THEORY AND STRUCTURE OF PORT COMPETITION: A CASE STUDY OF CONTAINER TRANSHIPMENT IN NORTH EUROPE

By

KOI YU ADOLF NG

For the degree of

DOCTOR OF PHILOSOPHY

Transport Studies Unit

Centre for the Environment

University of Oxford

2006

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Abstract for

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Global economic development has significantly increased the demand for container liner shipping which has led to its global restructuring. Under such a situation, hub-and-spoke liner shipping systems have become increasingly popular which cause more intense competition between major ports and thus transhipment traffic is perceived to play a more important role in deciding the competitive positions of ports. Although there was no shortage of studies investigating port competitiveness in the past decades, most of them had overlooked the necessity of theorising port competition while ignoring the importance of including less-readily quantifiable factors in the port competitiveness assessment process.

Thus, a research gap clearly exists and through investigating the competitiveness of Antwerp, Bremerhaven, Felixstowe, Hamburg, Le Havre and Rotterdam acting as container transhipment hubs in North Europe, this thesis attempts to theorise port competition. Apart from providing a theoretical framework, Port Competitiveness Model, to future port research, this thesis also aims to identify the major factors affecting port attractiveness, to assess port choice behaviour, to investigate the current port competitiveness and to forecast their future prospects in the market. Research methodology involves various quantitative modelling techniques including generalized cost calculations (to assess port attractiveness), Multinomial Logit Model (to assess port choice behaviours of liners and the current competitive positions of ports) and Logistic Regression (to predict port competitiveness in the future), while data collection includes a questionnaire survey of major liners and various in-depth interviews with port and shipping experts in Europe.

Findings indicate that money and time are not sufficient to explain the choices of liners and other less-quantifiable factors like geography, quality of services, values and perceptions, inertia, limitations of liners are also significant. Rotterdam is currently the overall market leader in the North European transhipment market but may be fragile in resisting challenges from competitors while Hamburg is a regional leader in the Scandinavia-Baltic market. On the other hand, Bremerhaven is currently an underachiever but possesses potential if it changes its current competitive strategies while Antwerp also possesses potential but faces different problems in its developments. For poor performing ports like Felixstowe and Le Havre, they need to improve significantly before they can really compete. Also, results suggest that ports should not only focus on expensive physical improvements (like infrastructure) but should also pay attention to software aspects in port operations e.g. management, marketing, etc. The key to achieve port competitiveness does not depend on port's administrative system but on how it executes the system and makes things work. In the foreseeable future, the author firmly believes that this thesis will become one of the theoretical 'pillars' in the theory of port competition.

DECLARATIONS

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Koi Yu Adolf Ng
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LIST OF ABBREVIATIONS

AAS	Average Appreciation Score
AHP	Analytic Hierarchy Process
ANOVA	Analysis of Variance
ANR	Antwerp, Container Port of
ASS	Average Significance Score
BBC	British Broadcasting Co.
BRV	Bremerhaven, Container Port of
CDP	Cost Distribution Pattern
CEO	Chief Executive Officer
DC	Duration Cost (average time spent in port)
DF	Degree of Freedom in Logistic Regression
DNQ	Dunkirk, Container Port of
DSK	Dvorsk Simplified Keyboard
DV	Dummy Variable/Disturbance
EC	European Commission
ECI	Port Efficiency Comparative Index
ECT	Europe Container Terminals B.V.
ED/C	Port Efficiency Discount/Cost
EDF	Electricté de France
EDI	Electronic Data Interchange
EI	Time Efficiency Index
EMS	Estimated Market Share
EP	European Parliament
ERS	European Rail Shuttle
EU	European Union
FDI	Foreign Direct Investment
FFM	Porter's Five Forces Model
FLX	Felixstowe, Container Port of
GATT	General Agreement on Trade and Tariff
GCCI	Generalized Cost Comparative Index
GCI	Locational Efficiency Comparative Index
GD/C	Locational Efficiency Discount/Cost
GI	Locational Efficiency Index
GNP	Gross National Product
HPH	Hutchison Port Holdings
HAM	Hamburg, Container Port of
IIA	Independence from Irrelevant Alternatives Property
IID	Independent and Identically Distributed Disturbance
IL	Interviewed Liners during Questionnaire Survey
IT	Information Technology
JC	Journey Cost
JD	Journey Duration
LE	Locational Efficiency
LECE	Locational Efficiency Cancellation Effect
LHV	Le Havre, Container Port of
LRM	Logistic Regression Model

MAE	Mean Absolute Error
MC	Monetary Cost
MiA	Mismatch in Anticipation
MNL	Multinomial Logit Model
NPM	Negotiation Process and Marketing (see PCM)
PA	Port Attractivity
PCM	Port Competitiveness Model
PD	Port Duration
PE	Port Efficiency
PoF	Port of Felixstowe Ltd.
PPD/C	Port Performance Discount/Cost
PPI	Port Performance Index
PSA	PSA Corporation Ltd.
PUSI	Port Users' Sphere of Influence (see PCM)
QFCI	Qualitative Factor Comparative Index
QFD/C	Qualitative Factor Discount/Cost
QFI	Qualitative Factor Index
RMS	Real Market Share (of North European container transhipment)
RPM	Rotterdam Municipal Port Management
RTM	Rotterdam, Container Terminals of
SOT	Southampton, Container Terminals of
TQM	Total Quality Management
TEU	Twenty-Foot Equivalent Unit, the Standard Unit of Containers
THC	Terminal Handling Charge (i.e. Container Handling Charge)
TIL	Tilbury, Container Port of
TMP	Thamesport, Container Port of
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
US	United States of America
USSR	Union of Soviet Socialist Republics
WTO	World Trade Organisation
ZEE	Zeebrugge, Container Port of

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Every bit of this thesis reflects my enthusiasm, energy, diligence and efforts in addressing this increasingly important issue and I am confident that it has played its appropriate role in enriching transport economics and geography literatures. It would surely be my greatest satisfaction if readers find this thesis interesting, informative and, perhaps most importantly, a valuable reference to the progress of transport economics.

Koi Yu Adolf Ng

CHAPTER ONE
INTRODUCTION

1.1. SETTING THE SCENE

Persistent increases in international trade, industrial outsourcing and global economic developments have significantly increased the demand for container liner shipping since the 1990s. With increasing container vessel sizes, mergers and acquisitions between shipping lines (hereafter called 'liners') and the formation of strategic shipping alliances, trunk-and-feeder route (or hub-and-spoke) systems become increasingly popular in global shipping. With the effects of economies of scale, it is not surprising that recent developments in global shipping have led to few port calls, thus causing more intensive port competition and the rising importance of transhipment traffic in deciding the competitive positions of ports, especially the major ones. Being one of the world's economic powerhouses, North Europe is no exception here.

Throughout the past decades, there was no shortage of works studying and modelling port competitiveness, both within and outside Europe. Nevertheless, due to various problems, most of these studies only included easily-quantifiable factors in their analysis, notably monetary cost and time, while the less-readily quantifiable but potentially equally significant factors were generally ignored throughout the research process. Under such situation, it was not surprising that the relevance and forecasting power of such models became questionable because the competitiveness of a port is unlikely to be only affected by readily quantifiable attributes. Although some scholars attempted to address such shortcomings e.g. Slack (1985), Tongzon (2002), Lirn et al. (2004), etc., until recently, the objectives of most of these works only focus on comparing the relative importance of quantitative or qualitative factors in explaining port competitiveness while largely ignored

the possible complementary or even mutually dependence of both attributes in affecting port choice decisions by users. As Song and Han (2004) had noted, most existing studies have yet to address the relative contributions of different attributes in explaining port attractiveness. A research gap clearly exists within the literature which is yet to be filled.

With such understanding, using the container transhipment market in North Europe as the case study, this thesis attempts to address this deficiency. This study does not only include the less-quantifiable factors that have formerly been largely neglected in assessing port competitiveness, but also making a real attempt to inscribe such factors into the port competitiveness model simulating process. Also, through creating such model, the strengths and weaknesses of North European ports serving as transhipment hubs and the current and future competitive positions of ports in this market will be discussed. It is anticipated that this thesis can offer a significant contribution to thorough understandings on the relations between port service suppliers and users so as to facilitate efficient port strategic management. Also, this thesis provides valuable opinions on the current and future competitive positions of ports in North Europe and provides new insights in future research in transport economics.

After setting the scene, the objectives and hypotheses of this thesis will be discussed in Section 1.2. It is followed by Section 1.3 explaining the thesis structure, while the research limitations and contributions will be illustrated in Section 1.4.

1.2. OBJECTIVES AND HYPOTHESES

Based on the above research gap, this thesis attempts to achieve six objectives. Firstly, it aims at giving a concise research platform in the decision-making process of liners in

choosing a transhipment hub and thus port competitiveness. Until very recently, attempts to establish theories on port competition have been extremely scarce. Thus, through creating a theoretical framework in explaining port competition, this thesis aims to achieve the status of becoming one of theoretical 'pillars' of port research in the foreseeable future.

Secondly, based on the theoretical framework, this thesis aims to introduce a practical methodological process in identifying the major factors and their roles in affecting port competitiveness. With reference to the research gap mentioned in Section 1.1, attention is focused on creating a method in estimating the monetary value of less-readily quantifiable attributes e.g. management efficiency, reputation, perception, etc. Although not without its limitations (as virtually all research studies would have), as illustrated in latter chapters, the methodology introduced in this thesis is decently supported by previous studies, careful data sampling and econometrical techniques.

Thirdly, this thesis attempts to assess the degree of significance of less-readily quantifiable factors like geography, service quality and subjective preferences in deciding the competitive position of a port. This is especially true with geographical location, where it is argued that the location of a port should not be decided only by money and time, but also its *centrality* and *intermediacy* within a region (Fleming and Hayuth, 1994). Together with the fact that serious investigation of the influences of less-quantifiable factors on port competitiveness is still in short supply, it is anticipated that this thesis will make a significant contribution to the maritime transport literature.

With a comprehensive theoretical framework and methodology, the fourth objective is to assess the competitive position of the Core-Six Ports acting as transhipment hubs between

North Europe and different European regions. Apart from assessing the strengths and weaknesses of ports, this thesis also tries to enhance the understanding of the current competitive positions of these ports in the market.

The identification of port competitiveness also implies that it is possible to identify the reasons in deciding the current competitive structure which also serves as the fifth objective. Focus is on how significant the influence and power of liners is on deciding the competitive positions of ports within the market. The aim is to assess whether the only way forward for ports in maintaining their competitive position is to continue investing heavily, or whether alternative strategies could be possible in controlling the bargaining power of liners and shipping alliances, thus depreciating the negative implications of scale economies on ports.

Apart from assessing the current situation, this thesis also aims to forecast future port competitiveness in the North European transhipment market. Attention will be paid on how beneficial ports would gain through improving their service quality and their abilities in protecting their business being extracted from their competitors. Through these forecasted results, practical recommendations to port managers in developing their future competitive strategies can be given.

The above objectives imply that several hypotheses can be identified. According to Frankfort-Nachmias and Nachmias (1996), hypotheses are tentative answers and must be clear, specific and value-free. Firstly, in the container transhipment market, the competitive position of ports mainly depends on liners. This is supported by some transport scholars like Ha (2004) who argues that the vessels of liners are the direct users of ports and usually other related parties within the industry do not care (or even know)

about such choices. If true, it implies that the competitive position of port in container transhipment market is directly related to the opinions and perceptions of liners on ports.

Secondly, while monetary costs and time requirements are critical factors in transhipment hub choices, they are not necessarily the only factors. Other less-readily quantifiable factors are also important factors affecting the ultimate decisions of liners and thus the competitive position of ports.

Thirdly, in terms of service quality, it is possible that user's reaction to good and poor quality can be different. For example, while poor service would likely discourage users away from a particular port, decent service does not necessarily guarantee an increasing number of port-calls by them. Thus, the decisions of users are not necessarily rational.

Fourthly, rather than passively awaiting their fate, ports can take more proactive approaches to enhance their competitiveness. Although the competitive position of a port also depends on factors which are not directly related to its service quality, it does not mean that a port has absolutely no control on it. For example, active port marketing can possibly address the problem that customers have special preferences for its competitor.

The above clearly indicates the author's attempt to bridge the gap between quantitative and qualitative factors in assessing port competitiveness. It implies that analysis can never be comprehensive when either side is ignored. As Preston (2004) has argued, alternative approaches should also be included so as to reflect the more structural and humanistic and the various developments they have inspired to transport research and this requires a mixture of state-of-the-art quantitative and qualitative approaches, including maritime transport.

1.3. THESIS STRUCTURE

After this introductory chapter, Chapter Two consists of the literature review and the theoretical framework. After reviewing the development of global container shipping and its implications on the geography of shipping networks, the rise of container transhipment and port competition, theories on business competitiveness and its applicability on port competition will be discussed. With the extreme scarcity of theories in addressing port competition (Meersman and Van de Voorde, 1998), focus will be paid to the competition models introduced by Porter (1985 and 1990). As Porter argued that less-readily quantifiable factors are also important in deciding the competitiveness of a firm within an industry, a review on former studies in analysing port competitiveness will also be undertaken. Finally, the author has introduced a theoretical framework in explaining port competitiveness, namely Port Competitiveness Model (PCM), which also acts as a diagrammatical platform in supporting the construction of a mathematical model in forecasting the future competitiveness of ports acting as container transhipment hubs in North Europe.

Chapter Three presents the study area, approach and research methodology. After introducing the six ports included in this study (Antwerp, Bremerhaven, Felixstowe, Hamburg, Le Havre and Rotterdam, hereafter called the 'Core-Six Ports'), the study approach will be discussed in the second section. The research methodology combines both quantitative and qualitative aspects in assessing port competition through estimating market shares, explaining and forecasting current and future competitiveness respectively. While the analytical process involves the calculation of generalized costs, estimation of market shares and the construction of Logistic Regression Model (LRM), data collections

involve a questionnaire survey directed towards liners and various in-depth interviews with port and shipping experts in Europe. The major discussion topics in these interviews are also discussed.

Chapter Four presents the results obtained from the questionnaire survey. Firstly, raw data obtained from the questionnaires will be illustrated and discussed, followed by data processing and the calculation of an index reflecting port performance namely Port Performance Index (PPI). Finally, PPI will be simulated into estimated monetary values and inscribed into the generalized cost equation to calculate the generalized cost.

Using the generalized costs, Chapter Five discusses the current competitive positions of ports in the market. By applying Multinomial Logit Model (MNL), the market shares of the Core-Six Ports in North European transhipment are estimated and compared to the real market shares which gives an immediate answer on whether the choices of transhipment hubs by liners are strictly based on port performances or whether there are other factors missing but critical in their decisions. Results obtained from this study support the possibility of a successful 'marriage' between quantitative and qualitative approaches in the choices of transhipment hubs as a more 'humanistic' input during the research process addresses many of the constraints from conventional methodologies. This chapter also gives comprehensive insights on the over- and under-achievers in the North European transhipment market.

Chapter Six discusses the current competitive positions of ports in the North European transhipment market. After assessing the strengths and weaknesses of the Core-Six Ports acting as transhipment hubs, the second section investigates how other factors have affected the transhipment hub choices of liners. Contents of this chapter give valuable

insights in explaining why some ports over- or underachieve in getting more transhipment business from potential clients. This chapter ends by summarising the reasons for the formation of the current port competitive structure of the North European transhipment market.

After assessing current competitiveness, Chapter Seven forecasts the future competitive position of ports. Through applying logistic regression, the procedure of constructing the LRM will be introduced and explained while its forecasting reliability will be statistically tested. With the LRM available, the future prospects of the Core-Six Ports acting transhipment hubs will be forecasted. Here special attention will be paid on the stability of the competitions in various European regions and whether the current competitive positions of ports, especially the strong ones, are sustainable and how the currently weaker competitors can enhance their competitive positions. Based on the forecasted results, some recommendations will be offered to ports on how they should construct their future development strategies.

Chapter Eight is the conclusive chapter. Here the objectives, hypotheses and contributions will be revisited and see if these aims have been achieved, together with the major findings and arguments being summarised. Finally, a few questions for potential further research will be suggested.

1.4. LIMITATIONS AND CONTRIBUTIONS

An introductory chapter cannot be completed without discussing the contributions and limitations of this thesis. Indeed, due the inaccessibility of data and restrictions of time and resources, limitations exist in all research studies and this thesis is no exception.

Firstly, limitation exists within the choice of study targets. Although this thesis has covered the most important ports in North Europe with the six ports studied here which dominate the North European container transhipment market, it is by no means complete and minor players like Amsterdam, Southampton and Zeebrugge are not included. Also, during the survey (see Chapter Three), interview targets consist of global top 30 liners only. Although this is adequate to cover more than 70% of the total container carrying capacity in North Europe, still, this study only covers the general picture while more specific local ones are mostly overlooked.

Another limitation involves the study focus, where it mainly investigates the decisions and opinions of liners when calculating the generalized costs. Although liners are the most important decision-makers in the choice of transhipment ports (see Chapters Two and Three), other players like shippers and freight forwarders may also have certain influences port competitiveness acting as transhipment hubs. To minimise the impact of this shortcoming, various measures have been conducted throughout the research process, like including the role of other players in the questionnaire survey and that in-depth interviews have been conducted to various players within the industry apart from liners. Also, as mentioned before, this study investigates the transhipment of containers only. Other non-containerised cargoes like raw materials and fossil fuels are not considered.

Limitations also exist in the methodology. One of the major challenges is to simulate the estimated monetary values of qualitative factors in a sensible way which proves to be difficult and here two assumptions had been made. Firstly, by transforming qualitative factors into monetary terms, the tricky process of cardinalising ordinal data (obtained from survey questionnaire) became inevitable. Secondly, while calculating generalized

cost, monetary cost was assumed to have a linear relation with other non-monetary factors. For example, if it were found that a non-monetary factor is 50% as important as monetary cost, then the monetary value of this factor was assumed to be 50% of real monetary cost. Of course, the sensibility of such assumption was open to debate (especially since within the academic field, reliable information in clarifying the relations between quantitative and qualitative factors is extremely scarce) while the modelling process could not proceed if such assumptions were not made sensible (the refusal of industrial players to provide commercially sensitive information has virtually ruled out the option of carrying out a research to test these assumptions). Nevertheless, such difficult decision had been made easier by the work of Nijkamp et al. (1990) who provided detailed guidance on how opinion questionnaire (especially score scale) should be designed in a way so that the above two assumptions could become mathematically justifiable (see Chapter Three). While not rejecting the notion that limitations still exist, with such academic support, the author was finally convinced that, these assumptions could be made sensible through designing the questionnaire and applying modelling techniques carefully.

Furthermore, during data collection, although the author received a good response rate in the questionnaire survey, it still suffered from some setbacks like the refusal of one important liner to participate in the survey and the declination of one important personnel within the industry to accept an in-depth interview invitation mainly citing busy time schedules and commercial confidentiality. Another limitation is that the price charged by a particular port to different liners was assumed to be the same which was not the case in reality. Nevertheless, again, commercial confidentiality was enough to stop the author's access to detailed rates charged by different ports to different liners. Keeping commercial

information secret was understandable since, as Porter (1985) had noted, it was an effective method to sustain the competitive edges of firms.

Finally, in this thesis, the role of hinterland in deciding port competitiveness acting as transhipment hubs is not analysed in detail. Although transhipment means a transfer of cargoes from a vessel to another vessel, hinterland also plays its role in affecting port's potential in becoming a transhipment hub. This is especially true for North European ports where their immediate surrounding regions are traditionally the industrial and economic powerhouses of Europe e.g. Germany's Ruhr District, Benelux regions, etc. Nevertheless, the role of hinterland itself was a very big topic and it was by no means an exaggeration to argue that its inclusion here could actually mean doubling the size of this thesis. Given the limited amount of time and resources to the author, the inclusion of hinterland was actually too big a task and thus it could not be investigated in detail here.

