# The Future of Feedering the Humber

## - Attracting cargo by improving efficiency -

**Master thesis of P.V.Vroegop**

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# Preface

This thesis is the result of study that reveals inefficiencies and provides solutions to improve efficiency in an existing feeder chain; "the Rotterdam-Humber corridor". By improving efficiency Port of Rotterdam should be able to attract more cargo from Middle and North UK. Gathering data to reveal inefficiencies and constructing a model for analysis was a difficult and time consuming work. To get the needed information a lot of interviews with different companies were conducted. Nevertheless, I have conducted this research with a lot of enthusiasm and devotion. The results are presented in the thesis you are about to read.

I conducted this research for the Department Corporate Strategy of Port of Rotterdam N.V. and to finish my study Business & Economics at Erasmus University Rotterdam. I always have had a fascination for ports and big (container) vessels. When I got the opportunity to combine the writing of my thesis with an internship at Port of Rotterdam, I did not have to think twice to seize that opportunity.

Although I wrote this thesis by myself, it would not have been possible without the help and support of a lot of people. Particular, I would like to sincerely thank Peter de Langen and Michiel Nijdam, who have supported me during the process and always gave me useful feedback. I would also like to thank the people at Port of Rotterdam and the companies I interviewed, who in spite of their busy agendas, always made time for me to give me useful feedback and information to write my thesis. Particular, I would like to thank the Department Corporate Strategy at Port of Rotterdam for the ability to participate in their daily business and for all the good moments I have experienced.

With the finishing of my thesis I also finish a period of 7 wonderful years of studying in Rotterdam. During these years I gained a lot of knowledge via my studies Business & Economics and International Marketing Management. This would not have been possible without the support of my parents. I would like to thank them for the opportunity and trust they always had in me. Especially, I would like to thank my dad because he always made time to help me with difficulties regarding my thesis during his own busy job. Last but not least, I would like to thank all my family and friends for the support they gave me.

I hope you will read this thesis with pleasure while it simultaneously informs you about a, in my point of view, very interesting topic.

Patrick Vroegop

Rotterdam, 2008

# Abstract

Feedering, which is an integrated part of transhipment, has not had much attention by the different scholars in the field of maritime economics. Most scientific literature is about transport networks, which includes transhipment. Or about the economic principles, which induced the creation of these new network structures. This thesis goes further where most literature stops. It provides more insight in the transhipment and feeder market in North West Europe. Besides the way feedering has originated, this thesis shows us where today's problems regarding feedering occur and what the main factors for shipping lines are for deploying dedicated feeders. Furthermore, this thesis shows how feeder chains are constructed and what the different (cost) components are in the feeder chain. A conceptual model of the feeder chain costs is created. By identifying the "Service Distortion Costs" in the feeder chain, a clear picture exists about where efficiency improvements could be made. The port of Rotterdam has been used as a case study for this research and the Rotterdam-Humber corridor has been used for analysis. The conceptual model is applied on the Rotterdam-Humber corridor and has revealed existing inefficiencies. The main goal of this thesis is to improve efficiency in the Rotterdam-Humber corridor in order to attract more cargo from Middle and North UK to port of Rotterdam. Solutions for feeder chain efficiency improvements are discussed and recommendations are given. In short, this thesis adds more knowledge to existing literature about feeder chain efficiency problems and improvements in the North West European container market by analyzing an existing feeder connection (Rotterdam-Humber) from Rotterdam to the UK.

## Acronyms

| | |
|---|---|
| ABP | Associated British Ports |
| DC | Distribution Centre |
| DDE | Delta Dedicated East |
| DDN | Delta Dedicated North |
| DDW | Delta Dedicated West |
| DBF | Dedicated Barge Feeder |
| ITT | Intern Terminal Transport |
| NETA | North European Trade Axis |
| RDC | Regional Distribution Centre |
| PoR | Port of Rotterdam |
| SDC | Service Distortion Costs |
| THC | Terminal Handling Charges |
| WTD | Working Time Directive |

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# Chapter 1 – Introduction

## 1.1 Background

The ongoing development in global trade has significantly increased the demand for container (liner) shipping. Together with containerisation, contemporary liner shipping is characterised by increasing vessel size, more comprehensive geographical network coverage and frequent restructuring of shipping lines, like mergers, acquisitions and shipping alliances (Heaver, 2002). In turn, this has led to increased popularity of using hub-and-spoke systems. As a result, transhipment has become a significant sector in the shipping industry and is increasingly important in determining port competitiveness.

Globalisation and the booming industry in the Far East (China) have contributed to annual growth rates of 11% in the container market between 1980 and 2006. In that time span container throughput has increased from 39 to 440 million TEUs (Drewry, 2007). This tremendous growth in world trade has led to capacity problems and congested transport networks at most North-West Europe container ports.

Ports with capacity shortages and congested transport networks are expensive and unable to provide reliable services. As a consequence shipping lines try to find other solutions to ship containers from and to their customers. Other solutions usually mean using the congested port as little as possible. The combination of increasing vessel size, tremendous growth in world trade and congestion at major container ports, will only increase the demand for transhipment.

According to Notteboom (1998) the assumption of larger mainline carriers calling at fewer ports and thus induce an increase in feeder traffic has not been actualised so far. However, It is in my opinion that increasing size of carriers will probably result in fewer ports getting a direct call from the shipping lines. The first reason is that not all ports are able to handle these big carriers, mainly because of draft and berth restrictions. Second, it is economically not profitable when a big carrier call at a lot of different ports in the same region. The trend of increasing vessel sizes can, in the future, lead to only one or two call(s) at one or two port(s) in North West Europe. Becoming the main port hub of Europe will increase container throughput tremendously and thus market share and revenues. Furthermore, this development will also lead to more demand for transhipment and feedering in the North West European region.

This evolvement in the shipping industry, which is an opportunity for Rotterdam because of its geographical location, has to be turned into a new strength. Providing sufficient transhipment possibilities to major shipping lines is important for ports, because it not only generates transhipment cargo but also additional (continental) hinterland cargo. When carriers do not have the possibility to tranship at a port, they will seek other ports in the region, which do have sufficient transhipment possibilities. The consequence is the fact that if a shipping line decides to move to another port, a part of the hinterland cargo generated by the moving shipping line will also move. In other words, if Rotterdam does not create an efficient and effective transhipment environment, they will loose (continental) hinterland and transhipment cargo to other ports in the region and eventually will loose the battle of becoming Europe's main port hub.

Port of Rotterdam (PoR) is always seeking to increase market share and their goal is to be the main port hub of Europe. In the transhipment business, Rotterdam wants to maintain its leading role (Bedrijfsplan HbR, 2008-2010). Because of its unique geographical location, Port of Rotterdam is besides its gateway function for the European continent very suited to be the main transhipment hub for Europe. But if Rotterdam wants to be the main transhipment hub of Europe, they have to provide all necessary facilities for transhipment and feedering.

In North West Europe transhipment has a share of 28% in total container throughput, which means that approximately 5.5 million TEU has to be feedered over the region (Dynamar, 2007). There are three dense intra-European feeder flows; Scandinavia and the Baltic, Northern Spain and Portugal and UK and Ireland. Rotterdam has the largest market share in the UK/Ireland and Spain/Portugal flows.

This thesis is about transhipment and feedering the UK via Rotterdam. It investigates the opportunities and possibilities of attracting cargo from North and Middle UK to the port of Rotterdam. A conceptual model of the feeder chain costs is created and analysed, in order to get an understanding of how the feeder chain works and where efficiency improvements can be made. Improving feeder chain efficiency is one of the key elements in this thesis. Improving chain efficiency should result in attracting more containers to the port of Rotterdam and improve chain performance

The focus of the thesis is on the Rotterdam-Humber corridor. This is a connection (feeder flow) between Rotterdam and a port area located in the middle of the UK along the east coast. It has a good accessibility towards North and Midlands of the UK and can therefore be seen as a global gateway for the North. The five ports that are located in the Humber are: Grimsby & Immingham, Hull & Goole, Rivers Hull and Humber and the River Trent. This is the most obvious port area to use for serving Middle and Northern UK markets via Rotterdam because of its geographical location.

This thesis will provide recommendations about how feeder chain efficiency in Rotterdam can be improved. It gives insight in what Port of Rotterdam and the industry should do to attract more cargo from North and Middle UK. In the next paragraph the problem analysis is presented.


*Figure 1.1: Inter-port distance*

## 1.2 Problem analysis

Felixstowe and Southampton are the two major container ports of the UK. At the moment these Southern UK ports and their hinterland transport network are heavily congested. After the privatisation of the UK port industry in the 1980's there has been a lack of investment in the transport network connecting the ports with the Middle and North of the UK. Together with growing demand for port capacity due to the increase in global trade, the two largest UK container ports have become unreliable and expensive in terms of services offered (Humber Logistic study, 2003). Other solutions are sought by shippers, carriers and forwarders to serve a significant part of the UK market. The congested ports in the South of the UK have led to companies rethink their supply chains.

Also the introduction of the Working Time Directive (WTD) in March 2005 has placed pressure on existing supply chains. Because of this policy implementation, all (truck) drivers are limited to a 48-hour week on average with a maximum 60-hour permissible. Because of the WTD transport costs in the UK have increased and shipping cargo, via the South of UK to parts of the Middle and North, have become expensive and unreliable in terms of costs and time. Time reliability is especially important because most retailers are operating with tight windows at Regional Distribution Centres (RDC).

A close examination of the container distribution in the UK, which is examined more extensive in chapter six, reveals that around 50 % of the import containers are designated for the Middle and North UK. However, most containers for this area are imported through the Southern container ports of Felixstowe and Southampton.

Major trends in the port and transport sector, expensive and unreliable services at the Southern deep sea port terminals because of congestion and the introduction of the WTD, have made the Rotterdam-Humber corridor a very attractive and viable option for shippers, forwarders and shipping lines to serve the Middle and North UK market.

When looking at PoR objectives for the coming years (Bedrijfsplan HbR, 2006-2010, Havenplan 2020), it becomes clear that this opportunity is in line with one of the company goals, which is to strengthen its competitive market position in the container market. This means that strengthening the Rotterdam-Humber corridor is in line with PoR objectives. Rotterdam already started with capacity expansion projects, such as the Dedicated Barge Feeder terminal (DBF) at the ECT Delta terminal and the Maasvlakte 2 project, to facilitate the largest vessels and to secure reliable feeder connections.

However, before the market is convinced that this corridor is truly the best way of serving Middle and North UK, proof has to be presented in terms of transit time, service reliability and total costs. These three factors are the cornerstones of today's shipping industry. Furthermore, to establish an efficient and competitive feeder connection, improvements at both sides of the corridor have to be implemented. Chain efficiency is most important in that respect. Therefore, this thesis will investigate how the efficiency in the Rotterdam-Humber corridor can be improved.

## 1.3 Objective

The above has resulted in the following objective for this research:

> **"Gain insight in the European Feeder market, with the aim to provide suggestions to raise the efficiency in the Rotterdam-Humber Corridor"**

By obtaining insight in the European feeder market, with a focus on UK, the inefficiencies that are present can be detected. Raising efficiency will lead to improvements in time, costs and reliability, three factors which are very important in the shipping industry.

## 1.4 Definitions

> *"Container transhipment can be defined as the exchange of containers between ships via a port terminal, involving two separate lifts between the ship and the quay" (MDS Transmodal, 2006).*

In this paragraph, definitions that are important with respect to this research are given. Transhipment and feedering are strongly associated. However, in the container business transhipment does not necessarily means feedering. There are different forms of transhipment (Dynamar, 2007):

- **Transit**: the handling of containers from a mainline ship directly or via the quay onto barges (or other modes) to the port's hinterland. However, in the context of this thesis transhipment concerns a move between sea-going ships. Containers transported to the hinterland by whatever mode (train, barge, truck) are in transit.

- **Interlining**: transhipment between two or more parallel running services operated by one carrier (or alliance) in the same trade, but serving different ports at the end of each string. By switching containers between mainline carriers, mostly at one common hub, all ports in the trade are served at a frequency equal to that of the total number of different (weekly) strings. Leading ports at which interlining takes place are; Hong Kong, Singapore, Antwerp and Rotterdam.

- **Relay**: transhipment of containers between East-West operating mainline carriers to usually a North-South trading mainline carrier (mostly smaller vessel), the container switches mainline routes.

- **Feedering**: transhipment from mainline carrier onto a sea-going feeder vessel, and vice versa, for short haul distribution to ports which are too small or lack sufficient volumes to be served by a mainline carrier. Feedering is an extension of the deep sea operation.

- **Shortsea:** shortsea shipping from a European point of view means the movement of cargo (and passengers) by sea between ports situated in geographical Europe or between those ports and ports situated in non European countries having a coastline on the enclosed seas bordering Europe. The big difference between shortsea and feedering is the fact that shortsea operators are searching for their own commercial cargo, while feeder operators do not have their own commercial cargo. Feeders only ship cargo that comes directly from a mainline vessel. The commercial cargo is from the mainliner and not from the feeder operator. Feedering is an extension of the mainline operation. Shortsea shipping is a totally own operation, providing customers (shippers) in Europe an intermodal door-to-door solution for the shipment of cargo between different countries in Europe or nearby Europe.

- **Hub-and-spoke:** The hub-and-spoke system is in fact an system that allows shipping lines to efficiently serve smaller markets by using a combination of very large mother carriers (>10.000TEU) that call only at a big hub port and smaller feeder ships. By including transhipment in the operation of shipping companies, they are able to achieve considerable economies of scale. Smaller ships then provide faster feeder services on inter-regional short routes or other low traffic routes. Transhipments offer an efficient way of serving smaller ports and countries and provide many more port-to-port connections to shippers than direct services (Damas, 2001). In fact, with the hub and spokes system, carriers can provide shipping service virtually between any two ports not connected by a direct service

- **Rotterdam-Humber Corridor:** is a (feeder) connection between port of Rotterdam and the UK Humber ports of Immingham & Grimsby and Hull & Goole, located at the Middle of the UK at the East coast. The corridor starts with the loading of the feeder vessel in the port of Rotterdam and ends when the container is delivered at the final customer in the UK. Therefore, the corridor consist of a part sea and a part land transport The corridor is an alternative for delivering a container in Middle and North UK via a direct call of a mainline vessel in Southern UK ports.

In the next chapter the research setup is presented. The main research question and the sub-research questions are discussed and the research strategy to answer the research questions is provided. Furthermore, the practical and scientific relevance of this thesis is argued.

# Chapter 2 - Research setup

## 2.1 Introduction

To raise chain efficiency it is important to know how a chain works; is created; what the different links in the chain are; and probably most important what the problems (inefficiencies) in the chain are. In this chapter the research method is described. According to Yin (2003) a research design is the logic that links the data to be collected and the conclusions to be drawn to the initial questions of the research. The first part of this chapter describes the type of research that is conducted. This is followed by the construction of the main research question and sub research questions. The research strategy, which gives an overview of the used methods to answer the research questions, is given in the last part of this chapter. Finally, a visualized overview of the steps taken to realize the aim of this research is given.

## 2.2 Type of research

According to Saunders, et al (2000) two types of research can be distinguished; a basic/fundamental oriented research and applied/practical oriented research. The types of research are put apart in the table below.

***Table 2.1: Fundamental and Practical oriented research***

| Fundamental/ Basic research | Practice oriented/Applied research |
|---|---|
| **Purpose:**<br>- Expand the knowledge of processes of business and management<br>- Result in universal principles relating to the process and its relationship to outcomes<br>- Findings of significance and value to society | **Purpose:**<br>-Improve understanding of particular business or Management problems.<br>-Results in solution to the problem.<br>-New knowledge limited to problem<br>-Findings of practical relevance and value to manager(s) in organisation(s) |
| **Context:**<br>- Undertaken by people based in universities<br>- Choice of topic and objectives determined by the researcher<br>- Flexible timescales<br>- Choice for research subject and goal | **Context:**<br>- Undertaking by people based in a variety of settings, including organisations and universities<br>- Objectives negotiated with originator<br>- Tight timescale |

*Source: Saunders et al 2000*

Practice oriented research is described by the product of the research, like concepts, views and methods, which are useful for specific management problems. Scientific oriented research, on the other hand, has the emphasis to gather general knowledge and contributes to the general science. The main difference is that practical oriented research has the aim to provide concrete knowledge for a customer or a group of customers for a specific problem or situation.

Taking the explanation of above into account this research is a practical oriented/applied research. It is practice oriented because this research provides a better understanding of feeder chains from and to Rotterdam, based on a case study of the Rotterdam-Humber corridor.

Although this thesis is practice oriented, it will have scientific value since the aim is related to create new insights in feeder chains in North West Europe. By using existing theory and information gathered by interviews, a conceptual model of the feeder chain costs is created. The conceptual model provides new insights in the North West European feeder business. By analysing the Rotterdam-Humber corridor, with the constructed conceptual model, solutions for (efficiency) improvements are put forward.

## 2.3 Problem statement

The research question of this thesis is presented in sub-paragraph 2.3.1. To give a clear and structured answer to the main research question, sub research questions are constructed. The sub research questions are given in paragraph 2.3.2.

### 2.3.1 Main research question

The main research question is derived from the objective. The following research question has been formulated for this research:

> **"How can Port of Rotterdam improve the efficiency in the Rotterdam-Humber Corridor, in order to attract import cargo from North and Middle UK?"**

### 2.3.2 Sub research questions

The sub questions are derived from the research question. Seven sub-questions are formulated to give a well structured answer to the research question.

**1.** **Which major trends and developments in the port and transport sector have led to transhipment and the use of the hub-and-spoke system?**

The answer to this question is given in chapter three. Insight has been gathered through a literature study.

**2.** **What makes a port attractive for shipping lines with respect to transhipment and feedering?**

Also a literature study provides the necessary answer to this sub-question. The answer can be found in chapter three.

**3.** **What are the market characteristics and principles of transhipment and feedering?**

The answer to this question can be found in chapter four. Literature research and interviews with different maritime companies have provided the necessary input.

4. **What are the (costs) components of the feeder chain and what factors are of influence?**

In chapter five a conceptual model of the feeder chain costs is created. This model gives a clear overview of the different costs components that are present in the feeder chain. The input for the model has been gathered mainly through face-to-face interviews and to a much lesser extends through literature research and Port of Rotterdam documents.

5. **Has the Rotterdam-Humber corridor potential for attracting cargo from Middle and North UK to the port of Rotterdam?**

By making an analysis of the UK (container) market with respect to Rotterdam, an answer to this question is given in chapter six.

6. **What are the feeder chain costs of the Rotterdam-Humber corridor compared with the costs of a direct call on a major Southern UK (container) port?**

To answer this question the Rotterdam-Humber corridor is used as a case study. By making a business case of transhipment via Rotterdam compared with a direct call on a Southern UK port, the difference in costs between the two options are revealed.

7. **Are there inefficiencies present in the Rotterdam-Humber corridor?**

In chapter seven the conceptual model of the feeder chain costs is applied on the Rotterdam-Humber corridor to reveal possible inefficiencies. Possible inefficiencies will be discussed and explained.

## 2.4 Research strategy

### *Research approach*

According to Saunders et al (2000), the research strategy is the general plan to answer the research questions. Choosing a research approach is the first step in creating a research strategy. There are two research approaches possible: induction and deduction. The differences between the two approaches are presented in the table 2.2.

The main difference is that in the deductive approach you develop a theory and hypothesis and design a research strategy to test the hypothesis. The inductive approach, on the other hand, you collect data and develop theory as a result of your data analysis. In other words, in the inductive approach theory would follow data rather than visa versa, as in the deductive approach

*Table 2.2: Differences between deductive and inductive approaches to research*

| Deduction emphasises | Induction emphasises |
|---|---|
| • Scientific principles<br>• Moving from theory<br>• The need to explain causal relationships between variables<br>• The collection of quantitative data<br>• The application of controls to ensure validity of data<br>• The operationalisation of concepts to ensure clarity of definition<br>• A highly structured approach<br>• Researchers independence of what is being researched<br>• The necessity to select samples of sufficient size in order to generalise conclusions | • Gaining an understanding of the meanings humans attach to events<br>• A close understanding of the research context<br>• The collection of qualitative data<br>• A more flexible structure to permit changes of research emphasis as the research progresses<br>• A realisation that the researcher is part of the research process<br>• Less concern with the need to generalise |

*Source: Saunders et al, 2000*

This thesis is an inductive research. It is inductive because there is no hypothesis that is tested. Furthermore, data is collected to develop a theory (conceptual model) as a result of the data analysis. Also the data collected in this research is qualitative.

### *Research strategy*

Saunders et al (2000) have identified eight different forms of research strategies. The experiment is a classical form of research and therefore probably the best known. This research uses the case study and an exploratory study as research strategies. Robson (1993) defines a case study as the development of detailed intensive knowledge about a single case, or a small number of related cases. The case study approach has the ability to generate answers to the question why? As well as, what and how question.

The exploratory study is defined by Robson (1993) as a valuable means of finding out what is happening; to seek new insights; to ask questions and to asses phenomena's in new light. This research strategy is a particularly useful approach if you want to clarify your understanding of a problem or gain more insight in particular matters. According to Saunders et al (2000), there are three principal ways of conducting exploratory research:

1. Literature study.
2. Talking to experts in the subject (interviews).
3. Conducting focus group interviews.

The research strategy gives an overview of the methods that are used to answer the research questions. All the research questions in this thesis are answered by conducting a case study combined with an exploratory study. The exploratory study is used to identify and analysing trends and developments in port and transport sector. Furthermore, the exploratory study is used to determine what the influence of these trends and developments is on European ports (in particular Rotterdam) and shipping company strategies. The case used in this study is the feeder connection between Rotterdam and the Humber; 'The Rotterdam-Humber corridor'. By focussing on this particular connection (case), answers to the (sub) research questions(s) could be given.

***Data collection***

There are different methods to collect data. A few examples are; questioners, interviews, focus groups and published data/literature. In this research the methods of collecting data was by interviews and by desk research. In total 20 unstructured in-dept interviews were conducted, of which 16 in the Netherlands; 3 employees of Port of Rotterdam; 8 shipping lines[1] in the top 20; 2 feeder operators were interviewed (Feederlink and BG Freight); 1 terminal operator (ECT); Short Sea Shipping and Port Info Link, and 4 interviews in the UK; APB ports Grimsby & Immingham and Hull & Goole; regional development agency (Yorkshire forward); CEO of 2 maritime companies (Danbrit & RMS) located in the Humber. These interviews, together with desk research, have generated all the necessary data to answer the sub questions and to create a conceptual model of the feeder chain costs. After creating the conceptual model, the model is used for analysing the Rotterdam-Humber corridor. By analysing the Rotterdam-Humber corridor the inefficiencies in the chain are revealed. In this way all the information needed to answer the main research question was collected.

## 2.5 Relevance

Considering the main objective, this thesis has a practical as well as a scientific relevance. A short elaboration on the practical and scientific relevance is given in the sub-paragraphs below.

### 2.5.1 Practical relevance

The maritime industry is very dynamic. During the last two decades a lot of consolidation has taken place in the industry. Also the size of the mainline container vessels is growing in a rapid pace, in order to gain more advantages of scale economies. With this enormous growth in vessel size not all European ports are able to accommodate these large ships. A logical result of the ongoing growth in vessel size is that less ports will and can be used by shipping lines and it is therefore valid to conclude that feedering will increase to deliver the cargo on its final destination. Furthermore, the increase in the price for road transport also supports this argument.

The European Union is also a proponent of shifting more cargo from road to water. A good example in that respect is the Marco Polo project (Baird, 2007). Furthermore, with the second Maasvlakte being built and with the trend of growing vessels, it is to be expected that transhipment is going to increase in Rotterdam. This in turn means that the percentage of feedering in the port of Rotterdam is also going to increase.

With transhipment figures increasing, it is important that Rotterdam possesses the requirements of an efficient main port hub. This research sheds light on the inefficiencies that are occurring in the Rotterdam-Humber corridor. However, the inefficiencies in this corridor can be projected on other corridors as well, this because most inefficiencies occur in ports (at both ends of the chain). Thus when problems, regarding feedering in Rotterdam, are solved and efficiency improves, this automatically means that the efficiency for more connections improves.

Before making a connection more efficient you have to know where the inefficiencies occur. That is exactly what is done in this thesis: revealing the problems (inefficiencies) and presenting solutions. By improving the

[1] ZIM, APL, Evergreen, CMA-CGM, OOCL, Maersk, Cosco and MOL

connections, in which Rotterdam plays a pivotal role, the total picture and attractiveness of Rotterdam as a port increases. This eventually will result in attracting more cargo to the port and better chain performance.

#### 2.5.2 Scientific relevance

Most scientific work that has been published regarding the subject of transhipment is about port criteria selection factors or about the economics of transhipment. Also the formation and restructuring of the hub-and-spoke system through time, has had a significant amount of attention. However, research about feeder chain efficiency and the positions of feeders in ports has never been published. In this respect, the research in front of you is unique. A conceptual model of the feeder chain costs is created (using the port of Rotterdam and the Rotterdam-Humber corridor as a case study) and therefore ads to the existing literature about the maritime industry.

In chapter three the most relevant literature about transhipment and feedering is discussed. By combining existing literature with interviews conducted in the market, as well in Rotterdam as in the Humber, a conceptual model is created. The conceptual model that has been created, tries to explain where and how feeder chain costs occur. In this way the model tries to increase the scientific knowledge about feeder chain efficiency in the hub-and-spoke system and the position of feeders in the port of Rotterdam.

### 2.6 Scope

There are many deep sea and shortsea trades. The most important deep sea trade, in terms of volume, is the Europe-Far East trade. It is on this trade where most cargo is shipped with the largest vessels deployed. The variety of feeder and shortsea networks in Europe is impressive. There are many connections between all ports in Europe. There are three dense feeder networks in Europe. These are to the Scandinavia and Eastern Baltic countries, UK and Ireland and Northern Spain and Portugal.

The focus of this research is on containerised import cargo shipped on the Europe-Far East trade with the final destination of the cargo being the North or middle of the UK. To reach this destination in the UK, containers can be shipped directly on a major UK port (e.g. Felixstowe or Southampton) or via a large port on the European continent (e.g. Rotterdam or Antwerp). This means that containers that are shipped from the Far East to, for example Rotterdam, have to be transhipped in Rotterdam to the UK. There are different manners to tranship a container but in this research feedering has the focus. The feedering of a container to the UK, with its destination being the Middle or the North of UK, can be done to a variety of ports. In this research the focus is on the Humber ports. Immingham is, in this region, the best known feeder port by the market. However, there are more ports in this region of which Hull is also well known. The purpose of this research is to improve the Rotterdam-Humber connection in a way that more containers with destination middle or north UK are (tran) shipped via Rotterdam instead of directly to UK. In short, the scope of the research is import containers from the Far East, which have a destination in Middle and North UK and which are transhipped via Rotterdam and feedered to the Humber.

## 2.7 Research framework

In this paragraph a visualized outline of the research setup is presented to get a better understanding about how this research is constructed to realize the aim of this thesis. First, an exploratory study has been conducted to get an overview of the global trend and developments in the port and transport sector. These trend and developments are analysed in order to get a better understanding what the influences are on port and shipping line strategies. Furthermore, the transhipment and feeder market is uncovered and the basic (economic) principals are presented.

Second, knowing the most important trends and developments and the reaction of ports and shipping lines on these global trends and developments, a case study is conducted for the North West European transhipment and feeder market with a focus on Rotterdam and UK. Desk research and interviews have provided the necessary information about the European transhipment and feeder market to identify the different costs components, needed for the construction of a conceptual model of the feeder chain costs.

The third phase of this research focuses on the actual creation of the conceptual model of the feeder chain costs. As stated above, by conducting interviews with different stakeholders of Port of Rotterdam, the feeder chain costs components could be identified and the conceptual model created.

The objective to create a conceptual model of the feeder chain costs is to get a better under standing of the feeder chains that are connected with Rotterdam. Therefore, the conceptual model of feeder chain costs can be applied on all feeder chains that have a connection with Rotterdam. By analysing different chains with the created model, inefficiencies in a particular chain can be revealed. In this research the focus is on the Rotterdam-Humber corridor but this could have been any other feeder corridor. Appling the conceptual model on the Rotterdam-Humber corridor is therefore the fourth stage of this research. In this stage, the future of feedering the Humber is elaborated. With the analyses on the European transhipment market and a special focus on the Rotterdam-Humber corridor, all research questions are answered and conclusions plus recommendations can be given, which will satisfy the aim of this research.

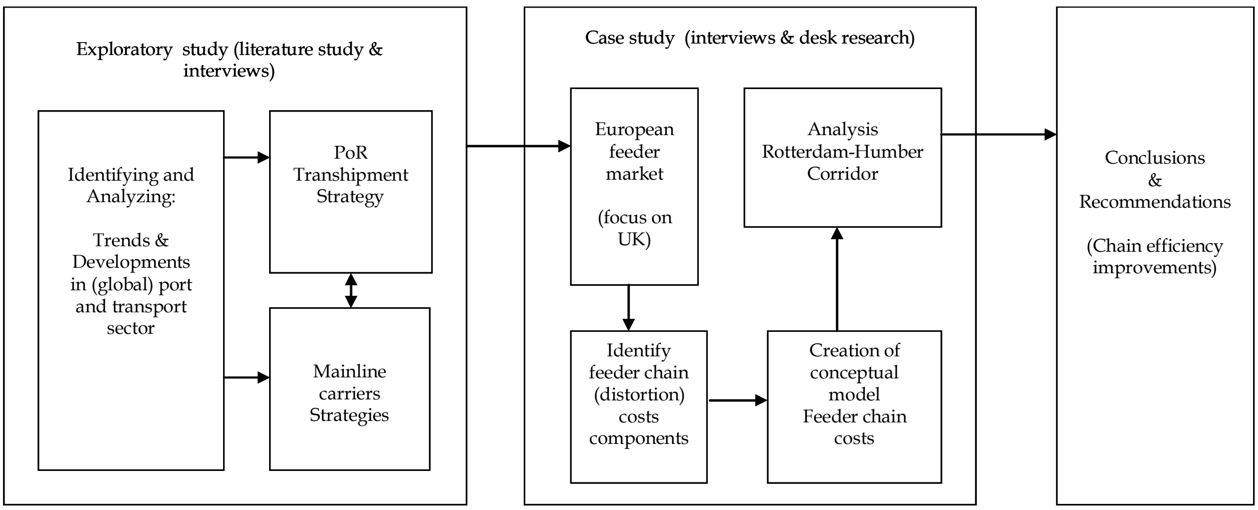



*Figure 2.1: Research framework*

## Chapter 3 - Literature review of transhipment

### 3.1 Introduction

This chapter gives an overview of the literature that has been published by different scholars about transhipment in liner shipping business. The purpose of this literature review is to provide a better understanding of why and how new (transhipment) network structures in liner shipping have evolved. First, major trends in the port and transport sector are discussed to get a better understanding of how global maritime networks, as we know them today, have emerged. Notteboom and Winkelmans (2001) have written about these changes in the shipping industry and about how port authorities should face the challenges that accompany these changes. De Langen and van der Lugt (2005) have contributed to the existing literature about port re-assessment strategies by investigating how ports should attract new activities in logistics in order to improve the attractiveness of their location. Also Hoffmann (1998) has written about changes in maritime logistics. Hoffmann (1998) discusses the concentration in ports and liner shipping, what the causes of this concentration are and its impacts. Robinson (1998), on the other hand, has written about more specific changes concerning hub and feeder networks in the shipping industry. He writes about the dynamics of restructuring the hub-and-spoke system.

Second, an assessment of the attractiveness of ports in Northern European container transhipment market is made and important port criteria and selection factors are discussed, based mainly on the work of Ng (2006) and Chang et al (2008). Chang et al (2008) discusses the different perspectives between trunk liners and feeder operators regarding port selection factors. Ng (2006), on the other hand, discusses the attractiveness of major ports in Northern Europe acting as transhipment hubs.

### 3.2 Changes in the maritime environment

The liner shipping business has changed dramatically the last two decades. The market environment, in which ports operate, have also changed. These changes have shaped current global transportation networks. Notteboom and Winkelmans (2001) have discussed the impact of some changes on international trade, transport and shipping and on strategic and operational issues in the framework of port management.

According to Notteboom and Winkelmans (2001) three changes in the maritime environment can be identified. The first big change is the transition from Fordism to post-Fordism. The Fordism economy is based on creating economies of scale, whereas post-Fordism is more focused on creating economies of scope and flexible organizations through cooperation in economic networks. The short product-life cycles, the short-time-to-market and also the outsourcing of activities[2] by global companies, have had a great affect on the transport flows in the sense that the number of products to be shipped and the shipment frequency increases, whereas batch sizes are becoming smaller. Shipping lines, forwarders, terminal operators and other transport operators have responded by providing global logistic packages (the one-stop-shop) and by increasing the scale of operations through alliances and mergers and aquisitions. Providing global logistic packages and increasing scale of operations have induced horizontal and vertical integration along the supply chains. Horizontal and vertical integration are the

[2] In the post-Fordian era, three basic forms of outsourcing can be distinguished with regard to supply chain management: *1) Outsourcing of the production components, 2) Value-added logistics, 3) Outsourcing of transportation, warehousing and distribution.*

second and third change in the maritime environment. The consequences are mergers and acquisitions, the creation of ever increasing carriers (>10.000 TEU) and the creation of large alliances in liner shipping.

The change of horizontal integration in the maritime industry, argued by Notteboom and Winkelmans (2001), are in line with the research Hoffman (1998) has conducted about concentration in the field of maritime transport. Hoffman concludes that the size of the largest container ships has almost tripled in the last two decades, the top 20 carriers now control more than half of the world's container slot capacity, the largest ten alliances now control about two thirds of the world's container slot capacity and that containers are increasingly transhipped. Ports that provide transhipment services have experienced high growth rates. In his article Hoffman provides three main motives for companies to merge and to form alliances. These are to reduce unit costs (i.e. to achieve economies of scale), to increase revenue (i.e. to increase market power) and to reduce the exposure to risk.

Although fewer global players remain, competition in shipping has actual increased (Hoffman, 1998). Together, scale economies and increased competition have impacted on unit costs, profits, overcapacity, freight-rate fluctuations, alliances, North-South and regional markets, transhipment, options for smaller liner operators, global trade and policy implications.

In the next paragraph the impact of scale economies, increased competition in transhipment and the restructuring of the hub-and-spoke system are reviewed and discussed by using research conducted by Robinson (1998). Although, the restructuring of the hub-and-spoke system is also a change in the maritime environment, it is decided to handle this topic in a separate paragraph because of the importance and significance this topic has for this thesis.

### 3.3 Hub-and-spoke system

Transhipment is a product of the way liner shipping companies organise their container shipping service. It is therefore important to know how this service concept works. There are different manners to tranship (see paragraph 1.4). In this paragraph the hub-and-spoke system will be discussed in-depth because this form of transhipment includes feedering.

As ship sizes continue to increase and shipping line mergers and alliances continue, the economic advantages of reducing the number of port calls become more visible. It is for large carriers economically more profitable to load and unload a large amount of containers in a few ports than calling at several ports to load and unload relatively small numbers of containers. This has to do with the high capital costs associated with container ship construction and the waiting time in ports. Another important reason, in favour of transhipment, is the fact that road transport has become much more expensive the last couple of years. Road transport is in fact a direct competitor of the feeder operator because when a shipping line decides to directly sail at for example the UK, the last leg to the final customer is in most cases by road and to a lesser extent by rail[3]. Feedering minimises the land transport because feeder ports are usually closer to the final customer than major main ports (e.g. Felixstowe). The trend of fewer port calls will continue and will favour the larger, centrally placed deep draft ports in a region.

[3] www.dft.gov.uk

However, increasing transhipment also implies increasing feeder volumes, which place demands on smaller ports to gear up to handle containers at (dedicated) container berths. Transhipment already has a significant place in the global market and its share is expected to increase even more.

In table 3.1 total world port container handlings are presented. The actual world (loaded) container traffic is much less than the port handling. In 2006 total container throughput was 440.4 million TEU's but world container traffic was 128.3 million TEU. The difference is caused by transhipment and the moves of empties. As can be concluded there is a significant difference between loaded container traffic and total port handlings, which indicates that transhipment is a large market in the shipping business

***Table 3.1: World container traffic and its components in million TEUs***

| | Port Handling | | | Transhipment | Port-to-Port | | Transhipment | | World container |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Full | Empty | | Full | Empty | Full | Empty | traffic |
| **2000** | 236,3 | 186.2 | 50.1 | 59.7 | 139.1 | 37.5 | 47.0 | 12.7 | 69.6 |
| **2001** | 248.3 | 193.9 | 54.4 | 63.3 | 144.5 | 40.5 | 49.4 | 13.8 | 72.3 |
| **2002** | 278.5 | 219.9 | 58.6 | 73.0 | 162.2 | 43.2 | 57.7 | 15.4 | 81.1 |
| **2003** | 314.8 | 249.4 | 65.4 | 82.3 | 184.2 | 48.3 | 65.2 | 17.1 | 92.1 |
| **2004** | 361.6 | 287.3 | 74.3 | 95.5 | 211.4 | 54.7 | 75.9 | 19.6 | 105.7 |
| **2005** | 399.0 | 316.6 | 82.4 | 105.0 | 233.3 | 60.7 | 83.3 | 21.7 | 116.6 |
| **2006** | 440.4 | 348.3 | 92.1 | 115.8 | 256.6 | 67.9 | 91.6 | 24.2 | 128.3 |

*Source; Drewry, 2007*

To get a better understanding of the transhipment market it is necessary to know how this market has evolved over time. Table 3.2 shows the total number of global port handled TEU and the share of transhipment in both TEU and percentage since 1985.

