden and Denmark, due to the time saving it offers being open 24 hours a day. When considering the cost factor, it remains more expensive for a standard truck to use the bridge rather than the ferries with the assumption that the bridge toll is set at the same level as the ferry tariff Helsingör-Helsingborg (SEK 1200).

4.7. Future for ferry services

On the 1st of July 1999, the demise of the tax-free system that is up to now the main funds provider for ferries will enter into force. This means that the ferry trade revenues

will decrease significantly. It has been announced in advance that some routes in the area will reduce its rotation or close completely. Thus, it signifies a reduction of passenger and cargo traffic. Therefore, for the ferry operators, the time for decision and change has come.

Ferry lines have invested in new high-speed vessels which will make as well an extra contribution to just-in-time deliveries (Hunt, 1993). According to the Business Development Manager of Scand Lines AB (Ostergaard, 1999), investing in fast ferries is not the best idea as a response to all external changes that affect the ferry business. In fact, it is less productive and more expensive than conventional ferries.

Therefore, emphasis is to be made on competitive prices, high frequency and reliability, criteria that the exporters ask for. Increased competition between ferry lines themselves in providing the best service based on the above criteria is to be expected.

A point in favour of the ferry leg is the drivers' regulation that forbids a truck driver to drive more than 4,5 hours straight (Oxley and Rushton, 1991). The ferry companies may exploit that rule in order to make the ferry a viable choice for longer journeys. As mentioned in Chapter 2, the major Swedish imports and exports concern the southern part of Sweden, from the Stockholm area to southern Sweden. The distance from Stockholm to Malmö is around 615 km, which is a transit time of more than 7 hours. Therefore, resting times are required for truck drivers coming from that area.

Transport of goods to East Europe by ferry lines will probably not be affected by the bridge. The expected traffic increase should be linked with the tax-free system still in place for non-EU countries, and with the expected economic growth of those eastern countries.

It remains to be seen what will be the future for the ferry companies in southern Sweden, bearing in mind that the demise of the tax free system onboard ferries will have a major impact on it.

4.8. Impacts on the main southern Swedish ports

Six years before the bridge, forecasts were made on the impact of the bridge on the port activities. In his article "The Gateways to Europe", Hunt (1994a) said that "The Oresund Bridge may, in some cases, benefit from the resultant growth and short distance communications offered by the fixed link with Denmark". By offering a variety of services, regular departures with high frequency, providing good access to markets and avoiding traffic congestion, Swedish ports can offer a tailor-made service to meet the customer's needs.

A consideration for this bridge is that it will reduce the traffic of the Scandinavian ports with cargo coming from distant points. In fact, cargo coming from America or Asia can be discharged in Rotterdam, Hamburg or Gothenburg, and from there be railed to Scandinavia using the bridge, without the need to tranship to Malmo, Copenhagen or Trelleborg for example.

On the deficit side, the port of Helsingborg will lose the traffic that was routed via Copenhagen (Danlink), and probably a part of the traffic to Helsingör that is destined to Denmark.

Once the bridge is open, the port of Malmö will also lose some ferry services, such as the Limhamn-Dragör line (traffic of 198,978 tons of goods in 1998 (Table 2, p.17)), but it is foreseen that this will be more than compensated by the growth which is forecasted

for the area benefitting Malmö harbour. According to Malmo Hamn (1999), new development opportunities are being created for the port of Malmö, with the new Oresund region of a population of over 3 million. Its considerable land reserves available at competitive prices create favourable conditions for establishing modern logistics centres and distribution installations.

Moreover, the Malmö and Copenhagen ports have formed a cross border 50/50 joint venture to develop and operate a new port, called CM-PORT with a Danish west harbour and a Swedish east harbour (PdI, 1999). The new alliance intends to cope with the expected growth that is foreseen for the Oresund region and to co-operate rather than compete, in the appearing shadow of the Oresund new fixed link (Lloyds list, 1999b). Developments will start in 2000 with a pro-forma annual cargo volume of 18,5mt and turnover of \$57.7m (Lloyd list, 1999c).