Despite its limitations, this thesis offers several significant contributions. Firstly, the response rate of the survey questionnaire is high and covered a dominant share of the market. Also, the relevance of the interview targets has been thoroughly discussed with experts within the industry and the author has been guaranteed that all survey participants are directly involved in negotiations and possess the most important authorities in the decision-making process, rather than just working under instructions with no real authorities. Furthermore, as illustrated in Chapter Seven, through calculating own and cross elasticities of demand, a forecasting model in anticipating the implications of improvements/cost reductions by different ports on themselves and their competitors becomes possible.

Perhaps most importantly, this thesis has played an important role in filling big research gap in maritime transport by theorising port competition and proposing a sensible method in treating qualitative factors during the mathematical model construction process. By introducing PCM, this thesis has made a pioneer attempt to express a port competitiveness model diagrammatically. This can become a valuable companion to future researchers as it is designed in a way where different mathematical models in addressing different aspects of port competition can be constructed through applying different modelling techniques on PCM's attributes. At present, there are extremely few (if any) scholars who have undertaken what the author had done. Although acknowledging the lack of port competition theories and the importance of qualitative factors, many scholars still preferred to ignore them or did not take further steps to address the issue e.g. Baird (2002), Veldman and Buckmann (2003), Jeffs and Hills (1990), Jose (2003), Ha (2003), Lirn et al. (2004), etc. Through this thesis, the author's intention of trying to move the discipline of transport economics and geography forward becomes very clear.

As a consequence, the contributions of this thesis have significantly overshadowed its limitations and its contribution to transport economics and geography is immense. While the validity of such statement is still to be tested, the author is very confident that the quality of this study would convince most readers that such positive self-assessment is not without the support of objective reasons.

CHAPTER TWO
LITERATURE REVIEW AND THEORETICAL FRAMEWORK

As Flowerdew and Martin (1997) have noted, it is important for all academic researches to review the major previous works related to the topic so as to give the researcher a strong background when undertaking the research project. The objective of this chapter is to fulfil this fundamental requirement.

This chapter is divided into five sections. After introducing the recent development of the global container shipping industry in Section 2.1, its implications on the geography of port competition and container transhipment will be illustrated in Section 2.2. In Section 2.3, conventional competitive models and their applications on port competition will be investigated, while Section 2.4 will review previous studies on port choice criteria. Finally, Section 2.5 will introduce the theoretical framework of this thesis, namely Port Competitiveness Model (PCM).

2.1. RECENT DEVELOPMENTS OF CONTAINER LINER SHIPPING

With a continuous annual growth rate of 8.3% since the early 1980s, container liner shipping industry has grown rapidly (Peters, 2001) which seems to contrast Sturmey (1966) who argues that by the 21st century shipping would become obsolescent and ships would be built *only for the sake of holidays and pleasure*. Such negative perception on maritime transport, at least until now, has not been realised and, in the foreseeable future, maritime transport is anticipated to continue its role as one of the most important components in global trade.

The continuous growth of liner shipping probably explains why so many studies on recent developments of liner shipping and ports have been undertaken throughout the past decades which involve various fields in social science like geography, economics and politics. Indeed, as part of the global transport system, liner shipping plays a significant role in economic geography through creating economic benefits for globalisation and enables the breeding of regional specialisation (Hanson, 2000) by linking these maritime corridors into networks and brings places closer together. Quoting Nijkamp et al. (1994), maritime transport is the *blood circulation* of the global economy and Europe is no exception, where 90% of all trades between Europe and the rest of the world are carried by sea (EC, 2005).

Towards the end of the 20th century, several factors have shaped recent global shipping including the growth of international trade, the emergence of new markets, global division of labour, regional specialisation of production, the emergence of new carriers and supply chain logistics. These factors have been encouraged by the recent trend of having some kinds of direct presence in a particular overseas location or market, complemented by the successful conclusion of the Uruguay Round of GATT (1986 – 1994) in the removal of trade barriers[1]. In turn, this has accelerated the process of globalisation, although it is unlikely to take place without the support of good transport connections as a critical condition in deciding the sophistication, productivity and thus the competitiveness of companies in the contemporary world (Porter, 2000). Indeed, a good transport network is not only essential in offering better access between manufacturers and consumers, but also a necessity to allow specialisation and geographical concentration to take place

[1] Further information on the Uruguay Round of GATT can be found in the official website of the World Trade Organization (see Bibliography), of which the 550-page document signed by members of GATT consists of about 60 agreements on the removal of trade barriers and liberalisation of investments in various industrial and service sectors.

(Krugman, 1998). According to Dunning (2000), changes in foreign direct investment (FDI) pattern are possible only if it can be accompanied by the minimisation of distance-related costs so that firms can exploit global markets effectively. With the process of globalisation and the rise of multinational corporations, the global economy has entered into a period where customers emphasise greater varieties, customer oriented business strategies, fitting individual demands and better quality of products. Since customer taste changes quite often nowadays, consumer goods have to be delivered within a short but right period of time commonly known as *just-in-time*.

These factors, complemented by technological improvements (notably containerisation and computerisation), which have led to expensive capital investments and mechanisation of general cargo-handling (Brooks, 2000), contemporary demands on liner shipping have also changed forever, notably increased demands for more reliable services in freight movements, being reinforced by the concept of intermodal transport and global logistics chains. As the *blood circulation* of the global economy, it also implies changes in the fundamental structure of maritime transport including both vessels and ports. In fact, as early as the late 1970s, Bennathan and Walters (1979) suggested that the world is going to witness a gradual increasing importance of transhipment within the industry towards the end of the 20th century and ports will concede their monopolistic position. Competition between ports is far from just wars between monetary costs and they argued that quality of services would become prominent in deciding the competitive position of ports.

New economic environment also implies the need of a new management philosophy. According to Notteboom and Winkelmans (2001), in order to succeed in such environment, suppliers and producers should possess flexible business attitudes and strategies to meet more diversified demands. Due to continuous development in

international trade and production, most traders also expect some innovated transport system for the smooth delivery of their commodities and thus, naturally, have higher expectations from transport operators. Within such change in perceptions, instead of only attempting the spread of fixed costs to achieve economies of scale, firms should put much more emphasis on customer tastes as well as to fulfil wider geographical coverage and more diversified and higher quality freight transport service, including liners.

Although the practices and decision-making process of liner shipping companies (hereafter called 'liners') can be confidential and thus inferring strategies can be speculative (Heaver, 2002), still, the effects on the recent trends of liner shipping have been studied widely. Contrary to some predictions[2], contemporary liner shipping is characterised by greater conformity, standardisation, mechanisation and homogeneity as the hallmark effects (Slack et al., 2002) which can mainly be divided into hardware and software aspects. For hardware aspect, the trend of increasing vessel size in container shipping industry has been observed as early as the 1980s (Chilcote, 1988) and this trend has seemed to sustain. While the mean carrying capacity of the vessels of top 20 liners had been 1,500 TEU[3] in 1989, this figure has jumped dramatically in the 1990s, with the mean size of 2,000 TEU and nearly 3,500 TEU in 1994 and 1999 respectively. The mean carrying capacity of the largest vessel of top-20 liners is equally impressive, increasing from 2,600 TEU in 1989 to 4,000 TEU and 5,000 TEU in 1994 and 1999 respectively (Drewry, 1998).

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[2] For example, Murray (1966) argues that there will not be any radical changes in shipping because of physical restrictions in port facilities which require significant capital investments. He argues that it is proper to move cargoes in and out of a ship in a horizontal plane rather than *lift it in the air and lower it again.* However, his opinion is clearly proved wrong by real world evidence.

[3] The introduction of Twenty Foot Equivalent Unit, or TEU, was inspired by the British journalist, R.F. Gibney, in 1969 as a solution to tackle the challenge of recording shipbuilding and freights with different sizes and dimensions of containers used by various liners in UK. His contribution to liner shipping is immense since, without TEU, the speed of containerisation is likely to be hindered due to competing container standards between different countries, regions and liners during its early revolution (Slack, 1998).

The continuing increase in vessel size supports the views of Slack et al. (2002) who argue that more uniformity and concentration have emerged within the industry. As Martin and Thomas (2001) have noted, due to the process of globalisation and the need to keep pace with the development of other sectors of the global economy, liners have sought to further rationalise its organisational structure by increasing their services. For example, the total number of container liner services provided by top 20 liners had risen from little more than 400 in the late 1980s to nearly 600 in the late 1990s (Slack, 2001). Some scholars go even further and argue that the implications of the global economy on global container shipping has already shifted *from demand-pull to supply-led strategies* and *cargoes followed ships rather than the other way round* e.g. Chilcote (1988), Cullinance and Khanna (2000), etc. With the assistance of the economies of scale in container vessel size and increasingly easy accessibility to advanced technology, liners adjust their development strategies based on their own future perceptions.

Although capital concentration also took place before[4], containerisation has clearly accelerated this process. By the start of the 21st century, the deployment of mega-sized container vessels is a common practice among top liners. Some liners like CMA-CGM already possess vessels with 8,000 TEU of loading size, while shipbuilder Hyundai Heavy Industries Ltd. is already accepting new orders for 13,000 TEU vessels (Hyundai, 2005). The largest global liner to date, Maersk-Sealand, is even investigating the possibility of designing mega container vessels with loading sizes of between 12,000 and 15,000 TEU. It seems that the scale economies approach in transport development, as noted by Krugman (1991), has been perfectly illustrated in liner shipping industry. There are two

[4] For example, according to Chrzanowski (1975), the number of shipping companies around the world was 1,790 and 1,389 in 1880 and 1907 respectively, while between 1914 and 1955, the number of shipping companies had dropped by almost 23%.

reasons in explaining this process. Firstly, it is due to the anarchic nature of the open sea[5] which implies the lack of artificial forces affecting its uniform pattern. According to McCalla (1999), such a deregulated environment enables liners to switch network operations according to the benefits of their own financial bottom line which implies that liner shipping is virtually operating under free competition or described by Chrzanowski (1975) as *shipping liberalism*. Unlike many other transport modes where the government can impose licenses to particular companies for operation, government has virtually no influence on deep-sea maritime transport which is not helped by the anarchic nature of the open sea and the use of flags of convenience by vessels[6].

Secondly, technological change requires more capital investments, with dedicated facilities necessary for handling containers, this implies that the number of companies which possess the financial and technical strengths to provide quality service have gradually decreased (or requiring a combination of strength). Quoting Palmer (1999), containerisation has occurred so rapidly that the shipping industry is not allowed a gradual response in terms of investments in cargo-handling facilities which differ significantly from historical experiences. With continuing increases in vessel size and services, major liners anticipate that they can only survive and make profits only if scale economy approach is included in development strategies. Such a trend is best described by Hanson (2000) that transport scholars and planners are often fascinated by the relations between infrastructure and prosperity, between network characteristics and what goes on at

[5] According to the Convention on the Law of the Sea by the UN, except a 12-miles zone stretching from coasts are declared 'territorial seas' with national sovereignty, all other maritime surfaces are declared as anarchic, where vessels of any states enjoy the right of *innocent passages*. See UN official website (see Bibliography).

[6] Under the Geneva Convention on High Seas, each country/region should fix the conditions for granting its nationality to vessels for the registration of vessels in its territory. A vessel registered to a country/region will be governed and protected by the laws of that particular country/region and has the right of flying its national/regional flag. Thus, *flag of convenience* becomes a popular way among shipping firms to avoid high taxes and problematic regulatory measures by registering their vessels at a country/region with minimum restrictions (usually small-sized and/or resource-scarce countries/regions). See Alderton (1973), Stubbs et al. (1984) and Pallis (2002).

network nodes.

Although some researchers questioned whether continuing rise in container vessel size was sustainable e.g. Johnson and Garnett (1971), Bekemans and Beckwith (1996), etc., notably limitation of ports to handle such vessels, implications of the oil crisis and environmental concerns, development since the early 1990s seems to suggest otherwise. Given the highly speculative nature of investments, economies of scale approach in liner shipping seemed necessary and running liner shipping had developed into an expensive lottery with only those who were willing to take the high risk of heavy investments had any chances of winning, leaving those who were unable/unwilling to participate in introducing larger vessels doomed to near certain failures. Perception and speculation in global shipping had completely altered the industry's landscape where, despite its high cost, containerisation occurs at a surprising rate since the 1970s not really because of confidence in containers, but more out of fear of competition. As Campell (1993) had noted, no major liners were courageous enough to risk leaving themselves out of the container revolution.

The implication is that liner shipping investments must preserve the delicate balance of providing capacity to meet customer demands but at the same time without creating overcapacity. As Notteboom (2002) has argued, scale economy approach in a capital-intensive industry like liner shipping can lower the market contestability of that industry because significant amount of sunk costs has significantly reduced the flexibilities of market entry and exit. Thus, once investments on new equipment and services have been made, considerable obstacles exist for investors to abandon the projects even if it were clear afterwards that demands for new services have been overestimated and that profit gains are minimal or even zero. With such dilemma, the only way for them is to go

forward and try to get as much as possible. Moreover, the increasing size of container vessels is directly proportional to the financial cost of their construction i.e. high proportion of fixed cost in the total cost and the cost of maintenance and operations. The average new-building prices of container vessels and containers since the turn of the century are presented in Table 2.1.

Table 2.1. Average new-building prices of container vessels and containers, 2000 – 04

YEAR	CONTAINER VESSEL			CONTAINER
	1,500 TEU (22,000 dwt)	3,500 TEU (45,000 dwt)	6,500 TEU (75,000 dwt)	One TEU
2000	€ 19,300,000	€ 32,600,000	€ 56,000,000	€ 1,253
2001	€ 19,200,000	€ 34,200,000	€ 58,400,000	€ 1,211
2002	€ 17,400,000	€ 28,200,000	€ 53,000,000	€ 1,127
2003	€ 18,900,000	€ 30,800,000	€ 55,500,000	€ 1,169
2004	€ 26,000,000	€ 42,000,000	€ 71,800,000	€ 1,587

Note: Initial figures are expressed in USD and being converted to Euros (Exchange rate: 1 USD = 0.835 Euros). Source: Drewry (2005)

By 2004, the building prices of container vessels with carrying capacities of 1,500, 3,500 and 6,500 TEU were 26, 42 and 72 million Euros respectively, while larger and newer generation vessels could cost 80 – 100 million Euros to liners (World Bank 2000). The price of containers is also high, with nearly 1,600 Euros required to buy a new one in 2004. According to Drewry (2005), due to global shortage of steel and increasing Far-East trade (and thus demands in container traffic), the new-building costs of containers and their carriers are anticipated to remain high in the foreseeable future. Such implies that significant sunk costs[7] have been agglomerated during this process which has counter-balanced the efficiency of economies of scale due to decrease in liner operation cost (Rodrigue, 1999) and this is supported by Rietveld and Vickerman (2004) who illustrates that the real cost indices (fixed and operation costs combined) of ocean shipping in pre-

[7] Sunk cost has two major characteristics – little opportunity cost and long payback period. Many transport infrastructure projects involve considerable sunk costs due to massive capital investments. See Hibbs (1993).

1945, 1960 (when the use of containers was introduced) and 1990 (when large-scale use of containers had been introduced for several decades) are 107, 47 and 51 respectively[8]. This indicates that massive capital investments can exert vast financial pressures on liners. However, rising prices seem to achieve little in encouraging liners to drop their investment plans, especially the major liners. As Haralambides (2005) pointed out, many liners choose to continue purchasing large vessels to pursuit economies of scale, even if they can perceive that they cannot fill them up completely. See Table 2.2.

Table 2.2. Orderbook of new container vessels with carrying capacity of 5,000 TEU or higher, May 2004

CATEGORY	NUMBER	TOTAL CARRYING CAPACITY
All Liners		
5,000 TEU +	286	1,980,340 TEU
6,000 TEU +	195	1,500,207 TEU
7,000 TEU +	147	1,186,625 TEU
8,000 TEU +	108	888,975 TEU
Top 30 Liners		
5,000 TEU +	251	1,800,764 TEU
6,000 TEU +	193	1,487,207 TEU
7,000 TEU +	140	1,132,625 TEU
8,000 TEU +	83	684,175 TEU
Other Liners		
5,000 TEU +	35	179,576 TEU
6,000 TEU +	2	13,000 TEU
7,000 TEU +	7	54,000 TEU
8,000 TEU +	25	204,800 TEU

Source: Ocean Shipping Consultants (2004)

With high fixed costs, only a small part of the total costs can be avoided even if the vessel is left idle. Such growth has indeed created significant challenges for shipping because liners have to add capacities to their fleets in a short period of time (Slack, 2003), not helped by the higher opportunity costs of larger vessels waiting in ports than smaller ones. Larger vessels also create other problems like high insurance costs, increasing problems

[8] Here year 1910 is set as the base reference point with a real cost index of 100.

in serving peripheral routes and more complicated loading/unloading system and thus potentially more idle time (Stubbs et al., 1984 and Chilcote, 1988).

Moreover, increasing vessel size also means that the cargo demands of the peripheral regions of the global economy are not adequate to fill up these vessels. Thus, from the perspective of liners, these regions should be given up and their mega-vessels should concentrate on the trunk routes where there are adequate demands on freight transport to fill up their vessels. Nevertheless, interestingly, even the core regions[9] do not necessarily have enough demands to fill up these vessels. Despite the anticipated market demands increase, such perceptions do not necessarily follow the same pace with increasing size of container vessels. For example, in the foreseeable future, it is anticipated that no single port in North Europe would load/unload more than 3,000 TEU of containers from a container vessel at one time (ECT, 2004). Thus, it shows that liners' strategy of scale economy approach is more based on perceptions and supply-led approach rather than demand-driven and multi-port services are still the features of global container liner shipping. Even after more than three decades, the unfavourable situation of liner shipping, which is characterised by highly capital-intensive but relatively low revenue returns (Chrzanowski, 1975)[10] has not really improved and, in some cases, became even worse. It means that competition within liner shipping industry has become more intense at a somewhat unexpected rate (Slack et al., 1996). As a consequence, these capital-intensive container vessels must also ensure that loading capacity should always reach its full capacity as much as possible.

[9] Here it implies North America, North Europe and the Far East. These three regions occupy about 90% and 33% of world trade and TEU throughputs respectively (Drewry, 2005).
[10] For example, throughout the late 1980s and the whole of 1990s, profits of only US$0.40 per year were realised by a sample of eleven global major liners (Slack et al., 1996).