***Table 3.2: Total share of transhipment in total world throughput***

| Year | Transhipment (share%) | Transhipment (TEU) | Total throughput (TEU) |
|---|---|---|---|
| **2007** | 26,2% | 128,000,000 | 487,800,000 |
| **2006** | 26,1% | 115,100,000 | 441,800,000 |
| **2005** | 26,1% | 104,200,000 | 398,700,000 |
| **2004** | 26,3% | 95,200,000 | 362,200,000 |
| **2003** | 26,2% | 82,400,000 | 315,100,000 |
| **2002** | 26,8% | 74,300,000 | 277,300,000 |
| **2001** | 26,0% | 64,600,000 | 248,100,000 |
| **2000** | 25,8% | 60,900,000 | 236,200,000 |
| **1995** | 21,6% | 31,400,000 | 145,500,000 |
| **1990** | 17,6% | 15,500,000 | 88,000,000 |
| **1985** | 14,1% | 8,100,000 | 57,300,000 |
| **1980** | 11,1% | 4,300,000 | 38,800,000 |

*Source: Drewry, 2007*

As can be conclude, is that the (absolute) numbers of TEU have increased strongly but that the (relative) share of transhipment has been stable since 2000. This indicates that the transhipment business is a very large and stable market and plays a significant role in today's shipping business.

Another conclusion that can be drawn is that approximately 1/3 of al TEU's handled are transhipped. In other words; there are always two moves involved when moving a container from port A to port B, the move of loading in port A and the move of unloading in port B. An additional move has to be taken into account when a container is transhipped before it reaches its final port. This means that if a container is transhipped before it reaches its final destination, it has had at least three moves. Knowing that 1/3 of the containers is transhipped, it can be said that on average a container is transhipped ones every journey.

It is in my opinion to believe that major shipping lines will continue to serve port regions by as few direct calls as possible, and that thus the role of hub-and-spoke container distribution will continue to increase.

Robinson (1998), using Asia as a case study, has investigated the dynamics and restructuring of hub and feeder networks. The changes and trends that have occurred in the maritime environment, have caused network changes and the creation of new networks. This creation and change of networks will have an impact on feedering. The restructuring of hub-and-feeder networks is discussed in the next sub-paragraph.

### 3.3.1 Dynamics and restructuring of hub and feeder networks

According to Robinson (1998) the mid-1990s were a defining moment in the restructuring of (shipping) networks, especially in Asia. Continuing high growth rates of containerized cargo have not only induced new ports but also an increase in volumes handled at ports. Furthermore, the rationalisation of already large container shipping lines into alliances and mergers, have caused a new level of market power that is able to force changes in shipping schedules, port rotations and feeder linkages.

Robinson (1998) argues that there are three sets of conditions that have forced fundamental reorientations in the mainline and feeder networks which have emerged. First, the formation of global alliances in liner shipping. These new alliances have implemented new services with increased frequencies, new patterns of rotation and port calls and new feeder networks. The introduction of the 5000-6000 TEU vessels into new restructured patters has had significant implications for network structures. Second, the integration of several Chinese ports into mainline service networks has induced the restructuring of mainline networks. Third, because of the integration of Chinese ports in to the network there has been a rapid growth of feeder networks to include Chinese ports (e.g. Thailand/China link or Singapore/China link).

The restructuring of mainline networks and the growth of feeder networks is also taking place in Europe. Especially the Baltic is causing feeder volumes to increase. The Baltic is a very large market with high growth rates. With mainline vessels getting bigger it is not an invalid argument to put forward that shipping companies are trying to reduce there port calls in a certain region. The first reason is that not all ports are able to handle the large mainline vessels. Second, because it is economically not profitable to call at four or five different ports in North West Europe. The principles of transhipment and thus why it is economically not profitable to call at many ports with large carriers, is explained in the next chapter.

The changes in ports and port development strategies are also adding to the restructuring of networks. Clearly, the rapid growth of some ports provide the necessary cargo threshold conditions for inclusion in new or existing mainline and feeder networks. New ports provide new options for network restructuring or development. However, in a very competitive regional environment inclusion in shipping networks has underlined the need for efficiency as well as growth. These conditions have impacted on and are still impacting on ownership and management strategies in regional ports.

Privatization and corporatization of ports (authorities) have been successful strategies in achieving higher efficiency. A Good example is Port Authority Singapore (PSA). But also shipping lines have focussed on gaining more control over terminal operations in order to control efficiency and/or other operational requirements. A dedicated terminal, such as the APM terminal in Rotterdam, is a good example.

### 3.3.2 Network transformation

The changes argued in the above paragraph have implications for port-shipping networks handling large volumes of containers. For ports, increasing volumes of containers through terminals under fixed capacity will cause delays and thus increased costs. New investments, on the other hand, will increase capacity and create economies of scale/scope. Furthermore, increasing container volumes will increase the potential for the port's inclusion into the mainline rather than feeder networks as critical thresholds are reached. For shipping lines, increasing volumes of containers will create pressures on capacity. The pressure on capacity will trigger an increase in capacity, such as charted-in vessels, slot-agreements, alliances and new buildings of vessels. New vessels are becoming larger and larger in order to reduce per unit costs (Robinson, 1998).

Given these driving principles and changes, the network itself comes under increasing pressure, so that existing networks transform into new networks that reflect an increasing segmentation of the market. Because of this transformation more hierarchical networks will evolve and older networks will become less hierarchical. In this way first, second and third order networks are created. There will be a hierarchy of hubs and in real time these networks will have overlap (Robinson, 1998).

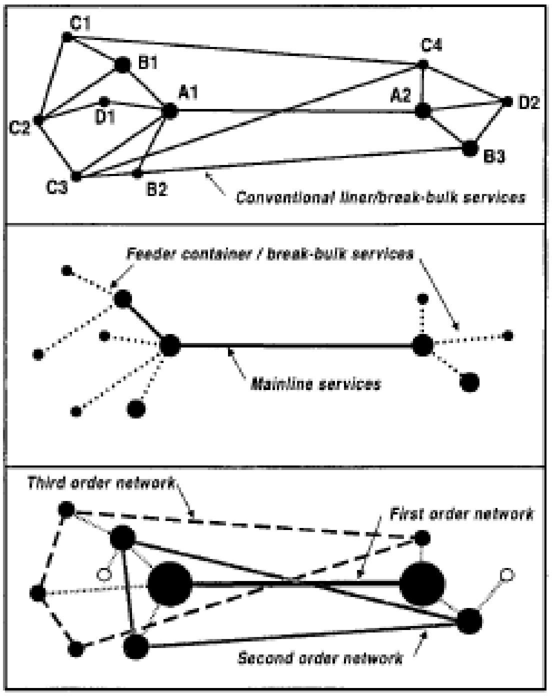
Figure 3.1 illustrates network transformation for a hypothetical set of ports and shipping linkages, which focus on Asia in particularly. The process, which is described by Robinson (1998), is simplified in a three stage process.

*Stage I:* In this initial stage conventional break-bulk liner services link ports in a well-connected network. Small but increasing volumes of containers begin to appear on some links in the network and from selected ports. This is the pre-1972 stage. Cellular container vessels were beginning to emerge in the Japan-oriented trades and in the Australia-Europe trades. It was in this stage that significant adaptation in the regional ports occurred. Hong Kong, for example, went through an extended period in which conventional berths were modified in numerous ways to deal with increasing numbers of conventional and part-modified conventional vessels, carrying deck loads of containers. Most ports struggled to cope with the new technology.

*Stage* 2: Increasingly, purpose-built cellular container vessels replace break-bulk vessels; and the port shipping network is progressively decomposed into mainline links supported by feeder shipping links. Hub ports become the centre points between mainline and feeder networks. This was the period of the emergence and consolidation of for example Singapore and Hong Kong as the major hubs in the Asia region

*Stage* 3: Continuing rapid growth in container volumes, with changes in size and complexity of ports and upgraded shipping services and operations, decompose existing networks into a reordered, hierarchical set of networks. Ports A1 and A2 reach sufficient volumes to evolve into first order ports, examples are the connection Shanghai-Rotterdam. In such networks, highly efficient shipping companies and terminal operators are present in high density trade corridor. Conceptually, they might be regarded as mega terminals. Ports B1, B2 and B3 represent second order networks and support shipping services that are excluded from first order networks, for example, Dalian (China) and Le Havre. Similarly, ports C1, C2, C3 and C4 represent a hypothetical third order level and serve shipping excluded from the first and second order networks. An example is the Rotterdam-Humber connection.

***Figure 3.1: The emergence of hierarchical port shipping networks handling containerized cargo under conditions of rapid growth***




*Source: Robinson, 1998*

Typically, higher order networks will have fewer ports than lower order networks. Note that numerous ports (Dl and D2, for example) will retain feeder status. This is the stage which coincides with major growth in container volumes in other regional economies and particularly the emergence of regional concentrations in China. It is the period of deregulation and the loosening of networks; of the exceptional growth in intra-Asian volumes; of the reorganization of schedules and port calls initiated by the new alliances. This stage stretches beyond the 1990s; mega terminals are emerging; the alliances remain unstable; China volumes continue to increase; more large vessels (10.000 TEUs) are on order and/or are added to major fleets. It will take some time before precisely defined hierarchical networks emerge; and even then they may not be as exclusive as the conceptualization suggests.

Also a stage four can be added to the conceptualisation. In a *Stage* 4 of the process, the degree to which a port's growth is dependent upon either its role as a hub (transhipment traffic) or its inherent ability to generate traffic other than transhipment traffic, will be critical in determining its position in the network hierarchy.

This paragraph has showed and discussed the significance of transhipment in today's shipping industry. Furthermore, this paragraph has given insight in the evolvement and transformation of the hub-and-spoke-system. In the above paragraphs the focus was on the changes in the maritime industry and the impact it has had on transhipment and the hub-and-spoke system. However, the roll of ports in the changing industry has not yet been discussed. In the next paragraph the focus will be on the ports.

### 3.3 Port strategies

Notteboom and Winkelmans (2001) have rightly noticed that all the above changes mentioned have affected port management strategies. There are a couple of important port management strategies that have to be re-assessed. The first one is that ports must be able to accommodate large port clients that are the result of the horizontal and vertical integration. Ports can no longer expect to attract cargo simply because they are natural gateways to rich hinterlands. Major port clients consider ports merely as a sub-system in the logistic chain. Accordingly, they concentrate their service packages not on the ports' sea-to-land interface but on the quality and reliability of the entire transport chain. Port choice becomes more a function of network costs. The ports that are chosen are those that will help to minimize the sum of sea, port and inland costs.

Another important port strategy is that of securing investments. Contemporary ports make investments based on speculations without actually knowing if traffic will increase. The main argument is that a lack of investments will certainly not increase traffic. Dealing with increased port competition is also a result of the changes mentioned. Shipping lines are creating new types of networks, based on hub and spoke systems. Hub ports used only for transshipment have emerged the last couple of years. Load centers, whose competitive strategy is completely based on their intermediacy, may find themselves in an unstable and highly fragile position, as this kind of traffic flow is more footloose and depends solely upon the strategy of shipping lines with respect to their service networks.

A last point mentioned by Notteboom and Winkelmans (2001) regarding port management strategies is that load centre ports have to deal with possible drawbacks. The economies of scale approach implemented by many seaports do not provide all necessary tools to cope with the highly competitive market environment and to secure their position in the global transport network. The economies of scale approach has to be complemented, if not partly replaced, by an economies of scope approach, based on greater flexibility and a focus on the logistics performance in the whole transport chain. This will allow a port authority to build inimitable and durable core competencies that form the basis of a port's competitive advantage.

This is also supported by de Langen and van der Lugt (2005). They also concluded that ports have to re-assess their strategy to a more economies of scope approach. Only their approach was from a different perspective (not from a shipping line strategy perspective but from a multinational company strategy). They have investigated the role of ports in global supply chains and the opportunities to attract new economic activities in logistics. According to de Langen and van der Lugt (2005), an interesting question that arises is the speed of the developments of multinational manufacturing and logistics firms towards sophisticated supply chain systems and the ability of ports to position themselves as attractive partners in changing supply chains. Ports with that ability will need to understand changes in logistics systems and the underlying drivers and be able to improve the attractiveness of their location.

### 3.4 Port criteria and selection factors

Now that the most important changes and trends of the maritime sector are known, it is now time to discuss the port criteria and selection factors. The changes in the industry have led to fierce port competition and port attractiveness is playing a pivotal role in this aspect. It is therefore important for port management to know what the customer wants and on what factors decisions are made in contemporary shipping industry by choosing a certain port as transhipment hub

There are many factors that affect port attractiveness, with monetary cost and time being the most easily identifiable attributes. However, according to Ng (2006) there also are less readily quantifiable factors which can also be significant. Clark et al (2001), argues that there must be a certain level of quality to ensure that a port operates with decent efficiency. According to Bennathan and Walters (1979), port managers need to ensure that their services can be differentiated from competitors, besides keeping their prices low. Port users, mainly shipping lines, do not always make decisions based on price only. Ng (2006) argues that other perceptive factors, like available information (from various sources like experience and port marketing) and the port's reputation, can be equally significant. It is important to note that research on significance of different factors in affecting port attractiveness is rather limited. Nevertheless, a few works supporting the importance of qualitative factors can be reviewed.

In the 1980s, Slack (1985) investigated port selection criteria through interviews with shippers in Europe and North America. Respondents were asked to choose different factors they considered important in selecting a port, based on four aspects; port selection criteria, port service criteria, liner characteristics and information sources. He found that, although improvements in port facilities were often necessary, it did not always have a direct impact on diverting cargo flows to other ports because shippers were largely conservative decision-makers, who were not very open to alternatives.

Tongzon (2002) conducted a survey questionnaire targeting shippers from Southeast Asia. He identified a few port choice determinants namely efficiency, shipping frequency, infrastructure, location, port charges, response to port user's need and reputation for cargo damage. He found that, geographical location, time efficiency and port infrastructure were important determinants, while port charge was considered relatively unimportant. Thus, he concluded that service quality was important in port attractiveness, which was consistent with the global trend attributed to changes in commodity patterns involving greater proportions of high value-added products and the adoption of logistical approaches.

Ha (2003) investigated the service quality offered by 15 ports around the world involved in container handling. Monetary cost, location, port turnaround time, facilities, management, information and customers' convenience, were identified as the major factors. Shipping lines ranked the importance of these factors and evaluated service quality through scoring. Ha (2003) found that, apart from monetary costs and time efficiency, ports should also focus on their service quality, especially information flows and data availability.

On the other hand, there are studies that suggest the opposite. Foster (1979) argues in a study he conducted that monetary costs are still the most important determinant in port selection. Lirn et al (2004) have also conducted a similar study like Foster which supports Foster's conclusion. While supporting the role of qualitative factors in port selection, they argued that monetary cost remained the most significant factor in deciding a port's attractiveness.

Ng (2006) has investigated the attractiveness of the major ports in Northern Europe acting as transhipment hubs. First of all, Ng (2006) argues that not one specific factor can actual dominate the total 'package' of factors which makes a port attractive. Using transhipment in Northern Europe as a case study, Ng (2006) has investigated the importance of different factors in affecting port attractiveness from a ports user's perspective. Through a Likert-style questionnaire, top 30 shipping lines have indicated that monetary costs are not the only component in explaining port attractiveness. Other factors, like, time efficiency, service quality and geographical location should also be taken into consideration. In terms of qualitative factors, shipping lines are most concerned about delays, port access and port's speed in responding to new demands. Other factors, which are perceived less important, but have some significance, are port infrastructure, advanced technology, availability of dedicated facilities for container transhipment and the availability of personnel in ports.

*Table 3.3: Hub port attractiveness factors*

| Factor | ASS |
|---|---|
| Monetary cost (terminal handling charge and port dues) | 4.26 |
| Time efficiency | 4.42 |
| Geographical location | 4.00 |
| Cases of delays in loading/unloading containers | 4.42 |
| Record of damage during container-handling | 2.89 |
| Custom procedures (eg inspection, documentary, etc) | 3.26 |
| Port authority policy and regulations | 3.05 |
| Accessibility of the port | 4.47 |
| Quality of port infrastructure in container-handling | 3.89 |
| Quality of port superstructure in container-handling | 3.42 |
| I.T. and advanced technology | 3.74 |
| Dedicated terminals and facilities for transhipment | 3.53 |
| Supporting industries (eg warehousing, insurance, etc) | 2.74 |
| Quality of other services (like pilotage, towing and mooring) | 2.95 |
| Availability of professional personnel in port | 3.89 |
| Preference of shipping lines' clients/shippers | 3.21 |
| Relations between port operator and shipping lines | 3.37 |
| Efforts of marketing on the port by port authority | 2.79 |
| Reputation of port within the region | 3.11 |
| Speed in responding to liner's new demands and requests | 4.05 |

*Source: Koi Yu (Adolf) Ng, 2006*

In Table 3.3 the most significant factors for hub port attractiveness are presented. The table is the result of the survey conducted by Ng (2006). The ASS stands for Average Significance Score. The table indicates that shipping lines still regard monetary costs and time efficiency as important factors in deciding port attractiveness. However, they also indicate that the significance of geographical location and qualitative factors should not be ignored because their influences are also considered when shipping lines make final decisions on port choice. For the UK and the Iberian Peninsula; Antwerp, Felixstowe, Le Havre and Rotterdam are all good options for shipping lines and thus the competitive position of ports in these markets seem to be dependent on whether ports can provide decent service quality to their customers. Furthermore, it seems that shipping line opinions on port attractiveness are consistent with their actual decisions in choosing their hubs in Northern Europe. While both Hamburg and Rotterdam are attractive options to shipping lines, they are not necessarily competing with each other. With the availability of port choices, especially in developed regions like Northern Europe, attractiveness is usually only a pre-requisite to allow the port to achieve competitiveness. While the role of attractiveness in port competitiveness is beyond debate, the latter is a more complicated matter which also depends on factors like how users perceive such attractiveness, whether they are always free to make the most rational decisions (Ng, 2006).

Another study, conducted by Chang et al (2008), investigated what the most important port selection factors are for (trunk) shipping lines and feeder operators. They have tried to determine the factors affecting shipping companies' port choice. According to Chang et al (2008) the increasing bargaining power of global shipping alliances further intensifies inter-port competition. As this trend of shipping alliances continues, a port may only have one of the two destinies; either become a stronger hub in the region or become feeder port in the regional 'hub and spoke system'. Thus, ports are in a difficult position, as they face severe port competition and are intimidated by the bargaining power of global alliances. To maintain its market position, a port should further enhance its competitiveness to stay ahead of its rival ports. Specifically, it should respond to the various new requirements of shipping lines and thus be able to adapt to an ever changing environment. As a result, a port should continuously make an effort to understand the factors affecting shipping lines' port choice.

Chang et al (2008) have revealed that that local cargo is the most important factor in choosing ports. Other important variables are; terminal handling charges, berth availability, port location, transhipment volume and feeder connections. There is, however, a difference in selection factors between mainliners and feeder companies. First, mainline shipping companies consider more factors in their port choice and do not seem to ignore any other factors highly considered by feeder operators. The five most important factors are local cargo volume, terminal handling charge, land connection, service reliability and port location.

Compared with the feeder operators, the mainline companies tend to look at other factors including land connection, service reliability, water draft, feeder connection, cargo profitability and port due. Meanwhile, the feeder service companies consider cargo volume, berth availability, terminal handling charge, transhipment volume and port location, as the five most critical factors. The results of Chang et al (2008) implies that feeder operators are mostly concerned if there is cargo for them in the port and after that if the port is reasonable to use. Other factors like land connection, service reliability, draft and even profitability are beyond their primary interests in port selection. It seems they still fall in the traditional conventional market, whereby the running of their businesses is determined by market size and cost, not by marketability and high quality services. Mainliners, on the other hand, mainly concern the economies of scale in vessel size and hinterland coverage and require more comprehensive and value-added services than the feeder operators. This means that mainline shipping companies are more sensitive to overall service quality and costs levels than feeder operators.

According to Chang et al (2008) these findings have important policy implications for ports. Since local cargo is the most important port choice factor for shipping lines, priority should be given to the building up of their local cargo base, if port operators want to attract more shipping lines to call at their ports. Building up local cargo base requires several measures including continued improvement of the overall environment for foreign direct investments and provision of sufficient incentives for local manufacturers and foreign logistics services providers to base their operations around the port.

The differences in port selection criteria between the mainline shipping companies and feeder operators imply that ports should adopt somewhat different strategies for these two types of shipping lines. Ports aspiring to become hubs and existing hub ports need to pay more attention to providing more comprehensive and value-added services to shipping lines and providing the services at the minimum possible cost, since these are the two most important concerns for mainline companies. With respect to feeder operators, the need to enhance the port market size and operational conditions for shipping lines should be given top priority in their overall port development strategy.

Furthermore, the studies of Chang et all (2008) and Ng (2006) do not include commercial interests of shipping lines. Commercial interests of shipping lines in ports, such as dedicated terminals (facilities) are of course a very important decision factor to use a port. Examples of shipping lines having commercial interest are; MSC in Antwerp and Maersk in Rotterdam (APM terminal). Providing dedicated facilities to major shipping lines is thus also a port strategy to attract and tie cargo to the port.

### 3.5 Conclusions

There are a few major changes in the maritime environment that have had a big impact on contemporary liner shipping. Current global transportation networks have changed due to transition from Fordism to post-Fordism. This transition has induced a lot of horizontal and vertical mergers and acquisitions between different companies in the maritime industry. The mergers and acquisitions have led to a concentrated maritime transport market but although fewer global players remain, competition in shipping has actual increased. The foremost motive to (horizontally) merge and form alliances is to create economies of scale and thus reduce unit costs. Vertical mergers and acquisitions have taken place in order to provide global logistic packages to customers. The creation of increasing scale economies has led to the increasing size of containers vessels. The size of largest container ships has almost tripled in the last two decades. The growth in ship size has caused transhipment volumes to increase tremendously the last twenty years. But that is not the only reason for increasing transhipment volumes. Two other important reasons are that not all ports are able to handle such large vessels and it is economically more profitable to (un) load a large amount of containers in a few large hub ports than calling at several ports to (un) load small number of containers. This in turn, has resulted in the demand for the use of more efficient network system. This efficient system is the hub-and-spoke system of which feedering is an important part. A logical result of the increasing transhipment volumes is therefore an increase in feeder volumes.

The changes and developments in the maritime environment have also impacted on port strategies. There are a couple of important port management strategies that have to be re-assessed. The re-assessment of the port's transhipment strategy is important to (re) consider with respect to this thesis. Now that it is known that port choice has become more a function of network costs and that the ports chosen are those ports that will help to minimize the sum of sea, port and inland costs, ports should take action to position and establish themselves in those networks. This way of thinking and re-assessing of port strategies is in line with the aim of this thesis. By improving the efficiency in the Rotterdam-Humber corridor, Port of Rotterdam is strengthening its position in a network by minimizing costs.

The studies about port criteria and selection factors have indicated which factors are essential for a port to be attractive and which factors influence the decisions of different shipping companies to use a port. The general conclusion that can be drawn from those studies is that the researchers have not adopted a general conclusion on the significance of qualitative factors in port choice. This is partly due to the minimal research that has been conducted on this subject. On of the weaknesses of most studies is that they focus on comparing the importance of different factors, while the importance of 'the package on offer', or generalized costs of using a particular port is ignored. However, the study of Ng (2006) has provided more insight in that respect.

Ng (2006) argues that not one specific factor can actual dominate 'the total package' of factors which makes a port attractive. The conclusion of his study is that monetary costs and time efficiency are not the only components for explaining port attractiveness but that other qualitative factors are also very important to take into account. Delays and port access are most important in that respect. Furthermore, Ng (2006) showed that there are no significant differences in attractiveness between Benelux port; that Rotterdam has the best geographical location for serving all northern European feeder regions and that Hamburg and Rotterdam are identified as most attractive ports and Felixstowe and Le Havre as least attractive.

The study of Chang et al (2008) reveals the most important port selection factors for mainliners and feeder operators. He argues that increasing bargaining power of global shipping alliances further intensifies inter-port competition and that to maintain its position a port should enhance competition by responding to new requirements of shipping lines. Chang et al (2008) revealed that local cargo is the most important factor in choosing ports. They also explained that there is a difference in selection factors between mainline and feeder companies. Mainline companies consider more factors in their port choice than feeder operators. Feeder operators are mainly concerned about the availability of cargo and if the port is reasonable the use. Mainliners on the other hand are more sensitive to overall service quality and costs levels. The conclusion that can be drawn from the study of Chang et al (2008) is that ports want to attract more shipping lines; they have to build up their local cargo base and pay more attention to providing more comprehensive and value added services at the minimal possible costs. With respect to feeder operators, ports need to enhance the port market size and operational conditions.

This thesis goes beyond the studies reviewed in this chapter and provides more insight into which factors make a feeder connection more attractive to mainliners and feeder operators, taken all the above factors for granted. The criteria and selection factors mentioned by Chang et al (2008) and Ng (2006) are indeed important for ports to be competitive (or being perceived as competitive). However, when the difference between ports is relatively small, which is the case in North West Europe, the difference in competitiveness/attractiveness can be made by improving efficiency in different supply chains and that is exactly what this research is trying to establish.

## Chapter 4 - Transhipment and Feedering

> *"Transhipment has become an integral part of the logistic strategy of many shipping companies. Indeed, from its origin to its final destination, any given cargo might have be transhipped three or four times. Transhipment can be viewed as routing goods in such a way that would decrease shipping costs, take advantage of economies of scale and improve the range of services or routes offered to customers. In particular, transhipment services provide shippers with additional routing options (especially towards final destinations at smaller ports) and reduced transit times" (Andriamananjara, Arce, Ferrantino, 2004)*

### 4.1 Introduction

In the previous chapter the changes that sparked transhipment have been discussed and with that a beginning is made to get a better understanding of why transhipment exists. Furthermore, the hub-and-spoke system is discussed and evaluated trough time and figures of increasing global transhipment volumes were presented.

This chapter provides more insight in the transhipment and feeder market of North West Europe. In the first section the focus is on transhipment. The principles of transhipment are discussed and explained, as well as the footloose character of transhipment. An important trend that has impacted on the deep sea container trades is the ongoing increase in the size of vessels deployed. Therefore, more information is provided on ship size developments, the order book and global forecast figures. The provided information will give more insight in the future development of the transhipment business.

In the second section the focus is on feedering. The first part of this section discusses the feeder market in Europe. Market characteristics and developments are elaborated and give the reader a better understanding of the feeder market. In the second part of this section the intra-European feeder areas are discussed. The market share of Rotterdam on the different feeder areas are given and thus provide information about the competitive transhipment and feeder position of Rotterdam. This section also provides information about issues that occur in main port hubs. After reading this chapter the reader has better insight in and understanding of the European transhipment and feeder market.

### 4.2 Principles of transhipment

The principal purpose of transhipment is to reduce the overall cost of shipping by exploiting the considerable economies of scale by using larger vessels for long haul routes. Deep sea carriers of 12.000 TEU and more are being built. To fill such large ships and to provide acceptable levels of frequency, these ships will only call directly at several mayor ports during their round trip. Usually the ports that are used are major load centres, like Rotterdam and Singapore. From these load centres other smaller economies are served by feedering (e.g. Baltic and Ireland). Further economies in port calls are made by interlining and relay en route, where containers are transferred between ocean-going ships on different routings to minimise the number of services required. For example, a Mediterranean to North America service could tranship to a South Africa to North Europe service at a port in the straits of Gibraltar.

The demand for transhipment is in part induced by the expansion of overall container traffic and particularly on long haul trades from the Far East[4]. Shipping lines are aware of the competitive market they are operating in. The competitive pressure encourages them to invest in ever larger vessels rather than to raise service frequency with existing smaller vessels. The consequence is that ports have to handle much larger vessels, which means that draft and berth facilities for the vessels have to be sufficient in order to sail into the port.

Not only does this limit the number of ports that can handle the larger carriers, it also contributes to the amount of cargo handled at the limited number of ports able to accommodate them. Transhipment leads to the volume of containers handled at ports is growing more rapidly than the actual trade that is served. This is because a transhipped container will cross a North European quay three times instead of once[5]. Large main ports will inevitably compete to establish themselves as hub ports, especially in North West Europe. The reason for this is that Europe is a very large import market and, as discussed in the previous chapter, it is for large mainline carriers economically not profitable to call at more than four ports. But there is another important reason; ports that are big transhipment hubs are able to charge higher tariffs for domestic (in their captive hinterland) through the particular capability they offer (MDS Transmodal, 2006). In line with this is the fact that higher throughputs can fund greater investment in maritime infrastructure to accommodate ever increasing carriers which offer further economies of scale to their clients; the mainline companies.

It is important to understand that the decision by a shipping line to tranship, either for example in UK, on the European continent or elsewhere, will be based on its own particular circumstances and reasons. The availability of port capacity (over and above that required by continental hinterland cargo) is important in that respect. Extra available port capacity provides an opportunity for a line to tranship. Transhipment occurs when the shipping line finds it in its interest to do so. This means that transhipment will be used to plan the most competitive door-to-door service for its clients. Container transfers between transport links will occur several times in a trip from for example a Chinese manufacturer to UK retailers distribution centre. The trip of the container can easily include several road, rail and sea legs before it reaches its final destination. Containers may be transhipped between deep sea carriers in the Middle East or Mediterranean to minimise ocean transport costs by using the largest possible ship, while serving as many individual ports as possible. From for example a journey from the Far East, transhipment to a feeder vessel in Rotterdam may be a substitute for transhipment to another deep sea vessel, scheduled to call at different European ports, such as Port Said in Egypt or Algeciras in Spain.

Shipping companies have a wide range of options in making such decisions. However, their options are strongly influenced by different offers that ports can make. Ports that are not congested and are able to offer several berths with a wide tidal window and have enough capacity for stacking will be more attractive than congested ports because (MDS Transmodal):

1. the excess of capacity over demand reduces the ports' bargaining power in setting tariffs
2. Port congestion increases the risk of vessel delay and is adding to the time that shipping lines have to build into their schedules to allow for delay (delay cost for a large carrier can be $50.000 a day).

[4] Appendix 1: Information about global container traffic figures and figures on different trades.
[5] Twice at the transhipment port and once at the load or destination port.

Clearly, transhipment and port capacity are highly related. Lack of port capacity may reduce the amount of money earned by an economy from transport activities and raises the cost to end users.

As mentioned, the replacement of a direct call by transhipment adds two port moves to each container shipment. Its increasing use thus provides a further boost and increase to growth in the in container port demand. Because of this the use of different forms of transhipment; relay, interlining and feedering are used more often.

### 4.3 Footloose business

The share of transhipment in the world container port market is significant. In 2007 this share was 26.2% (Drewry, 2007). The transfer of containers between vessels is therefore a major part of the total world port business. The continued utilisation of larger vessels in the deep sea trades will continue to drive this part of the business. This means there will be high volumes of transhipment operations in large hub ports all over the world.

According to Ocean Shipping Consultants (2007) this is a mixed blessing for terminal operators. On the one hand, transhipment does mean large volumes of containers handled for a particular customer and can be very attractive during the period of introduction of new terminal capacity. The increase in demand can occur very rapidly and this will have a positive effect on the cash-flow of a terminal.

On the other hand, this tends to be a poor paying business sector. With container port capacity (usually) limited by the capacity to move containers across the quay (rather than other restrictions such as terminal area or crane capacity) the tariff for a double transhipment move is usually less than that for an import and export container. Therefore, during periods of tight terminal capacity a high dependence on transhipment is less than optimal in terms of terminal profitability. Transhipment is not only poorly paying but is also a highly uncertain market sector. In the transhipment business, the terminal chosen for transhipment is not the final destination of the cargo. This means there is no real connection to tie the shipping line to a particular facility, unless the shipping company has its own dedicated terminal. The consequence is that in time of over-capacity, pricing issues emerge. When over-capacity occur the pressure on the price of container handling increases significantly to deal with the threat to move to another terminal. The result is that some ports get very low prices for the containers they handle and are thus not able to make new investments to anticipate on market developments. Rotterdam is a good example to underline the footloose character of transhipment. The percentage of transhipment (of the total Rotterdam throughput) shows ups and downs the last years[6]. The drop between 2005 and 2006 is caused by severe automation problems at ECT.

According to Dynamar (2007) ports that are dominated by transhipment fully depend on the shipping lines calling at that port. One port can easily be exchanged for another port, as long as the alternative is close to the interconnecting trade lanes and capable of accommodating the mainline carriers. Transhipment volumes can be lost easily if:

- An existing or new port in the area offers lower price

[6] (2006; 24%, 2005; 27%, 2003; 20%, 2002; 17%)

- Offer a better service at about the same rates
- Mainline schedules are changed

The mainline carriers decide where they hub the containers and this means fierce competition between ports in the same region. Some effects in this respect are to be seen in North West Europe and underline the footloose character of transhipment cargo

- During 2000, in a dispute with ECT Rotterdam, Maersk shifted around 300.000 TEU of transhipment containers to Bremerhaven, where APM terminals had started operations in 1999.
- MSC felt unhappy in Felixstowe (bad operations and an expensive British pound) and in 2001 moved much of its transhipment containers, around 250.000 TEU, to Antwerp where it has first priority.
- In 2007 CSAV Norasia moved the calls of its still fresh Europe-Indian Sub Continent service, including all associated feedering, from Rotterdam to Antwerp because they had lost patience with continuous problems in Rotterdam.

Ports that are often used merely for transhipment do not have a large (captive) hinterland. It is in that way, that it is difficult for a port to secure cargo to its terminals. Other reasons why transhipment is not only footloose but also volatile, contrary to the usually more stable gateway:

- Carrier consolidation, which may induce the concentration of transhipment activities on one terminal, meaning that another terminal loses transhipment activities (more moves means lower rates).
- Success of a port in attracting calls may result in congestion if the development of handling capacity at the hub is not in line with the growth of volumes.
- New direct service to ports that used to be served by feeders.

The requirement for transhipment will continue as a direct result of underlying shipping economics. According to Ocean Shipping Consultants (2007), common-user terminal operators will have to manage the requirements of their customers to combine import, export and transhipment operations for the same vessel call. For a large regional transhipment hub a transhipment share between 25-35 % is probably optimal. Such a compromise is necessary if the pressures for dedicated terminal capacity are to be adequately resisted.

### 4.4 Ship size developments and order book

One of the most important trends that have shaped the deep sea container trade is the ongoing increase in the size of vessels deployed. It is therefore that a more detailed elaboration is in place. The incorporation of scale economies is at the centre of strategic development for most shipping lines. Looking at the cost per slot per trip, the savings from using a larger vessel are significant and also one of the few factors that are under direct control by the shipping line. The competitive nature of the shipping industry forces all lines to engage in the employment of larger vessels. This has resulted in a rapid rise in the size of the largest vessels.

At the moment ships are deployed with a 14.500 TEU capacity. This size of vessels will put pressure on port demand and on the terminals that can handle vessels with a draught of 14.5-15m. Furthermore, the increase in ship size has also resulted in requirements for longer berths (>400m).

Table 4.1 summarises the general development of container vessels since the 1980s. It also provides an indication of the likely course of future developments, including berth depth requirements. In twenty years, vessel capacity has tripled.

***Table 4.1: Development of container vessels***

| | TEUs | LOA (m) | Beam (m) | Design draught (m) | Berth depth (m) |
|---|---|---|---|---|---|
| First generation: 1968 | 1,100 | | | | |
| Second generation: 1970-80 | 2-3,000 | 213 | 27.4 | 10.8 | 12.0 |
| Panamax: 1980-90 | 3-4,500 | 294 | 32.0 | 12.2 | 12.8-13.0 |
| Post-panamax: 1988-95 | 4-5,000 | 280-305 | 41.1 | 12.7 | 13.5-14.0 |
| Fifth generation: | | | | | |
| - 1996-2005 | 6,400-8,000 | 300-347 | 42.9 | 14.0-14.5 | 14.8-15.3 |
| Current development stage | 8,000-10,500 | 320-380 | 43-47 | 14.5-15.0 | 15.3-15.8 |
| Ultra large container carriers: | | | | | |
| - from 2008 | 12,500 | 380-400 | 58-60 | 14.5-15.0 | 15.3-15.8 |
| - from 2008 | 14,500 | 380-400 | 58.0 | 15.5 | 16.3 |

*Source: Ocean Shipping Consultants, 2007*

For this research it is important to know what the maximum and average sizes of future vessels will be on the major European container trades. Especially, on the Europe-Far East trade. This is important because the ongoing growth in vessel size will limed the amount of ports that are able to handle them and will thus induce an increase in transhipment cargo. In table 4.2 the (future) sizes of ships on specific trades are summarised.