Different forecasts for the future development of the port of Trelleborg indicate large growth potentials to the year 2010 and thereafter. The port's market share of the Swedish foreign trade is forecasted to increase from 11% to 14 % by 2010 (excluding ore and oil) (Port of Trelleborg, 1999). The extensive supply of ferry connections via the port of Trelleborg creates an efficient link to the continent, which is optimally integrated in the logistic chain to meet shippers and hauliers requirements by minimising terminal- and lead times. Thus, there is no logical reason that the port activities are going to decrease with the new fixed link over the Oresund.

The probable short-term decline in revenues from ferry operations presents a challenge to the ferry ports. It will be particularly important, therefore, for ports such as Malmö or Helsingborg to diversify in order to combat the loss of revenues from the ferries.

Finally, easy access to markets with frequent, regular and reliable transport and undamaged goods are the keys to the port's success.

4.9. Conclusion

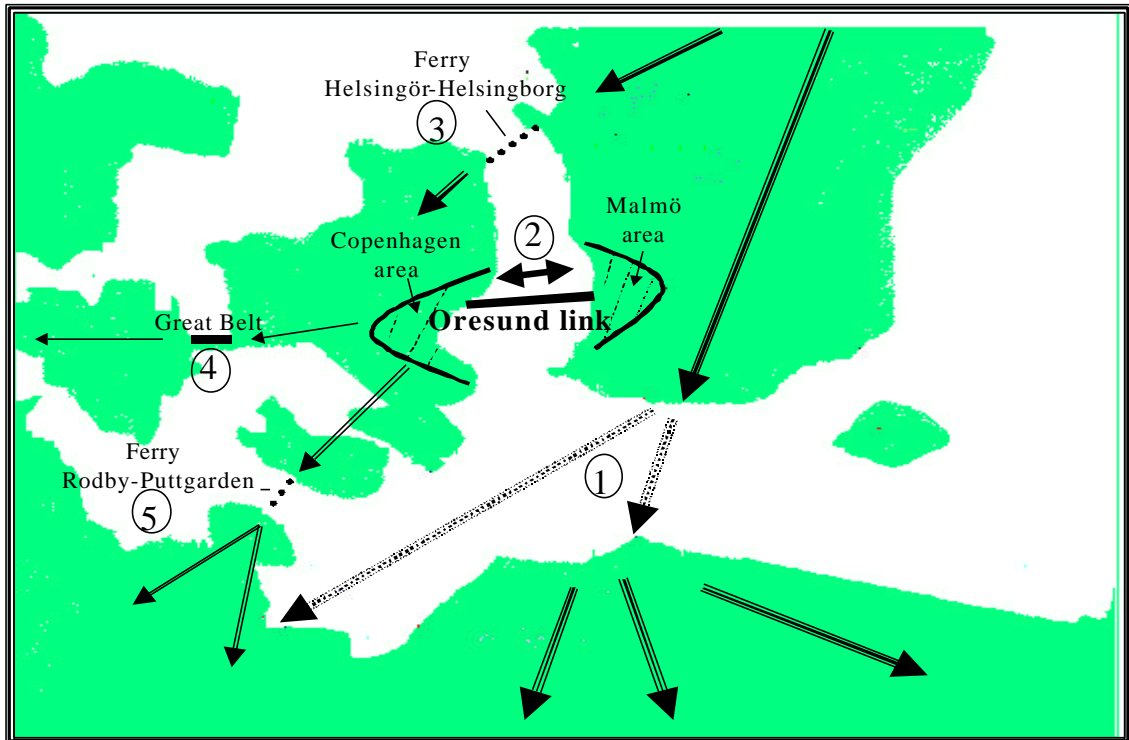
The outcome drawn from the facts exposed in this section shows that the new fixed link will have a direct impact on the Scandinavian population, economically and socially. However, its major influence relates to the new alternatives it presents in the logistics picture for its region, affecting the different modes of transport to a higher or lesser extent, as presented in the following table:

Table 6. Impact of the Oresund Link according to the transport mode

	Air	Ferry	Rail	Road
MAL/CPH	MEDIUM	VERY HIGH	LOW	VERY HIGH
SWE/EUR	MEDIUM	LOW	HIGH	MEDIUM

Figure 15 summarises on a map the way the goods would be moved from Sweden to Denmark and the continent.