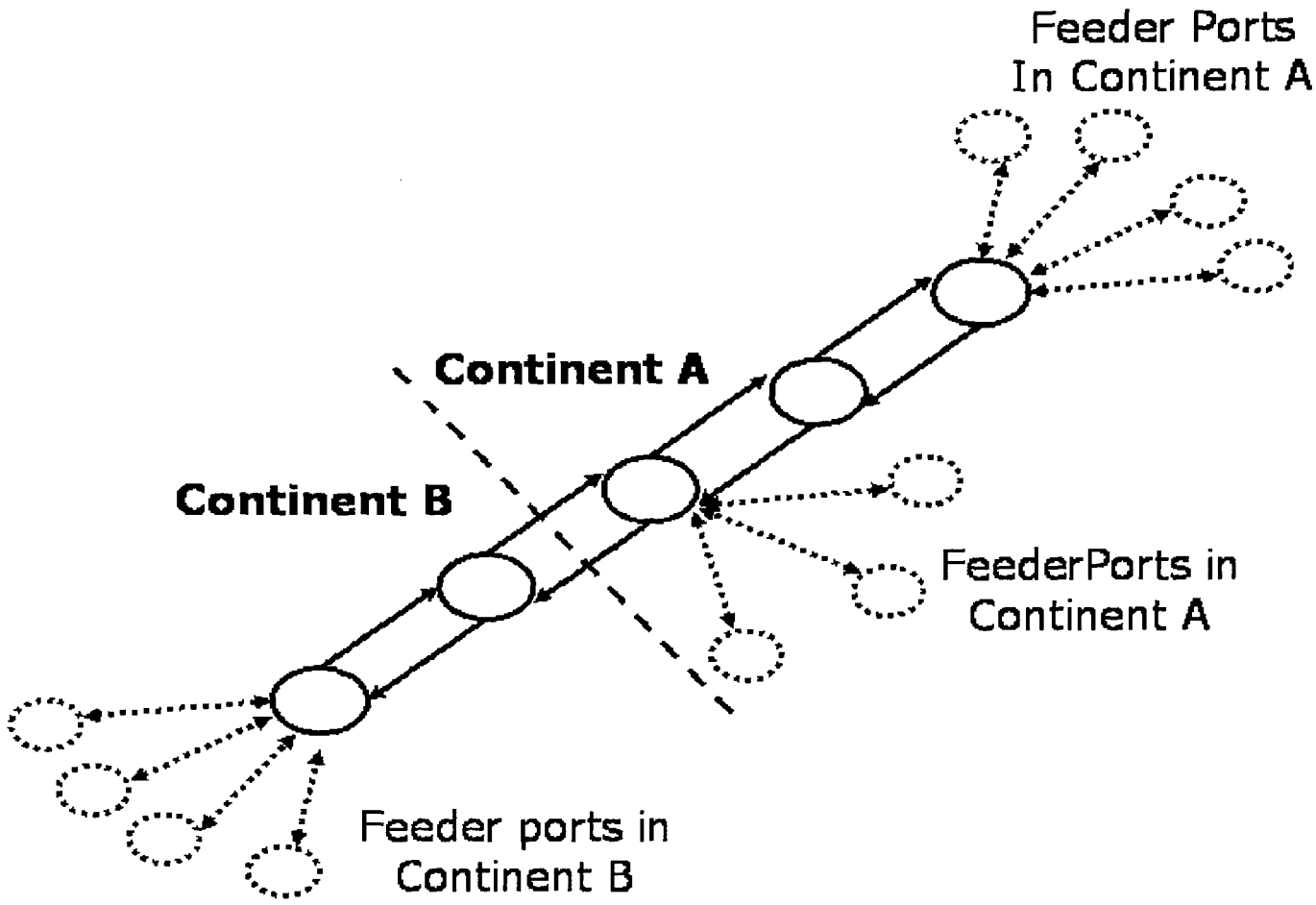
Thus, it is a necessity for liners to ensure that the exploitation of economies of scale pays dividends, implying that their vessels must be often fully (or at least largely) loaded and in operation more frequently (Liu, 1995) and this has serious implications on ports. The importance of port service quality in liner shipping industry's development is supported by Cullinane and Khanna (2000) who have calculated the impacts of port productivity of unit voyage cost of large containerships. They concluded that, if port productivity doubles the current rate[11], their unit costs can be reduced by about 20.18%, 12.64% and 9.92% for trans-Atlantic, trans-Pacific and Far East-European liner routes respectively. On the other hand, as vessels need to operate more frequently, it implies that fewer ports should be called. As Slack (1998) and Junior et al. (2003) have noted, the evolution of liner shipping requires a much higher demand for efficiency in ports due the need to maximise the number of voyages and minimise port stays for mega-vessels. In short, ports face pressures to enhance their services while at the same time face the risk of leaving new equipment idle because of the failure to attract liners to use their services.

However, it is clear that developments in hardware aspects need to be supplemented by software ones. With increasing competitions between liners, shipping networks must increase their geographical coverage so that demands for liner shipping can sustain their increased supplies. This is supported by Slack (2003) who notes that *geographical market presence* is vital to maintain the competitive positions of liners. Thus, they have to ensure that calling fewer ports must not affect the geographical coverage of their networks. This dilemma has led to various restructuring within the industry, notably in software aspects. Firstly, they start to establish 'hub-and-spoke' (or 'trunk-and-feeder') system where a few 'best' port(s) (from their perceptions) within the region would be chosen and ocean-

[11] The 'current year' of the article of Cullinane and Khanna is 2000.

crossing vessels would unload their containers there while smaller short sea vessels would transport containers to the final destinations. An example of hub-and-spoke system in liner shipping is illustrated in Figure 2.1.

Figure 2.1. Hub-and-spoke system in container liner shipping



Under the hub-and-spoke system, the best ports become distribution hubs where containers would agglomerate and distribute throughout the region, of which this confirms the prediction by Bennathan and Walters (1979). Under such system, a liner can serve even the more geographically-marginalised markets which initially did not economically justify direct links by large vessels and this process is known as transhipment. However, such development also implies that only the 'best' ports can benefit as the current business of other ports is likely be taken away with containers being agglomerated geographically to a few hubs, especially since bigger vessels imply that

wider access channels and deeper draughts have become more demanding than ever (see Table 2.3).

Table 2.3. Development of the design of large container vessels: a historical illustration

VESSEL GENERATION	CARRYING CAPACITY	VESSEL LOA	VESSEL BEAM	DESIGN DRAUGHT
First (1968)	1,100 TEU	(N.A.)	(N.A.)	(N.A.)
Second (1970 – 80)	2 – 3,000 TEU	213 m	27.4 m	-10.8 m
Panamax (1980 – 90)	3 – 4,500 TEU	294 m	32.0 m	-12.2 m
Post-Panamax (1988 – 95)	4 – 5,000 TEU	280 – 305 m	41.1 m	-12.7 m
Fifth (1996 – 2005)	6,400 – 7,500 TEU	300 – 347 m	42.9 m	-14.0 m
Near Future (2006 – 07)	8,000 – 9,000 TEU	330 – 380 m	43 – 47 m	-14.5 m
Long Term (2007 & later)	12,500 TEU	380 – 400 m	58 – 60 m	-15.0 m

Source: Ocean Shipping Consultants (2002)

Within this system, focus concentrates on the main market ranges and liners sought to provide services to such range by selecting the 'best' ports. The result is the creation of a hierarchy of ports where regional or local hubs would be connected by feeder vessels to outlaying ports (World Bank, 2000). Large vessels are utilised to provide services between regional hubs and progressively smaller vessels are used to pick up and distribute containers within the region.

Further reinforcing the scale of operations, another software restructuring of liners involves acquisitions, mergers and establishment of strategic shipping alliances like the takeover of APL by NOL, the merging between P&O and Nedlloyd and the formation of the Global and New World Alliances respectively. According to Kumar (2000) and Heaver (2002), the major reasons for horizontal integration include the need of protecting global market shares of participants, reducing cost through economies of scale, better perceptions of the market through information exchange, chances to enter new markets, stronger bargaining position *vis-à-vis* ports i.e. greater control in the decision-making process, combination of financial power to expand and the sharing of financial risks

(especially since liner shipping is becoming more capital-intensive). Apart from economic reasons, horizontal integration helps in enhancing shipping network's geographical coverage. In this sense, the restructuring of liner shipping is not dissimilar to the global trend of market liberalisation and technological advances where, towards the end of the twentieth century, dramatic increases of horizontal integration in other industries has also been found (Dunning, 2000).

It is important to note that acquisitions, mergers, shipping alliances are different from shipping conferences which existed before the 1990s. While shipping conferences emphasise stable freight rates and standardising regulations so as to avoid tense competition, acquisitions, mergers and shipping alliances focus on operation cooperation like re-scheduling liner routes which does not only lessen competition but also enhances the overall competitive position of different members. In other words, the latter is a more proactive approach in accumulating industrial capital and expanding geographical presence.

The formation of strategic alliances has enhanced their market presence and geographical coverage and allows liners to construct even larger container vessels as individual companies now only needs to concentrate on operating certain shipping routes of which they excel in. In other words, the alliance concept is to achieve full ownership and control within a *corporate umbrella* (World Bank, 2000). The process becomes so rapid that, by 2003, among the major liners, Evergreen and MSC are the major notable exceptions remaining outside any of these systems and as the industry becomes more mature, individual liners become more of an exception, while large allied companies become more of the norm, especially among the top ones. Liners seem to believe that they have discovered the benefits and solutions of combining collaboration and competition in their

business strategies and the above developments have complemented the opinions of Slack (2003) who indicates that the force of globalisation has led to rapid restructuring on the geography and structure of liner shipping.

2.2. IMPLICATIONS ON PORT COMPETITION AND TRANSHIPMENT

Ironically, the above 'solutions' of liners also suffer trade-offs. On the one hand, more extensive networks can lead to lower cost of liner service and greater geographical coverage. On the other hand, co-ordination and restructuring also exert upward pressures on both monetary and non-monetary costs (Bergantino and Veenstra, 2002) especially the risk of missing feeders due to port inefficiency. As noted by Notteboom and Winkelmans (2001), recent experiences suggest that strategic alliances have always been unstable and whether it can become a long-term solution in stabilising liner shipping competition is yet to be seen. In order to consolidate alliance stability, by the time of alliance formation, members tend to impose rather strict contracts and agreements among themselves with the Grand Alliance being a typical example. In this sense, a vicious cycle has formed as strong binding can cause potential problems among liners and potentially increase costs on their operations since the decisions and strategies of liners can become more complicated.

The underlying problems of strategic alliance, together with the generally accepted consensus that dramatic rise in freight rates to shippers is virtually impossible (Panayides and Cullinane, 2002), imply that cost minimisation is the most important objective that liners must achieve. In fact, the final outcome and degree of success of these 'solutions' greatly depends on the balance between cost savings and additional costs that are generated by strategic alliances and thus the effectiveness of any innovations in reducing

transhipment cost is crucial to the future success of liners (Taaffe et al., 1996). Since economies of scale in shipping is countered by increasing diseconomies of scale in terms of logistical costs (Haralambides, 2000), this comes back to the frequently repeated issue that ports are becoming a critical component in deciding such success.

Thus, since the 1990s, liners have a tendency to sustain pressurising ports to improve as benefits of economies of scale and alliances would not realise unless their costs spending on ports can be dramatically reduced. Here 'costs' do not only involve monetary ones, but also other less-readily quantifiable costs like efficiency and quality of service of which a port can offer. This is supported by Huybrechts et al. (2002) who argue that a port which contributes most in substantially reducing the generalized cost[12] of transport chains is most likely to be chosen. Quoting Van Klink and Van den Berg (1998), in contemporary liner shipping, direct monetary costs do not necessarily determine the competitiveness of a port alone because port choice also involves other non-monetary factors.

The negative implications of liners' scale economy approach on ports have been questioned as early as the 1970s by Gilman (1980), who argues that many ports cannot handle large amount of containers and thus potential increases of port container throughputs and the reduction of port costs was difficult. His view is supported by Chilcote (1988), Notteboom (2002) and Panayides and Cullinane (2002) who all note that large vessels cannot waste time and call additional ports for more cargoes due to high capital costs and high port costs of serving them. Since the development of higher speed large vessels is deemed economically impractical in the short term (World Bank, 2000), it implies that both the service frequency and turnaround time of large container vessels

[12] Apart from monetary cost, generalized cost also consists of other quantitative and qualitative attributes like time and quality of services. See Chapter Three.

have to increase and decrease respectively while the number of port calls has to be reduced. As Chilcote (1988) has noted, before containerisation, vessels usually called at a dozen ports within a region (say, Western Europe) within a liner service, compared to not more than five since containerisation.

Another implication of contemporary technological and economic development of liner shipping is that it has considerably enhanced the bargaining power of port service users (i.e. liners) *vis-à-vis* service suppliers. With improved transport networks through technological innovation, various scholars argue that liner shipping has become more footloose in choosing ports-of-call and the traditional consensus that ports possess certain natural hinterlands and thus little worry about losing customers is increasingly become obsolescent. For example, McCalla (1999) claims that container ports are increasingly becoming the 'servant' of their users while Hayuth and Hilling (1992) noted that, as Europe moves towards more borderless trading, discrete natural hinterlands would break down and replaced by *common hinterlands*. Although the footloose factor of liner shipping may be less convincing in peripheral regions, when considering more developed regions like North Europe, it seems sensible to argue that this factor has an influential impact on port competition. Liners now have more immense powers in controlling the fate of different ports especially since ports are increasingly become an important component within global logistics chains (Heaver 2002). This is supported by Slack (2003) who argues that the radical changes in the ports-of-call have contributed to the growing similarity between different liners, leading to the phenomenon that while winners win more, losers lose even more. This is enhanced by the fact that, in conducting their business, most ports negotiate with their customers independently and thus liners' bargaining power is enhanced through better information and playing the same 'threatening game' to different ports. To be fair, under the development of economies of

scale within the shipping industry, liners also have few choices but to pressurise ports because the increased earning capacities of their vessels cannot materialise if containers are not handled efficiently (Stubbs et al., 1984).

Thus, competition between major ports has intensified as described by Slack (1993) as *pawns in the game of global transportation system.* With changing demands circumstances, the traditional philosophy in port management is no longer valid, especially since the traditional objective that a port should act as the base to control its hinterland market during the colonial period (World Bank, 2000) has long gone. Increasing intensity in port competition is significant in Western Europe where the emergence of single market has exerted pressures on national and regional governments to give up protective measures to their respective ports such as state aid (Hinz, 1996). In order not to be left out from the development of global logistics chains, many major ports are forced to continuously improve their facilities and services and attract potential customers to use their services (Meersman and Van de Voorde, 1998). As Stone (1998) and McCalla (1999) have noted, the market shares of ports are no longer guaranteed and the global actions of liners have often led to port sufferings.

Facing such pressures, while liners have to invest heavily to accommodate containers, commitments of ports have become even greater (Slack, 1998) because only improvements in port infrastructure and services, usually accompanied by significant capital investments, are required so as to reduce ship's time in port and smoother documentary procedures in order to maintain their competitiveness by transforming themselves into container load centres (Chilcote, 1988). Ports need to be specially designed to meet cargo-handling and have to be more innovative so as to add value to their services, which in turn ensures their competitive position and survival in this ever

changing landscape. As Heaver (1993) and Slack et al. (1996) have noted, specially designed port for cargo handling, especially container handling, have led to increasingly competitive environments for port services as containerisation have represented a capital intensive activity for port authorities around the world and have put considerable financial burden on many ports. Also, as noted by Slack (1998), liners' scale economy approach requires high load factors and thus demand for quality services on container ports is likely to become more demanding than before (see later for further analysis). All the above developments have transformed port operation to become a much more complicated industry with particular complex functions (Robinson, 2002). Quoting Haralambides (2000), recent port developments had been dictated by developments in shipping rather than the other way round. It does not take long after the container revolution takeoff that the labour-intensive landscape of ports has been replaced by expensive cranes and ancillary container-moving vehicles dedicated for container stevedoring, while many ports have to relocate from the city centre to more peripheral locations due to increased space requirements.

Of course, even after such expensive commitments, there is no guarantee that vessels will come and use port services and this problem has been noted by various scholars. For example, Haralambides (2000) had warned that port development, notably physical infrastructure, were often built far ahead of existing demands simply in the fear that they would be lagged off if they did not do so. His concern was shared by Psaraftis (1998) and Van Ham (1998) who has warned the risk of ports being trapped into a vicious circle of creating wasteful overcapacity due to panic and unnecessary speculation and thus the latter urged for introducing market principles in future development in order to diminish potential dangers. Similarly, Powell (2001) has emphasised that long-term plans could pay dividends only if the resources spent on transport investments would not exceed the

benefits derived from those particular investments. As Notteboom (2002) had noted, loyalty of port customers cannot be taken for granted not only because of deficiencies in port service, but also due to liners' rearrangements in networks and new partnerships/alliances. McCalla (1999) even put it further, claiming that the major challenge of contemporary ports is the problem on how to turn *local pain* (like heavy infrastructure investments) to *local gain* based on pure perceptions of the long-term demands of port services. Similar to liners, ports have also fallen into the dilemma that heavy investment is required to remain competitive but adequate traffic is not guaranteed.

Using Canada, Dion et al. (2002) provide an excellent case in illustrating the problem of excess capital investments in ports. Throughout the years, the Canadian government has built up a vast network of ports and has provided substantial infrastructure. Nevertheless, until recently, only a few of these ports have been profitable and the vast majority of the port traffic is concentrated on about 10% of the public ports. Port operation is actually a highly speculative lottery game and investments in port facilities, usually durable and dedicated to the industry, bear significant risks (Hayuth and Hilling, 1992). According to Slack et al. (1996), due to a decrease in natural hinterlands and increasing bargaining power of liners, the pressure from increasing competition does not only affect small ports, but also large and established ports. In fact, ports choosing to become hubs are really extremely vulnerable to changing fortunes and desires of liners and shipping alliances (UN, 2000).

Thus, it is important for port managers to carefully evaluate their port development plans and needless duplication of facilities should be avoided as much as possible (Rimmer, 1998). Indeed, contemporary development within the shipping industry has added substantial pressures on ports to operate on increasingly thinner profit margins due to

increased competition and heavy capital investment requirements (Psaraftis, 1998). In order to enhance port competitiveness, port managers are forced to alter their focus from traditionally whether the port possesses the ability to handle a certain amount of cargo effectively to whether the port possesses the ability to attract potential customers possibly other ports' expenses. Such changes have posed significant implications on the methodology in assessing port performance because this is where the issue of 'port choice' has been put into question. As long as port users are offered options to choose from, rather than measuring physical output, port performance within a competitive market should be assessed through evaluating the economic cost i.e. the ability of a port in attracting potential customers to use it and its ability to fight off competitors. To sustain competitiveness, ports must ensure that the increase in operation cost of liners does not lead to significant increases in the values of goods being transported (Gubbins, 1988).

In theory, sensible investments can be achieved with the availability of objective port demand forecasting instruments. As Peters (2001) has emphasised, that *objectivity is vital* to avoid overstating or understating future container capacity and demands so that the ports do not have to tackle high congestion (at least in short and medium terms) nor waste substantial amount of money by leaving expensive container handling equipment idle. Nevertheless, the reliability and objectivity of these assessment instruments are often doubtful[13]. According to port operators (through in-depth interviews, see Chapter Three), they often need to convince customers that the port has a bright prospect while at the same time port projects must look appealing to generate adequate funds to make the projects move forward. As a consequence, as Huybrechts et al. (2002) have noted, port

[13] Of course, mismatch between port demand and supply always exists and a port usually regards 80% of utilisation rate of theoretical capacity as the realistic target (Juhel, 2001). By 2001, most major container ports around the world operate about 75% of theoretical capacity. It seems that most ports still tend to overestimate the demands of their customers possibly as a strategy to justify the funding of proposed projects, marketing purpose to customers and minimising congestion problems.

forecasting figures are often exaggerated, not helped by the increase in difficulty to make realistic forecasts due to the increase in *common hinterlands*, transhipment traffic and the existence of *hub hopping* where the number of competing ports is growing so rapidly that vessels can shift their port calls with only minimum costs (World Bank, 2000). This complements the view of Bennathan and Walters (1979) who argue that if competition exists between transhipment ports within the same region, transhipment demand of liners will tend to be *elastic*. The intensity of port competition is not helped by the fact that modern ports can possibly become significant *world players* in global logistics only if they possess and maintain their status as transhipment hubs rather than just specialising in niche markets (De Lombaerde and Verbeke, 1989).

A good example on *hub hopping* involves the dealings between Maersk-Sealand and Port of New York/New Jersey in 1999. Facing the threat of dumping the port as the transhipment hub on the East Coast by one of its biggest customers, a total sum of US$570 million has been spent on improving New York/New Jersey to ensure that the world's largest liners continues to use the port as its transhipment hub (World Bank, 2000). The potential danger of *hub hopping* is also prominent in North Europe as there are considerable established ports which can offer transhipment services within a rather small region. Likewise, *hub hopping* is also used as a bargaining tool by liners in other regions like Hong Kong-Pearl River Delta and Singapore-Malaysia. It seems that *hub hopping* has reduced the port's monopoly power of which it becomes more difficult to cover costs, let alone make profits, as liners possess the ability to play one port off against another (Bennathan and Walters, 1979). Thus, it seems that getting some long-term commitments from liners or reducing their elasticity in using a port seem necessary to maintain ports' long-term competitive positions.