According to Ocean Shipping Consultants (2007) the major Europe-Asia trades, where in the beginning of 2006, characterised by the deployment of vessels of up to at least 9,200 TEU, with typical vessels for major owners dominated by 5,500- 7,000 TEU units. By the end of 2006, the largest vessels were around 10,700 TEU and at the moment the Emma Maersk has a capacity of around 13.500 TEU. By around 2008, 12,500 TEU and 14,500 TEU vessels will become a feature of these long-haul trades. The result will be greater demand for deep-water berths and more productive terminals.

***Table 4.2: Forecast vessel sizes by major container trades to 2015***

| TEU capacity | 1998 | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|
| ***Deep-sea*** | | | | | |
| *Far East-Europe* | | | | | |
| Typical Vessel | 4,500-5,000 | 4,500-5,500 | 5,500-7,000 | 8,000-9,000 | 10,500 |
| Largest Vessel | 7,500 | 7,500 | 9,200 | 14,500 | 14,500 |
| *Transpacific* | | | | | |
| Typical Vessel | 4,500-5,000 | 4,500-5,000 | 5,500-6,500 | 7,000 | 8,500 |
| Largest Vessel | 6,250 | 6,700 | 8,100 | 9,000 | 10,500 |
| *Transatlantic* | | | | | |
| Typical Vessel | 3,500 | 3,500 | 4,000 | 5,000 | 6,500 |
| Largest Vessel | 4,500 | 4,500 | 4,800 | 6,500 | 8,500 |
| *North-South* | | | | | |
| Typical Vessel | 2,000 | 2,500 | 3,000 | 3,000 | 3,500 |
| Largest Vessel | 3,000 | 3,500 | 3,500 | 3,500 | 4,000 |
| ***Feeder*** | | | | | |
| Typical Vessel | 400 | 550 | 650 | 700 | 850 |
| Largest Vessel | 850 | 900 | 1,000 | 1,200 | 1,500 |

*Source: Ocean Shipping Consultants, 2007*

The trend of increasing vessels is not yet coming to an end. When looking at the vessel order book[7], the number of vessels (including TEU capacity) in a size range that are ordered between the years 2007-2011+, are given.

When looking at the number of vessels ordered, it becomes clear that the total capacity (in TEU) is about to increase with more than 50%. Since 2007, the demand for vessels above 4000 TEU is increasing every year. The most significant increase in demand is seen in the ordering of 10.000+ vessels. In total 1309 new vessels will be deployed the next couple of years. This means that the total world fleet will increase with 31.59% compared to 2007.

The trend of increasing vessel size put restrictions on the number of ports calls. Few ports have the capacity and draught to handle the ever increasing vessels. A logical result is that mega carriers will only call at a few (hub) ports in a certain region, using smaller ships (feeders) to serve other parts in the region (hub-and-spoke system). It is therefore legitimate to conclude that feedering is going to increase in the coming years.

## 4.5 Global forecast figures

The economic forecast presented has been developed taking into account economic developments at world level[8]. The forecast is based on the container forecast from Ocean Shipping Consultants in 2007. Furthermore, the forecast is based on the scenario that is most likely to occur. Of course, there are other scenarios possible but for the importance of this research only the 'base case' is selected.

The forecast in table 4.3 estimates the total container port demand (including the handling of transhipment and empty containers) on a regional basis for the period to 2020.

***Table 4.3: Total world container port demand by region to 2020 (incl. Transhipment) – Million TEUs***

| Base Case | | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East Asia | North Asia | 55.4 | 61.4 | 66.8 | 72.0 | 77.0 | 81.5 | 86.2 | 91.4 | 96.5 | 101.2 | 128.7 |
| | Chinese port region | 93.5 | 103.7 | 114.5 | 122.1 | 130.0 | 141.4 | 149.8 | 159.5 | 168.4 | 179.2 | 223.4 |
| | South East Asia | 58.6 | 64.0 | 67.5 | 72.2 | 76.5 | 80.1 | 85.5 | 90.3 | 96.5 | 101.5 | 128.9 |
| | **Total** | **207.5** | **229.1** | **248.8** | **266.3** | **283.5** | **303.0** | **321.5** | **341.2** | **361.4** | **381.4** | **481.0** |
| Americas | North Anerica | 50.1 | 53.6 | 57.0 | 60.6 | 64.3 | 68.2 | 72.4 | 76.7 | 81.3 | 84.0 | 109.0 |
| | other Americas | 26.9 | 29.6 | 31.8 | 34.0 | 36.4 | 38.8 | 41.3 | 43.9 | 46.6 | 49.4 | 63.8 |
| | **Total** | **77.0** | **83.2** | **88.8** | **94.6** | **100.7** | **107.0** | **113.7** | **120.6** | **127.9** | **133.4** | **172.8** |
| Europe/mediteranian | Nort Europe | 49.1 | 52.0 | 55.9 | 60.0 | 64.3 | 68.7 | 73 .2 | 77.9 | 82.6 | 87.2 | 109.9 |
| | South Europe/Med. | 42.9 | 47.2 | 51.8 | 56.8 | 62.0 | 67.4 | 73.1 | 79.0 | 85.2 | 91.6 | 117.0 |
| | **Total** | **92.0** | **99.2** | **107.7** | **116.8** | **126.3** | **136.1** | **146.3** | **156.9** | **167.8** | **178.8** | **226.8** |
| Others | M.East/ Indian subcontinent | 33.1 | 36.4 | 39.8 | 43.1 | 46.5 | 49.9 | 53.2 | 56.6 | 59.9 | 63.3 | 83.6 |
| | Sub-Saharan Africa | 8.2 | 9.0 | 9.8 | 10.6 | 11.4 | 12.3 | 13.1 | 13.9 | 14.7 | 15.5 | 20.3 |
| | Australasia | 8.1 | 8.7 | 9.3 | 10.0 | 10.6 | 11.2 | 11.8 | 12.5 | 13.1 | 13.7 | 17.0 |
| | **Total** | **49.4** | **54.1** | **58.9** | **63.7** | **68.5** | **73.3** | **78.1** | **82.9** | **87.7** | **92.5** | **128.8** |
| **Base case total** | | **425,9** | **465.6** | **504.2** | **541.4** | **579.0** | **619.4** | **659.6** | **701.6** | **744.8** | **786.1** | **1001.5** |

*Source: Ocean Shipping Consultants*

Depending on the given economic conditions, it is forecasted that demand will reach the 786 million TEU by 2015 and over 1 billion TEU by 2020. The Asian economies favour a progressive and continuing trend. China and India are likely to become dominant forces in the future market development. The more established markets, like EU

[7] Appendix 2: Containership order book
[8] Appendix 3: Forecast assumptions

and USA, will continue to record steady demand growth and therefore will require very heavy investment in new port capacity, information systems and more productive systems, in order to handle and accommodate the forecast demand.

Table 4.4 summarises the forecasted development of demand for transhipment container handling over the same period. Although there will be some increases in market share of direct calls in major port regions, the shift to larger vessels and lack of port capacity will continue to favour the option of transhipment. This sector will demonstrate strong and sustained demand growth. Transhipment in North Europe has a steady growth trend and is increasing continuous to 27.50 million TEU in 2020. This implies that, in absolute terms, the transhipment market in North Europe is continuing to grow.

*Table 4.4: Total world transhipment demand by region to 2020 in million TEU*

| Base case | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| North East Asia | 7.24 | 8.61 | 9.46 | 10.26 | 11.04 | 11.77 | 12.52 | 13.30 | 14.11 | 14.96 | 19.30 |
| Chinese port region | 17.5 | 19.47 | 20.65 | 21.83 | 22,99 | 24.11 | 25.24 | 26.38 | 27.54 | 28.70 | 33.95 |
| South East Asia | 27.89 | 30.10 | 32.20 | 34.32 | 36.48 | 38.48 | 40.80 | 43.02 | 45.31 | 47.67 | 59.63 |
| North Europe | 11.68 | 12.45 | 13.47 | 14.64 | 15.87 | 17.14 | 18.45 | 19.79 | 21.16 | 22.54 | 27.50 |
| South Europe/mediterranean | 15.05 | 17.58 | 19.82 | 22.21 | 24.74 | 27.32 | 30.03 | 32.87 | 35.80 | 38.83 | 48.15 |
| M. East/Indian subcontinent | 12.97 | 14.05 | 15.12 | 16.20 | 17.27 | 18.85 | 19.42 | 20.50 | 21.57 | 22.65 | 27.55 |
| Caribbean | 6.23 | 6.95 | 7.63 | 8.37 | 9.14 | 9.94 | 10.78 | 11.67 | 12.59 | 13.56 | 18.27 |
| **Total** | **98.56** | **109.21** | **118.35** | **127.83** | **137.53** | **147.25** | **157.24** | **167.53** | **178.08** | **188.91** | **234.35** |

*Source: Ocean shipping consultants, 2007*

## 4.6 Transhipment in North West Europe

In North West Europe the deep sea lines have a relative extended choice between transhipment ports. Typically, an individual deep sea carrier will call at four ports in North West Europe; Rotterdam or Antwerp, Hamburg or Bremerhaven, Felixstowe or Southampton and Le Havre (Port of Rotterdam, 2008). However, some shipping lines (e.g. Maersk) only call at two ports. The ports in the Hamburg-Le Havre range (HLH)[9] have a combined market share of 90% in total container throughput. But ports, such as Zeebrugge, Felixstowe and Southampton, are also of significance because of their position in transhipment cargo. In appendix 4 an extended overview is given about the North West European container market. In this paragraph the focus is only on transhipment and feedering.

The total number of transhipment containers, in terms of total containers handled, at various ports in North West-Europe is still growing. The result is an increasing demand for feedering. The existing trend of ships getting bigger (especially on the Far East trade) indicates that the future feeder volumes in North West Europe are only going to increase more. In this paragraph the statistics of the North West European transhipment market is presented, with a special focus on the most important ports in the range.

In table 4.5 the transhipment share of total container throughputs in North West European ports are given for the year 2006. Together these ports have handled almost 41 million TEU. Applying the latest known transhipment shares per port and after reduction of estimated relay and interlining activities, around 5.5 million TEU had to be

[9] Rotterdam, Antwerp, Hamburg, Le Havre and Bremerhaven.

feedered in and out of those ports, which is equivalent to approximately 11 million feeder moves. Therefore, the feeder market can be seen as a substantial market in Europe and is estimated to keep on growing.

*Table 4.5: Transhipment share and total container throughput in NW-Europe ports*

| Port | Transhipment | | 2006 | 2005 | 2004 | 2003 | 2002 |
|---|---|---|---|---|---|---|---|
| | TEU | Share | TEU | TEU | TEU | TEU | TEU |
| **Bremerhaven** | 2.431.000 | 55% | 4.420.000 | 3.699.000 | 3.442.000 | 3.158.000 | 3.004.000 |
| **Hamburg** | 3.811.000 | 43% | 8.862.000 | 8.088.000 | 7.003.000 | 6.138.000 | 5.400.000 |
| **Antwerp** | 1.867.000 | 27% | 7.019.000 | 6.488.000 | 6.064.000 | 5.445.000 | 4.777.000 |
| **Rotterdam** | 2.295.000 | 24% | 9.600.000 | 9.287.000 | 8.292.000 | 7.118.000 | 6.518.000 |
| **Zeebrugge** | 231.000 | 14% | 1.640.000 | 1.408.000 | 1.196.000 | 1.013.000 | 959.000 |
| **Le Havre** | 279.000 | 13% | 2.130.000 | 2.057.000 | 2.132.000 | 1.985.000 | 1.720.000 |
| **Felixstowe** | 370.000 | 12% | 3.080.000 | 2.800.000 | 2.675.000 | 2.480.000 | 2.710.000 |
| **Amsterdam** | 27.000 | 9% | 300.000 | 66.000 | 46.000 | 39.000 | 40.000 |
| **Southampton** | 120.000 | 8% | 1.500.000 | 1.375.000 | 1.441.000 | 1.378.000 | 1.275.000 |
| **Thamesport** | 38.000 | 5% | 756.000 | 687.000 | 620.000 | 525.000 | 500.000 |
| **Aarhus** | 32.000 | 5% | 639.000 | 581.000 | 500.000 | 447.000 | 369.000 |
| **Dunkirk** | 4.000 | 2% | 205.000 | 205.000 | 200.000 | 162.000 | 161.000 |
| **Gothenburg** | 16.000 | 2% | 820.000 | 788.000 | 731.000 | 666.000 | 646.000 |
| **total** | **11.521.000** | **28%** | **40.971.000** | **37.529.000** | **34.342.000** | **30.554.000** | **14.898.000** |
| **Growth** | | | **9,2%** | **9,3%** | **12,4%** | **8,8%** | **8,5%** |
| **Relay impact** | **478.985** | **4,2%** | | | | | |
| **Feeder moves** | **10.980.015** | **95,3%** | | | | | |

*Source: Dynamar, 2007*

Bremerhaven has the highest share of transhipment (55%) followed by Hamburg (43%), Antwerp (27%) and Rotterdam (24%). These four ports have the largest volumes, in terms of transhipment (and feedering), and are therefore direct competitors of each other for transhipment boxes. However, because these ports are located on different geographical locations not all four ports are direct competitors on the same feeder trades.

Hamburg and Bremerhaven have, due to their geographical location, a strong market share in the Scandinavia/Baltic. Especially the rising of the East European market has triggered transhipment and feedering to the Baltic region. Rotterdam and to a lesser extent Antwerp are serving the UK/Ireland region and Northern Spain and Portugal (The Iberian Peninsula). Rotterdam has the highest market shares on these two trades[10].

However, at the moment Zeebrugge is perceived as an excellent transhipment hub by global shipping lines. This has to do with; costs, higher productivity figures and not having delays in the port, as is the case in Rotterdam and Hamburg. It is therefore that Rotterdam has lost significant volumes of transhipment cargo to Zeebrugge. In the next paragraph a more detailed overview is given about the European feeder market.

[10] Appendix 6: Market shares per region European gateways

## 4.7 European Feeder market

*Feedering can be defined as:*

- *The first and/ or last maritime leg of an ocean borne container transport where the ports of loading and discharge of the mainline containership are not the same as the origin or ultimate destination port of the container*
- *The regional part of the transport global container transport system and as such an integrated part of the transport chain from door-to-door (that needs to be protected)*
- *A shortsea (short haul) trade and a product of transhipment. The principal of the feeder operator is the mainline carrier, not the cargo interests (Dynamar, 2007)*

The European feeder market is a market with its own characteristics, developments and inefficiencies compared to for example the Far-East feeder market. The feeder vessels deployed in Europe are small compared to other feeder markets in the world. Furthermore, the (European) feeder market is a kind of a spot market. Feeder operators never follow the same schedule and thus ports of call are not always the same. There are two types of feedering; common and dedicated feedering and it is expected that European feeder volumes are going to increase. A common feeder operator is not a customer of the terminal operator and a feeder always follows the mainline. The above and other market characteristics and developments are discussed and explained in the following (sub) sections.

### 4.7.1 Feeder market principles

Feeder market principles are distinctive features that give the feeder market its own personal character. The feeder market is a market on its own, even though it is a product of transhipment and thus also a part of the transhipment market. First, something is said about the costs of feedering as part of total transhipment costs. Second, the service reliability of feedering is discussed. The dynamic market character of feedering is presented in the last part of this sub-paragraph

***Costs***

The system costs of transhipment are high, in particular when involving feedering. Deep sea carriers generally try to improve their financial performance by carrying more cargo through the same number of ships (Economies of Scale), or by reducing on their complement of mainline vessels (Dynamar, 2007).

Shippers and consignees have a preference for direct services. Direct calls are perceived as more reliable and cheaper because transhipment, in most cases, makes the total supply chain longer, more expensive (because extra handling charges involved) and less reliable (because chance for delays increases). Therefore, where transhipment is competing with a direct service, the overall ocean freight charged to the shipper tends to be lower than for the direct connection, apparently to compensate for the perceived at least lower service reliability. This means that the carrier is absorbing a substantial part of the transhipment and feeder cost involved. Generally, feedering is more cost effective than direct services for low-volume origins/destinations only.

Shippers and consignees are often led by emotions when taking a decision. When volumes justify a direct call, this will be the preference even when it is more expensive, less reliable and has a longer transit time compared to transhipment. Knowing this, feeder operators are forced to offer a reliable service against low costs with fast transit times in order to stay competitive.

***Service reliability***

Being a reliable feeder operator means that you must offer sufficient departures a week to a certain destination, with an acceptable transit time. When a mainliner is delayed, it must have an option to book its container on another feeder vessel instead of waiting a week before the next vessel departs. This means that a feeder operator must have a high frequency of sailings a week. The standard (depending on volume) is three sailings a week per region.

The frequency of a feeder service is based on:

1. Volume; the volume on a specific trade determines the number of sailings
2. The schedule of the mother ship; depends on how often the mother ship berths at the port and how often the mother ship is delayed.
3. Specific desire of customer (mainliner)
4. Port costs (big differences between Northern European ports)
5. Guts to deploy an extra vessel in time of congestion

As can be concluded, a feeder operator must have a flexible operation in order to be competitive. Being a flexible feeder operator has its impact on the size of the vessels deployed in a particular service. High flexibility is only possible with smaller vessels because larger vessels are more difficult to switch between different schedules. Also a high frequency demand is keeping feeder vessels smaller in particular connections. Providing a reliable service is very important for the feeder operator. In the transport business reliability is key because customers hate waiting and not having your cargo in time can give serious production or inventory problems.

***Dynamic market***

The feeder market is a dynamic market. Feeder volumes to different regions are always fluctuating because of changing (economic) market circumstances. Figure 4.6 gives a visualised understanding of the dynamic character of the transhipment and feeder market. The figure is based on information from a major shipping line serving the UK.

Figure 4.6 shows the shift in feedered TEU between 2003 and 2008 for the UK market. In 2003 the situation in the UK main ports was stable and reliable. There was no congestion and the hinterland transportation costs where reasonable. However, in 2008 UK main ports are congested and the costs for inland transport have increased tremendously. The result is that as soon as circumstances in a main port get worse, feedering from other main ports in the region increases. This is especially the case in North West Europe because a lot of main ports are located in relative close proximity from each other. The shifting of transhipment cargo by shipping lines between different ports makes the feeder market a sort of a spot market. The feeder always follows the mainline thus when a mainline carrier moves its transhipment cargo from Felixstowe to Rotterdam, the feeder operator will follow.

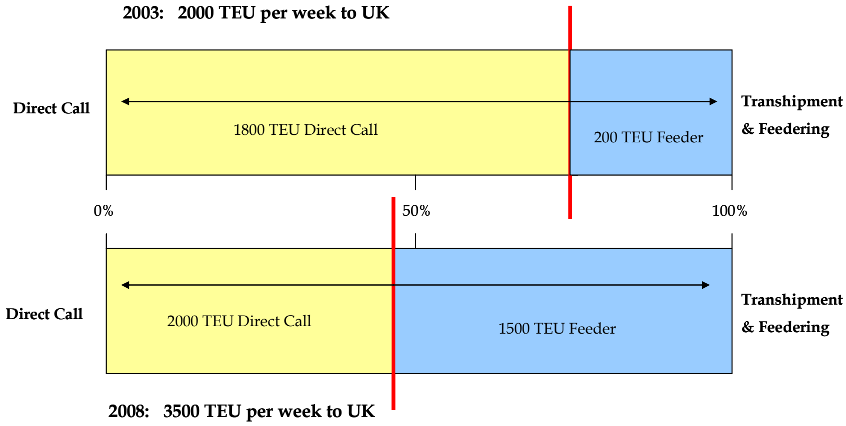



*Figure 4.6: Visualised dynamics of feeder market*

### 4.7.2 Types of feedering

There are two types of feedering;

1. **Common feedering:** A third party operator to who mainline carriers outsource the feeding of containers traffic flows to and from their mainline vessels.
2. **Dedicated feedering**: The feeder operators are the mainline carriers themselves. They usually achieve a higher efficiency because they only have to deal with own cargo.

When volumes grow, mainline carriers will investigate if it is costs effective to start dedicated feeder services. Before engaging in dedicated feedering, mainline shipping companies must have enough critical mass on a particular region to fill its feeder ships; otherwise engagement in dedicated feedering is not an option. According to the mainline companies interviewed, a critical mass of minimal 800 TEU per week is necessary for deploying an own dedicated feeder service. In theory it is true that dedicated feedering is more efficient than common feedering but in practice this is not always the case. There are some other factors than volume that influence the decision to deploy a dedicated feeder service

***Dedicated feeder factors***

The conducted interviews with mainline carriers have revealed that the following factors are important to take into consideration before engaging in dedicated feedering:

- *Volume*

Sufficient volume is needed to deploy dedicated feeder. Without sufficient volume the costs of operating a feeder service will be higher than the revenues. A common feeder operator is probably a better option to transport the cargo.

- *Costs and service quality of common feeder operator*

Engagement in dedicated feeder operations is only justified when the costs of dedicated feedering are lower or equal compared to common feedering. Almost the same is true regarding service quality, only here the service quality of dedicated feedering has to better or equal compared to that of common feedering.

- *Utilization of vessels*

The utilization of feeder vessels is important because the utilization determines the slot costs. The lower the utilization rate, the higher the costs per slot. When utilization rates on a specific feeder connection are low, engagement in dedicated feedering is not justified.

- *Imbalance*

Imbalance has an influence on the utilization rates. When an area has a lot of imports and almost no exports (e.g. UK), feeder ships have to return back to the hub port without cargo. This means that the costs per slot increases, making the dedicated feeder service expensive. This problem does not exist for common feeders operators because they also get paid for the transport of empty containers.

- *Marketing*

Marketing could be an important reason for engagement in dedicated feedering. Shippers are sensitive for extended market coverage. If shipping companies have large portfolios of different network connections, they are perceived as very good shipping companies. Having your own dedicated feeder services could therefore be a good marketing tool to attract cargo which is not necessarily connected to a specific feeder area.

- *(Costs) number of vessels needed to deploy reliable service*

To deploy a reliable (dedicated) feeder service, means that sufficient vessels have to be in service. A reliable feeder service has at least three sailings a week. If a frequency of three sailings a week is necessary to deploy a reliable service, at least three vessels per service are needed. Deploying three vessels is costly.

- *Rotation and scheduling of mainline*

The feeder service has to fit into the rotation and schedule of the mainline. Mainline carriers often have several calls a week in a specific port. The different ships calling at the port usually sail on different trades and thus all ships have different transhipment cargo for different regions on board. This makes it very difficult to construct a dedicated feeder service on a specific area.

- *Chain control of mainline*

Having control over the whole transport chain is something that a lot of shipping companies would like to have. The main reason is having more control over total costs that occur in the transport chain. Chain control is also the reason why shipping lines have engaged in dedicated terminals. The same applies for dedicated feeder services.

- *Alliance decisions*

Engaging in dedicated feeder services can be approved or disapproved by the alliance. It is therefore not always a decision that is made on (one) company level.

- *Provides extra flexibility to mainline*

Having your own feeder service means more flexibility because the dedicated vessels can easily be rescheduled where necessary.

- *Dedicated terminals*

Having your own dedicated facilities in a port usually means that you have large volumes of containers passing your facilities. This in turn makes dedicated feedering a more feasible option.

As can be concluded a lot of factors have to be taken into account before mainline carriers engage in dedicated feedering. Despite all deep sea alliances, consortia, vessel sharing agreements and slot exchange deals, liner operators are reluctant taking space on dedicated feeder vessels operated by their partners. The reason is that the feeder service is just too close to the actual shipper or consignee which induces the risk of revealing sensitive commercial information to the competitor.

### 4.7.3 Competition

Competition, especially on the thicker feeder routes, is fierce and cooperation low and often not existing. Instead of large feeder ships, a lot of smaller feeder ships are operating the same routes, keeping feedering rates low at the same time.

***Direct competition***

Logically, common feeder operators serving the same region are direct competitors of each other. Dedicated feeders, serving the same region, are also direct competitors of the common feeder operator. When a mainline company decides to deploy own dedicated feeders, the common feeder operators always looses cargo. On the other hand, the common feeder is not a competitor of the dedicated feeder. The reason is that feedering is a part of the mainline operation. It is the part of the sea transport that can be outsourced to an independent (common) feeder operator. Dedicated feeders, as well as common feeders, are part of the mainliners' door-to-door operation. The big difference is that a dedicated feeder, compared to the common feeder operator, is always sure of having cargo. This makes the dedicated feeder operation more a costs centre than a profit centre. Common feeder operators are profit centres because they are independent companies, with the aim of making as much profit as possible.

***Indirect competition***

Indirect competitors of the feeder operators are road and rail transport. After a direct call of a mainline in a certain port, land transport is needed to deliver the cargo at its final destination. The choice for a direct call by shipping lines automatically rules out the use for feedering. As discussed, direct calls are perceived as more reliable and cheaper by shippers and consignees. However, this is not always true. High oil prices, higher awareness of $CO_2$ emissions and stricter safety rules, have made road transport much more expensive the last decade. Furthermore, rail transport is not as flexible as road transport. In most cases of rail transport some form of road transport is needed to eventually get the cargo to its final destination. This has and is favouring feedering. Especially, the high costs for road transport has favoured feedering because feedering minimizes the number of road miles for destinations in the proximity of feeder ports.

That feedering is a product of transhipment is clear. However, the factors that are determining the choice of the mainline for a direct call are not discussed. Factors influencing that choice are numerous. The most important factors are summarised below:

1. Volume
2. Costs (port and land transport)
3. Transit time
4. Accessibility of ports
5. Dedicated terminals
6. Terminal capacity
7. Market demand
8. Reliability of port (congestion)

Congestion in and around a port has a big influence on the choice for a direct call, particularly involving (transhipment) cargo. The further away the owner of the cargo is located from the port, the more attractive transhipment becomes, especially when the location of the cargo owner is reachable via a feeder port. There are of course much more factors that influence the choice of mainline shipping companies. Other factors that are also important but to a lesser extent are: marketing, port facilities, alliance decisions, schedules, risk spreading, imbalance of containers and bunker prices.

***European feeder operators***

The largest feeder operators in North West Europe by order of carryings are:

- Common segment: Unifeeder, Team lines, X-press Container line (Sea Consortium) and Feederlink
- Dedicated segment: Maersk Line, MSC, and CMA-CGM.

Mergers and acquisitions have made the market less fragmented, with fewer providers to be played off against each other rate-wise. However, there are still a lot of smaller common feeders on niche routes.

In addition to the three carriers above, the list of mainline carriers involved in dedicated feedering is modest and includes; APL, Evergreen, K Line, and OOCL. However, it may be assumed that the list of dedicated feeders is to grow by at least those companies (to become) involved in dedicated terminals. Examples of such companies are: COSCO, Hanjin, Hyundai, MOL, Yang Ming and ZIM. These companies will absorb market share from the common feeders, especially on the ticker routes.

#### 4.7.4 Feeder vessels in North West Europe

There is a big difference in the size of feeder vessels deployed in Europe. The average size of feeder vessels deployed on the UK East coast by common feeder operators is around 600 TEU. Some operators have 550 TEU vessels and some have 650 TEU vessels. However, on the West coast of the UK (including Ireland) the average feeder ship is around 850 TEU. The size of feeder vessels is determined by the following factors:

- *Volume*

The most important factor is volume. When there is not enough volume it makes no sense to deploy a large ship. Utilisation will be low and per unit costs will be high.

- *Port infrastructure*

The capability of the feeder port determines the size of the feeder vessel. Draft and cranes are often not sufficient to allow very large feeders. On the UK East coast the maximum size for a feeder vessel is around 1000 TEU. Beyond this size there are tidal problems and cranes that can not (un)load the ships.

- *Frequency demand*

A lower frequency would allow the use of larger feeder ships to increase the number containers per call, reducing slot costs at the same time. However, weekly services have become the norm of the smaller regional ports as well, which thus restricts the feeder ship size. Larger ships mean lower frequency, which in turn mean lower reliability.

- *Type of feedering*

Dedicated feeders are, in the same trade, usually bigger than common feeders. This can be explained by the fact that the cargo of the dedicated feeder is fixed and secure. The cargo of the common feeder has a more variable character. It is always the question for the common feeder how many TEUs are booked by different mainliners.

- *Hub and terminals to be served*

The feeder ship size is also determined by the hub and terminals to be served. The feeder ship has to be tuned to specific demands at the hub ports. The mainline carrier may use one central hub in a region, or separate ports for inbound and outbound feedering. In a larger gateway port (e.g. Rotterdam) with hub activities as a secondary function, often more than one terminal has to be served. In Rotterdam, feeders may have to go to six different terminals in three different port areas. Moreover, deep sea terminals seldom have a dedicated feeder berth. The larger the terminal, the more often feeders may have to be shifted along the quay to pick up (or discharge) containers. The alternative is long horizontal moves on the terminal, which the stevedore will seek to prevent. The larger the feeder vessel the more complex and expensive shifting becomes.

- *(Un)Loading time*

Large vessels take more time to load and unload. This influences the frequency and thus the reliability of a service. Especially, when looking at the UK and more specific at the Humber, the sailing time from Rotterdam is only 14 hours. Vessels from 1000 TEU and above need more than 14 hours to unload. So the unloading and loading takes more time than the actual journey. The result is fewer roundtrips which affect the unit costs because the more roundtrips a feeder vessel can make the lower the unit costs will be.

- *Switching between schedules*

Larger vessels are not as flexible to switch between different services/schedules. This is a big disadvantage for a common feeder operator because the feeder market is a kind of a spot market. Therefore, changes in the feeder schedules are common practice.

#### 4.7.5 Market developments and trends

In the past years a number of developments have taken place in the feeder market. First of all, more mainline carriers have engaged in dedicated feedering because of growing volumes on certain trades (e.g. Baltic). They may use a separate brand to give their dedicated feeder operations a common (neutral) character. The brand may deploy its own ships in separately operated services, or charter slots on (dedicated) regional services of its mother company. If the feeder brand uses different ships, it may cooperate in a vessel sharing agreement with its parent company as well as with other carriers. Other more resent trends are; common feeders operating one or more of their ships under the name-style of a mainline customer (e.g. Team Lines for APL); Joint services between common and dedicated operators (e.g. NYK with X-press container lines); Regional cargo operators chartering slots on ships of common feeder operators (Samskip from Team Lines)

Indeed the above developments have taken place. However, after conducting interviews with common feeder operators and mainline shipping companies, it became clear that the above developments are not all a success. Almost all slot charter agreements, alliances and joint services between common feeder operators have failed. The reasons for failing are: distrust, cost allocation issues between companies and organization of the service.

- *Distrust*

Many feeder operators do not trust each other regarding (commercial) information. They are afraid that sailing in an alliance will lead to stealing customers from each other. This is because the feeder operator operates very close to the actual customers of the cargo compared to mainliners.

- *Organization of the service*

Ports of calls in feeder schemes are not that certain as by deep sea lines. This is because the feeder follows the cargo of the deep sea carrier. This makes the feeder market somewhat of a spot market. Because of this, it is more difficult for feeder companies to come to an agreement about operational and cost decisions. What happens in practice is that disputes arise concerning operations (deploy extra capacity or skip a port or not).

- *Cost allocation*

The costs that occur by feeder operators are mostly variable costs and thus are difficult to divide between different parties. This is the foremost reason that feeder companies can not come to an agreement about cost allocation. The different ship sizes in de market on the same connections are adding to the problem because different ship sizes mean different costs. Most operators are afraid that they have to pay more or are paying for costs that are made by the alliance partner.

***Consolidation***

Between 2005 and 2007 a lot of mergers and acquisitions took place in the Shortsea/Feeder market[11]. especially in North Europe. This is in line with what is happening in the mainline carrier market. Falling rates and escalating costs are no doubt the main drivers. A feeder company is an asset-light company as it often charters 100% of the fleet it operates. Therefore, acquisition of such a company mainly consists of goodwill (contract with mainline carriers), staff, ICT systems and an office building.

[11] Appendix 5: Consolidation in Feeder/Shortsea market

***Mainline developments***

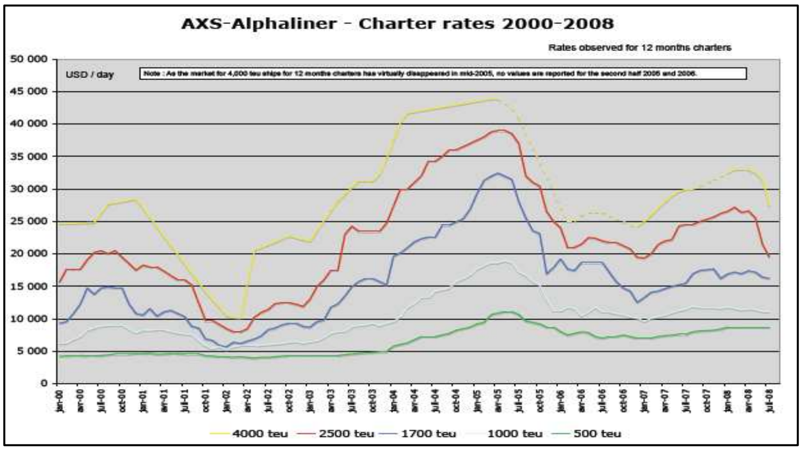
As discussed, feeder ships follow the mainline ships. Therefore, developments in the deep sea trade are important to feeder operators. Mergers and acquisitions among mainline carriers do affect the common feeder operator. The mainline company may grow to such size that it may start or increase its own dedicated feedering activities.

However, carriers are becoming bigger and bigger and because of the increase in size not al ships can call in every port anymore. This should increase the demand for feedering. Especially by shipping lines which do not have enough volume to engage in dedicated feedering.

#### 4.7.6 Charter market Rates

To be as flexible as possible towards seasonality and ever changing market demand, feeder operators charter most, if not 100% of the ships they use. Quite a proportion of those ships are chartered for three to maximum six months time charter (Dynamar, 2007). It is obvious that charter market prices are of huge importance to the feeder operators. In fact and as margins are very thin, freight rates for feeder containers often move closely along charter price developments, which are exactly known by the mainline carriers. As the green line shows, prices for around the 500 TEU segment seem to be less volatile than those for larger ships. In North West Europe, 500-1000 TEU ships are the most commonly used feeder vessels.

*Table 4.7: Charter rates container vessels*




*Source: AXS- Alphaliner, 2008*

To compensate for the volatility of the charter market, common feeder operators, locked into fixed freight rates (usually one year contracts, which mostly include escapes for mainliners), more than ones tried to levy a kind of charter market surcharge upon their customers; the deep sea carriers. This never has been successfully implemented.

#### 4.7.7 Intra-European feeder areas

The conclusion that can be drawn from previous paragraphs is that transhipment and feedering are a substantial market in North West Europe and that increasing numbers in the future are likely to come about. A huge stimulus for the feeder market in Europe is the autonomous growth of the Baltic countries. These countries seldom get a direct call of mainline carriers and are therefore feeder markets with high potential, especially for Hamburg and Bremerhaven. For Rotterdam and Antwerp the UK/Ireland and Northern Spain/Portugal are the most significant feeder areas. When exploring the feeder and transhipment market in North West Europe, the following feeder flows can be marked as most important or busiest in terms of volumes shipped.

The densest intra-European feeder flows are between the above ports mentioned and:

1. Scandinavia and Eastern Baltic countries
2. UK and Ireland
3. Northern Spain and Portugal

Mainline carriers handle their transhipment activity, along with gateway containers, in one (but usually more) of their direct ports of call. Therefore, these ports are called main port hub, rather than just hub. Their geographical location with respect to feeder areas is important but, as discussed in chapter three, also other factors are important for selecting a port for transhipment.

Table 4.8 shows the market share of Rotterdam on the three main feeder areas and the total number TEUs feedered to the main areas. In appendix 6, a complete overview is given of total numbers of full TEUs handled in the seven European main gateways[12], with each a transhipment share over 10%, to and from the three main intra-European feeder areas. For each of the gateway ports, the share by area and total volumes has been presented, which indicates the emphasis of each of the individual ports on a specific area. There is however one important remark that has to be made. There are no separate feeder and shortsea statistics available for none of the ports. Therefore, the figures presented include both.