Alternatives for the move of goods from Sweden to Denmark and the continent



- 1 Long distance to the continent: Use of the ferry lines
- 2 Short distance to and from Sweden: Use of the Oresund link
- 3 Freight traffic to and from Helsingör-Helsingborg: Use of the ferry lines
- 4 Transit over the Great Belt: Use of rail and road
- 5 Transit over Rodby-Puttgarden: Use of the ferry lines

Figure 15

With regards to road transport, the bridge is an advantage on short distance transport (below 100 km) or for urgent freight where time is a main consideration. On long

distance (over 100 km), it is more expensive to use the bridge rather than direct ferry lines to Germany. However, in case of urgent deliveries or high value cargoes, the use of the bridge will be justified.

Freight moved via train can be moved directly to the continent without interruptions through the fixed link. However, railway networks in Europe still do not provide full efficient services for the transport of freight. Problems remain in the allocation of slots for freight trains and in the legal and physical framework that links the different European rail systems.

Facilitation of air freight and consolidation of Copenhagen airport as a hub is another result. The bridge would probably favourably affect air transport, but this will also greatly benefit the bridge.

Ferry lines between southern Sweden and Denmark will face a decrease because using the bridge presents a gain of time as it can be used 24 hours a day. Ferry lines to the continent will face no changes since it is the most economical alternative to reach the continent. In addition, crossing time is taken as a resting time for truck drivers.

As seen above, the Oresund link will present opportunities for some activities, and challenges in others. Nevertheless, more important than the present considerations of who may be a winner or loser, it is the long-term influence of this work that will have an enduring effect for the population of the area.

CHAPTER 5

CONCLUSION

The Oresund crossing is among the 14 major projects identified as priorities in the development of the called TEN -Trans-European Network- and will provide both road and rail links. The Treaty on European Union, which came into force in November 1993, established Trans-European Networks in transport, energy and telecommunications as formal EU objectives. Trans-European Networks are modern, technologically advanced infrastructures, which will pull Europe together to create a stronger economy, more jobs and a better quality of life for all citizens by the new millennium (European Union, 1999).

The analysis of the impact of the new fixed link on the transport logistics serves to suggest that although the Oresund Link will be an important element of the Swedish transport system, it is unlikely to have a dramatic or even a measurable impact on the whole Scandinavian or European level, except at a local scale. It is bound to have an impact on transport patterns in southern Sweden if the current political, legal, economic, social, and technical environment remains unchanged.

It has to be underlined that any attempt to forecast what impact the Oresund link will have on freight movements and logistics is complex to perform due to the fast changing

technologies, as well as the economic and political environment. Therefore, the long-term impact might be different from what has been concluded in this paper.

The link is bound to affect the ferry side, particularly shortsea Ro-Ro's. Long sea crossings will be marginally affected, having the advantage to allow drivers to take their rest periods on board ships with the consequent time-money saving. Regulations on drivers' hours are the primary factor that limits the use of the bridge by trucks on long distance journeys.

The ferry industry in southern Sweden, especially on short distances between Sweden and Denmark has to seek alternatives for survival, such as a different focus on its sales of goods to passengers, and an increase in marketing efforts, promoting a safer, relaxed, environmentally friendly leg, or offering additional attractions during the journey (small presentations, games, etc.).

It appears that the time factor is the major advantage when choosing the use of the bridge. The bridge toll will not be the determining factor over a long distance that may limit the use of the bridge.

It seems reasonable to conclude that in general, freight demand will increase significantly in line with closer European economic integration, and that the greater part of this will continue to use the ferries, in particular driver accompanied traffic.

In the future, with the third fixed link that is being planned at Fehmarn Belt connecting Denmark to Germany (Rödby-Puttgarden), it may present some advantages for transport providers to use road or rail transport over a long distance from Scandinavia to southern Europe, crossing the two links, Oresund and Fehrman Belt.

In order to attract significant tonnage, whether in containers or using combined transport technology, high quality services should be guaranteed by the Fixed link and railways.