The above indicates that port projects are becoming highly risky betting games and successful port managers must be able to make good decisions through a smart and creative trade-off between providing more capacities and thus higher quality services (which can possibly attract more businesses) but at the same time without creating overcapacity to meet future market demands. Under this situation, as Slack (1985) has suggested, instead of just monetary cost, quality of service is likely to play a more pivotal role in the competitive positions of ports. Later, Slack (1998) further strengthens this view and argues that rather than physical innovation, organisational arrangement becomes even more important to meet the new circumstances. In fact, such necessity has been recognised as early as the 1970s. Using competition between Singapore and Hong Kong as the example, Bennathan and Walters (1979) demonstrate that due to increases in port size and investment costs in port development, the proportion of fixed costs becomes more important and inhibits the effectiveness of cost leadership, which in turn implies greater importance in service quality differentials. The changing demands on port is supported by Clark et al. (2001) who argue that besides distance and other non-changing variables, an important determinant of maritime transport costs is port efficiency, not only in terms money and time, but also quality of services provided by ports. Although a few scholars like Brooks (2000) attempt to play down the importance of port service quality by claiming that customers would found it increasingly difficult to distinguish between port services as infrastructure and equipment become more standardised, the increasingly importance of service quality in deciding port competitiveness seems to be generally accepted within the shipping community. Nevertheless, whether port service quality is important also greatly depends on who the major decision-makers in port choice e.g. liners vs. liners' customers like shippers/freight forwarders, which will be further discussed late in this chapter.

To tackle these challenges, ports have to strengthen their own power *vis-à-vis* liners and other ports, notably by transforming port management and operation towards a more business-like or private sector approach. Port management has to be more responsive to customer needs because new developments in the global economy and shipping have ensured that the physical layouts of ports, in many cases, are no longer in line with user requirements (Juhel, 2001). Such requirement had partly explained the increasing privatisation of port operations in different parts of the world and various studies had underlined this evolution e.g. World Bank (2000), Baird (2002), Heaver (2002), etc. For example, possibly with the major exception of French ports, container-stevedoring responsibility in most North European ports is now undertaken by the private sector, while most of the ports in this region are operating under the landlord or fully privatised port formula, mainly through the involvement of multinational port operators.

However, perhaps most importantly, recent developments of liner shipping, especially the rise of popularity in hub-and-spoke systems and the need for wider geographical coverage of shipping networks, have led to the growing importance of transhipment traffic, supplemented by the increasing global trade which greatly favours developments of ocean-crossing liner routes (Stubbs et al., 1984 and Palmer, 1999). Here it is necessary to explain transhipment in more detail. Rather than cargo shifts between two different transport modes (like vessel and road vehicle) or direct transportation, transhipment implies cargo shift within one transport mode from big ocean-crossing to smaller short sea vessels. According to Taaffe et al. (1996), while the major reason of transhipment between different modes is mainly because maritime transport is inaccessible to a number of inland destinations, transhipment within the shipping mode is due to structural changes within the liner shipping industry due to containerisation which led to reductions in handling costs, fewer port calls and the establishment of hub-and-spoke systems, of which

transhipment can potentially make use of the comparative advantages of large and smaller vessels in handling different freight movements.

Although the concept of transhipment can be dated back as early as the 1960s when containers were introduced (De Langen, 1998), it does not accelerate until the last decade and the growth of transhipment is a complement of the development of competitive hub ports (World Bank, 2000). Empirical figures support this claim. In the early 1980s, transhipment only occupied about 12% of global container throughputs (Damas, 2001), compared to just less than 15% in 1990 but then accelerated to more than 20% towards the end of the 20th century. Between 1990 and 2001, total container transhipment demands in North Europe have increased by threefold, from 2.18 million to 6.72 million TEU and the share of transhipment in total throughput had increased from 14.1% to 21.4%[14], with an average growth rate of 10.86% (see Table 2.4)

The above figures can be even more impressive if not due to the negative implications of the 9-11 terrorist attack on the global economy in 2001. Also, except 1996 and 1997, the annual growth of transhipment traffic had always been faster than direct shipping, of which it is likely to continue growing among major North European ports in the coming decade where North European container transhipment traffic is forecasted to grow at 6.49% annually between 2005 and 2015 (see Table 2.5). Actually, this figure can be significantly underestimated as the implication of the admission of new members into the EU and the likely increasing trades between Russia and Western Europe in the transhipment market is not taken into account.

[14] The market here includes the Hamburg-Le Havre range and the Baltic region, covering Scandinavia, Russia, the Baltic States, Poland and German Baltic ports.

Table 2.4. Container throughputs, annual growth and market shares in North Europe by traffic types, 1990 – 2001

LSR	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
Container Throughputs (in '000 TEU)												
DDS	14,014	13,830	12,815	12,027	11,168	10,428	9,707	9,085	8,556	8,222	7,608	7,079
CTS	6,720	6,504	5,821	5,140	4,368	4,044	3,790	3,527	3,041	2,734	2,464	2,177
DSS	10,671	10,432	9,779	9,233	8,735	8,023	7,464	7,329	6,459	6,373	6,167	6,136
Total	**31,405**	**30,766**	**28,415**	**26,400**	**24,271**	**22,494**	**20,961**	**19,941**	**18,056**	**17,330**	**16,239**	**15,392**
Annual Growth Rate (in %)												
DDS	1.33	7.92	6.55	7.69	7.10	7.43	6.85	6.18	4.06	8.07	7.47	----
CTS	3.32	11.73	13.25	17.67	8.01	6.70	7.46	15.98	11.23	10.96	13.18	----
DSS	2.29	6.68	5.91	5.70	8.87	7.49	1.84	13.47	1.35	3.34	0.51	----
Avg.	**2.08**	**8.27**	**7.63**	**8.77**	**7.90**	**7.31**	**5.12**	**10.44**	**4.19**	**6.72**	**5.50**	----
Market Share (in %)												
DDS	44.6	45.0	45.1	45.6	46.0	46.4	46.3	45.6	47.4	47.4	46.8	46.0
CTS	21.4	21.1	20.5	19.5	18.0	18.0	18.1	17.7	16.8	15.8	15.2	14.1
DSS	34.0	33.9	34.4	35.0	36.0	35.7	35.6	36.8	35.8	36.8	38.0	39.9

Note: LSR – Liner shipping route, DDS – direct deep sea, CTS – container transhipment, DSS – direct short sea. Source: Ocean Shipping Consultants (2002)

Table 2.5. Forecast combined container transhipment throughputs in major North European ports, 2005 – 15

YEAR	*TOTAL TEU THROUGHPUT	ANNUAL GROWTH RATE
2005	9,240,000	----
2006	9,880,000	6.93%
2007	10,570,000	6.98%
2008	11,320,000	7.10%
2009	12,110,000	6.98%
2010	12,950,000	6.94%
2011	13,740,000	6.10%
2012	14,560,000	5.97%
2013	15,430,000	5.98%
2014	16,360,000	6.03%
2015	17,330,000	5.93%

* Here it includes Antwerp, Bremerhaven, Felixstowe, Hamburg, Le Havre, Rotterdam, Southampton, Thamesport and Tilbury. Source: Ocean Shipping Consultants (2004)

Further evidence on increasing transhipment demand is provided by ECT (2004) suggesting that currently about 20% to 30% of all TEU throughputs in all major North European ports consist of transhipment traffic. This figure complements the estimation of Peters (2001) who forecasts that, by 2006, transhipment will represent about 27% of

global TEU throughputs. With a likely significant increase in market and the requirement for more market coverage but the need to call at fewer ports due to increased vessel size, it is clear that encouraging more transhipment traffic is the only significant way forward. This is what Bennathan and Walters (1979) had predicted that transhipment would play a significantly more important role in deciding port competitiveness in the 21st century. The result is that major ports are now taking dual responsibilities – keeping their traditional function serving their respective hinterlands while adding the transit function and enabling them to become components of the global and more complicated logistical networks. Nevertheless, although the rise of transhipment traffic implies extra business granted to the port, at least in theory, such generosity can be taken away by liners at any time they deem relevant, especially any innovations in reducing transhipment inefficiencies, notably the extra costs generated from the transfer of containers from one vessel to another, are important to the competitive positions of liners themselves (Taaffe et al., 1996). Especially in more developed regions where ports are geographically proximate to each other, the rise of transhipment traffic also implies more intense competition on quality of services provided by ports (Hayuth and Fleming, 1994)

Clearly, the establishment of hub-and-spoke system and transhipment have diminished the monopolistic nature of port hinterlands while port competition within the same geographical range intensifies (De Lombaerde and Verbeke, 1989) because transhipment traffic implies that cargo flows become even more geographically concentrated while ports gradually regard liners as their major customers (Heaver, 2002) and the bargaining power of ports *vis-à-vis* liners is weakened. This view is also supported by other scholars like Bennathan and Walters (1979) and Veldman and Buckmann (2003). The former argues that the methods by which liner service a particular port in container shipping are almost wholly under their control, while the latter note that the choice of a transhipment

port is made by liners and not their customers (also supported by Ha, 2003).

Also, increases in transhipment traffic highlight the problems related to port infrastructure and ports are clearly the victims of such development since transhipment demand is driven by the network restructuring of liners and ports have few opportunities to participate in this process (Ocean Shipping Consultants, 2004). A notable example for such limitations is Antwerp, where limitations on water depths and locks along River Scheldt partly explain why the port puts focuses more on trans-Atlantic liner routes rather than the Far East-European ones (where the vessels serving the latter routes are usually bigger in size). Furthermore, as liners have to ensure that their benefits will not be extracted due to price discrimination from ports, they have formed mergers, acquisitions and alliances to counterbalance the former monopoly power of ports. Actually, recent developments in global container shipping suggests that the practice of price discrimination between transhipment and feeder traffic that has been commonly imposed by port in the 1970s (Bennathan and Walters, 1979), of which the former usually enjoyed a much lower charge, does not really work anymore towards the end of last century. This implies the further weakening of port's ability in covering their costs[15].

Although the rise of transhipment hubs can possibly increase overall port demands (Notteboom, 2002, Ha, 2003 and Baird, 2004), transhipment cargoes are still likely to make the already-fierce port competition becoming even more intense as vessels are less likely to be restricted to any port of call. According to Hayuth and Fleming (1994), in a

[15] Bennathan and Walters (1979) argues that port demand for the home market would be highly inelastic (due to monopoly power) while demand for transhipment would be highly elastic. Moreover, from information provided by port operators (through in-depth interviews), the current payment structure is that port operator will only negotiate prices with liners operating ocean-crossing vessels for both mainline and feeder routes, while the price that feeder vessels need to pay is an affair between companies running ocean-crossing routes and companies running feeder routes (rather than the responsibility of the port).

deregulated environment, an increase in transhipment traffic implies the rising prominence of *intermediacy* (rather than *centrality*) in deciding port competitiveness[16]. Their view is echoed by Martin and Thomas (2001) who note that:

> *"Changes in the geography of maritime transport...have seen the concentration of container traffic through a smaller number of ports...[which] has led to increased competition between ports within the same continent which previously would not have considered themselves competitors [p. 279 – 280]."*

Their concern can be found in the UK where the British (Felixstowe, Southampton, Thamesport and Tilbury) share of North European transhipment market have risen from 11% in 1990 to 20% in 1999 before falling back to 8% in 2003 (Ocean Shipping Consultants, 2004). Although Wang and Slack (2000) suggest that increased port competition can lead to the opening of new port calls and a more diverse port selection pattern since challenges from periphery ports would take place when major ports reach maturity, quoting the example of South China, this phenomenon does not seem to take place in North Europe and six major ports remain dominating the market[17].

The increase in transhipment traffic and the need for effective strategic investments imply that it is necessary that ports must evaluate their respective current competitive positions which act as the platforms in establishing their future business strategies. Such understanding involves both exogenous and endogenous factors, including the foreseeable trend within port and shipping industries, customer satisfaction to their services, their future development prospects and relations with their potential competitors. Moreover, through self-understanding, as stevedoring service provider, port should develop strategies

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[16] According to Hayuth and Fleming (1994), *centrality* is generated from locally generated demands (both urban and industrial), while *intermediacy* is generated from port *en route* which usually involves long-distance in-transit and transhipment traffic.

[17] The major ports are Antwerp, Bremerhaven, Felixstowe, Hamburg, Le Havre and Rotterdam. See Chapter Three.

which can enhance their bargaining power *vis-à-vis* service users in order to further enhance their competitive position. Based on the above analysis, Palmer (1999) is right to claim that revolution, rather than evolution, is taking place within the geography and economics of port and shipping industries.

Finally, it seems that the major challenge of major ports in the twenty-first century is their difficulties to guarantee throughputs mainly due to two major reasons, namely the increase in *common hinterlands* and the rising importance of transhipment traffic. North Europe is an ideal region in studying port competition and transhipment, especially given its complex and 98,174.5 kilometres long coastline (BBC, 2005), its status as one of the world's major trading region, the existence of *common hinterlands* and increasingly importance of transhipment traffic within this region (see Tables 2.4 and 2.5). Given such situation, different North European ports may possess similar investment plans which likely lead to overestimations in port and transhipment demands (Huybrechts et al., 2002), although most liners would continue to choose North European ports as transhipment hubs in the foreseeable future (see Chapter Three). In summary, due to the above, there is an urgent requirement to conduct a research study on the competitive positions of ports in North European transhipment market.

2.3. REVIEWING STRATEGIC THEORIES AND APPLICABILITY ON PORT COMPETITION

In order to understand port competition, in the first place, one has to ask why competition takes place. Within this question, there are a few complicated issues. For example, what are the alternatives? This can vary from time to time. In the case of port, is it a stage where different ports compete for the same market, or whether a port also needs to face

competition from other transport modes, given the fact that a contemporary port is, in fact, only one of the many components of the transport logistics chain? Also, as decision-makers have to make choices, how do they make their choices? Is the decision-making process simply a function of the attractiveness of ports, or does it involve more complicated matters? Or does attractiveness and quality of services matter at all? Do decision-makers make choices individually (e.g. each liner makes their own decisions), or do different decision-makers cooperate in the decision-making process? Do ports have any chances in affecting customer choices? Finally, when decision-makers have to make choices, how well are they informed in their decisions? In turn, questions also arise on how well service suppliers are informed when they construct their competitive strategies.

In this context, competitive theories are required in explaining the above questions. Although the above section illustrates some existing studies on port and shipping industries, few of them have made serious attempts on theorising port competition. Such scarcity is endorsed by Meersman and Van de Voorde (1998) who noted that, until recently, there is a serious lack of theoretical research on this issue. Among these limited works, most of them applied the Five Forces Model (FFM) and Diamond Theory, introduced by Porter in 1985 and 1990 respectively, to analyse port competition e.g. Wiegmans et al. (1999), World Bank (2000), Haezendonck (2001), Huybrechts et al. (2002), Ng (2002), Panayides and Cullinane (2002), Robinson (2002), etc. (albeit possibly applying them using different approaches). These studies suggest that FFM and Diamond Theory are widely regarded as relevant management theories in explaining port competition. As Robinson (2002) has noted, Porter's models are *central to defining port development strategies*. With such understanding, a review of Porter's competitive models will act as the starting point in the construction process of the theoretical framework of this thesis.

In this section, the concept of FFM and Diamond Theory and their applicability on port competition will be reviewed. As mentioned, FFM and Diamond Theory are widely regarded as pioneering works in replacing comparative advantage as the major competitive strategy by competitive advantage. More importantly, FFM and Diamond Theory have another important implication since both of them argue that firms do not have to passively accept their fates as determined by the factor endowments of the country in which they are operating, but can actively engage in strategies and investments to generate their own capabilities, with managerial and organizational process as the supporting base (Audretsch, 2000). Here attention will be paid on the strengths and weaknesses of FFM and Diamond Theory in explaining port competitions and how potential shortcomings should be addressed.

2.3.1. Five Forces Model

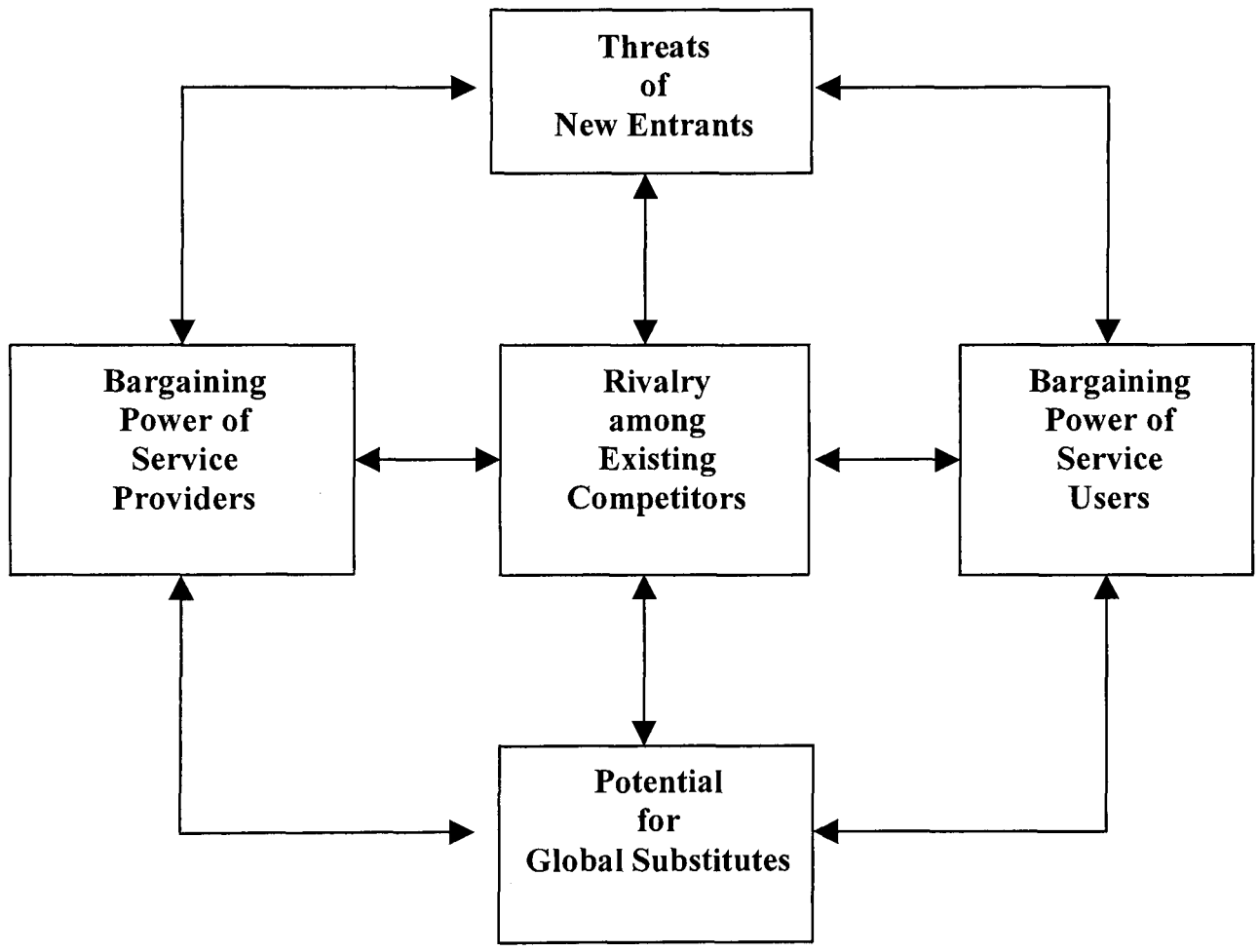
As an attempt to explain the competitive position and strategic challenges of various industries, Porter (1985) introduces FFM in his book entitled *Competitive Advantage* (see Figure 2.2). According to FFM, Porter argues that competitive advantage, rather than comparative advantage, is the major factor explaining the competitiveness and potential for development of an industry (Porter, 1985). Rather than static, FFM further points out that competitive advantage is dynamic which can be enhanced to increase the competitiveness of a firm in the global market through the interaction of five forces. These forces are common with various industries, although the degree of influence of various forces depends on specific industry's economic and technological characteristics. As mentioned before, FFM has been widely applied in explaining port operation and competition. The report by World Bank (2000) even argues that *the competitive landscape*

of ports in the twenty-first century will be shaped by the interactions [of the attributes] of FFM.