*Table 4.8: Rotterdam market shares on feeder areas*

| Feeder areas European gateway | 2006 Share | 2006 TEU | 2005 Share | 2005 TEU | 2004 Share | 2004 TEU |
|---|---|---|---|---|---|---|
| Scandinavia/Baltic | 14,5% | 567.200 | 15,5% | 545.400 | 14,4% | 460.800 |
| Spain/Portugal | 40,0% | 261.900 | 38,4% | 251.800 | 37,2% | 198.900 |
| UK/Eire | 59,6% | 1.488.700 | 60,1% | 1.431.400 | 60,9% | 1.321.600 |
| **Rotterdam Total** | **32,8%** | **2.317.800** | **34,0%** | **2.228.600** | **33,5%** | **1.981.300** |
| | | | | | | |
| Scandinavia/Baltic | 100% | 3.904.000 | 100% | 3.511.900 | 100% | 3.204.700 |
| Spain/Portugal | 100% | 655.200 | 100% | 655.100 | 100% | 534.200 |
| UK/Eire | 100% | 2.499.100 | 100% | 2.381.400 | 100% | 2.171.600 |
| **GrandTotal** | **100%** | **7.058.200** | **100%** | **6.548.400** | **100%** | **5.910.500** |

*Source: Dynamar, 2007*

According to Dynamar most volumes in 2006 (3.9 million TEU) are shipped to and from Scandinavia/Baltic via Hamburg, Bremerhaven and to a lesser extend Rotterdam. The volume shipped to and from the UK and Ireland was approximately 2.5 million TEU of which Rotterdam handled 59.6%. This means that almost 1.5 million TEU with origin or destination UK/Ireland is handled by the port of Rotterdam.

[12] Hamburg, Bremerhaven, Antwerp, Zeebrugge, Felixstowe and Le Havre.

## 4.8 Hub port issues

The geographical location of main port hubs is very important for the transit time of feeder services. However, costs and service reliability are equally important as well, sometimes even more than location.

*Gateway and hub at the same time*

In North Europe the main European gateways are located at a relatively short distance from each other. Direct calls to gateways make sense because of the major markets that are served through these ports. Therefore, almost all mainline carriers in Northern Europe call at three to five ports with most of their vessels. The choice about which ports will also be used as a hub, is made on the basis of the ports gateway position and not on the basis of transhipment. However, the most important criteria are costs, efficiency and speed. An additional criterion is transit time. The shortest transit times to and from feeder ports are attained by:

a) Arranging import feedering from the first port of call.

b) Arranging direct export feedering from the last port of call.

This is logical because if you unload import feeder containers in the third port of call, the transit time increase tremendously. Loading export cargo at the last port of call makes sense because otherwise the cargo is loaded on top of cargo that has to be unloaded in other ports. Being a main gateway and major hub at the same time gives problems regarding conflicting interests. The most import problem in a main port hub is a problem of priority.

*Priority*

The focus of main hub ports is on the mainliner. Especially for ports with a substantial own hinterland, transhipment does not have priority. Margins in the transhipment handling business are low and thus require high volumes. However, important reasons for a port operator to take interest in transhipment include (Dynamar, 2007):

1. Feedering is an indispensable part of an integral network that needs to be protected.
2. Efficient feeder links stimulate growth of containerisation in the ultimate origin and destination ports and thus mean business in the hub.
3. Handling transhipment at the same time strengthens a port's position towards hinterland cargo. On the North European Continent for instance, the high density of large ports makes almost every hinterland contestable.
4. Terminal operators that ensure high quality transhipment procedures contribute to the integrity of the deep sea carrier's network. They will find the mainline pleased to call at their terminal for both gateway and transhipment cargo.

Common feeder companies consistently complain that they have low priority (also in ports with dominant transhipment share) in securing berth space at hub ports. Failure to secure berth space means that they can not maintain their schedules. Not be able to maintain schedules in turn means that service reliability decreases, which makes the feeder service a less attractive option to use. Terminal capacity is also an issue in this matter. When there is enough terminal space, feeders are treated well. When space becomes scares and congestion is getting worse, common feeder operators are the first victims of shifting priorities.

The reason for this priority issue is that in most hub ports the feeder-carrier contractual agreements are on the basis of Free in and Out (the mainline carrier pays for the loading and discharge of the feeder ship at the hub port) or on the basis of Free in and Out (Mainline pays for the loading and discharge of the feeder ship at the hub and feeder port). This implies that the feeder operator is not the customer of the terminal operator regarding any container handling involved. The principal of the feeder operator remains the mainline, whose ship has left when the feeder vessel is to move to the berth to be loaded. If at that moment the next terminal operator's mainline customer ship is mooring, it will claim priority.

### 4.9 Conclusions

This chapter has provided insight in the principles of transhipment. The principal purpose of transhipment is to reduce overall costs of shipping by exploiting economies of scale by using larger vessels. A consequence of deploying larger ships is that fewer ports are getting a direct call. Main reasons are ship utilisation, costs and draft and berth restrictions. It has become clear that transhipment and port capacity are highly related and that transhipment is a very footloose business because the port (terminal) chosen for transhipment is not the final destination of the cargo. This means that there is no real connection tying the shipping line to the port. The requirement for transhipment will continue as a direct result of underlying shipping economics. When looking at global and European transhipment figures of the last two decades, it can be concluded that the transhipment business is a large and stable market and plays a significant role in today's shipping business. Furthermore, the ongoing growth is vessel size will further stimulate transhipment on a global scale and certainly in North West Europe. This in turn will result in more feedering in Europe. Global forecast figures confirm this development of increasing transhipment volumes.

The general conclusion that can be drawn about feedering is the fact that feedering (in Europe) is, besides the mainline developments such as increasing vessels, often triggered as a result of cutting costs, bad port performance, congestion and under capacity in ports. When the port of Southampton is full or is not performing well, carriers will deicide to move a part of their cargo to another port, for example Rotterdam. Furthermore, supply chain decisions are not always rational decisions and are often based on emotions rather than rationality. Service reliability is very important for feeder operators. Providing a reliable service means that there have to be sufficient sailings a week to a specific region/area, especially in times of congestion. The feeder market is very dynamic and competitive because transhipment cargo does not have a direct link to a specific port and thus cargo can be switched easily between different ports. This induces the necessity for feeder operators to be flexible in their operations and scheduling.

There are two types of feedering; dedicated and common feedering. Factors that determine deep sea carriers to engage in dedicated feedering are numerous. Dedicated feeders are direct competitors of common feeder operators, especially on the ticker feeder routes. However, this does not apply the other way around. The reason is that feedering is a part of the mainline door-to-door operation. Dedicated feeders always have cargo in contrast to common feeders. The latter depends on cargo from the mainliner and cargo that is feedered with dedicated feeders is a loss of cargo for the common feeder. Indirect competitors of feeder operators are land transport operators, which provide the last transport leg after a direct call of the deep sea carrier. The last decade feedering is gaining market share compared to land transport because of high road transport costs. The feeder vessels deployed in North West Europe are small compared to feeders in for example Asia. Also here numerous factors have influence on the size of feeder vessels. The most important factors to be reliable are volume and frequency. A higher frequency usually means deploying smaller vessels. At the moment the average vessel size on the UK East coast is 600 TEU.

In Europe more mainline carriers have engaged in dedicated feedering. Furthermore, common feeders have tried to work in alliances or other forms of partnerships. These partnerships have unfortunately failed because of distrust, cost allocation and organisational differences between different parties involved. Consolidation also has taken place in the feeder market. Mainline developments are important for feeder operators because feeder operators always follow the mainline. The most significant European feeder areas are; Scan Baltic, UK and Ireland, and the Iberian Peninsula. Rotterdam has the largest market shares on the last two areas mentioned.

A last conclusion that can be drawn is that common feeder operators are confronted with a priority issue in large main port hubs. The reason is that the feeder operator is not the customer of the terminal operator regarding any container handling involved and thus the focus is on the deep sea carrier. The deep sea carriers are paying the bill, also for the handling of the feeder, and thus have highest priority at the terminal

# Chapter 5 - Feeder chain

## 5.1 introduction

The previous chapters have provided insight in the changes in the maritime environment and in how port managers and authorities should react on these changes. Furthermore, the North West European transhipment and feeder market is explained and discussed. Knowledge about the principles of transhipment and feedering is gathered and most important feeder areas are discussed. However, this thesis is about improving efficiency in an existing feeder chain between Rotterdam and the UK; 'the Rotterdam-Humber corridor'. In this chapter the focus is on the actual feeder chain.

To improve or establish a new feeder connection it is important to understand how the feeder chain is formed and more important how it works. A lot of different aspects are influencing the choice for transhipment versus that of a direct call. Every shipping line has its own reasons for creating its shipping network. This means that some lines will choose feedering via a transhipment port and some lines will choose a direct call on a certain port for delivering cargo to its final customers. Driving forces in the process of supply chain construction are volumes, costs, transit time and reliability.

Feeder chain costs are costs that occur when a feeder service is deployed. The chain consist of a lot of different variables (components) and each of these variables is influenced by different factors. Not only monetary costs influence the attractiveness of a feeder chain but also non-monetary costs, such as service integrity and behaviour. In order to improve efficiency in a feeder chain, it is important to know what the different costs are. However, it is more important to know which factors are responsible for those costs. Which factors influence the costs components? That is the main question that has to be answered to reveal inefficiencies. Looking at the different costs that occur in a feeder chain makes it possible to divide the chain in different components. In that way, a better understanding of a feeder chain and the cost allocation between the different chain components is realised and inefficiencies can be better detected.

The first part of this chapter gives insight in how a feeder chain works and which (cost) variables are important to investigate, in order to improve efficiency in a feeder chain. First, a schematic overview of the feeder chain is presented to get an understanding on how the different links in the chain are linked and what costs occur in which part of the link.

In the second part of this chapter a conceptual model of the feeder chain costs is created. This model gives insight in the different costs variables that are present in the feeder chain. Furthermore, the model shows the most important factors on which the costs depend or are influenced by. When it is known which factors influences which cost variables, it is possible to make an analysis on how efficiency in the chain can be improved. The actual chain analysis of the Rotterdam-Humber corridor will be carried out in chapter seven.

The information needed to identify the different costs components and to create the conceptual model, has been gathered by conducting interviews. The most relevant information regarding this chapter has been extracted from the interviews with the mainline carriers and feeder operators. However, information extracted from the other interviews has also contributed. Furthermore, the findings are based on the port of Rotterdam, which was used as a case study.

### 5.2 Feeder chain stages and cost components

A feeder chain can be divided in different stages by looking at the different costs that occur along the chain. In this research the feeder chain is considered to begin with the feeder vessel calling at the port of Rotterdam and the chain is considered to end, when the container has reached its final destination in the Middle or North UK. The final destination of the container could be a DC in for example Leeds. Every stage in the chain generates its own sort of costs. These different sorts of costs are called cost components. In turn, these cost components are influenced by all sorts of factors which will be explained later on in this chapter. Figure 5.1 gives a visualised overview of a feeder chain and the different costs components that are present in the four different stages.

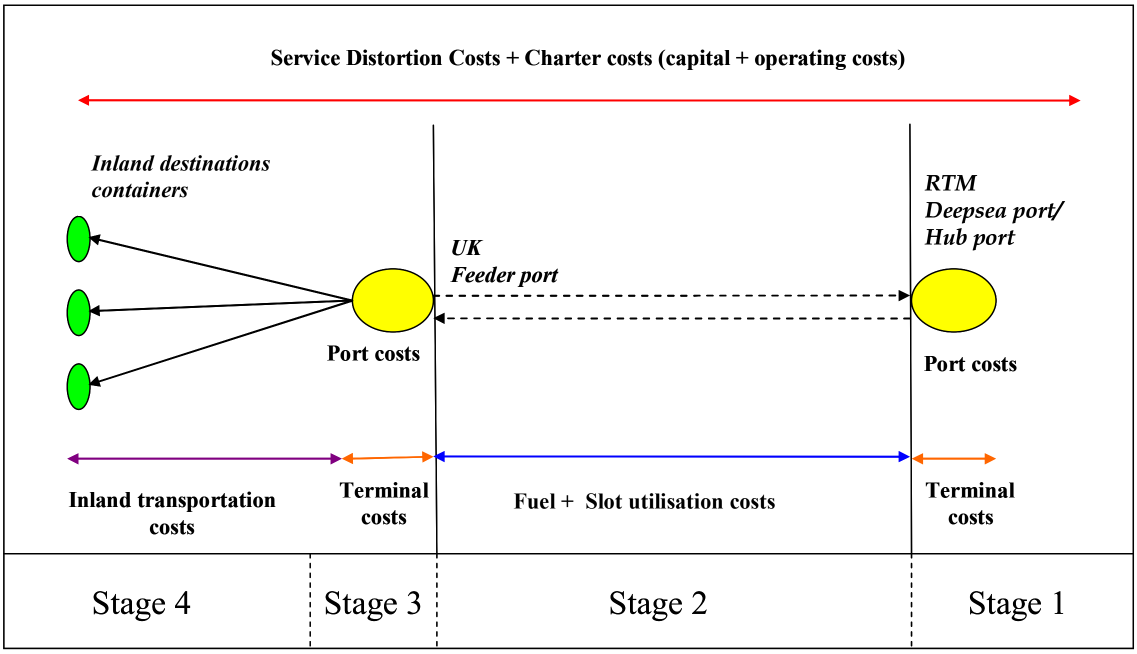



*Figure 5.1: Feeder chain stages and costs components*

A feeder chain can be divided in four stages and in these four stages five different cost components can be identified. However, there are also two other cost components that can be identified. These two cost components are present in all stages of the chain.

*Stage 1:*
In stage one of a feeder chain two different cost components can be identified. The port costs and the terminal costs. When a feeder calls at the port of Rotterdam, port costs have to be paid to the port authority and to other port service providers. Port costs are port dues that have to be paid to Port of Rotterdam and port service costs, like pilotage and towage costs, have to be paid to the companies providing the service. The terminal handling

charges, which occur when the containers are (un) loaded on the vessel by the terminal operator, have to be paid to the terminal operator.

***Stage 2:***

In this stage the transport of the cargo takes place. The feeder vessel has loaded his containers at the terminal and is on its way to the feeder port. At the moment the feeder is leaving the hub port, two different cost components can be identified; slot utilisation costs and fuel costs.

The slot utilisation costs are costs that occur when the ship is finished loading. When the ship is under utilised, utilisation costs occur. If a feeder vessel only has loaded 80% of its capacity, the costs per slot increases due to the fact that the ship is not fully loaded/utilised. The lower the utilisation of the ship is, the higher the utilisation costs will be. Calculating the slot utilisation costs for a common feeder operator is not as easy as it seems. First of all, the costs can be calculated per trip, week, month or year. Second, knowing your total fleet capacity is important for calculating exact cost per slot and thus the slot utilisation costs. However, a common feeder operators' total fleet capacity is never the same. In time of congestion extra vessels are deployed to keep frequency sufficient to stay reliable. This makes it very difficult to determine the exact slot utilisation costs[13].

The fuel costs are the second cost component allocated to this stage. Fuel costs are identified as an own cost component because of the high fuel prices. It is logical that fuel costs occur during the transport of the cargo. A remark regarding the fuel is that fuel costs are actually present in every stage of the chain. However, to keep a clear distinction between the different stages and different costs allocations, the researcher has chosen to allocate fuel costs to the second stage of the feeder chain because during the transport of the container most fuel is used. Fuel costs are costs that have to be paid to the bunker company in the port.

***Stage 3:***

When a feeder vessel enters the feeder port, it has to pay port costs to the port manager or authority. When berthing at the terminal for the unloading of the containers, the terminal handling costs have to be paid to the terminal operator. These costs are explained in stage one.

***Stage 4:***

In the last stage of a feeder chain the container has been unloaded at the terminal and is transported via land transport to its final destination. It is in this stage of the chain that the inland transport costs occur. It is true that the feeder itself is not used in this stage and therefore the costs that occur do not directly apply to feedering. However, inland transportation costs are indirect costs that are part of the total feeder chain costs. To compare the costs advantages between different supply chains, the total costs of the door-to-door operation have to be taken into account. Shippers are only concerned about the total costs of the door-to-door transport.

Therefore, to make a valid comparison between a direct call in an UK deep sea port and transhipment via Rotterdam, the inland transportation costs of both transport options have to be taken into account. Without the inland transportation costs, a full picture of total transportation can not be made and the real advantage in terms

[13] Source: interview Harry Kleipas; Feederlink

of costs is not revealed. Companies make decisions about there supply chain based on total costs of transport, reliability and transit time. It is therefore that the inland transportation costs have to be taken into account when looking at a feeder chain. Without the inland transportation costs the picture would be incomplete and a wrong understanding of the creation of supply chains would be the result.

***Overall cost components***

When allocating cost components to different stage of a feeder chain, it appears that there are two types of costs that occur in every stage of the chain. The first cost component that can be identified, is the cost for chartering the feeder vessel. As discussed, almost every (common) feeder operator charters the vessels it deploys in a service. However, some feeder operators do own their own vessels. Therefore it is important to know that the charter costs consist of two different elements; capital costs and operating costs. Capital costs depend on the way the ship is financed. They may take the form of dividends to equity or interest and capital payments on debt. Operating costs are costs that are involved with the day-to-day running of the ship, such costs (e.g. crew and maintenance) will be incurred whatever trade the ship is engaged in.

The second cost component that occurs in every stage of the supply chain is the Service Distortion Cost component (SDC). These are costs that occur because of distortions that are present in different stages of the supply chain. These costs are not always easy to express in exact monetary costs but are definitely adding to the total chain costs. SDC not only influence monetary costs but also non-monetary costs, such as reliability and transit time. Therefore, SDC are making the whole chain less attractive to shippers and shipping companies to imbed in their networks of different supply chains. A good example of a major distortion cost is congestion. When a port is congested, the cost will increase due to the effect of all different factors. Which factors influence the SDC and all the other cost components will be explained in the next paragraph.

### 5.3 Conceptual model: Feeder Chain Costs

To analyse an existing feeder chain a model for analysing is needed. The model needs to provide insight in the different costs that occur and more important the model needs to provide information over the different factors that influence the costs. If it is known, which factors influence which costs, it is possible to detect inefficiencies that are present per cost component and thus are present in the whole feeder chain. In this paragraph the model needed for analysing (European) feeder chains is created and explained per cost component. The model created is a conceptual model of the feeder chain costs. As discussed, the model is based on a case study of the port of Rotterdam and UK. The different cost components, which are explained in the above paragraph, are now investigated further. At this stage of the research the different factors that influence the different cost components are discussed. After reading this paragraph, the reader should have a clear understanding of the different factors influencing the feeder chain costs.

In chapter four the two types of feedering are discussed; common and dedicated feedering. By the interpretation of the conceptual model, these two different forms of feedering have to be kept in mind. Reason for this is that dedicated feedering is under control and organisation of the mainliner itself. Therefore, some factors influencing the cost components are not applicable to dedicated feeders. A good example is terminal costs; the agreement of the feeder operator with the carrier does not apply to dedicated feeders because they are both the same company.

It is therefore important to always ask yourself; does this factor apply for both types of feedering? The cost components and the factors of influence are now explained.

In figure 5.2 the conceptual model of the feeder chain is presented. The model has been visualised and shows the eight different cost components. Each cost component is explained by its own factors of influence. In the following sub-paragraphs the different factors influencing the eight cost components are discussed.

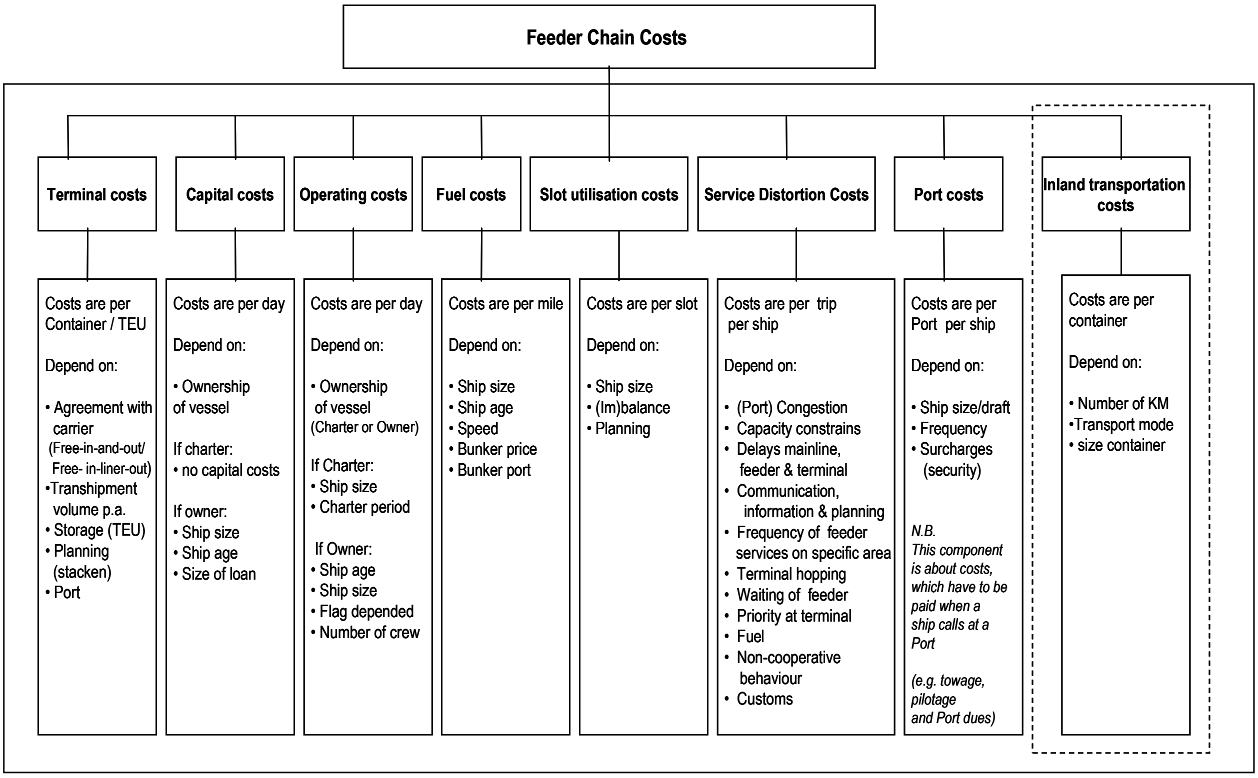



*Figure 5.2: Conceptual model of the feeder chain cost*

**5.3.1 Terminal costs**

The terminal (handling) costs are costs that are charged per container by the terminal operator. Storage costs of a container are charged per TEU. The following factors are of influence on the terminal costs:

- *Carrier agreement*

The conceptual model shows us that the terminal costs depend on the agreement the feeder has with the mainline carrier. This means that there are different forms of agreements, which could occur between feeder operator and mainliner. The agreement is not about the actual price of the terminal costs but about who is responsible for paying the costs to the terminal operator. As known, terminal costs occur in the hub port as well as in the feeder port. The most common form of agreement used in the market is that of Free-In-Liner-Out. This means that the mainline carrier is responsible for paying all the handling costs in the hub port and that the feeder operator is responsible for paying the terminal costs in the feeder port. Another form of agreement is that of Free-In-and-Out. In this agreement the carrier pays the terminal costs in both ports. In this form the carrier has all costs under its own control, which could be an advantage.

- *Transhipment volume*

Terminal costs also depend on the number of transhipment volume per annum. When a carrier can guarantee large numbers of (transhipment) containers to the terminal operator, it will get reduced tariffs for transhipment boxes (un)loaded. This makes the costs of loading the feeder cheaper. The same is true for the feeder company in the feeder port. This is one of the reasons why the agreement Free-In-Liner-Out exists. The feeder operator has in most feeder ports a better bargaining position than the mainline company because of the volumes it can offer the feeder port.

- *Storage*

Another factor that influences the (total) terminal costs is storage. When the carrier has to store containers for a long time, charges have to be paid to the terminal operator. At ECT there is a free storage of 7-8 days for transhipment containers and 4-7 days for continental containers. The frequency of feeder calls on the ticker routes is 3-4 times a week, thus extra costs for storage almost never occurs.

- *Planning*

Planning of the stack and planning of the berthing of the mainliner and feeder at the terminal are a factor, which can influence the costs. If the stack is not planned efficiently a lot of intern terminal transport (ITT) is needed to drive the containers between the mainline and feeder vessels. The same applies for the berth planning of the two vessels. If the mainliner has to berth at the DDN terminal and the feeder has to berth at the DDW terminal a lot of ITT is necessary to get the containers on the feeder vessel.

- *Port*

A last factor that influences the terminal costs is the port itself. There are big differences between terminal charges in ports. For example, the terminal charges in Zeebrugge are cheaper than in Rotterdam.

#### 5.3.2 Capital cost

Capital costs occur when the feeder operator is the owner of the ship. The costs are calculated per day. As discussed in previous parts of this thesis, a feeder operator almost never owns the vessel. When the feeder operator is not the owner of the ship, it has a charter contract with the ship owner. When a feeder has chartered a vessel, capital costs do not apply. If the feeder operator is the owner, than the capital costs depend on the size of the loan, ship age and ship size. Similar sized ships can have different cost structures. This depends on the age and size of the ship. Capital costs of older ships are usually lower compared to new ships. However, the operating and voyage cost of older ships increases relatively compared to new ships.

### 5.3.3 Operating costs

Operating costs only occur when the feeder operator is owner of the vessel and it are also costs that occur per day. If the feeder operator is not the owner of the vessel, it has to pay charter costs to the ship owner. Chartering a vessel can be compared with leasing a car. Crew and maintenance are all included. The charter price depends on the ship size and charter period. However, if the feeder company is the owner of the vessel, the operating costs depend on:

- Ship age; older vessels need often more crew to operate the vessel.
- Ship size; the larger the ship the more crew is needed to operate the ship.
- Flag; the flag under which the vessel is registered has influence on the salary of the crew.
- Number of crew; the more crew the more salary and thus the higher the operating costs.

As discussed, almost every feeder operator charters the vessels it uses. This can be explained by the dynamic character of the feeder market. It is not always certain how much cargo a feeder operator will have in a specific time period. In such a market, chartering a vessel makes much more sense because in time when cargo is scarce, the charter contract can be ended.

### 5.3.4 Fuel costs

Fuel costs are a significant cost component because of the high oil price. As discussed in the previous paragraph, the fuel costs occur everywhere in the chain but because the fuel consumption of the feeder vessel is the highest during the actual journey overseas, the costs are allocated to stage 2 of the chain. The fuel costs are calculated per mile and depend on the following factors:

- *Ship size & Age*

The bigger the vessel is, the higher the fuel consumption per mile. Also the age of the vessel has influence on the fuel consumption of the vessel. Older vessel are usually less fuel efficient than newer vessels.

- *Speed*

The speed of the vessel determines the fuel consumption. The higher the speed is, the more fuel the vessel consumes per mile.

- *Bunker price & Port*

The fuel costs logically depend on the price per ton of fuel. The price is linked to the world oil price. The bunker port also has a big influence on the fuel costs. In for example Rotterdam, the bunker prices are the lowest compared to other ports in Europe. Low bunker prices are an important advantage for a port. If a port has lower bunker prices compared to other ports in the region, mainline carriers will try to use that port as first port of call and will try to unload as much cargo as possible. The more cargo is unloaded. The more the carrier can bunker.

### 5.3.5 Slot utilisation costs

The slot utilisation costs are costs per slot. As discussed, the utilisation of the ship has to be 100% to have no slot utilisation costs. This is almost never the case in today’s shipping business. The utilisation costs depend on:

- *Ship size*

The size of the feeder ship is of influence because; the bigger the ship the more volume is needed to fully utilise the ship. It is therefore that most common feeder vessels are usually smaller than dedicated feeder vessels. Dedicated feeder vessels have guaranteed cargo. The common operator does not always have that guarantee, making vessel utilisation uncertain. However, when a big ship is fully utilised, the costs per slot are lower because of scale economies.

- *Imbalance*

The balance between imports and exports in a certain region has a big impact on the ship utilisation. If the number of import and export containers to and from a particular region are not the same, than there is a market (regional) imbalance. For example the UK market, this is a very imbalanced market. A lot of imports go to the UK but almost no exports leave the UK. The result is that feeder vessels to the UK are fully utilised but back to the hub port they are not and thus slot costs increases tremendously. This is one of the most important reasons why mainliners do not deploy an own dedicated feeder service on the UK. However, for common feeder operators the imbalance is not really a problem. The empty containers of the mainline carrier have to be repositioned. The common feeder operator, in contrast to the dedicated feeder, earns money with the transport of empty containers. In fact, empty containers are a lucrative business for common operators because a ship can carry more empty containers than full containers. However, the fact remains that the imbalance influences the slot utilisation costs because it is not always certain that empty containers are repositioned by feeders.

- *Planning*

Planning is important for the slot utilisation costs. Without a good planning of schedules the utilisation of the ships would be very low. The schedules of the feeder operators have to match with the schedules of the mainliners. This is more difficult for common operators because they often have several mainline customers. Dedicated feeders only have to deal with their own mainline carrier. Furthermore, the planning of which terminal to go first for loading containers is also important. This has to do with the stowage of the ship. If the ship loads light weight containers at the first terminal and heavy weight containers at the second terminal, fewer containers can be loaded on the vessel and thus slot utilisation costs increases.

#### 5.3.6 Port costs

The port costs are costs that every ship has to pay when it enters the port. The port costs depend on the following factors:

- *Ship size/draft*

The larger the ship the more draft and the more expensive the port costs are. Every extra meter in ship size is causing the port costs to increase. The same applies for draft every ten centimetres of extra draft induces extra port costs. When a ship is fully loaded it thus has to pay more port costs.

- *Frequency*

The number of port calls by the feeder vessel has an influence on the amount of port costs that have to by paid. The higher the frequency of port calls is, the more costs the feeder operator has to pay. Ports of call are determined by the number of ports that are in the schedule. In the feeder market a schedule is never the same and thus frequency of port calls differ every week.

- *Surcharges*

A last factor on which port costs depend are surcharges. Especially after 9/11, additional security surcharges have to be paid to numerous port authorities in the world.

### 5.3.7 Inland transportation costs

The inland transport costs are costs that occur in the final stage of the chain. The last transport leg for feeder cargo is often road transport. The costs are per container and depend on the following factors:

- *Number of kilometres*

The number of kilometres from the feeder port to the final destination of the container determines the height of the costs. The costs have to be paid to the transport company.

- *Transport mode*

The transport mode is also influencing the costs of the final land transport. Road transport is more expensive than rail transport. However, the interviews conducted revealed that the preference of most shippers is road transport. Road transport is more flexible than rail transport.

- *Size of the container*

The size of the container also influences the costs of the inland transport. The costs for transporting 40ft containers are higher than for 20ft containers.

### 5.3.8 Service Distortion costs

The SDC are already explained. It are costs, which occur due to the effect of distortions in the market. SDC have a negative impact on the three most important factors in the shipping industry; total costs, service reliability and transit time. These three factors are always taken into account when mainline companies are creating their strategies. SDC are costs that occur per trip per vessel.

The feeder market is a market that exists of a lot of different feeder connections between hub ports and numerous feeder ports in Europe. Every connection can have its own distortion costs and therefore its own solutions. However, most SDC apply to all feeder chains and most of the distortion costs are generated in the ports instead of during the actual sea transport. Furthermore, the interviews conducted have revealed that the feeder market of Rotterdam is a relative distorted market. All parties in the market agree that congestion and lack of capacity are the main drivers for service distortions. However, there are much more factors which influence the SDC. These factors are listed below.

- *(Port) Congestion*

Congestion is the foremost factor influencing the SDC. If a port or/and its transport network are congested, it automatically influences all other factors which are responsible for influencing the SDC. In congested ports with congested transport networks, delays will be longer and information, communication and planning will be more difficult because of all the changes that are constantly taking place. This in turn will result in longer waiting time for feeders. This are just a few examples of the effect congestion can have on the other factors in this cost component. A congested port or a congested transport network around the port is not attractive to mainline companies, especially not for those with transhipment cargo. Congestion increases total chain costs in terms of costs, reliability and transit time.

- *Capacity constrains*

Capacity constrains and congestion; are two factors which are inextricable linked to each other. When there is not enough capacity in a port to efficiently handle all volumes, congestion will be the result. It is therefore that capacity shortage is a factor which influences the SDC.

- *Delays mainline, terminal and feeder*

Delays can occur because of a number of factors; capacity constrains, bad weather or engine problems are just a few examples. Delays are always causing total chain costs to increase. Delays can be caused by all parties involved in the feeder chain but usually the mainline carrier, terminal operator or feeder operator is responsible. A delay of one of the parties mentioned automatically induces delays for the other parties in the chain. If a mainline carrier is delayed, it is not able to enter the port in its window. A window is an agreed time span that a carrier has to enter the port. Windows are important for the terminal operator because berthing and (un)loading schedules are based on those windows. When multiple carriers are too late for their window, the terminal planning becomes a chaos and long waiting times are the result. As discussed, the priority of the terminal operator is the mainliner. This means that in time of congestion and delays the mainliners have priority and feeder vessels have to wait until the mainliners are finished loading or unloading. At the moment more than 60% of the mainline carriers in Rotterdam are arriving outside their window[14].

However, not only mainliners are causing delays. The terminal and feeders can also cause delays because of for example automatic problems or bad planning. As discussed, capacity constrains is an important factor, which reinforces the length of the delays. The same is true about congestion. Congestion in the port and the port's surrounding transport network, are also adding to the problem. It is clear that congestion, delays and lack of capacity are all linked and have a big influence on each other. When looking specifically at feeder chains, all the problems regarding delays are often triggered when the mainline carrier arrives too late for its window. As known, the schedule of the feeder is fully based on the schedule of the mainliners. Therefore, schedule planning between feeder and mainline is the next factor that needs discussion.

- *Communication, (pre) information and planning*

Lack of good communication, (pre) information exchange and planning are all factors that can easily cause inefficiencies in a feeder chain. Good communication means direct and fast communication between the parties

[14] Source: interview Kees Notteboom; ECT Delta terminal.

directly involved with each other. In the case of feedering this means that the feeder operator, the mainline and terminal operator have to share important information directly and as fast as possible. Examples are; information about delays, about which container has to be picked up when and where and about final container destinations. These kind of (pre) information is important to make consistent planning's. In the case of feedering, first hand information has to be provided by the mainline company to the terminal and feeder operator. The faster (correct) information is shared and the faster changes in operations are communicated, the better the planning of all parties can be coordinated and made consistent.

- *Terminal hopping*

Terminal hopping means that a feeder has to berth at several terminals to load its ship. The shifting between terminals is called hopping. First, hopping increases the time of loading the ship and second, the more a feeder has to hop, the more chance it has on delays. Furthermore, hopping also has a negative impact on the stowage of the vessel, as discussed in the paragraph about slot utilisation costs. Hopping often occurs because common feeder operators have more than one customer and shipping lines spread their cargo over different terminals.

- *Priority at terminal*

The priority of feeders at the deep sea terminals has already been discussed in chapter 4. The conclusion was that the feeder has no priority at all at the terminal because it is not the customer of the terminal. The deep sea carrier is the paying customer and therefore it will always have priority, especially in time of congestion and delays. The principal of the feeder operator remains the mainline, whose ship has left when the feeder vessel is to move to the berth to be loaded. If at that moment a next terminal operator's mainline customer's ship is mooring, it will thus claim priority. This is a big distortion in the feeder chain because it induces long delays for feeder operators.

- *Waiting of feeder*

The time a feeder has to wait (delays) and is willing to wait before it can load its cargo is also a factor, which is influencing the SDC component. Time is money and the longer a feeder has to wait the fewer journeys it can make. Fewer journeys mean less income, which in turn mean higher costs per slot. The reasoning behind this is that the slot costs by a common feeder operator are calculated by dividing total cost per month over the total number of containers shipped in that month. The impact of this distortion factor depends on the time a feeder operator is willing to wait on cargo, which can not be directly loaded at one of the terminals. Not loading the cargo and the will of the operator to wait a long time on the cargo both induces higher costs per slot.

- *Frequency of feeder services on a specific area*

The frequency of a feeder service on a specific region can also be seen as a service SDC factor. If there is a frequency of four sailings a week on a specific area and every sailing the feeder vessel is not fully utilised, then extra costs are generated. If the frequency is brought back to three sailings a week, the ship probably will be fully utilised and thus the costs will decrease. However, the frequency is determined by different factors, which are discussed in chapter 4. An inefficient feeder frequency is mostly caused by congestion in the hub port and by delays of the mainline carriers. Mainline carriers want to have enough feeder departures per week to ensure that cargo is in time on its final destination. Also different feeder companies serving the same area, both having under utilised vessels, are in fact generating extra costs by not working together. For example; by not working together the total frequency on a region can be six sailings a week, while there is only supply for four sailings a week.

- *Customs*

In some ports customs can be marked as a factor which influences the SDC. Long and slow inspections are keeping cargo unnecessary long at the terminal. Also the paperwork involved can give problems. If documents are incomplete the container can not leave the terminal. Strong and strict measures of customs compared to other ports will lead to delays and are thus generating extra chain costs. Furthermore, it diminishes the attractiveness of the hub port.