Railways are a cheaper and more environmentally friendly mode of transport, which is still increasing its connections and reaching points throughout Europe. Using the railways through the Oresund Link reduces the time and cost added by loading and discharging boxes. The advantages offered by rail freight are an important point to consider.

The tendency nowadays is to promote rail transport mainly for environmental concerns. As an example, the European Commission has approved a plan for the Danish government to subsidize railways in order to help shift the transport of goods from road to rail. The EC said that the rail subsidy is substantially smaller than the estimated "external and infrastructure costs" caused by truckers and which they do not pay. The Danish subsidy plan, laid down in a 1998 Danish law, is designed to create a more equitable competition between road and rail transport (American Shipper, 1999).

With regard to logistics, the Oresund fixed link opens the window for combinations of sea-land and land-air transport. Facilitation of transport means that cargo becomes cheaper since it can arrive more economically and faster to its final destination. Therefore, all parts of the chain benefit: ports, airports, truckers, rail companies, sea carriers, and naturally, logistics providers, which are in the business of putting all these pieces together in order to find the better combination of service/price for their customers.

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ANNEX 1

Example of timetable used by SHENKER-BTL

TIDTABELL		Giltig fr.o.m. 1999-01-15	IMPORT	Malmö				
Avgångsland	Huvudort	Inhämtningsområde i utlandet (Postnummer el. motsvarande)	Hämtning hos avsändaren					
			MÅ	Ti	On	To	Fr	
Belgien (BE)	Mechelen	10-99.	Ank. On	To	Fr	MÅ	MÅ	
	Mechelen	Luxemburg	To	Fr	MÅ	MÅ	On	
Bulgarien (BG)	Sofia	Terminal Sofia	Ank. MÅ1	MÅ1	MÅ1	MÅ1	MÅ1	
Danmark (DK)	Köpenhamn	1000-3690, 3800-4890.	Ank. Ti	On	To	Fr	MÅ	
	Köpenhamn	3700-3790, 4900-4990, 5000-5985.	On	To	Fr	MÅ	Ti	
	Århus	8000-8260, 8310, 8361, 8381.	Ti	On	To	Fr	MÅ	
	Århus	6000-7999, 8261-8309, 8311-8360, 8362-8380, 8382-9990.	On	To	Fr	MÅ	Ti	
Estland (EE)	Tallinn	Tallinn	Ank. Fr	Fr	On	On	On	
	Tallinn	Övriga Estland	Fr	On1	On	On	Fr	
Finland (FI)	Helsingfors	00100-02380, 02500-02980.	Ank. To	To	Fr	MÅ	MÅ	
	Helsingfors	Övr. 02. 03-88, 90 exkl. 22.	To	Fr	MÅ	MÅ	To	
	Helsingfors	89, 91-99.	Fr	MÅ	MÅ	To	To	
	Åbo	20100-20900.	To	To	Fr	MÅ	MÅ	
	Åbo	00-19, övr. 20, 21-88, 90 exkl. 22.	To	Fr	MÅ	MÅ	To	
	Åbo	89, 91-99.	Fr	MÅ	MÅ	To	To	
	Vasa/Jakobstad	65.	Fr	Fr	MÅ	MÅ	MÅ	
	Vasa/Jakobstad	00-64, 66-88, 90-92, 94, exkl. 22.	Fr	MÅ	MÅ	MÅ	Fr	