According to FFM, there are five forces affecting the industrial environment, including rivalry among existing competitors (service provider), threats of new entrants, potential for global substitutes, the bargaining power of customers (service users) and the bargaining power of supplier. These five forces together form the *industrial structure*.

Figure 2.1. Five Forces Model

(Source: Porter, 1985)



Rivalry among existing competitors

The first and central force of FFM is the rivalry among existing competitors. In port competition, the players within this force are the existing port operators themselves who

try to enhance their competitiveness through developing various strategies to attract customers.

Existing competitors' rivalry depends on different factors including the number of competitors, investment cost, industrial growth, barriers of entry and exist and the degree of industry's concentration. The fewer the number and the larger the size of rivals, the less intense is rivalry (Porter, 1985). However, it is necessary for players to form different strategies to enhance their competitiveness or, at least, ensure their survival in the market. Here it is important to note that existing competitors do not necessarily only compete through cost leadership and prices but can also compete on non-monetary factors such as quality and value-added services. Thus, different companies can have different objectives and thus form different marketing efforts in attracting customers which range from lowest possible price to best service quality or a combination of different strategies (Wiegmans et al., 1999). For industries of which profit-margin is slim or requiring a long period of time before being able to recover start-up costs like the container port operation, competition can also take place on market share and returns on investments.

The capital-intensive nature of containerisation has led to specialisation among ports. In the container port industry, for example, competition exists between different container ports and they usually do not compete for other cargoes, say, bulk cargoes (Chilcote, 1988). The significance of existing competitors' rivalry varies within the port industry and depends on geography, economics and politics. Geographically, some ports possess competitive advantage as they locate at an intermediate location which serves as an ideal place for transhipment while on some occasions, only one major port is available serving the entire hinterland within a region, which is especially true for states possessing narrow coastline. A good example is the Iraqi port of Umm Qasr which acts as the only deep-sea

port within Iraq's narrow coastline of 58 km (BBC, 2005). In other regions like North Europe, there may be several ports sharing common hinterlands, like Antwerp and Rotterdam, of which the competitive advantage may decrease due to an increasing number of ports.

Economically, the rivalry between existing competitors depends on the regional port capacity of supply and the ability to create competition within the port. Poor transport infrastructure within the region may act as a barrier to a port's competitiveness, while a port may have advantages if its operator has a strong financial balance sheet and the potential to eliminate competition. Politically, government policies and the provision of subsidies may upset the competition platform, while international conflicts between countries can also narrow the geographical choices of ports for the users.

For ports, there is one point that needs to be mentioned. From real world evidence, it is extremely rare for port to be under the complete ownership and control of the private sector (ADB, 2000). Even for commercial ports, public involvement plays some role. For example, in North Europe, Felixstowe is the few notable examples where it is completely free from public sector involvement. In other ports, public sector, usually port authority, even participates in some commercial aspects, notably Rotterdam. From this point, it already hints that FFM may be inadequate in explaining port competitive structure comprehensively.

Here it is necessary to know the objectives of ports. What do they want to achieve? Also, what kind of indicators do they use in evaluating their effectiveness? Different objectives that ports would like to achieve would provide conceptual insights to the nature of port competition. Interestingly, from the information provided by various ports, it seems that

the most important objective of ports is to achieve cargo throughput growth and thus increase their respective market shares *vis-à-vis* potential competitors. This complements the work done by Lombaerde and Verbeke (1989) who argue that ports are primarily interested in their market share and regarded growth in traffic flows relative to competitors as the prime indicators of the competitive positions of ports in any types of cargoes.

The above clearly illustrates the importance of service quality in firm's competitive position within an industry, including ports. In fact, since the introduction of *scientific management* as the philosophy in enhancing a firm's performance by Taylor (1911), some works have taken place investigating how quality of service could help enhancing a firm's competitive position. For example, in his work, Hamill (1992) argues that the key factor in the competitiveness of a firm involves marketing e.g. different types of marketing strategies, marketing management issues, organisation and control dimensions of marketing, etc. Tenner and Detoro (1993) goes further and argued that customer focus, process improvement and total involvements (i.e. Total Quality Management or TQM) serve as the keys to gain competitive advantages. This is supported by Yip (1992) who ascertains that the core principle of competitiveness is to achieve competitive advantage through creating good network connections with customers. As Toyne and Walters (1989) has noted, the search for competitive advantage is the major motivation for firm marketing, presence and internal coordination of any kind globally and the search of competitive advantage through providing quality service has been generally accepted as the key to ensure a firm's success in the contemporary world.

One question requires particular attention here. Who should decide the quality of services and how should service quality be assessed? This involves determining who the major

decision-makers are and how service quality can be measured. It is clear that monetary cost and some factors involving quality of service like time can be quantified without too much difficulty. However, other factors like firm's reputation and relations between suppliers and customers are not always readily quantifiable (hereafter called 'less-readily quantifiable factors'). Despite such setbacks, a number of scholars argued that it is possible that service quality can be estimated indirectly. For example, in their work on TQM, Tenner and Detoro (1993) argue that quality of services should be regarded as the degree that customers feel that they have received a fair exchange by paying a particular monetary value. This is in accordance to Juran (1985) who stresses the importance of the cost of quality and the benefits of quantifying improvements in service quality in monetary terms. Garvin (1998) goes even further and highlights the degree of ability of a service supplier in satisfying customer expectations and/or wants are the keys where service quality should be determined, proposing his statement where *quality lies in the eye of the beholder*. Thus, customers should be the chief indicators of service quality and its estimation should be done by monetarising it.

From the above, it is clear that quality service is an important element in attracting customers from using its services and forms the basis for the competitive position of a firm. However, it is wrong to consider only improving service quality as enough in striving for competitiveness. This is because there are also other reasons which affect the competitive position of a firm like customer inertia of using that service, quality of services provided by competitors, the possible existence of better substitutes, to name but a few. In other words, competitive position of a firm does not only have an internal, but also an external dimension. On the other hand, whether service quality is really an important aspect in deciding the competitive position of a port is still open to debate. With

such understanding, it is necessary to investigate the factors other than service quality in affecting the competitive position of a firm, including port.

Ports mainly operate and develop their strategies on their own and cooperation or formation of coalition between ports is still rare. Although Notteboom (2002) argues that the capital-intensive nature of contemporary port industry allows significant opportunities to improve services through cooperation, citing the limited cooperation between some ports under multinational port operators e.g. Rotterdam (ECT) and Felixstowe, Hong Kong (Hong Kong International Terminals 4, or HIT-T4) and Shenzhen (Yantian International Container Terminals, or YICT), comprehensive inter-port cooperation still does not exist. As discussed earlier, this gives a disadvantageous position to port competition as information between ports becomes rather restricted and this offers liners the opportunity to exercise their bargaining power through *hub hopping*. Thus, for the sake of self-protection, common knowledge between ports is still restricted. This partly explains the speculative nature of port investments and developments as changes in liner shipping has a profound effect on ports around the world (Slack et al., 1996).

Threats of New Entrants

The second force is the threats from new entrants. Here is to note that new entrants can be two-folded. It includes setting up a completely new industrial complex or takeover of an existing industry. The consequence of new entrants results in the creation of new competition, change in cost and price, or even change in the whole industrial picture, depending on the significance of the new player. However, as Wiegmans et al. (1999) have argued, a new entrant is not necessarily only a threat, but can also be a force to ensure efficiency and better utilisation of resources, depending on the flexibility and adaptability of existing players. The importance of the threats of new entrants depends on

an industry's economies of scale, capital requirements and importance of brand reputation, of which new entrant threats could also be diminished by existing competitors through various means like customer loyalty, economies of scale, high investment capital, extension of services, etc.

The strength of the threats of new entrants in the port industry depends on geography, barriers to entry and exit, capital expenditure of setting up new port facilities and operational arrangements respectively. Threat of new entrants also becomes stronger if the switching cost of users to another port is small and customer loyalties to the existing ports are not significant, thus diminishing the competitive advantage of ports.

Since containerisation, starting a new business in the port industry is signified by difficulties due to the need for mass capital investments, high fixed costs and the existence of sunk costs (Brooks, 2000). Nevertheless, the situation is increasingly challenged by investing a new port situated in a good location with modern facilities, together with increasing private participation in port operations and the rise of global port operators. In other words, barriers for entry in port operation have reduced considerably in recent years. In North Europe, for example, two types of new entrants are emerging. The first one is expansion of global port operators, like the expensive investments by HPH of the British ports of Felixstowe and Thamesport and purchased controlling shares of ECT in the port of Rotterdam in the 1990s (Asian Shipping, 1999) which had significantly increased the company's presence in North Europe. At the same time, another type of new entrant is taking place in the same region i.e. dedicated terminals like Evergreen in the Italian port of Taranto and Maersk-Sealand (as A.P. Moller Ports) in Rotterdam. According to Heaver (2002), building dedicated terminals is an attempt by liners to achieve economies of scope and *door-to-door* logistics services i.e. vertical integration.

Participations of these new, but also big, players have completely changed the port competition landscape in North Europe.

However, with decreasing barriers to entry, together with the fact that the barriers to exit remain relatively high for the port industry due to high fixed cost and generally minimal alternative use value of port superstructure, modern port operators, especially new entrants, really need completely new strategies and management philosophies to tackle new challenges ahead.

Potential for Global Substitutes

This force involves the user's potential in shifting to other alternatives instead of continuing using existing services. Substitutes can create another potential threat to profitability of an industry concerned if the former emerges quickly from unexpected quarters (World Bank, 2000). The threat of substitute is significant when the current service is costly and/or difficult to use while cheaper and/or decent quality alternatives exist.

The competitive advantage of ports under this force depends on the availability of other global sources for products moving through the port, substitute products for imports and exports and their demand elasticity, the switching costs for substitutions, image of using port services and port costs in total price of delivery. For example, the use of air transport in transporting cargoes can act as an alternative to the use of container shipping (which also means an alternative to port services since port and liner shipping are interrelated), while port service, to some extent, can also be substituted by other means, like the mid-stream operation in Hong Kong. Another example is intra-European Short Sea Shipping (SSS) where the preference of shippers/freight forwarders in choosing unimodal road

vehicles or multimodal transportation is likely to affect the competitive position of ports. In tackling the potential threat of substitutes, ports can undertake various strategies like cooperation with other ports and collective promotions (Wiegmans et al., 1999)

In liner shipping, the influence of potential substitutes on port greatly depends on the nature of the shipping routes in which ports are aiming to serve. In long distance ocean-crossing routes, the threat of substitutes from alternative modes is not that significant for most cargoes due to various problems like unreliability (like the Trans-Siberian Railway between Asia and Europe) and economic unfeasibility (like high cost for air transport for most cargoes) of alternative options. With sea transport as the only reliable and economically feasible option, in the foreseeable future, it is unlikely that shippers can avoid using services provided by liners and thus also ports. Under this situation, port competition for transhipment traffic is unlikely to be seriously challenged by global substitutes[18].

Bargaining power of customers

The fourth force involves the bargaining power of service providers and customers. Porter assumed that these two parties are negatively proportional to each other i.e. the strengthening of one side is likely to weaken the other side. Such explanation between the relations of service users and providers has an important assumption that users and suppliers tend to be antagonistic and competitive in nature. According to FFM, firms are prepared to counter profit-threatening behaviour imposed by customers/service providers

[18] The importance of substitutes can be more significant in short-haul intra-continental freight transportation especially if the region's transportation network is relatively developed. For example, in North Europe, the market share of intermodal transport (which requires port services) expressed by total volume of good transported within EU is modest with only 1.63% in 1987 (this figure is expected to be doubled to 2.6% in 2010), while goods being transported by unimodal road transport in 1997 is 44% (Janic and Reggiani, 2001). This shows that port faces huge pressure from potential substitutes in serving short sea shipping due to a mix of highly competitive nature by road and weak combined transport solution by maritime transport.

and should be prepared to abandon existing customers/service providers readily in order to switch to new ones (Porter, 1985). In cases where customers in the industry are powerful, they can bargain hard to squeeze profits from the providers.

However, an important point needs to be emphasised here concerning the identification of players within this force. Within an industry, it is possible that there are direct and indirect customers using a particular service. As port is only one of the components of the logistical chain, direct and indirect port users exist. The former belongs to the vessels of liners while the latter belongs to those who are involved in the transport chain but not necessarily need to have first-hand information about port services like shippers and freight forwarders. The importance of the influence of particular player(s) on the game varies between different cases and thus, before going on any analysis, it is important to understand the degree of influence/dominance of different players when assessing port competitiveness.

There are several factors affecting the bargaining power of customers. It includes shares of individual user's volume relative to the total sales of service provider. For example, a customer which makes up nearly half of the port's moving capacity would likely to have strong negotiating position like MSC in Antwerp. The share of the purchases of key user's as a portion of user's total costs, standard or undifferentiated products, cost of switching from one provider to another, importance of the product to the quality of the user's products or services and availability of information to users all contributes to user bargaining position (World Bank, 2000). In port, liners tend to influence port management to their advantages. Such power of influence mainly depends on market concentration on port and the latter's importance to the local economy (World Bank, 2000). Finally, port

service user's power will also be enhanced if the user itself has invested heavily in dedicated facilities instead of using public port facilities[19].

As mentioned, existing studies suggest that developments in liner shipping tend to favour the bargaining power of port users and they are the major decision-makers in choosing transhipment hubs because they are responsible in constructing shipping networks. The agreement between ECT and P&O in constructing a dedicated terminal for the vessels of the latter at Rotterdam, *Euromax*, was a good example illustrating the position of users (Notteboom, 2002), though this also illustrates the increasingly co-operative gesture between suppliers and users. Such disadvantage is not helped by the fact that port operation suffers considerable barriers to entry and exit due to high fixed costs in capital investments, as the case of Maersk-Sealand and Port of New York-New Jersey had illustrated. The strong bargaining power of customers is perceived to be further enhanced by the relatively weaker linkage, information exchange, communication and alliance between ports during the negotiation process. The competitive strength of existing competitors is comparatively weak and certainly needs improvements. This also suggests that bargaining with customers is an important factor in deciding the competitive position of a port. As Haralambides (2000) had pointed out, recent port development had been dictated by liner shipping development.

Bargaining power of suppliers

Supplier implies the organisation providing necessary factors in allowing service providers to produce their products or offer their services effectively. The nature of such

[19] It is important to note that massive investments, which enhance the possibility of creating sunk costs, may also reduce port user's power. Whether port service user's investments will enhance or reduce bargaining power depends on specific circumstances e.g. market environment, bargaining power of service suppliers, etc.

organisations can vary, ranging from private, public and even voluntary non-profit making sectors.

For service providers, factors include the number of providers, degree to which the provider is obliged to contend with other substituted products, importance of the industry as a customer of the supplier group, importance of the suppliers' product to the user's business, product differentiation of suppliers, whether the supplier poses a credible threat of forward integration, etc. In port, it includes cargo-handling operators, warehousing, tug services, securities, etc. Their bargaining power depends on experience and capabilities, participation on facility financing, ability to survive in difficult times, contractual arrangements and negotiations with port user. Also, port service providers could enhance bargaining power if they control some key services, especially if the cost of shifting to other ports is high. Examples of suppliers in container port industry include government's lands department, firms which provide port machineries and IT equipment and port affairs interest groups. The bargaining power of suppliers includes its experience and capabilities, degree of participation in facility financing, interrelations between suppliers and customers, as well as whether *choke points* exist in ports (World Bank, 2000), notably labour issue. In France, for example, strong port labour unions can facilitate slowdowns or stoppages of port operations which offer considerable power that allows employees to force concessions from employers.

Finally, it is important to note that supplier does not necessarily only involve those who are directly related to port. A good example is the control of the access point between the open sea and River Scheldt by The Netherlands and throughout the years, the Dutch had placed certain checks on Antwerp's development. In this case, the Dutch government is a

service supplier which possesses strong bargaining position to limit Antwerp's competitiveness.

Applicability of FFM in port competition

FFM has dominated the academic field of business since the 1980s and has also become one of the major standards in strategic management. Indeed, FFM illustrates major market forces affecting an industry's competition and anticipates the competitive strengths and weaknesses of an industry, which is, in general, also relevant to the competitive structure of port. Most importantly, however, the contribution of FFM in understanding port competition lays in the fact that the model acted as a breakthrough in overcoming the traditional hardware approach in port strategy and management analysis. Indeed, provided the existing environment and development process of global container shipping industry, software or institutional environment should be the key element in analysing port competition (Haezendonck, 2001).

More importantly, FFM shows that, rather than just simple quantitative elements based on monetary cost (and possibly also time), less-readily quantifiable attributes like service quality cannot be ignored in deciding competitiveness. Although every industry is unique and has its own unique structure, FFM has exerted influences, to a greater or lesser degree, over the dynamics of port competition and how port will be competing. To sum up, FFM is a valuable tool in enhancing our understanding of industrial competitiveness and possibly explain why FFM had been widely applied in explaining port competition in the past.

However, despite its value, FFM is inadequate to explain port competitiveness. Firstly, whether the model fully captures all essential factors shaping the competitive structure of

port is questionable. FFM had only identified market forces as 'core' factors leaving non-market ones largely ignored. In reality, firms and industries operate under the influence of various non-market forces like regulations and government policies which is especially true for port (Ng, 2002) especially since, unlike many industries, a port is virtually immobile within a specific location[20]. Acting as the interface between land and sea, port is widely regarded as a strategic asset (World Bank, 2000) and thus not only affected internationally, but also nationally and locally. This is supported by Hayuth (1987), who argues that transport systems are not just dealing with the system itself but also related to political, economic and social environments involving technology, networks, transport modes, information, communication and logistics, including port.

Thus, it implies that port operation and thus competition can be affected by policies and regulations, as supported by the fact that many ports around the world are still not privately owned, even commercial ports. In North Europe, for example, with the notable exception of Felixstowe, public presence still exists in most ports. Ownership of ports can be at least divided into three types, namely publicly owned, privately owned and public/private ownership (World Bank, 2000). Recent development in ports, especially in container stevedoring, which involves various kinds of arrangements e.g. merger, privatisation, commercialisation, rise of global port operators, etc, have further complicated the issue. As a consequence, even within the same region, different ports may respond differently to the challenges due to different locations and institutional settings. This upsets the possibility of making decisions based on pure economic considerations, which in turn creates specific local market environments in different

[20] Of course, port's 'exact' location can change. For example, at the beginning of the 20th century, the port of Liverpool is located at Albert Dock which is close to the city centre. Since containerisation, the major terminals have moved out of the city core. Nevertheless, even under such situation, a port is still located 'within the region of which it belongs to'.

regions and thus affects the structure of port competition. Finally, it seems difficult to accept the complete ignorance of government policies and other non-economic factors by liners when making their port choices. As Porter himself even admits later, sound institutional structures, including political and legal, are important for an industry's competitiveness and growth (Porter, 2000).