- *Non-cooperative behaviour*

The overall cooperation between different stakeholders in the shipping business is low. Especially the cooperative behaviour between feeder operator, mainline company and terminal operator is far from optimal. None of the parties seem to care about the problems the different parties are facing. This is a strange way of thinking, when you consider that both parties are linked in such a way that they can not work without each other. For example, the feedering of containers by the common feeder operator is part of the total door-tot-door service, which is offered by the mainline to its customer. It is therefore strange that the mainline company does not care about the problems feeder operators are facing.

- *Fuel*

The last factor that influences the SDC is fuel. When the feeder ship is waiting for its turn to load containers at the terminal, it also consumes fuel. This is another sort of fuel than the fuel used for the transport. Logically, the longer the feeder has to wait, the more fuel is used and thus the higher the costs are. The price for this sort of fuel is higher than for the fuel on which the vessel sails.

## 5.4 Conclusions

For improving efficiency in a feeder chain, a model for analyses is needed. This chapter has provided such a model. By dividing a feeder chain into four different stages and by allocating different costs to those stages where the costs are generated, it is possible to analyse a feeder chain per stage and per cost component. However, knowing which cost component occurs in which stage, does not tell much about how the costs are really generated or by which factors the costs are influenced. Therefore, the factors which influence the cost components are given and discussed. These factors are important for analysing feeder chains and thus for improving efficiency.

In this chapter eight cost components are identified, with each its own factors of influence. Five of those cost components could be allocated to the four different stages. Two cost components seem to occur in all stages of the chain. The first five components are; terminal costs, fuel costs, slot utilisation costs, inland transportation costs and port costs. The two cost components that are present in all stages are; SDC and charter costs. All cost components together represent the total feeder chain costs.

Companies make decisions about there supply chain based on total costs of transport, reliability and transit time. This is the reason why the inland transportation costs have to be taken into account when looking at a feeder chain. Without these costs the total (cost) picture would be incomplete and a wrong understanding of the creation of supply chains could be the result.

The SDC component shows the distortions, which can influences the total chain costs. Especially the factors influencing the SDC component are of importance for this research because they reveal possible inefficiencies, which can be present in a feeder chain. However, inefficiencies can also be present in other cost components; such as terminal stack planning in the terminal cost component. In total eleven factors, which are influencing the SDC, are identified. The conclusion than can be drawn about those factors is that they represent inefficiencies, which are influencing the total cost of the feeder chain in a negative way. Furthermore, all factors influencing the SDC are also influencing and reinforcing each other.

# Chapter 6 – UK and Rotterdam

## 6.1 Introduction

In this chapter the UK and its connection with Rotterdam is discussed. The focus will be on revealing the potential that is present for using the Rotterdam–Humber corridor. In the next chapter the Rotterdam-Humber corridor itself will be discussed in the form of a business case. This chapter provides the basis for why this particular corridor could be a good alternative for serving a part of Middle and North UK, instead of a direct call on the Southern UK deep sea ports.

In the first part of this chapter the current UK situation is discussed. First, some information about the UK container market is presented. Second, UK import cargo distribution is discussed. Also the situation in Southern UK main ports is argued, as well as the situation in the Humber ports.

In the second part of this chapter the quality of connections between different main ports in Europe and the Far East are described. Having a more competitive connection than your competitor is an advantage for attracting cargo to your port. Here, a more competitive connection means more competitive in terms of costs, faster transit times, reliability and the size of vessels that can be handled in the port

After reading this chapter the reader should have a clear understanding of the potential that is present for using the Rotterdam-Humber corridor and why transhipment in Rotterdam in combination with feedering the Humber ,is a logical alternative for serving a part of Middle and North UK.

## 6.2 UK container market

This paragraph discusses the current UK situation. The UK container market has grown relatively quick. Over the period 1992-2004, the number of containers entering the UK has grown at a rate of approximately 7% per annum, measured in TEUs (MDS Transmodal, 2006). In 2007, a total of 8.938.000 TEU has been handled in UK ports. Table 6.1 shows that most volumes handled are Asia related. Some remarks concerning table 6.1 are; volume includes empty containers and only Intra-North Europe volume is considered as feeder/shortsea, others are deep-sea volume. This means that 1.849.000 TEU is feeder and short sea volume. According to the interviewed shipping lines and Port of Rotterdam, the share of feedering is 40% and thus shortsea's share is 60%. This implies that 739.600 TEU is feeder cargo, transhipped in Continental ports.

*Table 6.1: Volume handled in UK ports (2007)*

| Volume handled in UK ports | TEU ('000) | % |
|---|---|---|
| Africa | 436 | 5 |
| Oceania | 192 | 2 |
| Intra-N. Europe | 1849 | 21 |
| Mediterranean | 654 | 7 |
| Trans-Atlantic | 1677 | 19 |
| Asia | 4130 | 46 |
| **total** | **8938** | **100** |

*Source: Port of Rotterdam, 2007*

Furthermore, it is forecasted that the volume of containerised cargo will rise from 7.1 million to 10 million TEU (a growth of 487.000 TEU per annum) in the years to 2010 and will reach a total of 19.7 million TEU by 2030. It is anticipated that to 2010, average growth in lo-lo TEU will be 6% per annum, but with some countries growth will be higher. Between 2004 and 2030 the annual growth rate equivalent is 4.02%, meaning that the annual average growth till 2030 is 4.02%.

*Table 6.2: Forecast UK containerised traffic, by world region, 2004-2030 – TEU ('000).*

| | 2004 | 2010 | 2015 | 2020 | 2025 | 2030 | Growth |
|---|---|---|---|---|---|---|---|
| Ireland | 120 | 190 | 253 | 281 | 308 | 362 | 4.34% |
| NW Europe | 907 | 1,328 | 1,597 | 1,808 | 2,155 | 2,380 | 3.78% |
| Nordic | 350 | 543 | 575 | 692 | 635 | 713 | 2.77% |
| Mediterranean | 519 | 734 | 855 | 1,013 | 1,241 | 1,548 | 4.29% |
| E Europe | 73 | 115 | 142 | 190 | 219 | 244 | 4.77% |
| Africa Excl Med | 349 | 469 | 546 | 627 | 810 | 896 | 3.69% |
| N America | 830 | 1,035 | 1,165 | 1,338 | 1,555 | 1,894 | 3.23% |
| C&S America | 523 | 681 | 780 | 886 | 1,006 | 1,115 | 2.95% |
| W Asia | 539 | 765 | 931 | 1,101 | 1,283 | 1,454 | 3.89% |
| E Asia | 2,722 | 3,944 | 5,063 | 5,960 | 7,108 | 8,774 | 4.60% |
| Oceania | 153 | 206 | 238 | 271 | 314 | 348 | 3.22% |
| Total TEU | 7,086 | 10,009 | 12,146 | 14,167 | 16,633 | 19,728 | 4.02% |
| | | | | | | | |
| Container Units | 4,327 | 5,881 | 6,941 | 8,095 | 9,505 | 11,273 | 3.75% |

*Source: MDS Transmodal*

In the next few sections of this chapter, it will become clear that the Rotterdam-Humber corridor has a lot of potential to handle much more volume for Middle and North UK. It is clear that Asia traffic is most important for the UK. This is in line with the scope of this research, which focuses on import cargo from the Far East with the final destination Middle and North UK, transhipped via Rotterdam. Furthermore, when wanting to serve North and Middle UK, it is important to know where import cargo of the UK is concentrated and via which port it is shipped and distributed. In the next sub-paragraph the UK import cargo distribution is outlined.

### 6.2.1 UK cargo distribution

To reveal the potential for the Rotterdam-Humber corridor, it is important to know where UK import cargo is distributed and via which port the import cargo has entered the UK. In this sub-paragraph the container distribution of import containers is presented by using maps, which were constructed for a study of SMRS (2003). The maps show the scope that exists for targeting traffic, especially that currently using Felixstowe and Southampton, to switch to the Humber. They show where the competitive advantage can be gained in terms of current container distribution from the Southern ports to the Humber catchment area. This advantage will be both reinforced and extended when the effects of the WTD are considered, as it will effectively enhance the price competitiveness of the Humber (or reduce that of the southern ports) and hence increase the Humber's effective catchment zone.

The maps show there are four regions that receive in excess of 120,000 containers per year. These are:

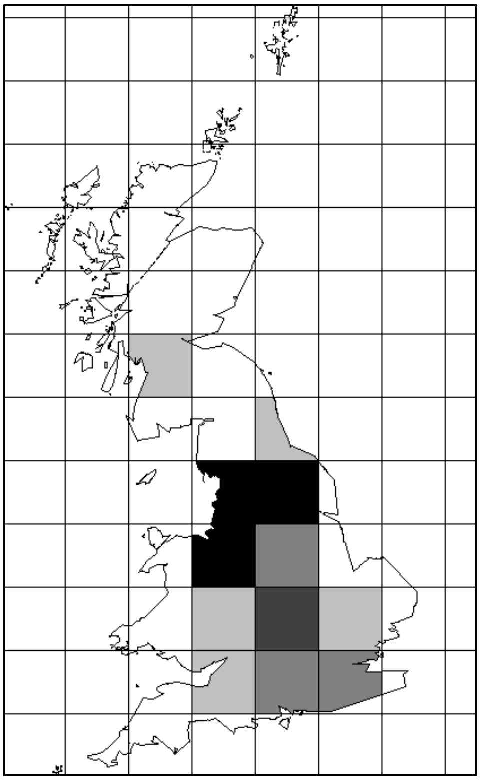
- The North West
- West and South Yorkshire

- West Midlands
- The London area

In addition, areas adjoining the North West and the East Midlands receive in excess of 60,000 units annually whilst Scotland (Clydeside) receives between 20,000 and 60,000. Furthermore, during the interviews mainline companies have indicated that about 50% of their containers are distributed to the Middle and North UK.

The first two maps represent the import cargo distribution of Felixstowe and Southampton. The third map provides insight in the total import distribution of the four major UK deep sea ports. This last map thus also includes Tilbury and Thamesport. These latter two ports are not treated separately because these ports serve mostly the London region.

***Figure 6.1: Container Distribution – Southampton***

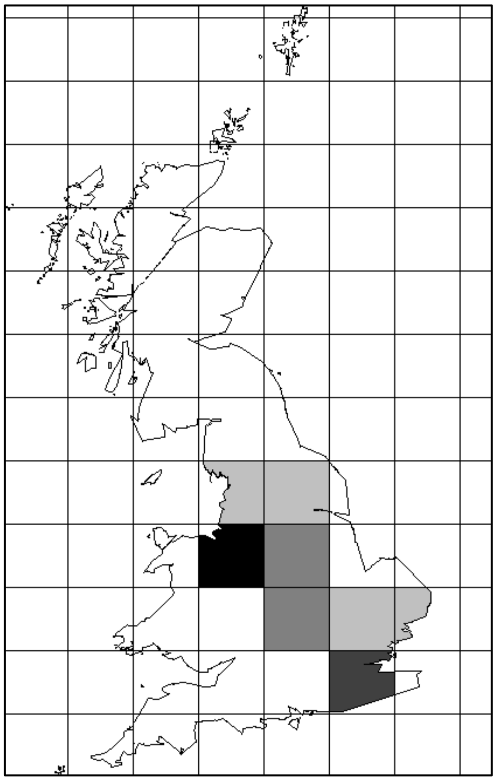


Containers / Year

| | |
|---|---|
| | > 11000 |
| | 7000 – 10999 |
| | 4000 – 6999 |
| | 1000 – 3999 |
| | 1 – 999 |

*Source: SMRS, 2003*

***Figure 6.2: Container distribution - Felixstowe***



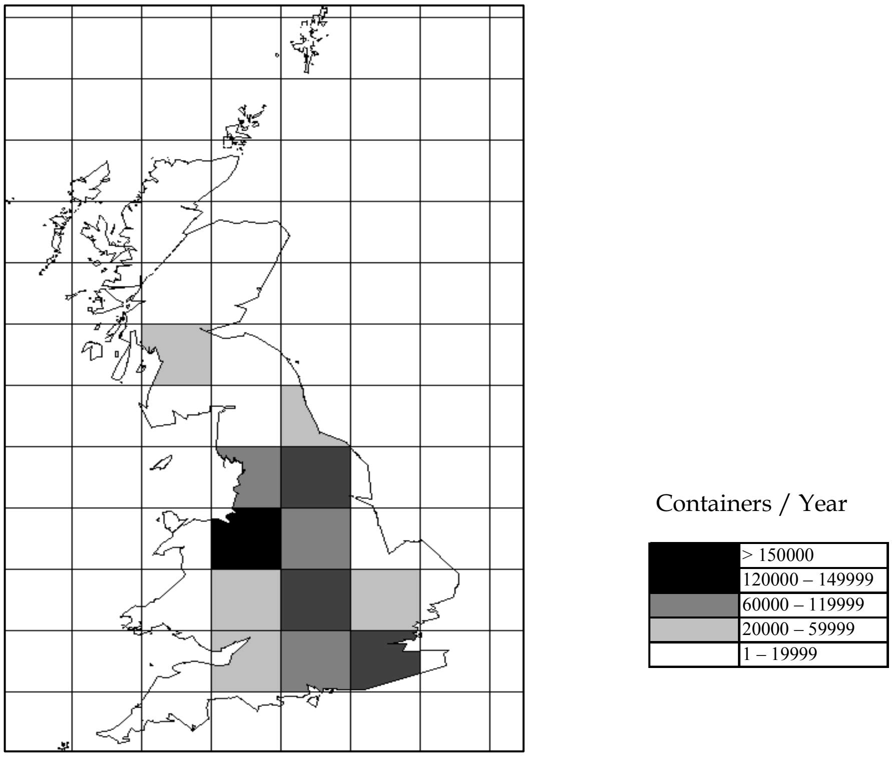
Containers / Year

| | |
|---|---|
| | > 9000 |
| | 7000 – 8999 |
| | 5000 – 6999 |
| | 3000 – 4999 |
| | 1 – 2999 |

*Source: SMRS, 2003*

The majority of containers imported through Southampton are moved to Merseyside, the North West and West and South Yorkshire. Only a small number are moved to Scotland although this flow is still greater than those from Felixstowe and Tilbury to Scotland. The majority of Felixstowe's traffic is the London area and the Midlands (plus Merseyside). Destinations from Tilbury and Thamesport are broadly similar. Especially, import containers, which enter the port of Southampton, are distributed to Middle UK.

*Figure 6.3: Import Container Distribution – All Import*




*Source: SMRS, 2003*

In Figure 6.3 the overall import distribution is presented. The map shows that most import cargo has its final destination in the West Midlands area. Also the London area absorbs a lot of import cargo. Furthermore, the maps show that around the Humber area large volume of import cargo is present.

These maps reveal that there is enough volume in Middle and North UK, which is shipped via congested major UK South ports. In the Humber catchment area 40 million consumers can be served[15]. This of course means that there is enough (cargo) potential for the Rotterdam-Humber corridor. Any future Humber marketing should be targeted at the Felixstowe and Southampton traffic destined for/originated from North of the Midlands. Especially, in the light of the WTD which have made road transport much more expensive. The marketing effort should focus on the alternative; transhipment via Rotterdam to the Humber. In the next paragraph UK ports are discussed. An analysis is made of UK port utilisation to show that UK deep sea ports are congested and that there is a demand for more feeder ports

[15] Jef Bakke; ABP Immingham

### 6.2.2 UK port capacity situation

This thesis frequently indicates that UK deep sea ports are congested and that therefore the demand for feedering will increase as a direct result of those congested deep sea ports. Furthermore, due to the increasing size of vessels, less deep sea ports in North West Europe will get a direct call (instead of multi porting), which will further increase the demand for feedering.

This sub-paragraph provides proof about the congested situation in the UK deep sea ports and the future feeder demand, which will be the result. The analysis starts with a (theoretical) volume estimation of total UK volumes by using the forecast growth of a Drewry study (2007). The second step evaluates the container vessel order book and the additional capacity that is added by deploying more and larger vessels. Third, an analysis is made of UK ports capacity. The most important ports (in terms of location and volumes handled) are discussed. The fourth step investigates the UK port utilisation in the future by looking at investments that are made in port capacity. The last step of the analysis provides insight in the amount of deep sea volume that will be converted to feeder volume as a result of the under capacity in Southern UK deep sea ports. The last step also provides insight in the utilisation of feeder/shortsea ports and the future demand for feeder ports.

**Volume estimation**

The first step of the analysis is a (theoretical) volume estimation of total UK volume. The net increase of deep sea volumes is calculated by applying the forecasted growth in North West Europe region of a Drewry study (2007), to UK ports.

*Table 6.3: UK volume estimation to 2012 in TEU ('000)*

| TEU ( '000) | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| Total UK Volume | 7,999 | 8,939 | 9,855 | 10,802 | 11,802 | 12,438 | 13,296 |
| UK Deep sea Volume | 6,346 | 7,089 | 7,819 | 8,571 | 9,209 | 9,868 | 10,549 |
| Increase rate | | 11,70% | 10,30% | 9,60% | 7,40% | 7,20% | 6,90% |
| Net increase of Deep sea volume | | 743 | 730 | 751 | 638 | 659 | 681 |

*Source: Drewry Shipping Consultants (2007)*

The estimation is a theoretical estimation because it does not take capacity constrains of ports into account. Furthermore, the next formula is used for calculating UK deep sea volume:

**UK deep sea volume = total UK volume - Intra-N. Europe volume (7089 = 8939 – 1849)**

After the UK deep sea volume is known, the growth rates can be applied on UK deep sea volumes to estimate the net increase of the deep sea volume. After calculating the increase in deep sea volume the next question have to be kept in mind; Can UK deep sea ports accept the increasing volume in reality?

**Evolution of deep sea vessels and fleet capacity**

Before the answer to the above question can be answered, a closer look at the deep sea carrier order book is in place. Larger vessels put more pressure on ports. It is therefore, that an evaluation of (future) vessel sizes and total fleet capacity are important.

*Table 6.4: Evolution of vessels and fleet capacity*

| | Existing Vessels | | Orderbook | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Until march 2008 | | 2008 (Apr-Dec) | | 2009 | | 2010 | | 2011 | | 2012 | |
| Vessel sizes | No. Of Vessels | total capacity | No. Of Vessels | total capacity | No. Of Vessels | total capacity | No. Of Vessels | total capacity | No. Of Vessels | total capacity | No. Of Vessels | total capacity |
| **2000-6999** | 1,889 | 7,108,156 | 168 | 706,271 | 181 | 846,459 | 139 | 687,639 | 51 | 245,520 | 21 | 98,326 |
| **7000-9999** | 213 | 1,787,835 | 26 | 225,882 | 34 | 293,585 | 60 | 525,093 | 21 | 183,330 | 0 | 0 |
| **10,000+** | 11 | 151,786 | 12 | 135,090 | 26 | 304,108 | 41 | 505,569 | 70 | 862,062 | 38 | 480,666 |
| **Total** | **2,113** | **9,047,777** | **206** | **1,070,243** | **241** | **1,444,152** | **240** | **1,718,301** | **142** | **1,290,912** | **59** | **578,992** |

*Source: AXS Alphaliner, 2008*

Table 6.4 shows that as from 2008, an impressive series of 10,000+ TEU vessels will be delivered. Mainline companies have indicated that the Far East-Europe trade lane is the favourite trade lane for 7000+ vessels. All 10,000+ delivered vessels are deployed in Far East-Europe trade lane. All future 10,000+ TEU vessels are expected to be on the Far East-Europe and Mid East-Europe trade lane. The conclusion that can be drawn is that new carrying capacities put more pressure on European ports, especially on congested UK deep sea ports.

**UK port capacity**

The third step of this analysis provides information about UK ports capacity and its contemporary utilisation rates. The analysis provides separate information about the most relevant deep sea ports for this study. These are the major deep sea ports in Southern UK (Felixstowe, Southampton, Tilbury and Liverpool). Teesport, for example, has also deep sea berths but is not taken into account because it is not likely that mainline carriers will sail directly to Teesport because of its geographical location.

Table 6.5 shows the total capacity of the major UK deep sea ports and the utilisation rate. The deep sea handling capacity is estimated upon quay cranes capacity development at different terminals, with full operational capacity.

The five UK deep sea ports have around 81% of total UK volume. If a terminal wants to have an efficient operation, a maximum of 85% of its terminal capacity can be used for deep sea related operations[16]. The other 15% is needed for other terminal operations, such as feeder and barge handling, and to be flexible in the total terminal operation. In turn, for feeder and short sea terminals the maximum utilisation is also 85%. When a terminal is utilised above 85%, it can not respond flexible to unforeseen happenings (e.g. broken cranes). The three major Southern ports are all having a total capacity utilisation above 85%. This implies that the terminal operators are facing difficulties in terminal operations. Especially, Tilbury and Southampton have high utilisation figures.

[16] Kees Notenboom; ECT

*Table 6.5: UK ports capacity and utilisation rates*

| | | | | Deep Sea Terminals | | | | Feeder/Short sea terminals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2007** | **total max capacity (TEUs '000)** | **Annual Volume (TEU '000)** | **Capacity Utilisation** | **Terminal name** | **No. of berth** | **Quay lengt (M)** | **Est. Capacity ( TEU '000)** | **Terminal name** | **No. of berth** | **Quay lengt (M)** | **Est. Capacity ( TEU '000)** |
| **Felixstowe** | 3700 | 3300 | 89% | Trinity Terminal | 7 | 2354 | 3182 | Landguard terminal | 2 | 554 | 518 |
| **Southampton** | 2035 | 1900 | 93% | Southapton container terminal | 4 | 1350 | 1832 | Southampton container terminal | 1 | 150 | 203 |
| **Tilbury** | 700 | 700 | 100% | Northfleet Hope Terminal-Riverside Berths | 2 | 600 | 350 | Northfleet Hope Terminal-Inner | 2 | 585 | 350 |
| | | | | | | | | Short sea terminal | 1 | 265 | |
| **Thamesport** | 750 | 650 | 87% | container terminal | 2 | 655 | 750 | No specific slit betwwen deep sea and feeder/short sea | | | |
| **Liverpool** | 1000 | 695 | 70% | container terminal | 3 | 707 | 1000 | | | | |
| **Subtotal** | **8185** | **7245** | | | **18** | **5666** | **7114** | | **6** | **1554** | **1071** |
| **Other UK feeder & short sea ports** | 2745 | 1694 | 62% | | | | | | | | 2745 |
| **Total** | **10930** | **8939** | **82%** | | | | **7114** | | | | **3816** |

*Source: Containerization International, Ocean Shipping Consultant, Dynamar, ABP, HPH UK websites*

The total estimated TEU capacity of the UK deep sea terminals (7.114.000 TEU) and feeder short sea terminals (3.816.000 TEU) are calculated. However, to get insight in future (deep sea) port circumstances, future total port utilisation has to be calculated.

**Future UK port utilisation**

The fourth step of the analysis provides insight in the future UK port utilisation. To get a better understanding of UK port utilisation, capacity investments that are going to be implemented have to be taken into account. By looking at the future deep sea volumes in combination with total UK deep sea terminal capacity, future port utilisation can be calculated.

Table 6.6 gives an overview of the future UK port utilisation for deep sea and feeder/shortsea terminals. The estimations for UK port expansion projects (see paragraph 6.3.2) are based on the most optimistic scenarios. Furthermore, the assumption is made that ports are under full operation.

***Table 6.6: UK port Utilisation till 2012***

| TEU ('000) | Deep sea Volume | Deep sea capacity | Utilisation | Remarks | Feeder/short sea volume | Feeder/short sea capacity | Utilisation | Remarks |
|---|---|---|---|---|---|---|---|---|
| **2007** | 7089 | 7114 | 99,6% | | 1849 | 3816 | 48% | |
| **2008** | 7819 | 7114 | 109,9% | | 2036 | 3816 | 53% | |
| **2009** | 8571 | 7514 | 120,5% | | 2231 | 3941 | 57% | (+) 125,000 TEU (first part PSA UK east Terminal Phase I) |
| **2010** | 9209 | 79 | 122,6% | (+) 400,000 TEU (first part Felixstowe south reconfiguartion phase I) | 2398 | 4066 | 59% | (+) 125,000 TEU (Second part PSA UK east Terminal Phase I) |
| **2011** | 9868 | 14 | 124,7% | (+) 400,000 TEU (second part Felixstowe south reconfiguartion phase I) | 2570 | 4316 | 60% | (+) 250,000 TEU (PSA UK east Terminal Phase II) |
| **2012** | 10549 | 9064 | 116,4% | (+) 700,000 TEU (Felixstowe South Reconfiguration phas II)<br>(+) 700,000 TEU (Felixstowe South Reconfiguration phas II) | 2747 | 3798 | 72% | (-) 518,000 TEU feeder/short sea capacity in Landguard Terminal in Felixstowe will be convetred deep sea terminal |

*Source: Containerization International, Ocean Shipping Consultant, Dynamar, ABP, HPH UK websites*

When looking at deep sea volume and deep sea capacity of UK ports, it becomes clear that the terminal utilisation for all years is much too high. In 2008 the utilisation for deep sea terminals is 109.9%. In 2012 the deep sea port terminal utilisation, including capacity expansion, will be 116.4%. Knowing that 85% is the maximum utilisation rate, this means that the deep sea terminals are facing severe congestion and that this will be worse in the future.

On the other hand, when looking at the feeder/shortsea terminals with current feeder/shortsea volumes calculated, the utilisation looks healthy. The highest utilisation is 72% in 2012. However, this is a situation in which congestion in deep sea ports is enormous. In this situation UK ports are not able to accommodate the increasing deep sea volumes. Ports have to find a solution to retain the utilisation of maximal 85%. The solution comes, for a large part, from the mainline carriers because congestion causes costs to increase and makes the supply chain unreliable. The result is that mainline carriers will seek other solutions for serving their UK customers. It is likely that mainline carriers will convert deep sea volumes to feeder volumes, using Continental hub ports for transhipment. Therefore, the last step of this analysis is the converting of deep sea volume to feeder volume. The deep sea volumes converted are the volumes, which are responsible for the exceeding of the terminal utilisation of 85%.

Table 6.7 shows the deep sea volume, which has to be converted to feeder/shortsea volume, in order for the deep sea ports to get back to an utilisation of 85%. In 2010, for example, a deep sea volume of 3162,000 TEU is converted to feeder/shortsea volume. If a new feeder/shortsea port utilisation calculation is made after the adopted feeder/shortsea volume, it appears that the utilisation of the feeder/shortsea ports are also exceeding the 85% maximum. Therefore, it can be concluded that there is a huge demand for feeder/shortsea ports.

***Table 6.7: Converted deep sea volume to feeder/shortsea volume***

| TEU ('000) | Adapted deep sea volume (85% capacity utilisation | Deep sea capacity | Deep sea volume converted to feeder volume | Adapted Feeder/ Short sea volume | Feeder /short sea capacity | Adapted feeder/short sea port utilisation |
|---|---|---|---|---|---|---|
| 2008 | 6047 | 7114 | 1772 | 3808 | 3816 | 99,8% |
| 2009 | 6047 | 7114 | 2524 | 4755 | 3941 | 120,7% |
| 2010 | 6047 | 7514 | 3162 | 5560 | 4066 | 136,70% |
| 2011 | 6387 | 7914 | 3481 | 6051 | 4316 | 140,2% |
| 2012 | 6727 | 9064 | 3822 | 6569 | 3798 | 173,0% |

### 6.3 UK ports

In the beginning of this thesis it is discussed that the two important deep sea ports in UK, Felixstowe and Southampton, are congested. Not only the ports are congested but also the entire transport networks around the ports. Congestion is causing costs to go up and thus making transport via the South UK ports more expensive and unreliable; two things shippers and shipping lines do not like. The enormous growth in global trade, the past twenty years, and the lack of investment in UK's transport network connecting the Southern ports to the Middle and North, have caused the congestion. It is therefore that shippers and liner shipping companies are looking for other solutions to serve Middle and North UK.

UK government wants its main ports to be national gateways and act as domestic transhipment hubs as well. In that way the deep sea ports can serve all ports around the UK by feeder, in order to relieve the over-crowded road and rail system. However, large volumes of containers are shifted from UK ports to Continental hub ports, such as Rotterdam, Antwerp and Zeebrugge. Between 2000 and 2003 the transhipment activity at the main South East UK ports (Southampton, Felixstowe, Tilbury and Thamesport) nearly halved, from 1.023.000 TEU in 2000 to only 538.000 TEU in 2003[17]. More recent figures are not available because they are not made public by the private port operators.

### 6.3.1 Southern UK deep sea ports

In this sub-paragraph the two most important UK deep sea ports are discussed. Felixstowe and Southampton are those two ports. First because they are the largest ports in terms of volumes handled and second because they are important ports for transhipment containers and UK feedering. Thamesport, Tilbury and Liverpool are also deep sea ports but are significant smaller than Felixstowe and Southampton.

***Felixstowe***

The location advantages of UK's largest container port are comparable with the advantages Rotterdam has. It has a central location for the three European main feeder areas and it has the ability to handle large vessels with deep draft. In addition, there is only one terminal operator which is Hutchinson Wampoa. This company owns the port. Hutchison is also fully owner of ECT in Rotterdam. Felixstowe has a port-wide ICT system that is smoothening transhipment. Yet, Felixstowe lost a lot of transhipment cargo of MSC and Maersk because of a combination of bad service, capacity constrains and high prices. However, Felixstowe is still dominated by MSC and Maersk.

***Southampton***

The location of Southampton is an advantage because it is one of the first ports which is passed, when mainline vessels are sailing to North West Europe. However, this has not resulted in many first calls of mainline carriers. The scheduling of mainline carriers is discussed in paragraph 6.4. Furthermore, in September 2006 Southampton inaugurated a dedicated feeder berth, equipped with a conventional port crane and presently accommodates seven feeder strings (Dynamar, 2007). The aim of Southampton is to regain UK feeder port business from the Continental hubs. Its goal is to raise the transhipment share to a 10% minimum of its overall throughput, which was 1.9 million TEU in 2007. Southampton is dominated by the Grand alliance. The owner of Southampton is ABP. They are terminal operator as well as port owner. ABP is the owner of twenty ports in the UK. Also the Humber ports are under direct control of ABP.

### 6.3.2 New projects and focus

Port owners in the UK have seen cargo switched to Continental hub ports. They are aware of the congestion issues that are present in the major Southern deep sea ports. To make the deep sea ports attractive again for major shipping line investments are taking place. Especially, Hutchinson is investing in additional capacity of Felixstowe in order to accommodate larger vessels and accompanied volumes. The following investments are in progress:

[17] www.ci-online.co.uk

- The Felixstowe South Reconfiguration project encompasses the conversion of the port's Dock Basin and shallow draft Landguard Terminal into a continuous deep sea quay, adding around 1.5 million TEU capacity from 2009 onwards.
- Felixstowe has announced that it is going to focus on domestic feedering after finishing the expansion project (1.5 million TEU). Most secondary UK ports are served with feeders via continental hubs.
- PD ports are building a new post Panamax container terminal (1.5 million TEU) in Teesport.
- PSA is constructing a new UK east terminal at Great Yarmouth. This will be a feeder and short sea port and the total capacity will be 250.000 TEU. To provide a more tailor made solution to its customers.

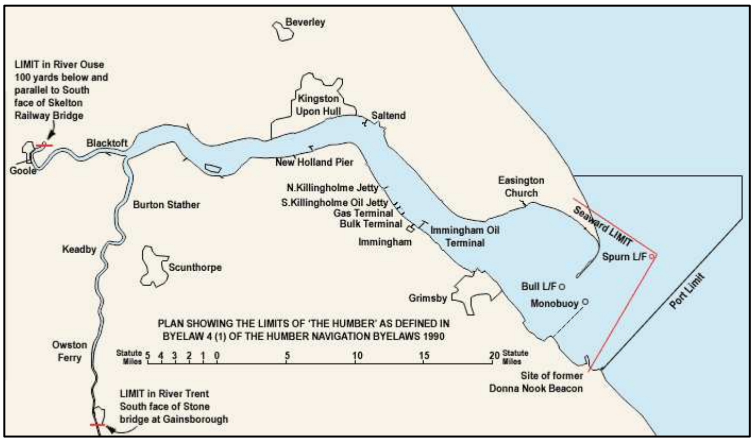
### 6.3.3 Humber ports

In contrast to Continental Europe, where many ports are publicly funded and subsidised, the majority of ports in the UK became privately owned and operated from the late 1980s onwards. ABP is the main port operator in the Humber and was recently the subject of competitive bidding activity between Admiral Acquisitions, a Goldman Sachs-led consortium and Macquarie Bank, with the former eventually paying £2.8bn pounds for ABP in 2006.

The Humber ports (Grimsby, Immingham, Hull, Goole and various other wharves) represent the largest ports conurbation in the UK in terms of volume. In 2006 the Humber handled 90.86 million tonnes of freight traffic. This accounted for 16.1% of all UK major ports traffic in 2006 (Department for Transport, 2007).

Northern UK ports are in competition but each has distinctive roles and markets. The North West has a national hinterland for Ireland and North America, whilst the North East and the Humber Ports mainly serve super-regional hinterlands. The ports play an important role in serving industries that have located in proximity to the ports. Although the different Humber ports are part of the same company (ABP), they are still in competition with each other and therefore cooperation between the ports in the Humber is very limited. Cooperation would enhance the efficiency in the Humber area.

*Figure 6.4: Map of Humber ports*

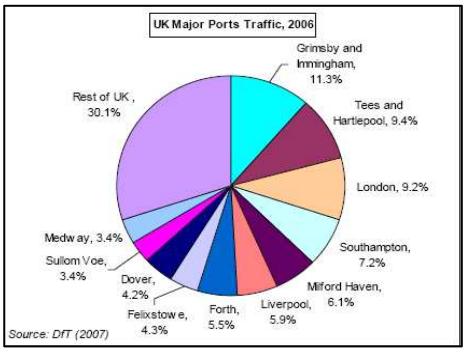



*Source: University of Hull*

**Humber freight traffic**

The port statistics show that the Humber Ports handled 90.9 million tonnes (Mt) of freight traffic in 2006. Traffic rose by 2.4 Mt in 2006, a 2.7% increase on 2005. Inward traffic to the Humber ports rose by 7.6% in 2006, however outward traffic fell by 12.0% (note: this is consistent with UK trends where inward traffic to all major UK ports rose 2.3% and outward traffic fell 5.7%)[18].

*Figure 6.5.: Major Ports traffic UK (2006)*




Source: Department for Transport UK, 2008

*Table 6.8: Humber port traffic (200-2006)*

Humber Ports Traffic (million tonnes), 2000-2006

| | 2000 | 2005 | 2006* | % change 2005-06 | % change 2000-06 |
|---|---|---|---|---|---|
| Grimsby & Immingham | 52.5 | 60.69 | 64.03 | 5.5% | 22.0% |
| Hull | 10.7 | 13.36 | 12.79 | -4.3% | 19.5% |
| Rivers Hull & Humber | 9.0 | 9.84 | 9.77 | -0.7% | 8.6% |
| Goole | 2.7 | 2.62 | 2.21 | -15.6% | -18.1% |
| River Trent | 2.4 | 1.92 | 2.06 | 7.3% | -14.2% |
| Humber Ports | 77.3 | 88.43 | 90.86 | 2.7% | 17.5% |

Source: Department for Transport
* denotes where port statistics are provisional

*Source: Department for Transport UK, 2008*

At Grimsby & Immingham traffic rose by 3.4 Mt or 5.5% in 2006. Traffic on the River Trent rose by 7.3% to 2.06 Mt in 2006. Hull, Goole and the Rivers Hull and Humber all experienced a fall in traffic in 2006. Since 2000, traffic in the Humber ports has increased by 17.5%. This increase was largely due to growth in the ports of Grimsby & Immingham and Hull, which both experienced around a 20% rise in traffic over this six year period.

The Humber Ports in a UK context[19]:

- Overall, the Humber ports handled 16.1% of all UK major ports traffic in 2006. This was a 0.6 percentage point increase on 2005 (15.5%)
- Grimsby & Immingham maintained its position as the UK's largest port in 2006, handling 64.03 million tonnes of traffic, or 11.3% of all UK major ports traffic
- Amongst the top eleven largest ports in the UK (by tonnage) in 2006, Grimsby & Immingham showed the third strongest growth (5.5%) behind Dover (12.6%) and Medway (22.5%) and was one of only five ports (including the only Northern port) in the top eleven to record a rise in traffic in 2006 (the others were Dover, Southampton, Felixstowe and Medway).

However, when looking at TEUs handled in the Humber ports, the figures reveal that the container segment has a low market share compared to other UK ports. The market share of the Humber ports of total UK TEUs handled was 9.2% in 2007. Hull & Goole handle most containers in the Humber. These are mostly shortsea containers. The containers handled in Immingham are mostly feeder containers. In the period 2003-2007, the number of TEUs handled in the Humber has grown 25%. In the period 2004-2005, there was an increase of 21% in volume handled but in 2006 the volume handled decreased again with 16%.