	Vasa/Jakobstad	89, 93, 95-99.	MÅ	MÅ	MÅ	Fr1	Fr	
	Marihamn	22100-22710.	On	Fr	Fr	On	On	
Marihamn	22720-22950	Fr	Fr	On	On	On		
Frankrike (FR)	Paris	03, 10, 14, 18, 21, 22, 23, 27, 28, 29, 31, 33, 35, 36, 37, 41, 44, 49, 50, 51, 53, 55, 56, 58, 60, 61, 64, 72, 75, 76, 77, 78, 79, 85, 86, 89, 91, 92, 93, 94, 95.	Ank. To	MÅ	MÅ	MÅ	To	
	Paris	09, 11, 12, 13, 15, 16, 17, 19, 24, 30, 32, 34, 40, 46, 47, 48, 65, 66, 81, 82, 87.	MÅ	MÅ	MÅ	To	To	
	Paris	2A, 2B.	MÅ	MÅ	To1	To	To	
	Lyon	01, 04, 05, 06, 07, 26, 38, 39, 42, 43, 63, 69, 71, 73, 74, 83, 84.	MÅ	MÅ	MÅ	MÅ	MÅ1	
	Roucy	02, 08, 59, 62, 80.	To	MÅ	MÅ	MÅ	To	
	Strasbourg	57, 67, 68.	Fr	Fr	MÅ	MÅ	MÅ	
Strasbourg	Strasbourg	25, 54, 70, 68, 90.	Fr	MÅ	MÅ	MÅ	Fr	
Grekland (GR)	Aten	Terminal Aten	Ank. To1	To1	To1	To1	To1	
	Aten	Maximum 50 km från terminal.	To1	To1	To2	To1	To1	
	Aten	Avstånd mellan 51 - 200 km från terminal.	To1	To2	To2	To1	To1	
	Thessaloniki	Terminal Thessaloniki	Fr1	Fr1	Fr1	Fr1	Fr1	
	Thessaloniki	Maximum 50 km från terminal.	Fr1	Fr1	Fr1	Fr1	Fr1	
Thessaloniki	Avstånd mellan 51 - 200 km från terminal.	Fr1	Fr1	Fr1	Fr2	Fr1		
Holland (NL)	Ede	10-15, 22-24, 27-30, 39-42, 49-58, 65-74, 80-82.	Ank. Ti	On	To	Fr	MÅ	
	Ede	16-21, 25-26, 31-32, 43-48, 59-64, 75-79, 83-89.	On	To	Fr	MÅ	Ti	
Irland (IE)	Dublin	Grevskap: AH, CE, CN, CW, D, DC, DN, FH, G, KE, KK, LD, LH, LK, LM, LS, MH, MN, OY, RN, SO, TE, TN, WD, WH, WW, WX.	Ank. On1	On1	On	On	On	
	Dublin	Grevskap: AM, C, DL, DY, KY, MO, Nordirland.	On1	On1	On	On	On1	
Italien (IT)	Milano	20-22, 28.	Ank. MÅ	MÅ	MÅ	MÅ	MÅ	
	Milano	10-19, 23-27, 29.	MÅ	MÅ	MÅ	MÅ	MÅ1	
	Milano	00-05, 70-75, 80-86.	MÅ	MÅ	MÅ	MÅ1	MÅ1	
	Milano	87-98.	MÅ	MÅ	MÅ1	MÅ1	MÅ1	
	Bologna	40-44, 48.	Ti1	Ti	Ti	Ti	Ti	
	Bologna	47, 60-63.	Ti1	Ti	Ti	Ti	Ti1	
	Bologna	06, 64-67.	Ti1	Ti	Ti	Ti1	Ti1	
	Florens	50-51, 53, 55-56.	Ti1	Ti	Ti	Ti	Ti	
	Florens	52, 57-58.	Ti1	Ti	Ti	Ti	Ti1	
	Padova	30-33, 35-38, 45-48.	Ti1	Ti	Ti	Ti	Ti	
Padova	34, 39.	Ti1	Ti	Ti	Ti	Ti1		
Lettland (LV)	Riga	Terminal Riga	Ank. Fr	Fr	Ti	Ti	Ti	

Ankomstdag utan siffror betyder att godset ankommer inom en vecka (avgångsdag ej specificerad)
Ankomstdag med siffror 1 - angiven dag plus 7 dagar (avgångsdag ej specificerad)
Ankomstdag med siffror 2 - angiven dag plus 14 dagar (avgångsdag ej specificerad) etc.
Inhämtningstiderna kan normalt skilja sig vid lördag, söndag och nationella helgdagar.

Source: Tidtabell för Schenker-BTL AB - EuroComfort (1999)

ANNEX 2

Route taken to transport refrigerators from Arvika to Duesseldorf.



Source: SCHENKER-BTL (1999)

ANNEX 3

Route taken to transport paper from Klippan bruk to Wrexham



Source: SHENKER-BTL (1999)