Secondly, the centrality of the industrial environment in explaining port competition is doubtful. Porter asserts that the industry environment is central in shaping firm behaviour and that industry structure determines the rule of the game. Although beyond doubt that industry environment plays a significant role, it does not necessarily imply dominating. Other aspects, like firm-specific characteristics, beliefs, perceptions, availability of information are also salient factors in shaping competitiveness. Refer back to container shipping, for example, liners have the choice to call at a public port or to invest in the construction of dedicated terminals. As Panayides and Cullinane (2002) have argued, Porter's view was too industry-driven and overlooked the fundamental characteristics of companies (and thus human mind) in affecting strategic decisions. For example, when dealing with liners, port operator can undertake a proactive strategy to tackle challenges like horizontal integration and long-term commitments with liners respectively. In other words, fundamental resources and capabilities should not be overlooked in constructing the competitive strategies of a firm. This is not helped by the fact that not all factors affecting industrial competitiveness are within the industry's structural framework. In port, some services are non-profitable quasi-public goods e.g. piloting, dredging, etc. As it is highly unlikely that profit-making organisations are willing to provide such services, such goods have to be provided by the public sector, or the former being obliged to provide non-profitable goods through non-market forces like governmental interventions or

concession agreements. Obviously, something more than the industrial environment is necessary to explain port competition.

Thirdly, FFM asserts on the antagonistic and competitive nature between service users and providers which is not necessarily true. In reality, collaboration between customers and service providers is possible. This deficiency is apparent in the port industry and collaboration can lead to a win-win situation, especially due to the industry's capital-intensive nature which has led to unprecedented financial demands and enhanced competitive pressures. Thus, inviting liners to involve in port investments becomes an attractive strategy to guarantee the commitments of port users to particular ports (World Bank, 2000). A good example in illustrating the existence of collaboration is Hong Kong's Kwai Chung Terminal 8 which is a dedicated terminal for COSCO's vessels. FFM also fails to explain various popular management strategies e.g. port operators' marketing, long-term contractual arrangements between port service providers and users, etc.

With such deficiencies, the author is convinced that FFM is valuable but inadequate. Such a view was supported by Weigmans et al. (1999) who tried to explain port competitiveness by adding *terminal environment* as an additional component to supplement FFM e.g. infrastructure, load units, transport networks environmental issues and regulations, etc. Unfortunately, their analysis was brief and overly oversimplified by only listing the factors and made no attempts to improve the applicability of FFM in explaining port competition. Later, even Porter himself recognised the problems and thus he introduced the Diamond Theory in addressing the shortcomings of FFM in his book entitled *The Competitive Advantages of Nations*.

2.3.2. Diamond Theory

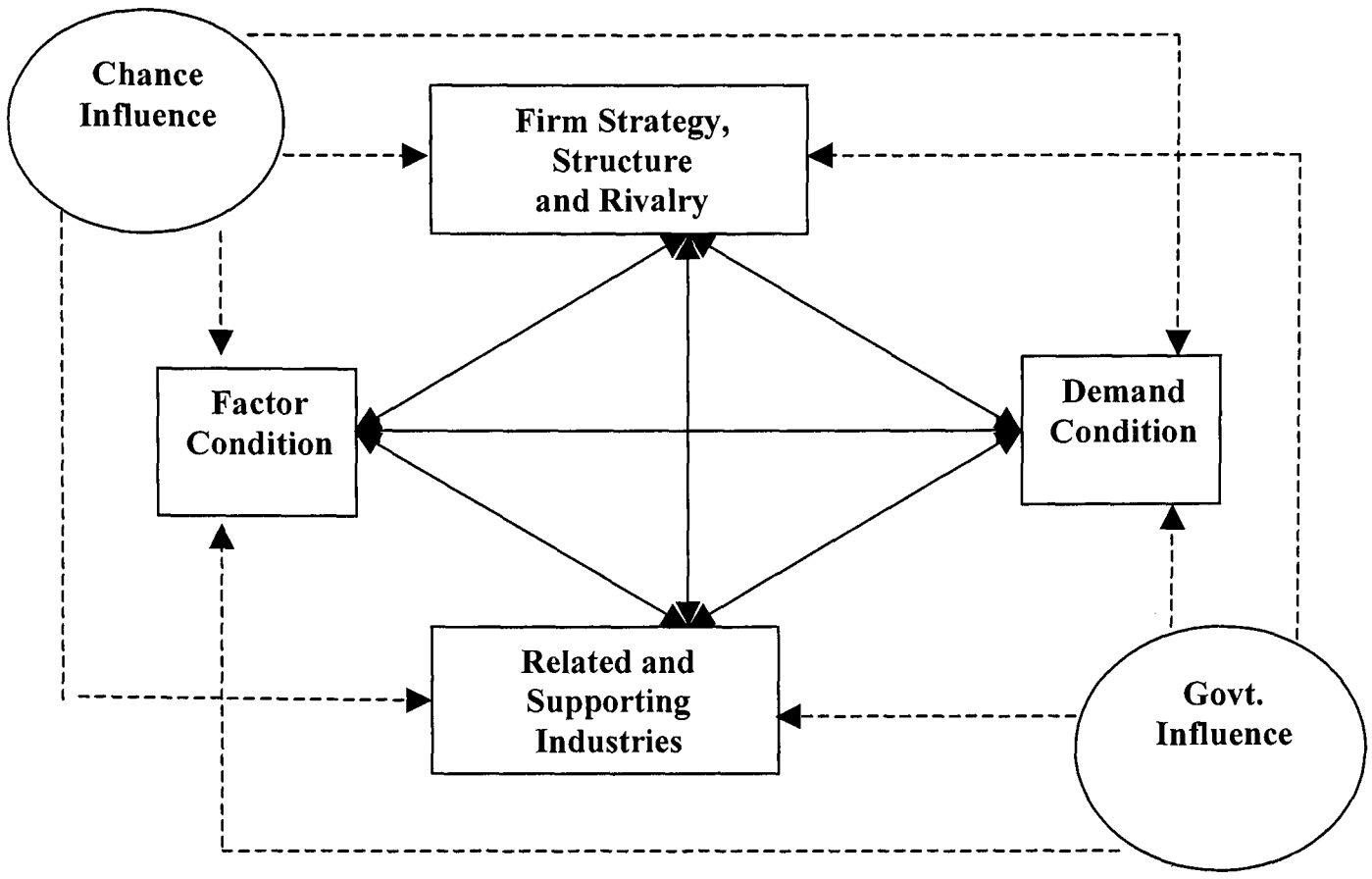
In 1990, Porter introduced Diamond Theory (see Figure 2.3) with new ideas and explanations on competitive advantages. Diamond Theory differs from FFM that the former gives a linkage in explaining how a firm can enhance its competitiveness through the creation of competitive advantage and also acts as a concept in capturing the key elements of a company's situation that influence its potential international strengths (Bowman and Faulker, 1997).

Here Diamond Theory has introduced an important concept that, rather than static focus on cost minimisation in relatively closed economies, competition in the contemporary world is dynamic and rests on innovation and the search for strategic difference because of the increase in countries open to the global economy, greater efficiency of national and international factor markets and diminishing factor intensity of competition (Porter, 2000).

Here Porter argues that the competitive position of a company depends on two factors including *operational effectiveness* (sought for the best operation practice) and *strategies* (sought to answer 'how to compete') (Porter, 2000). In explaining port competition, his idea can be interpreted as *engineering* and *economic* approaches in port development strategies which questions whether port should maximise their productivity or fight for customers. He stresses that, in order to succeed, a firm must sustain and improve operational effectiveness while at the same time creating strategies which distinguish itself from its competitors (Porter, 2000).

Figure 2.2. Diamond Theory

(Source: Porter, 1990)



Factor Conditions

Rather than focusing on inherited factors of production like labour, land, natural resources, capital and infrastructure, Diamond Theory emphasises on creating factors of production including basic (like unskilled labour), general (like normal infrastructure), advanced (like IT and professional personnel) and specialised (like container-handling cranes in container port industry) factors. Here Porter argues that the latter two factors are the most important in enhancing competitive advantage because they are more difficult to obtain. However, what is special about factor condition is that selective disadvantages in more

basic factors can enable firms to create competitive edges because they may be forced to innovate in order to compensate the disadvantages, provided that they are offered the chance and favourable circumstances to do so. For example, in container transhipment, geographical disadvantage of a port could possibly be cancelled out through better strategies in management and public relations.

Demand conditions

Demand conditions can be multi-folded in terms of local, regional, national foreign and global. Diamond Theory argues that when the market for a particular product is larger locally than in foreign markets, the local firm devotes more attention to that product than do foreign firms, leading to a competitive advantage when the local firm begins exporting the product (Porter, 1990). Character of demand also plays an important role as highly sophisticated buyers might force the firm to meet higher standards, while special local circumstances may also make demand character more complicated. This point is especially significant for ports since ports are virtually immobile. For example, direct competition between ports located at far away regions/continents like Rotterdam vs. Hong Kong is virtually non-existent. Also, a strong and growing local market offers a strong base for a company when going global and in the case of maturity local demand may also be an incentive for firms to move to foreign markets.

Related and Supporting Industries

According to Diamond Theory, another determinant of competitive advantage of nations is the availability of related and supporting industries. The role of related and supporting industries is similar to supplier in FFM, where such industries are important to ensure that goods and services can be produced and offered effectively. It comprises of complementary products of which an organisation can use and can coordinate particular

activities in the value chain together. However, the difference is that related and support industries here do not include institutions of the public sector since a complementary factor called government exists in Diamond Theory. In port, as mentioned before, related and supporting industries can be situated in the port like ship repairers, bunkers, warehousing, feeder providers, etc. The closer the relationship between service providers and related industries, the more effective coordination between different parties, the better the effectiveness of the port cluster, which leads to the possession of competitive advantage of that particular port.

Firm strategy, structure and rivalry

The major factor which distinguishes Diamond Theory from FFM is the concern of the former on management structure and resource limitations in affecting the competitive strategy of a firm. Recognising the shortcomings of FFM, Porter deliberately changes his explanations and admits that there is no one common strategy or management theory which can explain all the behaviours of firms because different management ideologies exist like personal beliefs and company culture (Porter, 1990). Rather than static, a firm is actually an *evolutionary creature* where past experiences and personnel have direct implications on future strategies and development. For example, in tackling fierce port competition, strategic decisions of ports can be multi-faceted e.g. revolutionary or conservative, expansionary or maintenance of *status quo*, market consolidation or specialisation, etc.

Porter later strengthens this point by emphasising that a company must develop their strategies creatively in order to compete effectively (Porter, 2000). Such philosophy has led to the rise of various new port development strategies towards the end of the 20th century e.g. cross-border investments of port operators, cooperation between competing

ports to achieve win-win results (Dong, 2002), intensive marketing[21], etc. Nevertheless, it is important to note that recent port operators' strategy in attracting customers is characterised by a combination between monetary cost and service quality where port believes that quality services to liners is the key to maintain and enhance their competitive position since, as World Bank (2000) believes, monetary cost itself is inadequate in explaining liners' decisions in port choice. Market environment is not the only decisive element in deciding strategies and competitiveness of a company. Also, the competitive position of a firm depends on whether it can exploit the surrounding environments towards its favour, whether the management hierarchy prefers stability or adventures and whether it accepts that change is necessary. In other words, how a firm perceives itself can play a role in deciding its own competitiveness.

Thus, Diamond Theory distinguishes itself from FFM in that the former has included elements that originated from Resource-Based Theory where a firm has the opportunities to decide on its own fate[22]. This point has made Diamond Theory a better option than FFM in explaining container port competition. For example, facing the rise of the bargaining power port service users within the industry, service suppliers have different strategic choices in counterbalancing challenges and maintain/enhance their competitiveness e.g. more physical infrastructure investments, drawing into long term commitments with their customers, more intensive marketing, coordination and cooperation with competitors, etc.

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[21] For example, according to Barba et al. (1998), by the end of the 20th century, resources allocated to port promotion and marketing by Rotterdam amounts to more than 30% of its annual budget, compared to just about 20% for Antwerp and Hamburg.

[22] Resource-Based Theory believes that the best performing firm can make use of its best available resources into producing high quality products/services. The selection of competitive strategies should be based on sensible evaluation of available resources and strategic decisions which are constrained by past resource deployments which result in further reinforcement of the company's profile. While FFM emphasises on industrial environment, Resource-Based Theory focuses on individual characteristics and believes that the fate of a firm in the competitive market mainly lies within its own hands. See Conner (1991) and Grant (1991).

Here one can identify another major difference between FFM and Diamond Theory. While FFM insists that the relation between service users and providers is always conflicting, Diamond Theory recognises possible collaboration between them for mutual benefits and all these are dependent on various factors like anticipation and corporate culture in dealing with competitions and challenges. The extent of such collaboration, of course, depends on individual cases. By rejecting the existence of individualistic nature of firms, it explains why FFM fails to recognise possible cooperation and coordination between suppliers and users as well as within suppliers themselves because FFM uses the 'billiard ball' approach in explaining competition where different companies are assumed to be similar to each other and the final outcome would greatly depend on circumstances.

Apart from the major attributes, Porter also adds some complementary factors into the Diamond Theory, although he insists that these factors do not qualify as core factors because they do not play direct roles in affecting the competitive advantage of an industry.

Government

The first complementary factor is governmental influence. Rather than a core player, Diamond Theory suggests that government should take the role as a catalyst and should encourage companies to raise higher levels of performance by creating a favourable environment for them to compete at a fair platform e.g. enforcing standards in service quality, encouraging competition, introducing and enforcing antitrust policies, providing necessary aid, etc. However, he argues that government should not act a core player within an industry and should not participate in company's management and competitive strategies because direct participation of government will lead to ineffectiveness and bureaucratic culture (Porter, 1990). According to Juhel (2001), in the port industry,

government should achieve three missions, namely catalyst mission (e.g. finances transport assets which are unlikely to get access to private or alternative financing sources, creates regulatory enabling environment, etc.), statutory mission (e.g. ensures navigation safety, coastal management, etc.) and facilitation mission (e.g. public governance, helps trade facilitation process, initiates trade integration, etc.). He further argues that all these require an established public sector (usually port authority) with well-defined roles in achieving this. His view was supported by Ng (2002) who notes that *public presence still matters in affecting the efficiency of port operations.*

Although liner shipping has largely been liberalised by the end of the last century (Preston, 1999), governmental influence in the industry can still be found worldwide, either in regional or national scales (World Bank, 2000). For example, state aids can still be found in many European ports (EC, 2005) while the public sector is also often involved in port projects like dredging and widening river channels[23]. In Western Europe, the role of government in ports differs considerably between countries where the Benelux countries, France, Germany and UK all have port policies (see Chapter Three). However, with a few exceptions, government influence on port policies in North Europe are mainly at regional and national scales. Until recently, common port policy at an EU level does not exist and any concerns on ports by the European Commission are still restricted to technical studies only[24].

[23] According to EC (2005), they even believe that limited amount of state aid to the maritime transport is necessary and thus should be justified.

[24] An attempt to adopt a common port policy, *Port Package*, has been made towards the turn of the century. However, it failed to win support from the European Parliament (in 2004 and 2006), with the second attempt being overwhelmingly defeated by 120 "Yes" against 532 "No" votes (25 abstentions).

Chances

Another complementary factor in Diamond Theory is chance. Porter suggests that industries are not completely influenced by rational factors and unexpected events can take place which benefit or harm the competitive advantage of a firm within an industry e.g. major technological breakthrough, wars and conflicts, natural disasters, fluctuations in global economy, etc. A good example of the influence of chance on the container port industry is the Japanese port of Kobe. Belonging to one of the top ten container ports in Asia throughout the early 1990s, after the disastrous Kansai Earthquake had taken place in 1993, with vast port infrastructures being destroyed or damaged, Kobe lost its top status for much of the remaining decade.

Clustering

Initially not included in the theory, towards the end of the last century, Porter adds clustering as a supplementary factor to strengthen the Diamond Theory where it is placed at the centre of all the attributes functioning as a coordinator between all the core and complementary factors. According to Porter (2000), a cluster is *a geographical component* where *a proximate group of interconnected companies and institutions (which can be either competitive or complementary) come together and act as a manifestation of the interaction among all facets of Diamond Theory*. He argues that the proximity of competitors near to each other can improve the industry as a whole due to proximity to specialised inputs and employees, access to information and knowledge, as well as ease of constant comparison in terms of performance. In turn, this intensifies competition where the competitive position of a firm must be based on performance and innovation, rather than local circumstances. He emphasised that creative strategies, innovations and a degree of good cooperation and interactions between different sections of the cluster are the key components in order to turn the advantages of clustering into competitive success. By

adding cluster into the Diamond Theory, Porter admits that the explanation of competitiveness is not complete without a geographical perspective. His opinion is appreciated by Dunning (2000) who argues that clustering minimises distance-related transaction costs and thus generate geographical attraction of a participant in the industry's competitive game.

As part of the global transportation system, clustering in the global economy also allows ports to cluster, thus creating certain *port clusters*, usually around major production and consumption regions like Hamburg-Le Havre range (North Europe), Pearl River Delta (South China) and New England (North East US). These *clusters* share some characteristics as proposed by Porter, notably increasing cooperation but also competition between ports due to the intensification of competitions in serving common markets. In fact, scholars like Rimmer (1998) even argues that port should actively take the initiatives to consider forming real port clusters among themselves through mergers and cooperation with other regional ports and develop *regional port complex.*

Based on Porter's definition, apart from a macro-geographical dimension (i.e. inter-port clustering), here the author argues that clustering also has a micro-geographical dimension, namely intra-port clustering. It is important to note that since the trend of port privatisation, contemporary container port is often a clustering of a group of interrelated companies and institutions and that their combined effectiveness reflects the overall quality of service provided by a particular port, as Heaver et al. (2000) described it, a *heterogeneous group* within port. For example, in the port of Rotterdam, it consists of container stevedoring companies (ECT and A.P. Moller), the public sector and various supporting institutions (like Erasmus University and various port consultants for education and development and professional advices). Port clustering is not dissimilar to

the concept of port governance, of which pioneer studies has been undertaken by Ng (2002) and Wang and Slack (2002) investigating port governance in China[25], followed by De Langen and Visser (2005) later who applied this concept into the Lower Mississippi port region.

Applicability of Diamond Theory in port competition

Diamond theory addresses the major shortcomings of FFM, where the former brings back several non-market factors into the formula in explaining port competition. Also, rather than passively using industrial environment to dictate the explanation of competition, Diamond Theory recognised the possible implications of fundamental strengths and weaknesses of ports in affecting port competition which in turn also highlights the possibility of competition and collaboration between port service users and providers. By doing so, rather than like a billiard table with balls passively moving around depending on circumstances, ports can also have initiatives and opportunities to shape their own fates through factors like the construction of progressive strategies, corporate cultures and geographical agglomeration i.e. clustering. In this sense, Diamond Theory is a better alternative in reflecting the real-world situation as it recognises port service providers could cooperate and achieve mutual benefits while reducing destructive competition between them, thus altering the overall port competitive structure. Diamond Theory can also cover the concerns over *port environment* as noted by Wiegmans et al. (1999).

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[25] The concept of governance is originated from the recognition of the limitation of the government in carrying out all the development roles and decisions and governance is rooted in *rejection of simplistic dichotomies that inform the social sciences* (Jessop, 1998). Thus, a society/an industry's development prospect should involve the agglomeration, participation and coordination of various sectors including government, private sectors and other relevant parties. Also, governance recognises the importance of the mutual-dependent relations between public and private sectors and argues that public-private coordination is a key factor in ensuring the healthy development of a society/an industry. As Stoker (1998) has noted in his *five propositions of governance*, governance recognises the blurring of boundaries and responsibilities in tackling social or economic issues and thus autonomous self-governing network of actors should interact to achieve collection tasks through the dependence of power within the society/industry's network. Here government is pivotal in guidance and steering but not commanding and authoritative.