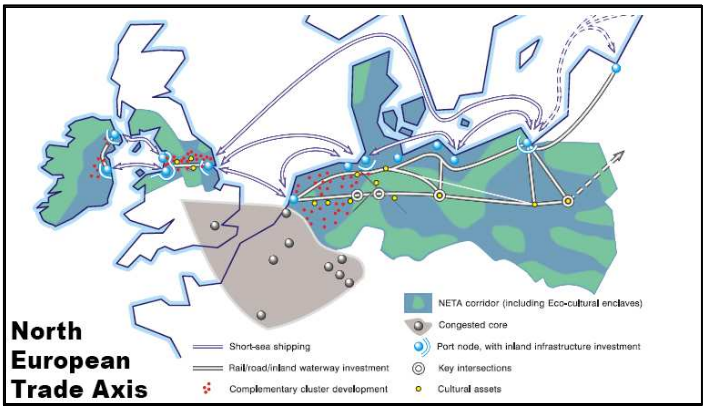
[18], [19] www.dft.gov.uk

In the UK there has been a 5-6% growth per annum of deep-sea lo-lo traffic in the last 10 years, reflecting the substitution of domestic manufactures for overseas imports (globalisation). This growth in traffic has mostly been accommodated in Southern UK ports but there is a general lack of deep sea lo-lo capacity as well as infrastructure constraints in South coast ports. Northern (mainly East-coast) ports benefit from feeder traffic via transhipment ports, such as Rotterdam and Antwerp, avoiding port congestion in the South and East. Continental transhipment offers extensive time, cost and reliability opportunities.

The Humber Ports are more than a Gateway for the North of UK; they can become the Global Gateway for the Midlands when appropriate investments in infrastructure are made. This would also bring benefits to the South East through reduction in congestion, savings in public investment, and savings for businesses (Northern Way, 2006). The Midlands catchment is a key to these considerations: it is in many respects regarded as the territory of the Southern and East ports but there are strong arguments for the area to be increasingly served by the Humber ports.

The Humber ports are at the heart of the multi modal North European Trade Axis (NETA) the broad trade and transport corridor along the axis from Ireland, to the Mersey ports, across the M62 corridor of Northern UK and via the Humber ports to the Netherlands, Germany, Poland and the Baltic States. A disadvantage of the Humber ports is the draft restriction. Immingham has the deepest draft (14m) followed by Hull (10.4m). The draft of 14 meters is only at one terminal (bulk) and this is not a container terminal. The deepest container terminal in Immingham is 10.4 meters. The draft restrictions in the Humber are one of the reasons why feeder vessels deployed on this region have an average size between 550-600 TEU.

*Figure 6.6: North European Trade Axis*




*Source: Northern Way, 2006*

Furthermore, the Humber is especially known because of its shortsea and ferry traffic to Hull. P&O and Samskip are important customers for the Humber. Both have dedicated terminals in Hull. Especially, large numbers of Ro-Ro cargo are shipped to the Huber area. There are multiple Ro-Ro sailings a day to the Humber, also from Rotterdam. Immingham is the best port to develop as a feeder port because of its location on the South bank and the infrastructure surrounding the port. Hull should only focus on shortsea cargo.

*Table 6.9: Port handled TEUs*

| TEU's | 2007 | 2006 | 2005 | 2004 | 2003 |
|---|---|---|---|---|---|
| Immingham & Grimsby | 321,092 | 300,910 | 433,547 | 320,642 | 292,146 |
| Hull | 430,000 | 397,364 | 361,240 | 341,705 | 292,345 |
| Goole | 72,600 | 87,300 | 116,000 | 48,700 | 35,000 |
| **Total TEU** | **823,692** | **785,574** | **910,787** | **711,047** | **619,491** |

*Source: Containerisation online*

Although, the market share of the Humber in total port handled TEU is not that impressive, the market share for intra North Europe handled cargo is much higher. As said, all containers handled in the Humber are mainly shortsea and to a lesser extend feeder containers. Therefore, the market share of the Humber in total intra European containers handled is; total containers handled in the Humber ports divided to total intra North Europe containers (1.849.000 TEU) handled in UK ports. This calculation shows that the Humber ports have a market share of 44% in terms of shortsea and feeder cargo handled in UK ports in 2007.

When looking at the forecast figures of MDS Transmodal in 2006, it appears that the Humber has performed much better in terms of port handled TEUs. It was forecasted that 634.000 TEU would be handled in the Humber ports in 2004. However, the actual number of containers handled in 2004 was 711.047 TEU. Furthermore, the forecast for 2010 is 693.000 TEU but in 2007 the number of containerised traffic in the Humber already was 823.692 TEU. This indicates that container traffic in the Humber ports has grown faster as was forecasted by MDS Transmodal. A plausible explanation for the higher growth in the Humber is the congested situation in the South and the higher costs of land transport.

***Humber port perception***

SMRS has conducted a market survey (2003) in which 550 companies where interviewed about the above options. The conclusions of the survey revealed that there is a wide awareness of the congestion issues in UK Southern deep sea ports and that there is a low awareness of the Humber ports. However, because of the problems in UK deep sea ports and the UK transport network, it appears that there is high interest in the Rotterdam-Humber proposition and a willingness to explore it further. In the survey the respondents where asked which UK ports they used most for importing cargo. The results are shown in table 6.10.

*Table 6.10: Ports used for imports*

| Port | National | Regional | Overall |
|---|---|---|---|
| | % | % | % |
| **Felixstowe** | **44.0** | **37.4** | **40.5** |
| **Southampton** | **35.7** | **23.9** | **29.5** |
| **Dover** | 13.0 | 12.6 | 12.8 |
| **Hull** | **4.8** | **17.8** | 11.7 |
| **Tilbury** | 12.1 | 8.3 | 10.1 |
| **Liverpool** | 9.2 | 7.8 | 8.5 |
| **Immingham** | **5.3** | **9.1** | 7.3 |
| **Thames Port** | 9.7 | 5.2 | 7.3 |

*Source: SMRS final report (2003)*

This confirms the dominance of Felixstowe and Southampton and the regional appeal of the Humber ports. A much higher percentage of regional companies (45.9%) indicated that they use the Humber ports compared to the national companies (27.6%). Some other conclusions of the survey are; Location was stated as the main advantage by almost half of those respondents (49%), who use the Humber ports. This figure was 60.7% for the regional companies compared to 28.1% for national companies. Location was also given as the main disadvantage for not using the Humber ports, although interestingly the main reason for not using the Humber ports was lack of shipping routes.

In terms of factors which would encourage companies to switch to the Humber, 32% stated reduced costs and access times, 22% stated reliable services and 19% stated that an efficient feeder service would encourage them. These figures are an average and were higher for national companies compared to regional ones. Only 11% of companies were aware that B&Q had switched to the Humber and 30% of all respondents indicated that they felt transhipping via Rotterdam would be a good idea (SMRS, 2003).

The conclusion that can be drawn is that in terms of tonnage the Humber ports together are the largest port complex of the UK. However, when looking at containers the market share of the Humber ports, in terms of total containers handled at UK ports, is below 10%. The shortsea segment is a strong segment compared to the feeder segment. The reason for the feeder segment lacking behind can be explained by a study conducted by SMRS (2003). This market study revealed that there is a relatively low/poor awareness level of the Humber, both in terms of location and facilities, both locally/regionally and across the UK as a whole. Not unsurprisingly this low awareness extends to both Asia and USA. Furthermore, the study has revealed that a significant proportion of local and regional companies do not use the Humber at all or to a certain extent. Reasons are; low frequency of feeder services and costs.

## 6.4 Rotterdam – UK Connection

Rotterdam has due its geographical location and its deep draft ports a unique position in Europe. Not only is Rotterdam a gateway to the European Continent. It also is an important hub port because of its central location for the three main feeder areas. A relative large captive hinterland is the reason for mainline carriers to include Rotterdam in their schedule for import, export and transit containers. The large Maasvlakte terminal, with a continuous dept of 17 meters, directly at the North Sea is a real advantage for Rotterdam.

Rotterdam has the largest number of shortsea and feedering connections and is therefore probably the only port in North West Europe with dedicated terminals for shortsea and feedering (e.g. RCT Maasvlakte and Dedicated Barge Feeder terminal with a 900.000 TEU capacity). In terms of feedering and shortsea Rotterdam has by far the highest market share on the UK/Ireland region followed by Zeebrugge.

***Table 6.11: UK/Ireland market shares and number of full loaded/discharged TEUs***

| Main port Hub | 2006 Share | 2006 TEU | 2005 Share | 2005 TEU | 2004 Share | 2004 TEU |
|---|---|---|---|---|---|---|
| Rotterdam | 59,6% | 1488700 | 60,1% | 1431400 | 60,9% | 1321600 |
| Hamburg | 1,1% | 27300 | 1,1% | 25900 | 0,9% | 20400 |
| Bremerhaven | 1,8% | 43900 | 1,5% | 35100 | 1,0% | 20700 |
| Antwerp | 11,1% | 277700 | 10,5% | 250700 | 9,2% | 199500 |
| Zeebrugge | 20,1% | 502600 | 20,5% | 489200 | 20,5% | 445300 |
| Felixstowe | 3,2% | 79500 | 3,0% | 72500 | 3,4% | 74600 |
| Le Havre | 3,2% | 79300 | 3,2% | 76600 | 4,1% | 89500 |
| **Total** | **100%** | **2499000** | **100,00%** | **2381400** | **100,00%** | **2171600** |

*Source: Dynamar, 2007*

In table 6.12 a more detailed overview of the Rotterdam–UK traffic is presented. The table shows total UK imports and exports in TEUs. The figures are the sum of shortsea and feeder containers. As stated before, there is no separate data about feedering and shortsea available. However, we know that the share of shortsea is approximately 60% and 40% is feedering. The figures also include empty containers. That is the reason why the UK export numbers are relatively high.

*Table 6.12: Rotterdam – UK traffic (including empty containers)*

| Rotterdam/ UK traffic (TEUs) | 2007 | 2006 | 2005 | 2004 | 2003 |
|---|---|---|---|---|---|
| Imports UK | 726.428 | 710.930 | 688.441 | 339.873 | 302.408 |
| Exports UK | 665.217 | 647.880 | 647.860 | 335.035 | 287.728 |
| Total UK | 1.391.645 | 1.358.810 | 1.336.301 | 674.908 | 590.136 |

*Source: Port of Rotterdam*

Since 2003, the Rotterdam-UK traffic has increased with approximately 58%. For imports the traffic has increased also with approximately 58% the last five years. This implies that feedering has increased from 120.000 TEU to 290.000 TEU the last five years.

The main reason for this high growth rate is the capacity constrains in the Southern UK main ports of Felixstowe and Southampton. Not only have both UK ports a shortage of capacity, which has induced port congestion. Also the road networks around the ports are heavily congested. This makes the Southern UK ports less reliable and more expensive compared to Continental ports.

Furthermore, there is a shortage of truckers in the UK, causing tariffs for road transport to increase. The congestion in the Southern ports, increasing road transport costs and the implementation of the WTD are all favouring the option of transhipment via Rotterdam. Feedering becomes an option for shipping lines if the door-to-door costs including feedering equals (or is lower than) the costs of the door-to-door transport arranged via a direct call on the UK.

***Port of call***

Mainline carriers make an average of 3.7 calls per voyage within Western Europe before returning to Asia, Africa, Australasia or the Americas. Since on average, ships make roughly 3 calls on the Continent, normally in French, Benelux and a North German port. That means that some 7 out of 10 services call at a UK port (Dynamar, 2007).

Services that do not make a UK call have three options for delivering the containers in the UK. First, the containers can be switched on the European continent to other deep sea ships calling in a UK port, in that way the container will still arrive at a South-Eastern deep water port. Second, the containers can be put on a truck, in for example, Le Havre or Rotterdam and delivered at the UK by using the tunnel. However, the option preferred by most shipping lines for serving the UK when not calling at a UK deep sea port, is the option of feedering from a continental main hub port, like Rotterdam.

An increasing proportion of containers for the UK are delivered from Continental hub ports via transhipment and feedering, to provide a more local level of service and at the same time reducing inland transport costs (but on the other hand, adding to port and maritime costs). This can be seen in the high growth of shortsea and feeder volumes of Port of Rotterdam to the UK; 58% in five years. Grangemouth, the Tyne, Tees, Humber, Bristol and the Mersey are all benefiting. Depending upon the inland origin or destination, such transhipment can make a marginal reduction in end to end delivery costs to some parts of the UK. Especially for the North and Middle UK.

Furthermore, feedering from Continental hub ports, which are often used as first port of call, can offer faster transit times. Especially, Rotterdam has a good geographical location for serving the UK. This can also be seen in the market share of Rotterdam in UK transhipment and shortsea cargo, which is 59.6%. Rotterdam is often used as first port of call and sometimes as last port of call because of its central location and low bunker price. A lot of containers are discharged in Rotterdam so that carriers can bunker large amounts of fuel. Besides location and fuel prices, the high frequency of feeders on different areas makes Rotterdam an attractive main hub port. Another important factor for carriers to choose a hub port, is the quality of connections with the other world regions, such as the Far East. The quality of connections, of the most important ports in North West Europe, is discussed in the next paragraph.

## 6.5 Quality of connections

All major ports in the world (in terms of volumes handled), are connected with each other through liner shipping. The quality of connection between ports can be expressed with the help of a connectivity index. This connectivity index can be used to compare different ports. The quality of a connection is stipulated by four different variables:

1. Frequency of direct calls in a port.
2. Transit time between ports.
3. Ship size used between ports.
4. Number of competing shipping lines with direct calls in a port.

The connection figures of 2007 are used for the configuration of the connectivity index as presented in Table 6.13. The analysis made in this table represents the connectivity of Rotterdam compared with competing ports in Europe on the Asia-Europe trade. Especially, the UK ports are of importance for this thesis because later in this thesis a comparison is made for serving Middle and North UK between transhipment via Rotterdam or a direct call on Felixstowe or Southampton.

***Table 6.13: Overall connectivity index; Asia trade***

| Overall | Asia | China | Japan | Korea | Australia | Gulf | Singapore&Malaysia |
|---|---|---|---|---|---|---|---|
| Rotterdam | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Hamburg | 0,86 | 0,83 | 0,70 | 0,99 | 0,85 | 0,96 | 0,94 |
| Antwerp | 0,71 | 0,77 | 0,62 | 0,47 | 0,21 | 0,77 | 0,53 |
| Felixstowe | 0,69 | 0,68 | 0,34 | 0,82 | 0,26 | 0,33 | 0,67 |
| Le Havre | 0,62 | 0,56 | 0,80 | 0,28 | 0,47 | 0,48 | 0,82 |
| Southampton | 0,64 | 0,72 | 0,83 | 0,22 | 0,00 | 0,39 | 0,72 |
| Bremerhaven | 0,61 | 0,59 | 0,71 | 0,58 | 0,04 | 0,21 | 0,59 |
| Zeebrugge | 0,35 | 0,42 | 0,03 | 0,00 | 0,00 | 0,33 | 0,61 |
| Tilbury | 0,24 | 0,15 | 0,21 | 0,16 | 0,88 | 0,29 | 0,29 |

*Source: Port of Rotterdam*

The overall (inbound and outbound) connectivity of Rotterdam with Asia is the best compared to all other ports in North West Europe. Also when looking at countries in Asia separately, Rotterdam has the best overall connection with all destinations. Hamburg is the strongest competitor in terms of overall connectivity. Antwerp, Felixstowe, Southampton and Le Havre share third place. Bremerhaven, Tilbury and Zeebrugge have the lowest quality of connections with Asia. Especially, Tilbury and Zeebrugge score very low.

When only looking at connectivity for inbound cargo, the same conclusion can be drawn as for the overall connectivity. Rotterdam has by far the best connection with Asia. Rotterdam has a strong competitive advantage as import port because of more direct calls with larger ships then its competitors. Rotterdam has for inbound cargo two advantages compared with Antwerp. First, a significant shorter transit time (on average 5 days shorter) and second Rotterdam has more direct calls of more competing shipping lines (Port of Rotterdam).

***Table 6.14: Inbound connectivity index; Asia trade***

| Inbound | Asia | China | Japan | Korea | Australia | Gulf | Singapore&Malaysia |
|---|---|---|---|---|---|---|---|
| Rotterdam | 1 | 1 | 1 | 1 | 0,87662 | 1 | 1 |
| Hamburg | 0,74 | 0,76 | 0,47 | 0,70 | 0,67 | 0,89 | 0,85 |
| Antwerp | 0,61 | 0,55 | 0,65 | 0,39 | 0,40 | 0,47 | 0,50 |
| Felixstowe | 0,67 | 0,67 | 0,49 | 0,41 | 0,40 | 0,22 | 0,61 |
| Le Havre | 0,60 | 0,61 | 0,60 | 0,22 | 0,21 | 0,14 | 0,75 |
| Southampton | 0,63 | 0,65 | 0,87 | 0,07 | 0,00 | 0,16 | 0,66 |
| Bremerhaven | 0,52 | 0,56 | 0,61 | 0,26 | 0,00 | 0,09 | 0,39 |
| Zeebrugge | 0,27 | 0,32 | 0,06 | 0,00 | 0,00 | 0,26 | 0,40 |
| Tilbury | 0,39 | 0,28 | 0,33 | 0,29 | 1,00 | 0,36 | 0,44 |

*Source: Port of Rotterdam.*

This research is about how to attract more cargo from the middle and north UK by improving efficiency in the Rotterdam-Humber corridor. It is therefore important to know how the connectivity between Asia and the UK is and how this connectivity is compared with Rotterdam. Rotterdam has a much better overall connection with the Far East compared to UK ports. The same applies when only looking at the inbound connectivity. However, this already indicates that Rotterdam has a more competitive connection with Asia in terms of frequency of mainliners, direct calls and transit time. It is also important to investigate the connectivity differences, between UK ports and Rotterdam, a little further.

In this context, inbound containers out of Asia are important because most imports for the UK and European Continent are inbound from Asia. In table 6.14 two major ports in Asia are selected (Shanghai and Singapore) to compare the transit time between major UK container ports and Rotterdam. Also the number of direct calls is included. Direct calls are important in this respect because when vessels are getting bigger, fewer direct calls are made. On the Asia trade the largest vessels are deployed and therefore having a direct call inbound gives a port a competitive advantage over other competing ports. Shanghai and Singapore are chosen because these are the two largest ports in Asia from where a lot of containers are shipped to the UK and Europe.

***Table 6.15: Transit time and direct calls inbound***

| Port | Shanghai | | Singapore | |
|---|---|---|---|---|
| | fastest transittime | total calls | fastest transittime | total calls |
| **Rotterdam** | 25 | 8 | 16 | 7 |
| **Felixstowe** | 27 | 3 | 18 | 6 |
| **Southampton** | 21 | 4 | 22 | 2 |
| **Tilbury** | 0 | 0 | 22 | 1 |

*Source: Port of Rotterdam*

It can be concluded that Rotterdam has the fastest transit time and most direct calls from Singapore. From Shanghai the fastest transit time is to Southampton. However, Southampton has twice as less direct calls as

Rotterdam. The overall picture indicates that Rotterdam is, in terms of transit time and direct calls, the most competitive port.

**Transit time advantages**

Faster transit times in combination with being the first port of call can provide substantial advantages. The above indicates that in terms of transit time, costs savings can be made, if a container is transhipped in Rotterdam and feedered to the Humber. Table 6.16 presents the savings in days when using Rotterdam as transhipment and feeder port. The potential early delivery to the consignee in the UK can be between 5-10 days. Such a reduction will allow the consignee to reduce their in-transit stock by the same amount.

*Table 6.16: Time savings Rotterdam*

| Component | Saving (days) |
|---|---|
| Container arriving at UK port as Rotterdam is 1st Port of Call | 5 |
| Reduced UK port handling time | 4 |
| Reduced UK inland transport | 1 |
| **Total** | **10** |

*Source: SMRS report (2003)*

For the shipper this could mean:

- up to 5-10 days earlier delivery (depending on ship routing)
- Reduction in inventory of up to 5-10 days stock
- Higher reliability of delivery

For the logistic company this could mean:

- Reliability of port arrival
- Reliability of port collection
- Reduced port ship unloading time
- Reduced port – customer UK inland transit time (depending upon destination)

For the shipping company this could mean:

- Reduced UK port time
- Reduced Inland transportation costs (depending upon destination

Referring to the shipping line, in one of the interviews a shipping line company stated that if they could miss out the UK altogether and only use transhipment and feedering via Rotterdam to serve the UK, then the time saving would allow them to make one addition Europe - Far East trip per year.

### 6.6 Conclusions

The UK container market is still a growing market. Not surprisingly, most import cargo is coming out of Asia. When looking at the container distribution of the UK, it seems that large volumes of import containers, which are imported via Felixstowe and Southampton, have an inland destination in Middle and North UK. Especially, import cargo of Southampton has a final destination in Middle UK. This import cargo distribution analysis reveals a part of the potential for the Rotterdam-Humber corridor because the Humber is located at the East coast of Middle UK and therefore has a good (geographical) position to serve parts of Middle UK.

Another advantage, which highlights the potential of the Rotterdam-Humber corridor, is the UK port situation. After the calculations made in this chapter, it can be concluded that UK port capacity is not sufficient for an efficient handling of todays and future (forecasted) container volumes. Even though capacity projects are started, the increasing number of containers in combination with mainline vessels getting larger will not solve the immense pressure on todays and future UK (deep sea) ports. This has induced a large demand for feeder ports. The Humber ports can fulfil a part of that demand.

The deep sea ports Felixstowe and Southampton are the largest container ports of the UK. These two ports are congested, which makes them unreliable and expensive for shipping line companies. The Humber ports are the largest port conurbation of the UK and handle most UK cargo volume in terms of tonnes. Furthermore, the Humber is at the heart of the NETA and has a good accessibly infrastructure. When looking at TEUs handled in the Humber, it can be concluded that the market share of the UK container segment is not huge (below 10%). However, when only looking at UK shortsea and feeder segment, the market share becomes impressive (44%). This is mainly shortsea and not feeder cargo. Furthermore, if the Humber ports really want to become a large feeder port, investments should be made in container handling infrastructure.

Rotterdam has a perfect geographical location for feedering the UK. This can also be seen in the market share Rotterdam has in the UK shortsea and feeder segment (almost 60%). The distance between Rotterdam and Immingham is 234 miles, which is equivalent to a sailing time of approximately 12 hours. The last few years the Rotterdam-UK traffic has increased due to the congestion in the UK deep sea ports and the introduction of the WTD. Furthermore, Rotterdam is often the first port of call in shipping lines schemes and has the best quality of connection with the Far-East. Transhipment in Rotterdam and feedering to the UK can provide a transit time advantage of 10 days.

Against the advantages, that are favouring the potential for the Rotterdam-Humber corridor, also some negative factors have to be put forward. First, there is a low awareness of the Humber ports by most companies including shipping lines. Second, there is a negative perception of the Humber ports and third there are limited container handling facilities and capacity in the Humber ports. Furthermore, the Humber ports are unable to handle large container vessels and most shippers find that there is to limited frequency and speed of feeder services between Rotterdam and the Humber.

The main conclusion that can be drawn is that the Rotterdam-Huber corridor has a lot of potential to attract more cargo for Middle and North UK. Especially regarding import cargo that is now shipped via Southampton.

Companies have indicated that they felt transhipping via Rotterdam would be a good idea. However, if the Humber ports want to become competitive feeder ports, then port infrastructure investments have to be made.

Now that the potential of the corridor has been clarified, a last step has to be made to reveal the competitive position of the Rotterdam-Humber corridor compared to direct calls on UK deep sea ports. Before shipping lines and shippers decide to tranship in Rotterdam, insight in the costs of different options have to be known. In that respect, it is important to know what the exact captive hinterland of the Humber is. Knowing the borders of the Humber hinterland, gives insight in to what (geographical) extent the corridor is competitive in terms of total transportation costs. Therefore, in the next chapter the Rotterdam-Humber corridor itself is analysed. The corridor will be analysed by using the conceptual model of the feeder chain costs, which was created in chapter five. By analysing the corridor with help of the model, inefficiencies can be detected and solutions can be but forward. In that way the Rotterdam-Humber corridor can be improved and made more efficient in terms of costs, reliability and transit time, so that more cargo can be attracted.

## Chapter 7 – Rotterdam –Humber Corridor

*The Rotterdam - Humber corridor is a (feeder) connection between port of Rotterdam and the UK Humber ports of Immingham & Grimsby and Hull & Goole, located at the Middle of the UK at the East coast. The corridor starts with the loading of the feeder vessel in the port of Rotterdam and ends when the container is delivered at the final customer in the UK. Therefore, the corridor consist of a part sea and a part land transport. The corridor is an alternative for delivering a container in Middle and North UK via a direct call of a mainline vessel in southern UK ports.*

### 7.1. Introduction

The previous chapter proved that there is potential for attracting cargo to the Rotterdam-Humber corridor. It was also stated that the borders of the captive Humber hinterland are important in that respect. Among other things, this chapter calculates the captive hinterland of the Humber ports (Immingham). In this chapter the focus is on the Rotterdam-Humber corridor itself.

In the first section of this chapter a business case of the Rotterdam-Humber corridor is made. Here, the two alternatives for serving Middle and North UK; transhipment via Rotterdam and a direct call on Southampton or Felixstowe, are discussed. The business case provides insight in the different costs of the two alternatives and calculates the borders of the Humber hinterland for different scenarios. The business case also provides information about the costs allocation of a common feeder operator, operating in the Rotterdam-Humber corridor

In the second section of this chapter the analysis of the corridor is conducted. The conceptual model of the feeder chain costs, which was created in chapter five, is applied on the Rotterdam-Humber corridor. Also an overview of the inefficiencies, indicted by the companies interviewed, is presented. This overview is used to review the analysis conducted with the perception of the market. The corridor is analysed in order to reveal inefficiencies that are causing feeder chain costs to increase.

In the last section of this chapter the conclusions of the corridor analysis and business case are presented. The conclusions give an overview about the occurring inefficiencies in the Rotterdam-Humber feeder chain and about the cost advantages that are present for serving parts of Middle and North UK when using the corridor.

### 7.2 Business case: "The Rotterdam – Humber Corridor"

In this paragraph the Rotterdam-Humber corridor is investigated in practice. A cost comparison is made between two alternatives for serving North and Middle UK. The first alternative is a direct call on Felixstowe or Southampton, including the additional land transport needed for delivering the cargo to the final customer. The second alternative is transhipment via Rotterdam including the additional feedering and land transport. The only variable that is investigated in this paragraph are the costs.

It is true that transit time and reliability are also important variables to take into account. However, costs are mostly the main driver for liner shipping companies to rethink or create new supply chains. Furthermore, transit time difference between the two alternatives and the possible costs savings are discussed in the previous Chapter. The conclusion was that Rotterdam has the fastest transit time out of the Far East and at the same time has most direct calls. This gives the Rotterdam-Humber corridor a competitive advantage over a direct call in Felixstowe or Southampton in terms transit time (5-10 days). Especially, if the direct call on a UK port is not the first port of call.

The difference in reliability between the two alternatives is hard to express in costs or figures. However, it can be done by looking at the extra measures feeder operators have to take in order to stay reliable in terms of frequency of departures from a specific port. Another way of looking at the reliability is by looking at the extra costs that occur due to the effect of congestion in Southern UK ports and its surrounding transport network, or due to the long delays in for example Rotterdam. The reliability of different transport corridors and the difference in reliability between two transport corridors are both difficult to measure. Long and uncertain waiting times and delays are indictors of an unreliably service, which are causing transport costs to increase. Southern UK ports and their surrounding networks are congested and they are facing serious capacity constrains. This in turn has made UK deep sea ports unreliable and expensive. On the other hand, Rotterdam is at the moment also congested and UK transhipment cargo is starting to move to Zeebrugge[20]. Rotterdam acknowledges the congestion issues and has recently opened the DBF terminal at the new Euromax terminal. However, opening a new terminal is a solution for improving efficiency (and lower costs) in the feeder chain. Revealing inefficiencies in the Rotterdam-Humber corridor is the topic of the next paragraph and providing structural solutions to those inefficiencies is the main subject of the next chapter.

In the first part of this paragraph the costs of the day-to-day operation of a common feeder operator, serving the Humber, is discussed. The cost allocations between the different cost components of the feeder chain are revealed and insight in the real costs of a feeder service, between Port of Rotterdam and Immingham, are put forward.

In the second part, the calculation, to compare the costs difference between delivering a container in the Middle and/or North UK via a direct call in a Southern UK port (Felixstowe or Southampton) or via transhipment in Rotterdam using a common feeder operator for delivering the container in the Humber, is made. By making a calculation of the different costs in both transport chains, the two alternatives can be compared and the captive hinterland of the Humber ports, Felixstowe and Southampton becomes visible.

#### 7.2.1 Costs allocation

A feeder service on the East coast of the UK usually consists of six vessels. With six vessels a frequency of three sailings a week is viable. However, in times of congestion and delays, feeder operators often deploy an extra vessel. The deployment of an extra vessel is necessary to remain reliable for your customers (to maintain three departures a week) and thus causes total costs to increase.

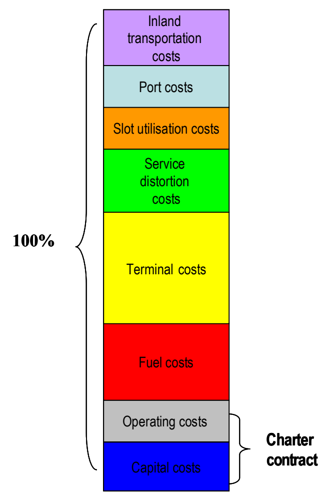
[20] Source: interview Harry Kleipas; Feederlink

The different feeder chain components are all contributing to the total chain costs. As explained, the total chain costs of the Rotterdam-Humber corridor begins with the loading of the feeder vessel in Rotterdam and ends when the cargo has reached its final destination in Middle or North UK. The costs are based on the day-to-day operation of an existing common feeder operator, serving Middle and North UK via the Humber.

Figure 7.1 visualises the feeder chain and its cost components. The total chain consists of eight different cost components, as discussed in chapter five. All eight components together represent 100% of the total chain costs.

To get insight in the operation of a common feeder operator and thus in a big part of the total feeder chain, it is evident to know what the allocation of costs is to the different cost components of. Table 7.1 provides information about the percentages of the different cost components, which together form total feeder operator costs. The costs structure of dedicated feeders is different because dedicated feeders are used by mainline companies as costs centres. Common feeder operators are profit centres.

*Figure 7.1: Feeder chain cost components*




Not all the cost components of the feeder chain are costs for a feeder operator. The best example is the inland transportation costs. These costs are not part of the day-tot-day operation of the feeder operator but are for sure part of the total feeder chain costs. Especially, when wanting to compare two different alternatives of serving a certain region.

The inland transportation costs are based on road haulage costs because the lorry is still the most used mode for delivering cargo in the UK[21]. The cost components that can not be directly allocated to the feeder operator are given in table 7.2.

It appears that the charter costs and terminal costs are the largest cost components of a common feeder service. The charter costs (capital + operating costs) have a share of 33% of total costs and terminal costs have a share of 30%. The terminal costs are the costs at the feeder terminal (Immingham) because in the hub port (Rotterdam) the costs are paid by the mainline carrier. The third major component are the fuel costs. Fuel absorbs 19% of the total costs. These three components together absorb 82% of the total costs of a common feeder operator. Port costs have a share of 10% and the insurance and overhead have a combined share of 8%. Overhead costs are costs generated by the office. The slot utilisation costs are 20%. The 20% slot utilisation costs indicate that costs per slot increase with 20%, if the ship is utilised for 80%.

[21] www.dft.gov.uk

*Table 7.1: Cost allocation feeder operator*

| Cost components | Percentage of total costs |
|---|---|
| Charter costs | **33%** |
| Fuel costs | **19%** |
| Port costs | **10%** |
| Terminal costs | **30%** |
| Insurance | **1%** |
| Overhead | **7%** |
| **Total** | **100%** |
| Slot utilisation costs | **20%** |

*Source: interviews*

On average a feeder vessel in the Rotterdam-Humber corridor has an utilisation between 80-90%. This cost component is not directly incorporated in the 100% because the utilisation of a vessel is always different and the slot utilisation costs are causing total costs (100%) to increase with 20%. Underutilisation therefore means that the total costs (per slot) will increase with 20%.

*Table7.2: Service distortion costs and UK road haulage costs*

| Cost components | Percentage and costs p/KM |
|---|---|
| SDC | **14%** |
| Road haualge cost UK | **€ 0,9 p/KM** |

*Source: interviews*

The SDC that are present in the feeder chain are 14% of the total costs, which means that the chain costs are at least 14% higher than necessary. However, it is not always clear where the SDC appear. SDC can be different each month, making them hard to measure. The inland transportation costs are measured per kilometre. The costs per kilometre are € 0.90 cent.

This sub-paragraph has given insight in the shares of the different cost components regarding total feeder chain costs. It revealed that SDC are causing the total chain costs to increase with at least 14% and that charter and terminal costs are absorbing a large part of total feeder costs. This insight provides information and better understanding of the costs regarding the Rotterdam-Humber corridor. However, it does not provide insight in the (cost) differences between the different options for serving Middle and North UK. In the next sub-paragraph these differences will become clear.

### 7.2.2 Rotterdam-Humber case

Shipping lines, forwarders and logistic service providers make decisions based on total costs, transit time and reliability. In this sub-paragraph the different options for delivering a container in Middle or North UK are discussed. The differences in cost between the two different options are calculated and presented in an economic case. The two options are:

1. Importing direct via the Southern UK deep sea ports.
2. Transhipment in Rotterdam and feedering to the Humber.

**Economic case**

To make an economic case of the Rotterdam-Huber corridor to compare different options for serving Middle and North UK, some important costs have to be put forward. Any economic case should be based on costs. Problems are always encountered, when quoting costs, due primarily two reasons; the inherent secrecy of the industry and the difficulty of quoting average figures due to the variability of the cost components and routing options. However, due to interviews and desk research realistic cost figures, regarding the different options for serving the Middle and North UK, are provided.

***Table 7.3: Feeder tariffs to Humber***

| Full | Tariffs (incl. THC) |
|---|---|
| 20 ft | € 219 |
| 40 ft | € 338 |
| 45 ft | € 459 |
| **Empty** | **Tariffs (incl. THC)** |
| 20 ft | € 169 |
| 40 ft | € 263 |
| 45 ft | € 411 |

*Source: interviews*

Table 7.3 provides information about the feeder tariffs for containers from Rotterdam to the Humber. These tariffs include the THC at the feeder port and port cost in hub and feeder port. The THC of the ports used in this case are presented in table 7.4. The THC for Rotterdam are the most expensive but in the UK deep sea ports a congestion surcharge has to be paid per container.

***Table 7.4: Terminal Handling Charges***

| Port | THC (direct call) | | THC (transhipment) | | Congestion surcharge |
|---|---|---|---|---|---|
| | 20' | 40' | 20' | 40' | |
| **Rotterdam** | € 137,50 | € 137,50 | € 120 | € 120 | x |
| **Felixstowe** | € 86,94 | € 86,94 | x | x | € 36,36 |
| **Southampton** | € 86,94 | € 86,94 | x | x | € 36,36 |
| **Immingham** | € 81,90 | € 81,90 | x | x | x |

*Source: interviews*

A remark has to be made between the difference in THC for a direct call and for transhipment. THC are costs that the carrier charges to its customer. These THC are in most cases higher than the costs the carrier is paying to the terminal operator for the handling of the container. This means that when a shipper is importing cargo via a direct call it has to pay € 137.50 per container. However, in the case of transhipment the 'real' THC costs are important because the carrier is absorbing the costs of transhipment itself. On average the deep sea THC for the carrier is around € 80 and the THC for the feeder in the hub port is 50% of the deep sea THC, thus in this case € 40. In total the THC[22] for transhipment containers are € 120. It should be kept in mind, that the THC for very large shipping line companies with large volumes can be lower than € 80, making the total delivery costs to the destination in the UK cheaper.

[22] Source: Frans Vroegop (ZIM) and Frans Weevers (CMA-CGM)

To make a realistic comparison between the two options and to keep the case understandable, some assumptions have to be made. For this case the following assumptions are made[23]:

1. Port costs of UK deep sea ports (Felixstowe and Southampton) and Rotterdam are equal.
2. THC and port costs of feeder port are included in the feeder tariff.
3. Congestion charge per container has to be paid for a direct call on Felixstowe and Southampton.
4. Transhipment THC are lower than non-transhipment THC.
5. Lower THC for non-transhipment containers are not passed on to customers.
6. Inland transportation also has to include the reposition of the empty container.
7. Empty containers are assumed to be repositioned at the port of entrance, at cost of the shipper.
8. The economic case provides information for 20ft and 40ft containers.