Despite such improvements, Diamond Theory still suffers from several deficiencies in explaining port competition. Firstly, it involves the question on whether government should be regarded just as a complementary factor. According to Diamond Theory, chance and government are regarded as complementary factors. While not rejecting the former as a complementary factor, whether the latter only deserves complementary status only is questionable. Diamond Theory insists that government is not a core factor as it only indirectly affects the interactions of the core factors. However, such insistence seems doubtful about its applicability on port competition. As mentioned before, port does not only have economic, but could also have non-economic functions. In reality, government may go beyond that of a catalyst but as an additional key component of the Diamond Theory (Huybrechts et al., 2002). As noted before, most of the ports in continental Europe are still not completely privatised and government, especially local authorities, still have significant influences on port development. For example, until very recently, foreign companies are not allowed to hold controlling shares in container stevedoring joint ventures in China. If the philosophy of Diamond Theory were applied directly into port competition, it seems that port operation would be based on tool or landlord port models and competition must be battles between commercialised firms and it is not necessarily the case. This problem has raised doubts over Diamond Theory in explaining port competition. It seems that, in many cases, government (either national or regional or local) has more direct influences in port competition. As illustrated later in this thesis, the presence and participation of the public sector in some of the ports studied here, in many cases, does play a difference in the competitive position in a port. In fact, Huybrechts et al. (2002) recognise this problem and introduce an *Extended Diamond Theory* to with the objective to emphasise that government's role should not be just regarded as periphery.

Secondly, the emphasis on factor conditions in explaining port competitiveness is also questionable. Here Diamond Theory asserts that advanced and specified factors are significantly more important than general factors. While this might be true for most other industries, this argument is doubtful when applied to ports. Since ports are virtually immobile within a specific location, a number of factors like maritime access and hinterland access can still play significant roles in the competitiveness of a port and one still could not ignore the importance of factors like the (in)efficiency of geographical location (Huybrechts et al., 2002). For example, in the rivalry between the ports of Antwerp and Rotterdam, the former has restrictions on its maritime access and so possesses a competitive disadvantage in the transhipment market. Efforts can be made to enhance the draught of the access route artificially through technological means but, until now, it is still impossible to attain the draught level as Antwerp wants due to technical problems, not helped by a political factor in that the Dutch government is unwilling to allow better port access to Antwerp so that it could affect the potential competitiveness of Rotterdam. Although it is claimed that non-location bound factors, like EDI system, capital and superstructure, are becoming more important (Huybrechts et al., 2002), the effects of some general factors still cannot be ignored in ports.

Perhaps most importantly, there is the issue of whether the anticipated and actual demands between service providers and users are similar. In both FFM and Diamond Theory, Porter seems to overlook the role and significance of an important issue involving the relations between service providers and users, here termed as 'Mismatch in Anticipation' (MiA). A service provider offering quality services to customers does not necessarily guarantee competitiveness because business decisions of the former are often affected by estimations and perceptions of customer demands. It implies that the competitiveness of a service provider does not only depend on industry environment and

its own strengths and weaknesses, but also on how their customers appreciate their efforts and use their services. Of course, the significance of MiA depends on various factors existed in FFM and Diamond Theory e.g. the bargaining power between customer and service provider, availability of information to customers about the services, availability of alternatives, etc.

With the highly speculative nature in its development, MiA certainly takes place in the container port industry. As discussed before, there is no guarantee that liners will use the services offered by ports and no one can ensure that quality performance automatically increases market shares, especially with the increasing prominence of transhipment where port demands by liners are becoming more *elastic* (Bennathan and Walters, 1979). According to a study conducted by the World Bank, a container port with a use rate of 80% should be regarded as highly satisfactory, while the normal use rate of major ports around the world is about 75% (Juhel, 2001). Port development strategies which are purely based on FFM and/or Diamond Theory become highly supply-led and the port bears the risk that it becomes more attractive to customers but not necessarily more competitive *vis-à-vis* its competitors as there is no guarantee that customers will automatically increase their demands. In fact, the ignorance of the existence of MiA by Porter has significant effects on the development strategies of many contemporary ports where they often concentrate in hardware aspects while the significance of software aspects is often overlooked (see Chapter Three).

With the existence of MiA, it means that both FFM and Diamond Theory fail to explain clearly the relations between service quality and different competitive forces. Undeniably, a firm would become competitive only when it possesses a certain level of service quality, or attractiveness. While competitive forces lean towards the firm only with the existence

of attractiveness provided by the firm, it is not necessarily the case the other way round. A certain degree of attractiveness provided by a port would likely to attract a certain number of vessel calls, but not necessarily at the expense of the competitors of the former. In other words, the interrelation and interdependence of service quality and competitive forces imply that competitiveness of a firm does not only have a comparative perspective, but also an absolute perspective. As a consequence, in researching port competition, there is a need to consider the effects of MiA where such considerations should be reflected in the theoretical framework and methodologies. Thus, while the above theories are valuable references, adjustments have to be made when constructing the theoretical framework.

Despite the potential shortcomings, all the competitive models introduced here have brought an important message i.e. port competitiveness does not depend only on readily-quantifiable factors like money and time and other less-readily quantifiable factors like geography, quality of services and customers' beliefs and limitations should also be put into context. Of course, this argument is not necessarily true and some studies have investigated its relevance. Before illustrating the theoretical framework, the next section reviews previous studies which investigate the significance of port choice criteria.

2.4. REVIEWING PREVIOUS STUDIES IN CAPTURING PORT CHOICE CRITERIA

In most cases, when a user decides to choose a particular port, it must be somewhat related to its attractiveness. There are many factors which can affect port attractiveness and thus choices with monetary cost and time being the most easily-identifiable factors. However, apart from that, there may also be other less-readily quantifiable factors which are also significant in affecting port attractiveness and choice. As Clark et al. (2001) has

noted, *there must be a certain level of quality to ensure that a port could operate with decent efficiency* (in terms of quality of port services) and their view was supported by various academic and consulting works e.g. Drewry (1998), Bendall and Stent (2001), Hensher and Brewer (2001), Pallis (2002), etc. As Bennathan and Walters (1979) had noted, although port managers often want to keep their prices below their competitors, they also want their respective ports can offer differences in service quality. Given the fact that the quality of service provided by liner shipping often involves logistical factors like IT, efficient response to customer requirements and network coordination (Haralambides, 2004), port service quality actually has more direct implications on the service quality provided by liners to shippers themselves.

In the academic world, studies investigating the importance of qualitative factors of choices between different options in freight transportation can be dated back as early as in the 1980s. Academically, it seems that many transport scholars agree that monetary cost is not the only criterion in deciding the decisions of transport users. According to Gubbins (1988), quality of services is overwhelmingly important in modal choice of shippers and transport users in freight transportation. Her idea is supported by Jeffs and Hills (1990) who also question the dominance of quantitative factors, especially monetary cost, in the determination of transport choice. Further supportive work includes Farrell (1999) who argues that massive reduction in labour employment and high capital costs have increased the importance of service quality of ports, especially container terminals, relative to competitive price, while Heaver (2002) argues that the scope of services provided by terminal operators is critical to ensure continuing calls by vessels of liners. Also, while Murphy et al. (1991) note that port users are willing to accept higher prices in return for better services from ports, Pallis (2002) goes even further by arguing that qualitative factors are decisive in deciding the attractiveness of a port. In short, scholars who support

quality of service as a decisive factor in transport choice can be summarised by Polak and Heertje (2000) who state that quality of service is an important criterion applying to transportation.

The view that qualitative factors are important in port choice also seems to be shared by Rotterdam Municipal Port Management (RPM), the port authority of Rotterdam. In the *Projections 2020* brochure, Rotterdam's competitive position is defined as *to what extent [Rotterdam] can distinguish itself from other ports and locations in Europe [and] this distinctiveness determines its competitive position... such as... sufficient space, clear legislative and regulatory framework* (Port of Rotterdam, 2005) which clearly indicates that RPM does not believe that monetary cost can dictate the final choices of port users. Such diverse opinions have aroused a keen interest on investigating the degree of importance of qualitative factors in the selection of a transhipment hub.

However, studies which suggest otherwise also exist by insisting that qualitative factors are just existing components and will become insignificant when customers have to trade-off with money and time, although not as many as those who suggest otherwise. For example, according to Lirn et al. (2004), although they support the view that qualitative factors played a role in port selection they also believe that monetary cost remains one of the most significant factors of liners in deciding which port to call, while the work of Foster (1979) also suggest that monetary cost is still the most important port choice determinant. Understanding such divergent views, the issue concerning capturing qualitative factors and assessing their importance in port competition have to be addressed.

However, before doing so, this section reviews previous work on capturing these less-readily quantifiable factors in affecting port attractiveness. One of the methodological problems in addressing transport issues is that considerable contemporary transport studies still follows the trend of positivism inherited from the 1960s and 70s, usually emphasising on monetary cost as the primary focus of analysis (Slack, 1985 and Hanson, 2000)[26]. As illustrated before, this approach is becoming more and more outdated and new perspectives on methodology, both quantitative and qualitative, are necessary, especially with emphasis on investigating how quality of services would affect the competitive position of ports.

There are a number of works which have discussed the role of different qualitative factors on port choice e.g. Fleming and Hayuth (1994), Heaver, Meersman and Van de Voorde (2001), Heaver (2002), Song (2003), etc. and the contribution of these studies in enhancing the understanding of port choice criteria is beyond doubt. However, most of these studies only focus on the identification of port choice factors and measuring port performance without considering seriously how these factors would affect the generalized cost of port users in calling at a particular port to load and unload their cargoes. Moreover, since these studies mainly 'discuss the issue' rather than 'to address the problem', most of them cannot fill in the research gap in question.

Although considerable works on the implications of qualitative factors within the transport literature can be found, most of them focus on passengers rather than freight transportation (like Hensher and Prioni, 2001), possibility due the relative ease in data collection as passengers are easier to identify quality of services like comfort and

[26] During the latter 20th century, the influence of positivism on transport research is so strong that many theoretically based understandings on other broader perspectives, like social implications and humanistic behaviours in decision-makings, have been widely neglected or even completely ignored (Johnston et al., 2000).

convenience. On the other hand, it is interesting to found that a number of works highlight the importance of service quality on modal choices with special attention to maritime transport but does not really include it in their methodology. For example, while Yang (1999) argues that ports should create an *attractive service environment* to attract calls from vessels, the nine attributes that he has included in his model are all related to monetary cost. On the other hand, although Veldman and Bückmann (2003) have noted the importance of quality of services like responsiveness to the wishes of customers and the availability of advanced technology, they choose to ignore them completely in their modelling, claiming that all such factors cannot be quantified. It seems that many studies have chosen to turn a blind eye to this potential problem rather than to solve it.

Nevertheless, works assessing qualitative factors in modal choice for freight transport can also be found, although most of them focused on the evaluation of time factor. For example, Blauwens and Van de Voorde (1988) have applied a revealed preference approach in estimating the monetary values of time in the transportation of different types of cargoes with different values. More recent example includes the work by De Jong (2000) who used a methodology, *value of time savings* (mainly through a stated-preference questionnaire), in capturing value of time in the generalized cost function of using road, rail and inland waterway transport for freight transportation. Works focusing on qualitative factors other than time also exist, including Allen and Liu (1995) who introduce a service quality index to measure truck's performance in terms of transit time, routing and equipment, as well as Jeffs and Hills (1990) who try to assess the perceptions of transport decision-makers on the importance of several qualitative attributes in customer service e.g. reliability, flexibility, etc.

Further example can be given by Dougall (2002) who assesses the economic viability of developing short sea shipping within the UK by quantifying social costs like road accidents and damages into the generalized cost equation. Another interesting work has been done by De Maeyer and Pauwels (2003). Through reviewing different methodologies in assessing qualitative factors affecting modal choice, they highlight the concept of qualitative factors as a percentage discount of freight rates where such qualitative factors could act as a force to decrease the generalized cost of a particular port. In other words, the combination of different qualitative factors can either enhance or deteriorate the attractiveness of a particular transport mode. This point is especially significant here as it supports the belief that different qualitative factors actually affect the generalized cost of using a particular port for container transhipment (see Chapter Three). In turn, this also affects whether certain users would actually use them. This is well-supported by INRETS (2000) who have persuasively noted that service quality can be perceived either as an incentive in enhancing the attractiveness of a particular mode competing with others, or the other way round, an additional cost in raising the generalized cost of a particular option.

The problem mentioned above has significantly increased the difficulty of constructing the research methodology of this thesis, not to mention the extreme scarcities of previous studies focusing on the choices of ports. Indeed, many previous maritime transport scholars have complained about the shortage of previous works focusing on the relations between service quality and port choices, usually acknowledged in their works. For example, Ha (2003) notes that, until very recently, work focusing on port service quality is still extremely rare and little attention on this topic has been paid. Such scarcity has also been highlighted by Tongzon (2002) who argues that most previous studies focus on modal choice and carrier selection rather than between competing ports. Even when some

works have included service quality in their discussions of port choice, in many cases, their conclusions either lack empirical support (like Wang, 1997) or, as mentioned before, service quality simply meant the inscription of more readily quantifiable non-monetary factors into the cost equation, notably time efficiency e.g. Baird (2002), Sánchez et al. (2003), etc. Thus, until recently, general consensus on how port choice should be assessed does not exist and a research gap is yet to be filled.

Nevertheless, several works investigating other aspects of service quality can still be identified and will be discussed here. As early as the late 1970s, Foster has attempted to investigate the importance of qualitative factors on port choice. He conducts two surveys, both targeting shippers, and asks them to identify the major factors in port choice. The results, however, are rather contradictory because while the first survey indicates that service quality should be more important than monetary cost and managers do not often compare costs between ports (Foster, 1978), the second survey illustrates that port charge (i.e. monetary cost) is the most important factor in port selection (Foster, 1979). It is clear that his work is inconclusive, although his pioneer effort in highlighting monetary costs as *one of the costs* rather than *the cost* in port choice has clearly offered fresh insights.

Though, until the 1980s, little work has been done on port selection (Slack, 1985). Despite such limitations, however, some works in port selection criteria can still be identified, including the one by Slack (1985) and Murphy et al. (1987). In his work, Slack (1985) investigates the important port selection criteria through interviews targeting shippers from Canada, US and Europe where open discussions, together with a questionnaire survey requesting respondents to choose different factors of which they consider as important in choosing a port based on four major aspects – port selection criteria, port service criteria, liner characteristics and information sources. He found that

price and quality offered by land and ocean carriers should be more important than the attributes and characteristics of ports in the selection process and shippers would regard decent port service quality as something taken for granted. Based on these results, Slack concludes that, although improvements in port facilities is important, it does not necessarily have any direct implications on diverting cargo flows to ports because shippers are largely conservative in port selection and thus unlikely to consider alternatives once they feel satisfied with the services offered by a particular port. Finally, he argues that the rising importance of liners can make them the key players in port choice rather than shippers in the future.

Slack's work has two major contributions. Firstly, his work is one of the pioneer works recognising the unnecessarily positive relation between facility improvements and the competitive position of a port. Secondly, by requesting shippers to rate liner characteristics and information sources, he successfully illustrates that the major decision-maker of port selection could belong to liners rather than shippers. Both findings have significant implications on future research on port and shipping industries. Nevertheless, as Slack himself has also noted, the major challenge in future research in ports is that the relative importance of monetary cost and service considerations in port selection is still rather unclear.

Another group of researchers in the 1980s also try to investigate the relations between quality of services and port choice. Murphy et al. (1987) identify all players that are involved in the use of ports, including the port operator, liners, shippers and freight forwarders and attempt to investigate their difference in perception on the significance of different factors in affecting port choices, including load/unload facilities, accommodation for large volume shipments, frequency, freight rate, equipment availability, convenient

pickup and delivery time, information availability, assistance in claim handling and flexibility in meeting special handling requirements. By requesting survey respondents to rate the importance of potential factors in port choice through a scoring scale ranged from 1 to 5 (from very unimportant to very important respectively), they conclude that different parties mentioned above perceive the importance of service quality differently and that port service providers should improve their communications with their customers so that they can offer more customer-oriented port services. A major weakness of their work is that it focuses on perceptions of different factors rather than investigating how different ports have actually performed.

Some recent works can also be discussed here. Using China as the case study, Tiwari et al. (2003) apply conventional transport mode choice models in assessing liner and port selection behaviours of shippers. The major contribution of their work is their recognition that the port choice decision-making process is not necessarily based on concrete figures and decision-makers are not always fully-informed and decisions are often based on vague information and perceptions known as *the internalisation of port characteristics*. However, such recognition also forms their major weakness since their attributes are only based on readily quantifiable factors like throughput volumes, number of cranes, distance of shipper from port, distance of foreign ports while all other less readily qualitative factors are excluded e.g. management quality, port policy, marketing, port reputation, etc. Clearly, it is a piece of work which highlights the importance of service quality but make few attempts to really address the problem.

A more realistic attempt to investigate service quality in port choice is made by Tongzon (2002). He conducts a survey questionnaire targeting shippers and Malaysia, Singapore and Thailand. He identifies several port choice determinants, namely efficiency, shipping

frequency, infrastructure, location, port charge, response to port user's need and reputation for cargo damage and respondents are requested to give rankings to these factors. He found that geographical locations, efficiencies and infrastructures are the important determinants while port charge is considered relatively unimportant and thus he concludes that quality of services is important in the choice of ports. He also argues that the results are 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. Finally, he recommends that ports with disadvantage in geographical location should give priorities to efficiency and infrastructure improvements.

His most important contribution is that he is one of the few scholars tries to challenge the status of monetary cost (i.e. port charge) as one of the most important determinants in port choice. By highlighting the importance of location and efficiency, Tongzon indicates that using a port is using a 'package' rather than just a *money game*. However, Tongzon's work has several weaknesses. Firstly, he fails to indicate clearly the relations between the determinants e.g. when he argues that efficiency and infrastructure improvements can compensate the geographical disadvantage of a port, he does not investigate how much should a port improve in order to fully compensate its geographical disadvantages. Moreover, by using the ranking method in his questionnaire, Tongzon riskily assumes that all the factors that he has identified must necessarily have some significance on port choice.

Also, Tongzon largely neglects commercial issues like relations between port service suppliers and users and marketing where he chooses to ignore the fact that contemporary port operation is actually a business (World Bank, 2000) and thus it is doubtful whether he has really identified the major determinants. Finally, he never indicates what kind of

port he is referring to (although given the study area, the author assumes that he is referring to container ports). This is especially important because different cargoes have different characteristics of which port choice for different types of cargoes also has different decision-makers.

Another group of Belgian researchers attempt to investigate port competition through assessing port performance. Huybrechts et al. (2002) conduct a survey in evaluating the competitiveness of Antwerp, directed towards all major parties involved in the port industry (as well as some academic scholars). This survey is similar to the one conducted by Murphy et al. (1987) before. However, the difference is that, rather than identifying the significance of different factors in port choice, interviewees are requested to give scores to different factors that they have identified as the major determinants in port choice. They conclude that port accessibility, mainly due to the restrictions of River Scheldt, is the major obstacle in preventing Antwerp to become a market leader within the Hamburg-Le Havre range.

The major success of Huybrechts et al. (2002) is that, unlike Murphy et al. (1987), they succeed in identifying the major weakness of the port concerned and what measures the port management hierarchy should take. On the other hand, however, they fail to indicate what factors are more important in affecting port competitiveness. Moreover, just like Tongzon (2002), they assume that all the factors identified in the extended diamond must necessarily affect all interviewees in their port choice decision-making process. Of course, their study area is rather restricted where only one port is focused, thus lacking a comparative perspective in assessing port competition.