Knowing the assumptions, it is now possible to compare the two options. The two options are evaluated and compared by calculating the cost differences of the total transport costs. The most important variable for comparing the two options is the final destination of the container in the UK. It is logical that destinations in the North favour transhipment in Rotterdam because of the high road haulage costs in the UK. Furthermore, it is important to know, where the exact hinterland borders of the Humber towards the South are (regarding Southampton and Felixstowe). The number of inland KM, from the Humber ports to the final destination of the container, is thus important in that respect. Knowing the break-even-point in KM, between Immingham and Southampton, provides information about the competitive advantage/captive hinterland border of the Humber in terms of KM from the Humber. This can be translated to following equation:

X = # KM from Immingham
Y = #KM from Southampton
# KM Immingham-Southampton= 376
Y= 376 - X

Direct call Southampton = 86.94 +36.36+ 2(0.9X)
Feedering via Rotterdam = 120 + 219 + 2(0.9Y)

Break-even-point = 86.94 + 36.36 + 2(0.9X) = 120 + 219 + 2(0.9Y)
= 123.30 + 1.8X = 339 + 1.8(376-X)
= 123.30 + 1.8X = 339 + 676.8 – 1.8X
= 3.6X = 892.5
= X = 248 KM
= Y = 376 – 248
= Y = 128 KM

Immingham has a competitive advantage over Southampton of 128 KM towards the South. In other words, it is cheaper to tranship a 20ft container in Rotterdam and feeder it to the Humber (instead of a direct call on Southampton), if the final destination of the cargo is 128 KM or less on the line Immingham–Southampton. This is approximately the distance from Immingham to Nottingham (123 KM). However, there are different scenarios

[23] Based on conducted interviews

possible for each option. First of all, there are two UK deep sea ports. Both ports have different break-even-points regarding the Humber. The break-even-point equation for Felixstowe is;

X = # KM from Immingham
Y = #KM from Felixstowe
# KM Immingham-Felixstowe = 326
Y= 326 - X

Direct call Felixstowe = 86.94 +36.36+ 2(0.9X)
Feedering via Rotterdam = 120 + 219 + 2(0.9Y)

Break-even-point = 86.94 + 36.36 + 2(0.9X) = 120 + 219 + 2(0.9Y)
= 123.30 + 1.8X = 339 + 1.8(326-X)
= 123.30 + 1.8X = 339 + 586.8 – 1.8X
= 3.6X = 802.5
= X = 223 KM
= Y = 326– 223 KM
= Y = 103 KM

As can be concluded from this equation is that it is cheaper to tranship a 20ft container in Rotterdam and feeder it to the Humber (instead of a direct call on Felixstowe), if the final destination of the cargo is 103 KM or less on the line Immingham – Felixstowe. That is approximately the distance from Immingham to Newark.

Besides two different ports, there are different tariffs for feedering 20ft or 40ft containers to Immingham and furthermore the congestion charge will disappear when the congestion is solved. Both will have a negative influence on the competitive advantage of the Humber. In total there are four scenarios possible for each port; with or without congestion charge and transporting a 20ft or 40ft container. For a 40ft container with congestion charge in Southampton, the break-even-point Immingham-Southampton is 95 KM to the South of Immingham. Without congestion charge it is 85 KM to the South of Immingham. In table 7.5 the different break-even-points are calculated.

***Table 7.5: Break-even-points for different scenarios***

| | 20ft | | 40ft | |
|---|---|---|---|---|
| | Congestion charge | No charge | Congestion charge | No charge |
| **Southampton** | 128 KM | 118 KM | 95 KM | 85 KM |
| **Felixstowe** | 103 KM | 93 KM | 70 KM | 60 KM |

The calculation of the break-even-points was the first step of revealing the captive hinterland of the Humber regarding Southampton and Felixstowe. The Break-even-points indicate where the captive hinterland borders of the Humber are located. However, to get a full picture of the captive Humber hinterland borders some additional calculations have to be made. These additional calculations are necessary because the border line moves up or down, depending on which deep sea port is taken into account. The more west of Felixstowe the destination of the container is, the more the hinterland border of the Humber goes down. The opposite is true for Southampton. In figure 7.2 he captive hinterland border are drawn in a map of the UK. Figure 7.2 shows the captive hinterland borders of two scenarios per port. The scenarios of 20ft and 40ft containers for Felixstowe and Southampton (including congestion charges) are calculated.

The dashed lines represent the captive hinterland borders of the Humber regarding 40ft container. The captive hinterland for 40ft containers is smaller than for 20ft containers. The reason is that the feeder tariff of a 40ft container is more expensive than for a 20ft container. Furthermore, there are no price differences at UK deep sea ports for handling a 20ft or 40ft container. If the congestion charge would disappear the lines will move 10 KM to the North for both 20ft and 40ft containers.

The different captive hinterland borders of the Humber come together in Nottingham. Most large cities of the Middle UK are located in the Humber's captive hinterland. Examples are Manchester and Leeds. In less than four hours drive more than 90 million consumers can be served via the Humber ports. Furthermore, large cities in the North, like Middlesbrough, could also be served via the Humber ports but competition between smaller ports on the UK East coast is fierce

*Figure 7.2: Captive hinterland of Humber for 20ft and 40ft containers when transhipped in Rotterdam*

## 7.3 Corridor analysis

In this paragraph the corridor analysis is conducted by applying the conceptual feeder chain costs model. The model and conducted interviews are used to reveal inefficiencies that are present in the feeder connection. This paragraph discusses the different cost components of the model. The cost components and its influencing factors, which are causing inefficiencies and are thus responsible for total feeder chain costs to increase, are discussed and explained.

### 7.3.1 Corridor inefficiencies

The conceptual model of the feeder chain costs consist of eight cost components, which are all influenced by different factors. In this sub-paragraph the feeder chain cost components of the Rotterdam-Humber corridor are analysed. Every component is reviewed on possible inefficiencies and explained where necessary.

***Terminal costs***

This cost component is not causing direct significant inefficiencies in the corridor. The two most important factors of influence are the carrier agreement and planning.

- *Carrier agreement & transhipment volume*

The most common form of agreement is the Free-in-liner-out agreement. This is a logical and costs efficient agreement because the (common) feeder operator has in most cases a better bargaining position in the feeder port (Immingham) than the mainline carrier. The reason is that the feeder operator can guarantee more volume because it consolidates cargo from different mainline carriers and thus gets lower terminal handling prices. The same applies for the mainline carrier in Rotterdam. The more transhipment cargo it can guarantee the lower the THC will be.

- *Planning*

The planning of the stack is not directly causing feeder costs to increase. However, it has a big influence on the efficiency of other cost components. Containers for the Humber are delivered by different mainliners at different terminals in Rotterdam. If containers for the Humber (or UK East coast) would be stacked at one terminal in one stack, than this would really enhance total chain efficiency in terms of speed. Furthermore, it would minimise terminal hopping which is one of the most significant factors of causing delays and thus total feeder costs to increase.

- *Storage & port*

Storage is not an influencing factor in the corridor. Terminal operators in Rotterdam and Humber provide sufficient free storage. This is not causing chain costs to increase. Different ports have different costs. This is not a factor which is influencing the efficiency of the Rotterdam-Humber corridor.

***Capital costs and Operating costs***

Together these two components are part of the charter contract a feeder operator has with the ship owner. Most feeder operators charter their vessels. This is also the most occurring form of ship deployment in the Rotterdam-

Humber corridor. This is the most efficient way of deploying a ship in a feeder connection because in times when cargo is scarce the contract can be ended.

***Fuel costs***

The fuel costs are influenced by different factors on which the feeder operator has to a certain extended direct influence. Having direct influence on costs is a huge advantage because it allows the feeder operator to control the costs. The fuel costs are a significant part (19%) of the total feeder operator costs.

- *Speed, size & age*

The speed a ship sails has influence on the consumption. The larger the vessel, the more fuel it consumes and new vessels are more fuel efficient than old vessels. Sailing at economy speed can decrease the costs to minimum. The largest feeder vessels deployed in the corridor are 800 TEU. These are relatively small container feeder vessels compared, to for example the Asian feeder market, where vessels of 1500 TEU are deployed. However, sailing at economy speed means that no delays can and may occur in the chain because delays are forcing (feeder) vessels to increase speed to be in time at other ports and/or terminals. The problem in Rotterdam is the fact that there are delays and that feeder vessels often have to increase speed to make up lost time.

- *Bunker port & price*

The bunker port and price are important factors that are influencing the fuel costs. Rotterdam has the lowest bunker price of the world. This is a huge advantage for the corridor because mainliners want to bunker as much fuel as possible in Rotterdam. They therefore try to unload as much import cargo as possible in Rotterdam.

There is also another sort of fuel that has to be taken into account when analysing the corridor. When a feeder vessel has berthed it also uses fuel. This is another and more expensive sort of fuel. In times of delays and long waiting times at the terminal (which is the case in Rotterdam), the feeder is using more fuel than necessary, which thus increases total chain costs. More about this fuel will be discussed in the SDC component because this fuel consumption is influenced directly by SDC factors.

***Slot utilisation costs***

The slot utilisation costs are influenced by three factors; Ship size, (im) balance and planning. All three factors are influencing the slot utilisation costs in the Rotterdam-Humber corridor. At the moment the slot utilisation in the corridor is between 80-90%. The ship's size and supply of volume are of influence on the decision what size ship should be deployed in the corridor. Before discussing the influence the ship size in the corridor has on the slot utilisation costs, some more background information is needed.

The ship size of common feeder vessel deployed in the corridor is on averaged 600 TEU. Vessels of 600 TEU are relatively small compared to other feeder regions. As known, larger vessels create economies of scale and it would therefore be efficient to deploy larger ships in the corridor. However, there are some drawbacks in that respect. The deployments of larger feeder vessels in the Rotterdam-Humber corridor are influenced by different factors, which are explained and discussed in chapter four.

One of the factors is port infrastructure. It is the capability of the feeder port that determines the size of the feeder vessel. The Humber has relatively shallow waters and a limited number of large cranes. Feeder vessels above 1000 TEU can not be accommodated in the Humber ports (when fully loaded).

Feeder ship size also has to be tuned to specific demands at the hub port Rotterdam. Mainline carriers use one central hub in a region, or separate ports for inbound and outbound feedering. In the larger gateway port, like Rotterdam, with hub activities as a secondary function, often more than one terminal has to be served (terminal hopping). In Rotterdam, feeders may have to go to six different terminals in three different port areas. Moreover, deep sea terminals seldom have a dedicated feeder berth. However, Rotterdam recently opened the DBF terminal. The larger the terminal, the more often feeders may have to be shifted along the quay to pick up (or discharge) containers. The alternative is long horizontal moves on the terminal, which the stevedore will seek to prevent. The larger the feeder vessel the more complex and expensive shifting becomes and the more difficult it becomes to shift a vessel between different schedules/services.

Individual demand at the feeder port in the Humber and other ports in the region served by Rotterdam, is one of the factors deciding on feeder ship size. More regional ports on the schedule may allow for the use of a large feeder, but could consequently affect service frequency and voyage duration.

A lower frequency would allow the use of larger feeder ships in the corridor. This would increase the number of containers per call and reducing slot costs at the same time. However, three sailings a week to the Humber have become the norm, which thus restricts the feeder ship size. This norm is induced by the different mainline loops coming to getter in Rotterdam. Furthermore, a lower frequency has a negative impact on reliability

Competition between hub ports in North West Europe for transhipment and also between terminals in a hub port reduces the handling costs for the mainline carrier. However, it increases the costs of feedering as the turnaround time of the feeder ship (having to load/unload at various facilities) is extended. The more roundtrips a feeder vessel can make, the lower the unit costs become. A last comment with respect to turn around time, is that the sailing time from Rotterdam to the Humber is only 12 hours. Large ships take to much time to fully load and unload (more than 12 hours). This has an influence on the number of trips a vessel can make. Fewer trips mean less income, which in turn means less profit.

- *Ship size*

The ships deployed in the corridor are not big compared to other regions, mainly because of the factors mentioned above. The slot utilisation costs are always between 10-20%. This indicates that in theory the ship size is inefficient and that smaller ships in terms of utilisation would be more efficient. However, the 10-20% utilisation costs are average figures. This means that some ships are fully utilised and some are utilised for only 70%. Therefore, in practice it is difficult to say that the ship size of the feeders deployed in the corridor is inefficient or efficient. The ship size in the corridor depends on to many different factors to say that the size of the vessels deployed is inefficient. Delays, congestion, slow (un)loading time and high frequency demand are important factors in that respect and are keeping ships smaller than they could actually be. These are all factors that are present in the corridor and are thus indicting that ships size is inefficient. Furthermore, when you consider the scale economies theory, small ships are always less efficient than larger ships. On the other hand, the ships deployed in the corridor are adapted to market/corridor circumstances, which indicate that the most efficient ships are deployed given the circumstances. Determining the most efficient ship size for the corridor would be a good subject for a future study.

- *Imbalance*

The UK market is a very imbalanced market. This has a big influence on the slot utilisation of vessels. As explained in chapter six, the imbalance of the UK is one of the most important reasons for not deploying dedicated feeders. The imbalance is not really a problem for common feeder operators because they also charge the mainline company for the transport of empty containers. The imbalance is one of the reasons why there are no shuttle services deployed between the hub port and an UK feeder port, such as Immingham. Imbalance can thus be seen as inefficient.

- *Planning*

The planning is important for fully utilising vessels. The planning made by the feeder operators, operating in the corridor, are often optimised. However, in Rotterdam the planning/schedule of the feeder company has to be changed constantly because of delays, priority issues and terminal hopping. This causes utilisation costs to increase.

***Port costs***

The port costs depend on three factors; ship size/draft, surcharges and frequency. Only frequency in the corridor is a matter of issue regarding efficiency. The frequency norm to the Humber is three sailings a week. This frequency norm is partly based on possible delays and congestion in Rotterdam. When all operations are going smoothly, the frequency could possibly be two sailings a week, instead of three, with perhaps larger feeder vessels. This would decrease the total port costs per week.

***Service distortion costs***

The SDC component is responsible for almost all inefficiencies, which are present in the Rotterdam-Humber corridor. The interviewed feeder operators have indicted that approximately 14% of the total feeder chain costs can be contributed to service distortions in the Rotterdam-Humber corridor. The factors influencing the SDC are presented below.

- *(Port) Congestion*

The port of Rotterdam is facing congestion issues, especially regarding feedering. The delays that occur because of congestion are sometimes more than 48 hours[24]. This not only increases monetary costs of feedering but also has a negative impact on transit time and reliability. To keep a reliable feeder service, feeder operators are forced to charter extra vessels to deploy in the corridor. This of course is highly inefficient. Congestion in Rotterdam exists because of a number of reasons. Most factors that are causing congestion, are all other SDC factors.

[24] Source: Harry Kleipas, Feederlink

- *Capacity constrains*

Rotterdam has capacity constrains. The huge growth in container handling the last years, has fully filled up terminal space and is causing congestion in and around the port. Especially for feedering the capacity is just not there. The DBF terminal recently opened. This is a first step in providing more capacity for feeders but is probably not sufficient to accommodate all feeder vessels calling in Rotterdam. Furthermore, the DBF terminal will increase the number of ITT at the terminal, which can induce more terminal congestion. It is logical that capacity constrains have an influence on (port) congestion. When capacity is getting scarce and the demand for capacity is increasing, which is the case in Rotterdam, congestion is inevitable.

- *Delays mainline, terminal and feeder*

The delays feeders are facing in the Rotterdam-Humber corridor are significant. In the port of Rotterdam the feeder vessels always have to deal with delays caused by other parties in the chain. The mainline carriers are responsible for most delays in the port of Rotterdam. In chapter six it was mentioned that more than 60% of the mainliner carriers arrive outside their window. This is a disaster for the terminal planning and because of the low priority of feeders at the terminal, feeder delays are often long and uncertain.

- *Priority of feeder at the terminal*

In Rotterdam the priority of a feeder is very low. The mainline carrier is the only customer of the terminal operator. They are the one who have a contract with the terminal operator and are paying for the loading and unloading of the feeder and thus always get primacy. With a relatively congested port, capacity constrains, numerous mainline carrier delays and low feeder priority at the terminal; the problem of the feeder operator becomes clear. To maintain a reliable service extra costs have to be made (e.g. extra ship deployment). This is a real distortion in the corridor. The problem of priority is made worse because of non-cooperative behaviour.

- *Terminal hopping*

Terminal hopping has already been mentioned several times in this thesis. It has become clear that in the port of Rotterdam common feeder operators have to hop a lot between different terminals to load their cargo. Hopping means extra costs and more chance on delays, especially in Rotterdam because of the large distances between different terminals in different port areas. Dedicated feeders do not have to hop as much as common feeder operators. The reason is that dedicated feeders only have cargo from its own mainline carriers and they usually unload all their cargo at one terminal, which means that dedicated feeders do nor have to hop.

- *Communication, information & planning*

There are several comments on this factor when analysing Rotterdam. Even the most advanced ports and terminals in the world, as well as their carrier customers, often still appear to be ill-equipped/prepared to handle the information flow around the container efficiently. This happens despite the fact that every container on board of a ship must be at least in one computer system. Too often information, between 20%-60%, on the next move is lacking at the moment of discharge from mainline ship (Dynamar, 2007). This implies the risk for too long dwell times, a reason of terminal (stack) congestion, and is causing more ITT than necessary, another reason for terminal congestion. At the moment this is the case in Rotterdam. It also means that proper pre-planning of containers to be transhipped is often not possible. This results ultimately apart from security/safety issues into extension of the transit time.

Also the information exchange from the mainline to other stakeholders regarding delays or other issues is insufficient. This has far reaching implications. If the mainliner does not communicate, to the feeder operator and other parties in the chain, that a container is delayed, problems in the feeder port can occur. An example of such a problem is that truckers chartered by the shipper to pick up a container, are waiting at the UK terminal gate on a container, which will not arrive. This will not be appreciated by the shippers and the consequence could be that the shipper decides to us another supply chain solution.

Mainline operators in Rotterdam, using common feeders, tend to make last minute decisions about mode and/or operator to use. Considering the generally low ocean rates, carriers want to profit from yet lower on-carriage bid from feeder operators, who still has empty slots.

When looking closer at the Rotterdam-Humber corridor it appears that there are a few other issues present. At the ECT terminal a feeder has to notify the terminal operator 72 hours in advance, which containers have to be picked up, at which terminal in order that the terminal operator can ITT the containers out of the stack. On areas where sailing times are short, such as on the UK, a 72 hours notification time is too tight. The result is that feeder operators are making up load list to be certain that the terminal operator will help them. Between 12 and 16 hours prior before loading, the feeder operator has to confirm the load list for the terminal operator. Also here time is tight because of last minute bookings and containers which are in hold at customs.

- *Frequency of feeder services on specific area*

The frequency of sailings from Rotterdam to the Humber is on average 3 times a week but at the moment 4 sailings a week are scheduled because of long and uncertain waiting times. There is only one common feeder operator active in the corridor (Feederlink). Other feeders, which are operational in the corridor, are dedicated feeders (e.g. APL and CMA-CGM). The frequency of the common feeder operator in the corridor depends on various factors, as discussed in previous chapters. Most important are the different schedules of different mainline carrier companies, volume, delays, congestion and market demand. Especially, delays and congestion in Rotterdam, are causing feeder operators to include an extra sailing in to their schedules. This in turn is causing slot utilisation costs to increase because not all vessels are fully utilised. In terms of efficiency it would be better to have two sailings a week with larger vessels. When having two sailings a week, without congestion and delays in Rotterdam, the cargo can be delivered in the UK in 3 days.

Furthermore, on other feeder regions often more than one feeder operator is operational. For example on the Baltic, the feeder market is fragmented, which means that there are a lot of common feeder operators operational. The more operators are active in different feeder regions, the more chance on delays in the hub port. This of course influences the delays for feeders operators in the Rotterdam-Humber corridor.

- *Waiting of the feeder*

It is discussed that the common feeder has to hop to several terminals in Rotterdam to pick up its containers. The willingness of waiting of the feeder at one specific terminal for a few containers is important. If the feeder operator decides to wait until it can load the containers, the SDC component will be influenced and the total chain costs increases. The willingness for waiting depends on the number of containers that have to be loaded. The willingness of waiting of the common feeder operator in the Rotterdam-Humber corridor is not very high. The reason is that the common operator is serving multiple mainline customers.

- *Non-cooperative behaviour*

The overall cooperation between different stakeholders, operating in the Rotterdam-Humber corridor, is low. Especially, the cooperation between mainline company, terminal operator and common feeder operator, is far from optimal. Mainliners do not acknowledge that feeders are a part of their own total door-to-door service, which is offered to the customers. Most mainline companies in Rotterdam do not care about the problems the feeder is facing. This non-cooperative behaviour is causing inefficiencies, such as longer delays and more congestion.

- *Customs*

Customs are always inefficient. Customs are always causing longer delays and waiting times because of inspections. However, customs are necessary for safety reasons and to prevent illegal trade. Customs in Rotterdam is a cooperative partner. Communication and information exchange with different stakeholder is going well. Furthermore, in Rotterdam custom procedures for transhipment cargo are very efficient. For UK transhipment cargo no extra documents are needed. The mainline company has to enlist the container as a transhipment box at customs.

- *Fuel*

Fuel that is consumed when the vessel is waiting, are causing total costs to increase. In this respect, fuel is certainly a distortion factor. The situation in Rotterdam is clear; there is congestion and there are delays. The waiting time for feeders is longer than normal and this is causing fuel consumption to be higher than normal.

***Inland transportation costs***

This cost component is not responsible for inefficiencies in the Rotterdam-Humber corridor. The inefficiencies in the UK regarding land transportation, are favouring the option of transhipment in Rotterdam.

This sub-paragraph has analysed the Rotterdam-Humber corridor by using the conceptual feeder chain costs model. The analysis is conducted by reviewing the eight feeder chain cost components and its influencing factors on the corridor. The analysis has revealed where the inefficiencies in the corridor are present and more important how they are influenced. The next-sub paragraph gives an overview of the inefficiencies, indicted by the companies interviewed.

### 7.3.2 Interview results

To complete the corridor analysis, it is necessary to know what the opinion/perception is of the different stakeholders regarding corridor inefficiencies. By reviewing the answers, which were given during the interviews, a ranking of factors, which are causing chain distortions, is created. The ranking shows the factors that are perceived as most significant in causing corridor inefficiencies.

During the interviews companies were ask which factors they perceive as inefficient (causing feeder chain cost to increase) in the Rotterdam-Humber corridor. Table 7.6 shows the results. The overall perception of the market is in accordance with the conducted analysis of the corridor. This is not a surprise because most information from the interviews is used for the creation of the conceptual feeder chain cost model. However, the conceptual model does not indicate which factors are perceived as most disturbing. This sub-paragraph provides that information.

It is obvious which factors are perceived as most significant by the interviewed companies. Capacity constrains at the terminal has been indicted by 19 of the 20 companies interviewed. Congestion, delays (of mainline and terminal), communication, information and planning, terminal hopping and feeder priority at terminal al score 50% or more. Not unexpected these factors are al factors of the SDC component. However, factors from other costs components were also mentioned, such as port costs (15%) imbalance (20%) and ship size (5%).

*Table 7.6: Indicated Rotterdam-Humber corridor inefficiencies*

| Feeder chain inefficiencies Rotterdam- Humber Corridor | Indicated by interviewed companies | % |
|---|---|---|
| Capacity constrains | 19 | 95% |
| (port) Congestion | 18 | 90% |
| Delays | 17 | 85% |
| Terminal hopping | 14 | 70% |
| Communication, information and planning | 13 | 65% |
| Feeder priority at terminal | 10 | 50% |
| Frequency of services/fragmented feeder market | 8 | 40% |
| Non cooperative behaviour and emotions | 8 | 40% |
| Waiting of feeder | 5 | 25% |
| Imbalance | 4 | 20% |
| Port costs | 3 | 15% |
| Customs | 2 | 10% |
| Fuel | 1 | 5% |
| Ship size | 1 | 5% |

A remark that has to be made, is that different companies have different objectives and therefore some factors are not perceived as inefficient by one company but are by others. An example; feeder priority at the terminal is perceived as highly inefficient by a common feeder operator but is not perceived as inefficient by most mainline carriers. The reason is that mainline carriers are the customer of the terminal and thus not have priority issues. However, most managers interviewed have answered the questions from different market perspectives and therefore the corridor analysis gives a very realistic view of the reality.

### 7.4 Conclusions

In the previous chapter it became clear that there is potential for attracting cargo from Middle and North UK to Rotterdam and feeder it to the Huber. In this chapter the focus was on the Rotterdam-Humber corridor itself. The business case presented has provided the reader more insight in the day-today operation of a common feeder operator, active in the Rotterdam-Humber corridor. A few conclusions can be drawn from the business case.

First, the costs allocation of the different cost components have revealed that the largest cost components, for a common feeder operator, are terminal costs (at the feeder port) charter costs and fuel costs. The cost structure of dedicated feeders is different because they are a cost centre of the mainline carrier company. The slot utilisation costs are usually 20% of total feeder operating costs. This indicates that on average the ship utilisation in the corridor is about 80%. The SDC are approximately 14% of the total costs. This means that if all distortions in the corridor are solved, the total feeder chain costs of the corridor will decrease with at least 14%.

Second, the economic business case has calculated the cost differences between the two options for serving Middle and north UK. By calculating the break-even-points in terms of costs between Immingham and Felixstowe and between Immingham and Southampton, the captive hinterlands of the Humber are revealed. The captive hinterland of the Humber shows the geographical area in which the Humber is more competitive in terms of total transportation costs compared with Felixstowe and Southampton. The calculations are made for different scenarios. The conclusions that can be drawn are that for 20ft containers the captive hinterland of the Humber is larger (more to the South) than for 40ft containers and that the more west of Felixstowe the destination of the container is, the more the hinterland border of the Humber goes down. The opposite is true for Southampton. Furthermore, the city of Nottingham is the crossing point of the different hinterland border lines and in the captive hinterland of the Humber a few big cities are located, such as Manchester and Leeds.

In the second section of this chapter the corridor has been analysed by applying the feeder chain costs model. The conclusion that can be drawn from the corridor analysis is that there are indeed inefficiencies present in the corridor. Almost all inefficiencies, which are present in the corridor, can be contributed to the SDC. The factors that are influencing the SDC, and are thus causing feeder chain costs to increase, are all present in the corridor. Capacity constrains, congestion, delays of the mainline carrier and terminal operator, terminal hopping, communication, information and planning and feeder priority at the terminal are considered as most important and significant factors, which are disturbing the feeder chain between Rotterdam and the Humber. However, some less significant inefficient factors are also present in the corridor. A general conclusion about all the factors, which are influencing the feeder chain cost components in a negative manner, is that they are all influencing and reinforcing each other as well.

The overall conclusion is that the captive hinterland of the Humber, compared to the two largest deep sea ports in terms of costs, is large enough to be competitive in serving large cities located in Middle and North of the UK via transhipment in Rotterdam. However, the corridor has efficiency issues. When these issues are solved the Rotterdam-Humber corridor would be much more attractive in terms of costs, transit time and reliability. In the next chapter solutions are provided to solve the inefficiency issues, which are present in the corridor and in the Rotterdam feeder market as a whole.

## Chapter 8 – Conclusions and Recommendations

### 8.1 Introduction

In the following chapter the conclusions and recommendations of this thesis are provided. The conclusions are based on the information discussed and analysed in chapters 3, 4, 5, 6 and 7. The drawn conclusions provide the basis for the recommendations discussed in this chapter. The recommendations will provide and discuss the solutions that are necessary to improve feeder chain efficiency in the Rotterdam-Humber corridor. By discussing the solutions to improve efficiency in the corridor, the research question of this thesis will be answered;

> ***"How can Port of Rotterdam improve the efficiency in the Rotterdam-Humber Corridor, in order to attract import cargo from North and Middle UK?"***

Furthermore, recommendations about how Port of Rotterdam should position itself, in order to improve efficiency and attract cargo, are discussed. The chapter ends with some recommendations for possible further research regarding transhipment and feedering in North West Europe.

### 8.2 Conclusions

This thesis is based on a research done for the department Corporate Strategy of Port of Rotterdam. Via an exploratory study combined with a case study more insight in the North West European transhipment and feeder market is assessed and inefficiencies in the Rotterdam-Humber corridor are revealed. Although the thesis is practical oriented, a theoretical approach is used for the elaboration of the practical part of this research. During the course of this research the sub questions are answered, which was needed to answer the main research question. In this paragraph the most important and significant conclusions of this thesis are presented and discussed.

***Major trends and developments in the port and transport sector***

There are a few major changes, trends and developments that have had a big impact on contemporary liner shipping and with that have induced the use of the hub-and-spoke system. The most important changes, trend and developments are summarised below:

1. Horizontal and vertical integration along the supply chain.
2. Increased concentration in the maritime industry
3. Growing vessel sizes.
4. Demand for more efficient transport system (hub-and-spoke system)
5. Increase in containers transhipped and feedered
6. Re-assessment of port strategies to be included in global networks

Horizontal and vertical mergers and acquisitions between companies in the maritime industry have led to a highly concentrated maritime transport market but although fewer global players remain, competition in shipping has actual increased. The foremost motive to (horizontally) merge and form alliances is to create economies of scale and thus reduce unit costs. Vertical mergers and acquisitions have taken place in order to provide global logistic packages to customers and have more control over total chain costs. Another option to create scale economies is by deploying larger vessels. The deployment of larger vessels has resulted in the demand for the use of more efficient network system. This efficient system is the hub-and-spoke system of which feedering is an important part. This in turn, has caused transhipment volumes to increase tremendously the last twenty years. But increasing vessel size is not the only reason for transhipment volumes to increase. Two other important reasons are that not all ports are able to handle such large vessels and it is economically more profitable to (un) load a large amount of containers in a few large hub ports, than calling at several ports to (un) load small number of containers. These market changes have induced ports to re-asses their (transhipment) strategies. Port choice has become more a function of network costs and ports that are chosen are those ports that will help to minimize the sum of sea, port and inland costs. Ports should take action to position and establish themselves within those new transport networks. To be able to establish themselves in those networks, it is important to know which factors make a port attractive especially in terms of transhipment and feedering.

***Port criteria and selection factors***

The general conclusion that can be drawn about port criteria and selection factors, is that there is no general conclusion adopted on the significance of qualitative factors in port choice. The weaknesses of most studies is that they focus on comparing the importance of different factors, while the importance of the package on offer, or generalized costs of using a particular port is ignored. However, the study of Ng (2006) has provided more insight in that respect. The conclusion of his study is that monetary costs and time efficiency are not the only components for explaining port attractiveness but that other qualitative factors are also very important to take into account. Most important qualitative factors are:

- Delays.
- Port accessibility.
- Speed on responding to new demands of carriers.

There are no significant differences in attractiveness between Benelux ports. Rotterdam has the best geographical location for serving all Northern European feeder regions. Furthermore, Hamburg and Rotterdam are identified as most attractive ports and Felixstowe and Le Havre as least attractive.

There is a difference in ports selection factors between mainliners and feeder operators. However, local cargo is for both the most important factor in choosing ports. Table 8.1 presents the five most important factors for mainliners and feeder operators.

The overall differences between the two companies are:

- Mainline companies consider more factors in their port choice.
- Mainliners are more sensitive to overall service quality and costs levels.

- Feeder operators are mainly concerned about the availability of cargo and if the port is reasonable the use.

*Table 8.1: Five most important selection factors for mainline and feeder*

| Mainline operator | Feeder oprator |
|---|---|
| Cargo volume | Cargo volume |
| Terminal handling charge | Berth availability |
| Land connection | Terminal handling charge |
| Service reliability | Transhipment volume |
| Port location. | Port location |

*Chang et all, 2008*

The conclusion is that ports, which want to attract more shipping lines, have to build up their local cargo base and pay more attention to providing more comprehensive and high quality services at minimal possible costs. With respect to feeder operators, ports need to enhance the port market size and operational conditions. In North West Europe the differences between ports are relatively small. Therefore, the difference in attractiveness (competitiveness) can be made by improving efficiency in different supply chains. By doing so, the total costs of transport are minimised and ports become more attractive for shipping companies.

***European transhipment and Feeder market***

When looking at the global and European transhipment figures from the last two decades, it can be concluded that the transhipment business is a large and stable market and plays a significant role in today's shipping business. Furthermore, the ongoing growth is vessel size will further stimulate transhipment on a global scale and certainly in North West Europe. This in turn will result in more feedering in Europe. Global forecast figures confirm this development.

The general conclusion about feedering is the fact that feedering (in Europe) is, besides the mainline developments such as increasing vessels, often triggered as a result of cutting costs, bad port performance, congestion and under capacity in ports. Service reliability is very important for feeder operators. Providing a reliable service means that there have to be sufficient sailings a week to a specific region/area, especially in times of congestion. The feeder market is very dynamic and competitive because transhipment cargo does not have a direct link to a specific port. Therefore, cargo can be switched easily between different ports. This induces the necessity for feeder operators to be flexible in their operations and scheduling. There are two types of feedering:

1. Dedicated feedering
2. Common feedering.

Dedicated feeders are direct competitors of common feeder operators but this does not apply the other way around. The reason is that feedering is a part of the mainliners' door-to-door operation. That is the reason why dedicated feeders always have cargo in contrast to common feeders. The latter (also) depends on cargo from the mainliner and cargo, which is feedered with dedicated feeders, is a loss of cargo for the common feeder. Indirect competitors of feeder operators are land transport operators, which provide the last transport leg after a direct call of the deep sea carrier. The last decade feedering has gained market share compared to land transport because of high road transport costs.

In Europe more mainline carriers are engaging in dedicated feedering because of the increase in volumes on specific feeder areas. To increase the scale of operations and reduce total frequency on feeder regions, feeder operators have tried to work in alliances or other forms of partnerships. These partnerships have unfortunately failed because of distrust, cost allocation problems and organisational differences between different parties involved. However, consolidation also has taken place in the feeder market. Mainline developments are important for feeder operators because feeder operators always follow the mainline. The most important European feeder areas are;

- Scan Baltic,
- UK and Ireland,
- The Iberian Peninsula.

Rotterdam has the largest market share on the last two mentioned areas. A last conclusion that can be drawn is that common feeder operators are confronted with a priority issue in large main port hubs. The reason is that the feeder operator is not the customer of the terminal operator in respect of any container handling involved. Therefore, the focus is on the deep sea carrier. The deep sea carriers are paying the bill, also for the handling of the feeder, and thus have highest priority at the terminal.

***Feeder chain cost components and factors of influence***
By dividing a feeder chain into four different stages and by allocating different costs to those stages, were the costs are generated, it is possible to analyse a feeder chain per stage and per cost component. However, knowing which cost component occurs in which stage, does not tell much about how the costs are really generated or by which factors the costs are influenced. Therefore, the factors which influence the cost components are given and discussed. These factors are important for analysing feeder chains and thus for improve efficiency. To provide a clear overview of the different feeder chain costs and factors, a conceptual model was created.

Eight cost components are identified, with each its own factors of influence. The operating and capital costs can be identified as one cost component; the charter costs. The reason is that almost all feeder vessels deployed in Europe are chartered.

1. Terminal costs
2. Fuel costs
3. Slot utilisation costs
4. Port costs
5. Inland transportation costs
6. Operating costs
7. Capital costs
8. Service distortion costs

The first five components occur in different stages of the feeder chain. The last three (or two) are present in every stage of the feeder chain. The SDC component shows the distortions, which are present in a feeder chain. Especially the factors influencing the SDC component are of importance because they are responsible for possible inefficiencies, which can be present in a feeder chain. However, inefficiencies can also occur in other cost components; such as terminal stack planning in the terminal cost component. In total eleven factors, which are influencing the SDC, are identified. They are presented in the conceptual model of the feeder chain costs (figure 5.2). The conclusion about those factors is that they represent inefficiencies influencing the total cost of the feeder chain in a negative way. Furthermore, all factors influencing the SDC are also influencing and reinforcing each other.

***Rotterdam-Humber potential***

There is indeed a potential for attracting cargo from Middle and North UK to the port of Rotterdam. The most important findings that confirm this potential are:

- The UK container market is still a growing market and large volumes of import containers, which are imported via Felixstowe and Southampton, have an inland destination in Middle and North UK. In terms of geographical location this can be seen as a potential for the corridor.

- The ports of Felixstowe and Southampton are congested and the UK port capacity is not sufficient for an efficient handling of today's and future (forecasted) container volumes. Even though capacity projects are started, the increasing number of containers in combination with mainline vessels getting larger will not solve the immense pressure on today's and future UK (deep sea) ports. This has induced a large demand for feeder ports. The Humber ports can fulfil a part of that demand, which further enhances the potential of attracting cargo to the port of Rotterdam.

- The Humber ports are the largest port conurbation of the UK and are handling most UK cargo volume in terms of tonnes. The Humber is also located at the heart of the NETA and has a good accessibly infrastructure. In turn, Rotterdam has a perfect geographical location for feedering the UK. This can also be seen in the market share Rotterdam has in the UK shortsea and feeder segment (almost 60%). The last few years the Rotterdam-UK traffic has increased due to the congestion in the UK deep sea ports and the introduction of the WTD. Furthermore, Rotterdam is often the first port of call in shipping lines schemes and has the best quality of connection with the Far-East. Therefore, transhipment via Rotterdam and feedering to the UK can provide a transit time advantage of 10 days.

However, against the arguments, which are favouring the potential the corridor, also some negative findings have to be put forward.

- There is a low awareness of the Humber ports by most companies including shipping lines.
- There is a negative perception of the Humber ports.
- There is limited container handling facilities/capacity in the Humber ports. Furthermore, the Humber ports are unable to handle large container vessels (draft and equipment restrictions)

- Most shippers think that there is a limited frequency and speed of feeder services between Rotterdam and the Humber.

The main conclusion that can be drawn is that the Rotterdam-Huber corridor has a lot of potential to attract more cargo for Middle and North UK. Especially, regarding import cargo that is now shipped via Southampton. Companies have indicated that they felt transhipping via Rotterdam would be a good idea. However, if the Humber ports want to become competitive feeder ports, port infrastructure investments have to be made and marketing should get top priority.

***Transhipment versus Direct call***

To compare the costs differences between transhipment via Rotterdam and a direct call on Felixstowe and Southampton, a business case was made of the Rotterdam Humber corridor. By calculating the break-even-points in terms of total chain costs between Immingham and Felixstowe and between Immingham and Southampton, the captive hinterlands of the Humber regarding the two deep sea ports, are revealed. The captive hinterland of the Humber shows the geographical area in, which the Humber is more competitive in terms of total transportation costs, compared with Felixstowe and Southampton. The calculations are made for different scenarios. The conclusions that can be drawn are:

- For 20ft containers the captive hinterland of the Humber is larger (more to the South) than for 40ft containers.
- The more West of Felixstowe the destination of the container is, the more the hinterland border of the Humber goes down. The opposite is true for Southampton.
- The city of Nottingham is the crossing point of the different hinterland border lines
- In the captive hinterland of the Humber a few big cities are located, such as Manchester and Leeds.

The overall conclusion is that the captive hinterland of the Humber, compared to the two largest deep sea ports in terms of costs, is large enough to be competitive in serving large cities located in Middle and North UK via transhipment in Rotterdam. Especially, when you consider the UK import cargo distribution, which showed that large number of containers imported via Southampton have a final destination in captive hinterland of the Humber.

***Corridor inefficiencies***

To identify inefficiencies in the Rotterdam-Humber corridor, the conceptual feeder chain costs model is applied on the corridor. The conclusion that can be drawn from the corridor analysis is that there are indeed inefficiencies present in the corridor. Almost all inefficiencies present in the corridor can be contributed to the SDC component. The (distortions) factors that are influencing the SDC, and are thus causing feeder chain costs to increase, are all present in the corridor.

Table 8.1 provides an overview of the cost component and its factors of influence, which are identified as inefficient in the Rotterdam-Humber corridor. A general conclusion about all the factors that are influencing the feeder chain cost components in a negative manner, and are thus causing inefficiencies, is that they are all influencing and reinforcing each other as well.

With the identification of the inefficiencies present in the Rotterdam-Humber corridor, the last important conclusion is discussed. This paragraph has provided an overview of the most significant conclusions of this thesis. In the next paragraph the recommendations are presented and with that the answer to the main research question.

***Table 8.2: Overview of present inefficiency factors in Rotterdam-Humber corridor***

| Cost componenets | Factors | Ineffcient in R-H Corridor |
|---|---|---|
| **Terminal costs** | Carrier agreement | |
| | Transhipment volume | |
| | Storage | |
| | Planning | X |
| | Port | |
| **Capital cost** | Charter | |
| | Owner | |
| **Operating costs** | Charter | |
| | Owner | |
| **Fuel costs** | Ship size | |
| | Ship age | |
| | Speed | |
| | Bunker price | |
| | Bunker port | |
| **Slotutilisation costs** | ship size | X |
| | imbalance | X |
| | Planning | |
| **SDC** | (port) Congestion | X |
| | Capacity constrains | X |
| | Delays | X |
| | Comminuication, information &planning | X |
| | Frequency feeder service | X |
| | Terminal hopping | X |
| | Waiting of feeder | X |
| | terminal priority | X |
| | Fuel | X |
| | Non-cooperative behaviour | X |
| | Customs | |
| **Port costs** | Ship size | |
| | Frequency | |
| | Surcharges | |
| **Inland transportation costs** | Number of KM | |
| | Tranport mode | |
| | size container | |

## 8.3 Recommendations

The share of the SDC component in the Rotterdam-Humber corridor is 14% of the total feeder chain costs. By improving efficiency in the corridor the total costs of feedering can thus at least be lowered with 14%. Besides, decreasing feeder chain costs, also the reliability and transit time will improve, by improving efficiency in the corridor. Costs, reliability and transit time where defined as the most important decision making factors by mainline companies for choosing/creating a certain supply chain. Thus by solving the corridor inefficiencies these three factors are enhanced and the corridor becomes much more competitive and attractive to use compared to other alternatives for serving Middle and North UK.

However, solving the inefficiencies in the corridor is easer said than done. First of all factors causing inefficiencies are also influencing and reinforcing each other. An example is that bad terminal planning will result in a less effective use of terminal space, which reinforces capacity constrains, which in turn reinforces congestion. On the other hand, solving one factor can thus have a positive impact on other factors.

Second, there has to be the will to solve the inefficiencies. At the moment there is a non-cooperative attitude present in the market. Mainliners, feeder operators and terminal operators are only concerned about their own interests. This in fact is a SDC factor which needs to be solved. Different market parties have to acknowledge that they can not do business without each other and that some concessions have to be made. The mainline carrier for example, does not really care about the long delays of the feeder operator, which is strange, knowing that the feeder is a part of the total 'transport package 'of the mainline carrier. The most important and significant factors, which cause inefficiencies indicated by most companies interviewed, are:

1. Capacity constrains
2. Congestion
3. Delays mainline carriers
4. Terminal hopping
5. Feeder priority at the terminal
6. Communication, information and planning

These six factors are a good starting point to improve the chain efficiency in the Rotterdam-Humber corridor. In the next section the above six factors are discussed in terms of solutions. Other factors, which are also responsible for inefficiencies, are discussed in short at the end of this paragraph.

***Providing additional capacity***

Most companies in the maritime industry are convinced that capacity constrains, is the foremost factor, which is causing congestion (and inefficiencies) in the port of Rotterdam. It is therefore that these two factors are discussed together. According to the market, providing extra capacity is the solution for congestion, delays and other inefficiencies. The solution for capacity constrains is building more terminal space (including equipment). More space will result in decreased pressure on the terminals and congestion will disappear. Port of Rotterdam is aware of the capacity and congestion issues it has and is therefore started the development of Maasvlakte 2. This solution is the overall opinion of the market. However, my opinion is a bit different in that respect. I believe that providing additional capacity is indeed a solution for solving congestion but this is only a solution for the short/medium term. When the additional capacity is full, the same problems and inefficiencies will occur as before the capacity expansion. Structural solutions (long term) for improving efficiency in the corridor are presented in the solutions for the remaining factors.

***Bonus-malus system***

The delay of the mainliner is the most important factor, which is causing inefficiencies in today's congested situation. More than 60% of the mainliners, calling at port of Rotterdam arrive outside their window at the container terminal. Reasons for delay can be many. The mainliner can have had delays at other ports before sailing to Rotterdam. The point is that the mainliners can (most of the time) make up lost time caused by delays by sailing at a higher speed. However, carriers are reluctant to do so because of the high fuel prices. In line with this is the fact that there is no incentive at all from the terminal in Rotterdam to led mainliners increase speed, when they know they are not going to be in time for their window. This makes terminal planning very difficult because of the uncertainty in time of arrivals. This in turn, is also a disaster for feeder schedules. They always have to wait until the mainline vessels has been (un)loaded before they are getting permission to berth. The mainline carrier is the only paying customer at the container terminal, which means that they always have priority. Therefore, when mainliners are arriving outside their window and terminal capacity is scarce, the delays for feeder vessels will increase and congestion will be worse. Trying to get mainliners to be in time for their window should be a solution to get better and more reliably terminal planning's and feeder schedules.

The introduction of a bonus-malus system by the terminal operator is a solution for trying to convince mainliners to increase speed when delayed. The system gives an incentive to the carrier to be in time for the agreed window by setting a higher price for terminal handling outside the window. This system gives carriers the opportunity to calculate at sea, if it is more profitable to increase speed or to arrive outside their window sailing economy speed. For a main hub port, such as Rotterdam, most carriers have to unload large volumes of import cargo. The more cargo has to be unloaded, the more profitable it is for the mainliner to be in time for his window. This solution is a more structural solution than continuously adding terminal capacity, which is a long and expensive process. By giving mainliners incentives to be in time for their window, efficiency would be improved by more reliable schedules, faster transit times and fewer costs.

***Dedicated stacks, feeder berths and customers***

Terminal hopping is highly inefficient, especially in Rotterdam, where feeder operators have to load cargo at five or more different terminals. The reason is that common feeder operators have more than one customer, who al (un) load containers at different terminals. This hopping between terminals is increasing the change of delays and ads to the port costs of the feeder operator. Terminal hopping can be solved by a better terminal planning in terms of vessel and terminal space. By creating for example a dedicated Humber stack or a dedicated UK stack in combination with a dedicated feeder berth, feeders serving the UK do not have to hop between different terminals anymore. This should improve efficiency by more reliable feeder schedules, less delays and congestion. The feeder operator could also engage in a strategy of customer dedication. By only serving customers, who unload cargo at a specific terminal, no hopping is necessary.

***Fixed windows for feeder vessels***

The priority of the feeder at the container terminals is low because of discussed reasons. Having no priority in times of congestion means that a feeder operator has highly uncertain loading times but worse is the fact that the feeder operator has to deal with long uncertain delays in the port of Rotterdam. This uncertainty is very bad for the reliability of the feeder service. To keep services reliable feeder operators are forced to deploy more vessels to provide a sufficient frequency of departures. More vessels mean usually smaller vessels because smaller vessels are easier to switch between schedules. More and smaller vessels deployed means extra total costs and higher costs per slot. A solution for the uncertain delays would be fixed windows for feeders at dedicated feeder berths. By giving more priority at the feeder vessel, the long delays can be minimised and no extra costs will occur. Mainliners do have to get first priority but fixed windows for feeder vessels will certainly increase efficiency.

*Improved communication and cooperation*

The information, which is used between parties to inform each other, is sufficient. Most data is digital and easy to access for the companies involved. However, the problem is the communication between different companies. It is often a fact that delays or a change in the load list of the feeder operator occurs. This does not have to be a problem causing confusion and uncertainties. When the new information about for example delayed containers is communicated in time to the other party, new list or schedules can be made. This will improve the uncertainty in operations and will influence delays and congestion in a positive way.

The pre-information of the carrier to the terminal operator can and should be improved. At the moment the terminal operator has no idea what the destination of the container is. It logical that the final destination of a container is none of the terminal operators' business but it is reasonable to give information about the final region/country a container is going and about the time/day when the container is picked up by the feeder operator. This will decrease the number of ITT containers for the terminal (less ITT means less terminal congestion and delays) and enables the terminal to make better stack planning's (dedicated stacks). By a better and faster communication of changes in information and by providing more pre-information, the efficiency in the corridor will improve. The same problem exists in communicating (pre) information to the feeder operator. The feeder operator often gets container pick up information to late. This distorts the planning and schedules and is thus causing delays, congestion and uncertainties, making the feeder service unreliable and more expensive.

The solution for this inefficient way of sharing information is better planning and better communication of information. This in turn, can only be achieved if the different parties are willing to work together. The non-cooperative behaviour, as discussed, is not helping to improve inefficiencies in the transhipment/container market and thus also not in the Rotterdam-Humber corridor. Companies should recognise and acknowledge that they eventually are all trying to achieve one common goal; getting the container to the customer at the lowest cost possible, as fast as possible and as reliable as possible.

*Other possible efficiency improvements*

The above solutions provided are targeting the most significant inefficiencies present in the Rotterdam-Humber corridor. However, after reading this thesis it is clear that there are more inefficiencies present in the corridor and in the transhipment market of Rotterdam as a whole. Other more general efficiency improvements are:

- Vessel sharing, form alliances and consortia and consolidation in the feeder market (creating scale economies).
- Port call rationalization mainline (less ports per journey) and stowage rationalization (on final destination).
- Terminal Sharing (ECT-APM) and terminal design.
- Bigger feeder vessels with minimum frequency of sailings.
- Terminal operator itself could engage in providing feeder service to shipping companies.

*Recommendations for Port of Rotterdam*

Improving efficiency is a though challenge for Port of Rotterdam. The main issue is the fact that the inefficiencies have to be solved by different private companies in the market. Port of Rotterdam only has a facilitating role, which makes it impossible to force companies to implement or engage in more efficient operations. The key to success is therefore bringing parties together and try to turn the mentality of non-cooperative behaviour around. Port of Rotterdam has already started a feeder platform. Here, different parties are brought together to talk about the current problems that are present in the transhipment market and about solutions to solve the inefficiencies. This is a first step towards a better and more efficient transhipment market and therefore will also benefit the Rotterdam-Humber corridor. However, a few recommendations to achieve higher efficiency and to attract more cargo can be made.

Port choice has become more and more a function of network costs. This means that the shipping line companies consider the reliability and costs of the entire transport chain and not only the sea-to-land interface of the port. The ports, which are chosen, are those ports that can help to minimise total transport costs. Therefore, Port of Rotterdam should map all significant connections in which they play a pivotal role and analyse those connections on possible inefficiencies. In that way, Port of Rotterdam is helping to minimise total chain costs. Furthermore, Port of Rotterdam must be flexible to react on changing market demands.

Port of Rotterdam should (together with the mainline carrier companies) engage in a more direct approach towards large companies, which are transporting large number of containers. By including large companies (e.g. Ikea, Heineken, Nike and Tesco) in the construction of supply chains, Port of Rotterdam is able to show the advantages of transhipment via Rotterdam compared to the alternatives for transporting a container. Large companies in for example the Far East always book a container for Middle UK via Felixstowe or Southampton. The reason is that they are not aware that for some destinations it is cheaper, faster and more reliable to tranship via Rotterdam. Marketing is a perfect tool to convince companies around the world to ship cargo via Rotterdam. Therefore, Port of Rotterdam should focus more on effective direct marketing of big global multinationals and shipping companies.

To attract more cargo from Middle and North UK, Port of Rotterdam has to create a reliable and stable transhipment environment. Furthermore, Port of Rotterdam should try to tie large carriers to its port. This could be done by providing dedicated terminals to different alliances (is done at Maasvlakte 2) or by giving costs incentives in for example port dues.

***Recommendations for further research***

This thesis provides more insight in the inefficiencies in a feeder connection. This thesis has revealed the inefficiencies in the Rotterdam-Humber corridor and has provided solutions to improve efficiency in the corridor. The implementation of those solutions will have a positive (cost) affect on the total chain costs. This thesis argues that the feeder chain cost will decrease with at least 14%, when efficiency is improved (SDC share is 14% of total chain costs). However, to get a real understanding of the cost advantages and impact, which will be induced by efficiency improvements, new calculations for of different scenarios have to be made. The first recommendation for further research is therefore to investigate the impact of different solutions for improving feeder chain efficiency.

A second issue for further research is the optimal ship size of a feeder vessel in Northern Europe for different regions. During the course of this thesis ship size has been mentioned a lot. Larger vessels provide scale economies but smaller vessels are more flexible to switch between different schedules. What should be the optimal ship size of a feeder vessel deployed on the East coast of the UK is a research question that could be used for further research regarding feeder chain efficiency.

A third issue for further research is to investigate what kind of incentives would be most effective in attracting more cargo to the port. In line with this, a study about port policy can be helpful. The way how Port of Rotterdam can influence or convince companies to change/improve market inefficiencies by giving incentives or other kind of measures should be the main topic of such a research.

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## List of Appendices

## Appendix 1 – Global container traffic figures

**Annual growth in container activity by region**
('000 TEU of port handling, including empties and transhipment)

| | | 1980 | 1990 | 2000 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **North America** | | 9,531 | 16,659 | 30,824 | 37,464 | 40,782 | 44,466 | 46,884 | 49,707 |
| **West Europa** | | 11,753 | 22,552 | 51,714 | 63,477 | 71,180 | 76,530 | 82,458 | 91,507 |
| | *North Europa* | 8,647 | 15,996 | 31,771 | 37,679 | 42,752 | 46,853 | 50,956 | 56,941 |
| | *South Europe* | 3,106 | 6,556 | 19,943 | 25,798 | 28,428 | 29,677 | 31,502 | 34,566 |
| **Far East** | | 7,694 | 23,066 | 71,403 | 102,967 | 121,26 | 135,911 | 154,151 | 175,807 |
| **SE Asia** | | 1,871 | 9,679 | 34,36 | 45,818 | 51,818 | 55,533 | 60,713 | 67,125 |
| **Middle East** | | 1,943 | 3,583 | 11,085 | 16,515 | 20,032 | 22,383 | 24,343 | 27,138 |
| **Latin America** | | 2,358 | 5,078 | 17,907 | 21,541 | 25,264 | 27,929 | 31,22 | 34,266 |
| **Oceania** | | 1,611 | 2,334 | 5,025 | 6,507 | 7,293 | 7,492 | 7,931 | 8,568 |
| **South Asia** | | 249 | 1,780 | 5,481 | 7,298 | 8,600 | 9,777 | 11,531 | 13,387 |
| **Africa** | | 1,469 | 2,715 | 7,373 | 10,729 | 12,099 | 14,525 | 15,525 | 17,414 |
| **Eastern Europe** | | 373 | 627 | 1,119 | 2,492 | 3,271 | 4,503 | 5,622 | 6,876 |
| **World** | | **38,852** | **88,071** | **236,29** | **314,807** | **361,598** | **399,049** | **440,378** | **491,794** |
| | | | | **Share of world container Port Througput** | | | | | |
| **North America** | | 24,5% | 18,9% | 13,0% | 11,9% | 11,3% | 11,1% | 10,6% | 10,1% |
| **West Europa** | | 30,2% | 25,6% | 21,9% | 20,2% | 19,7% | 19,2% | 18,7% | 18,6% |
| | *North Europa* | 22,3% | 18,2% | 13,4% | 12,0% | 11,8% | 11,7% | 11,6% | 11,6% |
| | *South Europe* | 8,0% | 7,4% | 8,4% | 8,2% | 7,9% | 7,4% | 7,2% | 7,0% |
| **Far East** | | 19,8% | 26,2% | 30,2% | 32,7% | 33,5% | 34,1% | 35,0% | 35,7% |
| **SE Asia** | | 4,8% | 11,0% | 14,5% | 14,6% | 14,3% | 13,9% | 13,8% | 13,6% |
| **Middle East** | | 5,0% | 4,1% | 4,7% | 5,2% | 5,5% | 5,6% | 5,5% | 5,5% |
| **Latin America** | | 6,1% | 5,8% | 7,6% | 6,8% | 7,0% | 7,0% | 7,1% | 7,0% |
| **Oceania** | | 4,1% | 2,6% | 2,1% | 2,1% | 2,0% | 1,9% | 1,8% | 1,7% |
| **South Asia** | | 0,6% | 2,0% | 2,3% | 2,3% | 2,4% | 2,4% | 2,6% | 2,7% |
| **Africa** | | 3,8% | 3,1% | 3,1% | 3,4% | 3,3% | 3,6% | 3,5% | 3,5% |
| **Eastern Europe** | | 1,0% | 0,7% | 0,5% | 0,8% | 0,9% | 1,1% | 1,3% | 1,4% |

Source: Drewry, 2007

**Major container trades 200-2006 (million loaded TEU's)**

| | | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|
| **North America** | | 9,6% | 9,6% | 8,9% | 9,0% | 5,4% | 6,0% |
| **West Europa** | | 8,7% | 10,1% | 12,1% | 7,5% | 7,7% | 11,0% |
| | *North Europa* | 7,5% | 8,9% | 13,5% | 9,6% | 8,8% | 11,7% |
| | *South Europe* | 10,5% | 12,0% | 10,2% | 4,4% | 6,2% | 9,7% |
| **Far East** | | 17,8% | 16,1% | 17,8% | 12,1% | 13,4% | 14,0% |
| **SE Asia** | | 11,7% | 11,1% | 13,1% | 7,2% | 9,3% | 10,6% |
| **Middle East** | | 12,3% | 19,2% | 21,3% | 11,7% | 8,8% | 11,5% |
| **Latin America** | | 3,3% | 10,9% | 17,3% | 10,5% | 11,8% | 9,8% |
| **Oceania** | | 11,7% | 8,4% | 12,1% | 2,7% | 5,8% | 8,0% |
| **South Asia** | | 12,4% | 10,6% | 17,8% | 13,7% | 17,9% | 16,1% |
| **Africa** | | 12,5% | 21,3% | 12,8% | 20,1% | 6,9% | 12,2% |
| **Eastern Europe** | | 25,0% | 26,2% | 31,2% | 37,7% | 24,8% | 22,3% |
| **World** | | **12,2%** | **13,0%** | **14,9%** | **10,4%** | **10,4%** | **11,7%** |

Source: Ocean Shipping Ltd., 2007

## Appendix 2 – Containership order book

### Containership order book by size and scheduled delivery year

| Size range (TEU) | 2007 | 2008 | 2009 | 2010 | 2011+ | total | current fleet | % of current fleet |
|---|---|---|---|---|---|---|---|---|
| | | | | 000 TEU | | | | |
| <500 | 2 | 1 | 0 | 0 | 0 | 3 | 136 | 2,54% |
| 500-999 | 53 | 50 | 17 | 8 | 0 | 128 | 549 | 23,32% |
| 1000-1499 | 61 | 95 | 42 | 4 | 0 | 202 | 722 | 27,98% |
| 1500-1999 | 53 | 71 | 66 | 17 | 0 | 207 | 826 | 25,06% |
| 2000-2499 | 32 | 14 | 0 | 0 | 0 | 46 | 692 | 6,65% |
| 2500-2999 | 84 | 137 | 76 | 57 | 8 | 362 | 947 | 38,23% |
| 3000-3999 | 66 | 81 | 81 | 45 | 0 | 273 | 1082 | 25,23% |
| 4000-4999 | 154 | 278 | 381 | 131 | 0 | 944 | 1553 | 60,79% |
| 5000-5999 | 51 | 145 | 68 | 46 | 0 | 310 | 1300 | 23,85% |
| 6000-6999 | 50 | 235 | 301 | 182 | 20 | 788 | 740 | 106,49% |
| 7000-7999 | 14 | 0 | 0 | 28 | 0 | 42 | 360 | 11,67% |
| 8000-8999 | 108 | 185 | 191 | 314 | 0 | 798 | 767 | 104,04% |
| 9000-9999 | 92 | 148 | 115 | 0 | 0 | 355 | 336 | 105,65% |
| 10000+ | 41 | 92 | 258 | 381 | 85 | 857 | 68 | 1260,29% |
| **Grand Total** | **861** | **1532** | **1597** | **1213** | **113** | **5315** | **10077** | **52,74%** |
| | | | | No. of vessels | | | | |
| <500 | 9 | 4 | 0 | 0 | 0 | 13 | 438 | 2,97% |
| 500-999 | 65 | 61 | 20 | 9 | 0 | 155 | 752 | 20,61% |
| 1000-1499 | 54 | 78 | 35 | 3 | 0 | 170 | 611 | 27,82% |
| 1500-1999 | 31 | 41 | 38 | 10 | 0 | 120 | 486 | 24,69% |
| 2000-2499 | 15 | 6 | 0 | 0 | 0 | 21 | 302 | 6,95% |
| 2500-2999 | 31 | 52 | 29 | 22 | 3 | 137 | 348 | 39,37% |
| 3000-3999 | 19 | 24 | 24 | 13 | 0 | 80 | 317 | 25,24% |
| 4000-4999 | 35 | 64 | 88 | 30 | 0 | 217 | 354 | 61,30% |
| 5000-5999 | 10 | 27 | 13 | 9 | 0 | 59 | 239 | 24,69% |
| 6000-6999 | 8 | 36 | 46 | 28 | 3 | 121 | 114 | 106,14% |
| 7000-7999 | 2 | 0 | 0 | 4 | 0 | 6 | 49 | 12,24% |
| 8000-8999 | 13 | 22 | 23 | 37 | 0 | 95 | 93 | 102,15% |
| 9000-9999 | 10 | 16 | 12 | 0 | 0 | 38 | 36 | 105,56% |
| 10000+ | 3 | 9 | 24 | 33 | 8 | 77 | 5 | 1540,00% |
| **Grand Total** | **305** | **440** | **352** | **198** | **14** | **1309** | **4144** | **31,59%** |

Source: Drewry Shipping Consultants, 2007

## Appendix 3 – Forecast assumptions

**Economic conditions and characteristics - BASE CASE** *(regarded as the most likely outcome)*

- Continued growth of US economy, accompanied by free-trade policies
- Economic and financial stability in Latin America and Caribbean economies
- Economic and currency stability in East Asia
- Continued deregulation, restructuring and revitalisation of the Japanese economy, resulting in a closer balance in its trade flows
- Political stability, economic expansion and continuing structural reforms in China
- Strengthening economic recovery and free trade policies in the EU
- More flexible economic management in the euro zone
- Oil price stable at relatively high levels
- Stable trade framework and continued foreign direct investment in emerging and developing economies.
- Successful economic and financial management with stable investment climate in Russia
- Continued liberalisation and integration of central and eastern European economies with EU

(Source: Ocean Shipping Consultants, 2007)

## Appendix 4 – European container market

### Market shares per port in the HLH-range

| Ontwikkeling marktaandelen containerhavens 1998 - 2006 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | verschil |
| Hamburg | 21,2% | 20,6% | 21,4% | 23,0% | 24,0% | 24,6% | 24,9% | 26,0% | 26,3% | 5,1% |
| Bremen | 10,8% | 12,1% | 13,9% | 14,6% | 13,5% | 12,8% | 12,3% | 12,0% | 13,2% | 2,4% |
| Rotterdam | 35,9% | 35,0% | 31,7% | 30,0% | 29,2% | 28,7% | 29,5% | 29,8% | 28,5% | -7,4% |
| Antwerpen | 19,5% | 19,9% | 20,7% | 20,6% | 21,3% | 21,8% | 21,5% | 20,8% | 20,8% | 1,3% |
| Le Havre | 7,9% | 7,6% | 7,4% | 7,5% | 7,7% | 8,0% | 7,6% | 6,8% | 6,3% | -1,6% |
| Zeebrugge | 4,6% | 4,7% | 4,9% | 4,3% | 4,3% | 4,1% | 4,3% | 4,5% | 4,9% | 0,3% |
| Totaal | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 0,0% |

Source: Port of Rotterdam

### Container throughput HLH-range

| Container throughput per world region, 2002-2006 (TEU '000) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Rotterdam | Hamburg | Antwerpen | Bremen | Le Havre | Zeebrugge | Totaal |
| **Azië** | | | | | | | |
| 2002 | 2.649 | 2.653 | 1.639 | 673 | 578 | 197 | 8.389 |
| 2003 | 2.960 | 3.104 | 2.058 | 736 | 693 | 223 | 9.774 |
| 2004 | 3.577 | 3.630 | 2.379 | 829 | 739 | 278 | 11.432 |
| 2005 | 3.896 | 4.265 | 2.584 | 849 | 813 | 380 | 12.787 |
| 2006 | 4.137 | 4.836 | 2.684 | 1.009 | 867 | 518 | 14.051 |
| **Europa** | | | | | | | |
| 2002 | 2.323 | 1.890 | 953 | 1.177 | 395 | 721 | 7.459 |
| 2003 | 2.470 | 2.141 | 1.084 | 1.226 | 525 | 756 | 8.202 |
| 2004 | 2.908 | 2.376 | 1.175 | 1.424 | 633 | 874 | 9.390 |
| 2005 | 3.371 | 2.718 | 1.280 | 1.551 | 624 | 975 | 10.519 |
| 2006 | 3.639 | 3.005 | 1.472 | 1.775 | 588 | 1.062 | 11.541 |
| **Amerika** | | | | | | | |
| 2002 | 1.303 | 666 | 1.578 | 1.051 | 602 | 17 | 5.217 |
| 2003 | 1.380 | 708 | 1.657 | 1.098 | 583 | 5 | 5.431 |
| 2004 | 1.482 | 800 | 1.833 | 1.081 | 575 | 12 | 5.783 |
| 2005 | 1.511 | 861 | 1.945 | 1.178 | 506 | 17 | 6.018 |
| 2006 | 1.480 | 795 | 2.117 | 1.466 | 502 | 32 | 6.392 |
| **Overig*)** | | | | | | | |
| 2002 | 251 | 164 | 607 | 130 | 145 | 26 | 1.258 |
| 2003 | 290 | 185 | 646 | 129 | 183 | 29 | 1.382 |
| 2004 | 324 | 206 | 664 | 135 | 185 | 33 | 1.431 |
| 2005 | 449 | 242 | 672 | 166 | 175 | 36 | 1.562 |
| 2006 | 356 | 226 | 745 | 194 | 181 | 41 | 1.7435 |
| **Totaal** | | | | | | | |
| 2002 | 6.526 | 5.373 | 4.777 | 3.031 | 1.720 | 961 | 22.323 |
| 2003 | 7.100 | 6.138 | 5.445 | 3.189 | 1.984 | 1.013 | 24.789 |
| 2004 | 8.291 | 7.012 | 6.051 | 3.469 | 2.132 | 1.197 | 28.036 |
| 2005 | 9.227 | 8.086 | 6.481 | 3.744 | 2.118 | 1.408 | 30.886 |
| 2006 | 9.612 | 8.862 | 7.019 | 4.444 | 2.138 | 1.653 | 33.728 |

*) Africa and Oceania
Source: Port of Rotterdam

## Appendix 5 – Consolidation Feeder/Short Sea market

### Mergers & acquisitions Feeder/Short Sea market

| Buyer | Take Over | From | Share | Month | Year |
|---|---|---|---|---|---|
| Norfoikline (AP M-M) | Norse Merchant | Wayzata | 100% | Jul | 2005 |
| CMACGM | Dextramar | Shareholders | 100% | - | 2005 |
| DFDS | Lys-Line | Simonsen (remaining 34%) | 100% | Dec | 2005 |
| Samskip | Geest North Sea Line | Geest Nederland | 100% | Mar | 2005 |
| Samskip | Seawheel* | Management | 100% | Aug | 2005 |
| Cobelfret | Dart Line | Bidvest | 100% | Jan | 2006 |
| Delphis | Team Lines* | Finnlines | 100% | Jul | 2006 |
| Delphis | Portlink* | Safmarine (AP M-M) | 100% | Aug | 2006 |
| DFDS | Norfolkline Containers | Norfolk Holdings | 100% | Aug | 2006 |
| Eimskip | Containerships | Container Finance | 65% | Sep | 2006 |
| Eimskip | Kursiu Linija | Shareholders | 100% | Sep | 2006 |
| Grimaldi Naples | Finnlines | Shareholders | 51% | Dec | 2006 |
| Samskip | Odiel Bilbao (shortsea) | Naviera del Odiel | 100% | Sept | 2006 |
| Tallink | Silja Line | Sea Containers | 100% | Jun | 2006 |
| Tallink | Superfast Ferries (Baltic) | Attica | 100% | Apr | 2006 |
| Tschudi Shipping | TECO Lines NS | Samskip (remaining 50%) | 100% | Sep | 2006 |
| Rhenus | RMS(remaining7s%) | Shareholders | 100% | Jan | 2007 |
| Montagu ** | Unifeeder* | Founding fathers | 100% | June | 2007 |
| Cobelfret | Ferryways | D&WAgencies/MSC | 100% | June | 2007 |
| Samskip | Delphis' door-to-doorservices | Delphis | 100% | June | 2007 |
| AELLA PIc (?) ** | lrish Continental Group (ICG) | Stocklisting | % | June | 2007 |
| | (Eucon, Eurofeeders*, Feederlink*,lrish Ferries) | | | | |
| FESCo | ESF-Euroservices(jointventure) | Owners; newjointventure | 50% | July | 2007 |

Source: Dynamar, 2007

Notes:
* Predominant feeder operators - ** Financial takeovers- AP M-M = A.P. Møller-Maersk

## Appendix 6 – Feeder area market Shares of European gateways

### European gateways and feeder areas (Market Shares & TEUs)

| Feeder areas<br>European gateway | 2006<br>Share | 2006<br>TEU | 2005<br>Share | 2005<br>TEU | 2004<br>Share | 2004<br>TEU |
|---|---|---|---|---|---|---|
| Scandinavia/Baltic | 43,8% | 1.709.000 | 45,0% | 1.578.600 | 43,0% | 1.379.300 |
| Spain/Portugal | 28,3% | 185600 | 32,3% | 211.800 | 26,8% | 143.400 |
| UK/Eire | 1,1% | 27300 | 1,1% | 25.900 | 0,9% | 20.400 |
| **Hamburg Total** | **27,2%** | **1.921.900** | **27,7%** | **1.816.300** | **26,1%** | **1.543.100** |
| Scandinavia/Baltic | 27,5% | 1.072.000 | 26,1% | 917.900 | 28,2% | 903.400 |
| Spain/Portugal | 0,3% | 2.100 | 0,3% | 1.900 | 0,3% | 1.500 |
| UK/Eire | 1,8% | 43.900 | 1,5% | 35.100 | 1,0% | 20.700 |
| **Bremerhaven Total** | **15,8%** | **1.118.000** | **14,6%** | **954.900** | **15,7%** | **925.600** |
| Scandinavia/Baltic | 14,5% | 567.200 | 15,5% | 545.400 | 14,4% | 460.800 |
| Spain/Portugal | 40,0% | 261.900 | 38,4% | 251.800 | 37,2% | 198.900 |
| UK/Eire | 59,6% | 1.488.700 | 60,1% | 1.431.400 | 60,9% | 1.321.600 |
| **Rotterdam Total** | **32,8%** | **2.317.800** | **34,0%** | **2.228.600** | **33,5%** | **1.981.300** |
| Scandinavia/Baltic | 10,9% | 426.900 | 10,1% | 356.100 | 10,2% | 328.000 |
| Spain/Portugal | 18,9% | 123.700 | 18,2% | 119.500 | 20,0% | 106.700 |
| UK/Eire | 11,1% | 277.700 | 10,5% | 250.700 | 9,2% | 199.500 |
| **AntwerpTotal** | **11,7%** | **828.300** | **11,1%** | **726.300** | **10,7%** | **634.200** |
| Scandinavia/Baltic | 2,3% | 90.600 | 2,2% | 78.300 | 2,2% | 71.800 |
| Spain/Portugal | 1,3% | 8.800 | 0,1% | 900 | 0,0% | 0 |
| UK/Eire | 20,1% | 502.600 | 20,5% | 489.200 | 20,5% | 445.300 |
| **Zeebrugge Total** | **8,5%** | **602.000** | **8,7%** | **568.400** | **8,7%** | **517.100** |
| Scandinavia/Baltic | 0,8% | 30.000 | 0,8% | 27.500 | 1,3% | 40.400 |
| Spain/Portugal | 4,4% | 28.900 | 4,0% | 26.500 | 6,6% | 35.500 |
| UK/Eire | 3,2% | 79.500 | 3,0% | 72.500 | 3,4% | 74.600 |
| **FelixstoweTotal** | **2,0%** | **138.400** | **1,9%** | **126.500** | **2,5%** | **150.500** |
| Scandinavia/Baltic | 0,2% | 8.300 | 0,2% | 8.100 | 0,7% | 21.000 |
| Spain/Portugal | 6,7% | 44.200 | 6,5% | 42.700 | 9,0% | 48.200 |
| UK/Eire | 3,2% | 79.300 | 3,2% | 76.600 | 4,1% | 89.500 |
| **Le Havre Total** | **1,9%** | **131.800** | **1,9%** | **127.400** | **2,7%** | **158.700** |
| Scandinavia/Baltic | 100% | 3.904.000 | 100% | 3.511.900 | 100% | 3.204.700 |
| Spain/Portugal | 100% | 655.200 | 100% | 655.100 | 100% | 534.200 |
| UK/Eire | 100% | 2.499.100 | 100% | 2.381.400 | 100% | 2.171.600 |
| **GrandTotal** | **100%** | **7.058.200** | **100%** | **6.548.400** | **100%** | **5.910.500** |

Source: Dynamar, 2007