A further piece of work related to qualitative factors and port choice was done by Ha (2003). Through a questionnaire survey, he investigates the service quality offered by 15 ports around the world in container handling. Seven factors, including information, location, port turnaround time, facilities, management, monetary cost and customers' convenience, have been identified and interviewees i.e. liners are requested to rank the importance of these factors and then evaluate the service quality of the seven factors offered by different ports through appreciation scoring. He concludes that, apart from monetary cost and time efficiency, ports should also focus on their service quality, especially information flows and data availability. Here his work has two major implications. Firstly, he notes that studies focusing on the quality of services provided by ports are still very limited and a large research gap exists. Secondly, he points out that in modern container shipping liners, rather than shippers or other traffic managers, are the major decision-makers influencing port choice.

However, his work still suffers from three major weaknesses. Firstly, by choosing the ranking approach, he assumes that the seven factors that he has identified must necessarily have certain degrees of decisiveness in port choice decision-making process. Together with other previous studies mentioned above, it is somewhat interesting that many transport scholars are very self-confident and believe that all their respondents, when deciding the choices, must necessarily be affected by all the factors of which they have identified.

Secondly, although he has successfully identified the strengths and weaknesses of the ports, Ha does not make any real attempts to investigate the overall strength of different ports. Of course, different ports have different strengths and weaknesses, however, when all these factors are combined together to form the 'overall quality', he fails to tell which

port provides the overall highest service quality (possibly except Singapore, where his results show that it has the highest scores in all the seven identified factors). As a consequence, his results are inconclusive since he only notes that some ports (like Long Beach, Hong Kong and Rotterdam) are somewhat better than others (like Shanghai) in an ambiguous manner.

Finally, Ha does not make any attempts to justify the most important theme of his work which is the relation between improving service quality and port competitiveness. For example, Ha claimed that Singapore provides the highest level of service quality. However, does it mean that Singapore's market share size would be larger and in accordance to its high service quality? In this perspective, he does not give any explanations or elaborations. On the other hand, when discussing the situation of Busan, he stated that *improving Busan's service level will result in an improved competitive position which may lead to increased market share*. However, throughout his article, he never provides any empirical evidence to justify his conclusion. Due of such weakness, the contribution of his work becomes limited as he does not give any real evidence to justify his arguments that improving service quality can enhance port competitiveness.

With the understanding that decisions are often made based on a combination of vague figures and impression, together with the general ignorance of less readily quantifiable factors, the work of Lirn et al. (2004) worth special attention. Here they introduce a technique, Analytic Hierarchy Process (AHP), to capture the selection criteria and the performance of transhipment ports for global ocean-crossing shipping. The work by Lirn et al. (2004) is a valuable component to understanding quality of port service because the inclusion of factors like geographical location, port management and administration highlights the importance of subjective judgements of different factors affecting port

selection. Unlike Veldman and Bückmann (2003), who try to shy away from solving the problem, Lirn et al. (2004) make a real attempt to transform subjective judgments into some recognisable and analysable figures.

While the work of Lirn et al. (2004) is valuable, some shortcomings still exist in understanding to the choice of port due to various reasons. Firstly, in investigating port choice, it is not appropriate to put management and administration into the same criteria (as they have done) because port operation in Europe is, in many cases, a structure where the port operator and the public sector are interdependent rather than an indivisible unit. It implies that port users may treat the influence and importance of management and administration differently rather than the same. They also ignore some important factors in port selection criteria which are especially prominent like the relations between port and liners while they are too general on some factors like port management. Such ignorance implies that the results might not reflect the realistic situation since some major factors in port choice are not included.

Secondly, while they illustrate some of the deviations between port operators and liners in their perception of port selection criteria, they fail to point out exactly the competitive position of individual ports relative to competing ports within the same region and what these ports should do/improve in order to enhance their competitiveness in attracting more calls from vessels. In other words, they do not try to solve the problem. Thus, their work offers little contribution to the competitive framework of ports, thus diminishing its relevance in assessing port competition.

Thirdly, and perhaps most importantly, their work fails to inscribe their results in assessing the competitiveness of the port industry as a whole. They create some

interesting indictors but do not transform it into monetary values and inscribe it into generalized cost and limit the values of these indicators. As a consequence, it is extremely important to find a way to inscribe qualitative factors affecting port selection into the generalized cost function. Although Dong and Yeo (2004) use a similar methodology by applying AHP in assessing competitions between different container ports in China and give more convincing answers to address the first and second shortcomings that exist in Lirn et al. (2004), they still fail to address the third shortcoming. In other words, still, none of them take a further step and inscribe quality into the generalized cost equation.

A number of common inadequacies shared by most previous studies can be identified. Firstly, most of them fail to bridge the relations between improving service quality and change in port competitiveness. In many cases, the research process comes to an end when the researcher feels confident enough to conclude whether service quality is more important than quantitative factors or which particular port provides a higher quality of service than the other. In short, most of these studies are being too mechanical and fail to deliver persuasive solutions on the research problem.

Secondly, a lack of further research on the relations between service quality and port competitiveness also implies that previous studies pay few attention to the competitive relations between different ports. As discussed before, the rise of global port operators can affect the competitive relations between different ports e.g. Rotterdam and Felixstowe may not necessarily be competitive with each other anymore since both the majority of the ports are under HPH's ownership. If a particular port improves its service quality in container loading/unloading and thus increases its market share, very few studies raise the question on who will then be the loser(s). Such deficiency has lowered the usefulness of

previous studies because ports cannot use these studies to identify which ports are their major competitors and how to tackle them.

Thirdly, previous studies often ignore the complementary nature between quantitative and qualitative factors and put most of their attention on comparing whether which one is more important and neglect the importance of the overall pattern. Very few studies make real attempts to investigate the implications of the 'package' offered by a particular port on the final decisions of port users, possibly with Clark et al. (2001) as the only notable exception[27]. As noted by Hensher and Prioni (2000), the overall level of satisfaction should be best measured by how users evaluate the total package of services on offer rather than individual factors[28]. Port choice factors, both quantitative and qualitative, are actually mutually dependent on each other. Thus, in order to see the whole picture of port choice and competitiveness, further research is necessary to investigate the 'package' rather than just different individual factors.

Fourthly, without further investigations, most studies seem to be convinced that improvement in quality of services must necessarily lead to increases in market shares and growth in the port's throughput which is highly doubtful. For example, in many previous studies, there is often a question on whether port users will have the same feelings on a particular port under different circumstances like whether it makes sense to assume that improvements might help if port users have negative impressions on the service offered

[27] Clark et al. (2001) try to inscribe port efficiency into the generalized cost equation but their methodology is different from conventional ones. Rather than identifying different factors in port choice and obtained information from those who are directly related to port and shipping, they use the relations between GDP per capita and infrastructure released by the *Global Competitiveness Reports* (published by Harvard University and World Economic Forum) in deciding the value of port efficiency. After then, they try to evaluate the determinants of port efficiency mainly through literature review. Actually, it is rather doubtful on the appropriateness of such an approach.

[28] Here Hensher and Prioni (2003) refer to bus passengers. Nevertheless, it is believed that port users also evaluate their port choices from a 'package' perspective rather than distinguishing clearly between quantitative and qualitative factors since their choices are also the consequence of 'humanistic' decisions.

by a particular port. However, it remains doubtful if further improvements also imply higher throughputs if port users are already satisfied with the service of a particular port even before any improvements. Even if an alternative port improves its performance, it does not mean that it has done enough so as to persuade users to abandon their current choices. This is something that few of the previous studies have seriously addressed. Another example illustrating this problem is from the work of Song and Yeo (2004) who assume that the service level of a port must necessarily be directly proportional to port competitiveness[29]. As discussed before, with the existence of transhipment and *hub hopping* (World Bank, 2000), performance is only one of the many aspects in explaining the competitive positions of ports.

Fifthly, even within qualitative factors, bias existed on the question of what factors should be included. Many academic studies of port choice (in fact, not just port, but transport analysis in general) only investigate factors which are readily quantifiable, notably time. By considering only these factors, they have clearly neglected other less readily quantifiable but perhaps equally important factors e.g. port reputation, relations between users and customers, regulations, etc. Such bias is understandable due to various reasons like the difficulty in constructing new methodologies to quantify less-quantifiable factors, avoiding controversial arguments in their methodologies, or simply trying to ignore the fact that the effects of other qualitative factors do matter in transport choices. However, it is highly doubtful whether the decision of making a port choice is based on such quantified mechanism. According to in-depth interviewees from liners (see Chapter Three), they indicate that it is extremely rare for them to make their decisions simply by

[29] Song and Yeo (2004) define port competition as *the development of application of differentiated strategic alternatives* so as to attract more customers to competitive ports. Clearly, their definition of competitiveness is more applicable to port's attractiveness than to competitiveness itself. As mentioned, customers do not necessarily always increase calling a port when the latter improves its attractiveness. Thus, Dong and Yeo's have ignored an element of competition which is exclusivity.

counting figures. This does not mean that decision-makers do not refer to quantitative figures when making decisions but, rather than remembering the exact number of incidents, most decisions are made through *impression and perception of port's service quality*. For example, on most occasions, they only classify ports into roughly-estimated classifications like *many delays*, *some delays* and *few delays* rather than counting how many days or hours of delays their vessels need to bear in a port. In this sense, it implies that 'perception on performance' can actually be more decisive than performance itself.

Finally, and perhaps most importantly, the above studies suggest that port choice assessment is still highly divided in terms of methodological approach e.g. who the interview targets should be, what factors should be included in the survey, research objectives, whether scoring or ranking method should be used, etc. From previous experiences, different researchers focus different targeted interviewees e.g. liners, shippers, freight forwarders, public sector, etc. while a dominating approach in evaluating port choice is yet to exist. Some researchers even seem to 'lose focus' when conducting their studies as the work Tongzon (2002) has illustrated. This fragile nature can be partly explained by the complexity of the topic and the extreme scarcity of port choice models in explaining the behaviours of port users, as noted by Meersman and Van de Voorde (1998). Without any strong theoretical frameworks, everyone is trying to interpret the issue based on their own beliefs and perceptions on what exactly port choice is and thus causing confusions and divisions. It is clear that port choice assessment is still undergoing its embryonic stage where researchers still struggle to identify the major players and thus use different approaches towards the same issue.

Therefore, although the concepts and results of previous studies offered a valuable reference framework, shortcomings have made previous work relatively limited in terms

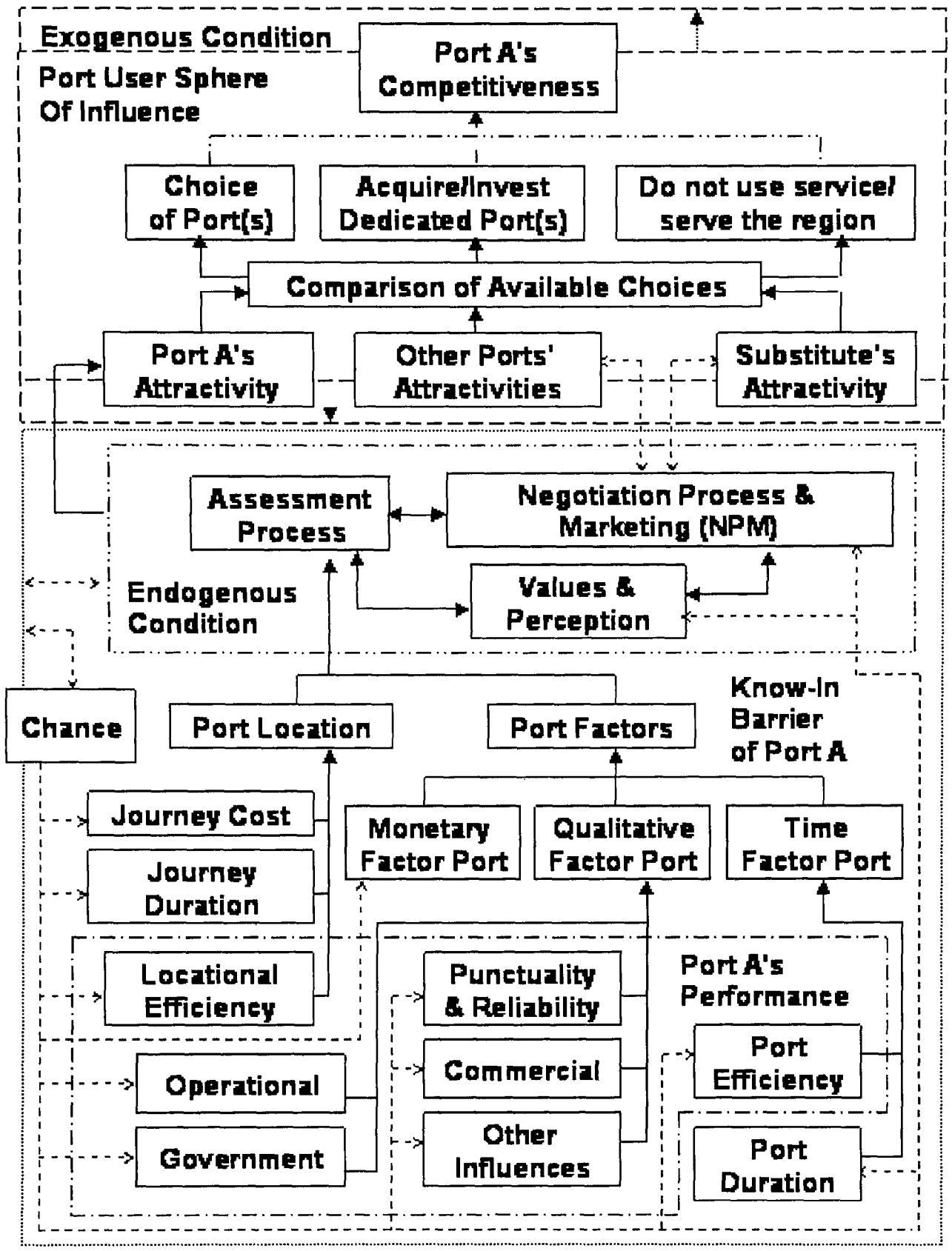
of contributing to a thorough understanding of the relations between port performance and port competitiveness. Together with the scarcity in serious research in port choice, the methodology of this study must be able to address at least some of these shortcomings and makes a serious attempt to fill in the research gap. It will start with the creation of a supportive theoretical framework which will be presented in the next section.

2.5. THEORETICAL FRAMEWORK: PORT COMPETITIVENESS MODEL

The theoretical framework of this thesis, Port Competitiveness Model (PCM), can be found in Figure 2.4. PCM is constructed after detailed literature review and analysis on the information obtained from various in-depth interviews with elites within port and shipping industries (see Chapter Three). The objective of PCM-construction is to address the inadequacies of Porter's FFM and Diamond Theory and the ideas of other transport scholars in explaining the competitive positions of ports.

PCM believes that port competitiveness is not only decided by readily quantifiable factors like monetary cost and time but also on other less-readily quantifiable factors e.g. service quality, business strategies, beliefs and perceptions of port users, chances, etc. Also, while most previous studies had considered how ports can improve their services, PCM goes a step further by taking the decision-making process of port users into the equation which enables itself to highlight the difference between 'port competitiveness' and 'port attractiveness', of which many previous scholars had mixed up during their analysis.

Figure 2.3. Port Competitiveness Model



Keys:

- Direction of Decision-Making
- Direct Reflection
- Influence
- Limit of Port User Knowledge/Information
- Factors within Endogenous Condition
- Limit of Port User Sphere of Influence (PUSI)
- Greatest Possible Extension of PUSI
- Port Performance

Perhaps most importantly, PCM is one of the pioneer attempts to express a port competitiveness model diagrammatically of which, surprisingly, very few (if any) previous studies had tried to do before. By applying various modelling techniques on PCM's attributes, different mathematical models can be constructed in explaining different aspects of port competition. In this thesis, for example, through calculating generalized cost and applying multinomial logit model and logistic regression (see Chapter Three) on PCM's attributes, the author had created a mathematical model in forecasting the competitiveness of different ports acting as transhipment hubs in North Europe (see equation [7.1] in Chapter Seven). With such significance, it is anticipated that PCM will become one of the major 'benchmarks' in future port competition research.

Within PCM, the most important concept is Port Attractivity (PA) which can be understood as the potential ability of a particular port in convincing potential users to pay a certain amount of money to use its services, under the condition that the latter has demands on port services and are given a certain number of choices. This 'certain amount of money' must be, at least, able to ensure the port's short-term survival and allow it to maintain a certain market share within a specific period of time. Within PA, there are three major aspects namely 'Assessment Process', 'Values and Perceptions' and 'Negotiations Process and Marketing' (NPM). For analytical purpose, Values and Perceptions and NPM are classified as 'Non-Assessment Process' factors which will be used throughout this study. All the above aspects are, of course, subject to the availability of knowledge and information termed as the 'Know-In Barrier'.

'Assessment Process' mainly consists of factors which reflect how decent a port can provide its service. It can be divided into two aspects – 'Port Location' and 'Port Factor'. Port Location represents a port's geographical location in terms of proximity to

destination ports/regions which affects 'Journey Cost' (JC) (mainly vessel operation cost between origin and destined ports) and 'Journey Duration' (JD) (the longest time that a port user can accept for its vessel to travel from origin to destination). However, here is to note that the exact time required for a vessel to travel from origin to destination ports vary which in turn also affects the psychological perception of port users on whether a port is geographically well-located, here termed as 'Locational Efficiency' (LE). The concept of LE is complementary to the ideas of Fleming and Hayuth (1994) who argue that factors like *centrality* and *intermediacy* can affect the attractiveness of a particular port to liners. Since a certain period of time is always required to go from one place to another, JD also poses extra costs to port users. As Hibbs (1993) has noted, as a derived demand, freight transportation being wanted for its own sake is virtually non-existent and the time incurred in the movement surely incurs extra costs to its users. For example, in transhipment, no matter how good a port can perform, it always involves a certain amount of time to move a container from the large to small vessels. Thus, the question here is how to minimise rather than how to eliminate such costs. The existence of Port Location actually complements Diamond Theory where the competitive position of a port often has a geographical perspective.

Port Factor consists of three components, namely 'Monetary Cost', 'Time' and 'Qualitative Factors'. Monetary cost consists of various charges at the port e.g. container-handling charge, port dues, etc. For time factor, it is divided into two aspects, namely 'Port Duration' (PD) and 'Port Efficiency' (PE). PD is the usual amount of time (e.g. how many hours, how many days, etc.) that port users would normally expect their vessels staying at a port. Like JD, since a certain amount of time is always necessary for a vessel to handle containers, PD always bears extra costs to port users.

Nevertheless, the extra costs incurred from PD and JD can be discounted through PE. While a port has little control on JD, it can help its customers to discount extra costs aroused from PD through enhancing PE. Here PE means the rate for finishing the process of loading/unloading and thus port's waiting time. For example, if a port can finish the container-handling process faster than the time that port users usually expect (i.e. PD), it can be regarded as an efficient port. On the other hand, poor PE bears an extra cost to port users in using that particular port. For Qualitative Factors, it consists of other potential factors influencing the quality of port services. Qualitative Factors consist of four major aspects, namely 'Punctuality and Reliability', 'Operational' [30], 'Commercial' and 'Governmental' (and any other specific factors of specific port users). Together PE, LE and Qualitative Factors form the overall 'Port Performance' of a particular port. If a port performs well, such good performance would act as a discount to the generalized cost which in turn enhances its PA. Otherwise, apart from monetary and time costs, it becomes an additional cost to the generalized cost and thus a decline in PA.

However, being an attractive port is not equivalent to being a competitive port because it has yet to achieve its objective i.e. fight off potential competitions and to be chosen by port users. Apart from the port-related attributes mentioned above, the choice-decisions of port users are also affected by factors which are not directly influenced by ports themselves e.g. inertia, traditions, subjective beliefs and preferences of port users, etc. Thus, while 'Assessment Process' mainly consists of objective factors, those within 'Non-Assessment Process' are not. For 'NPM', it consists of the bargaining power between port users and providers, marketing and the ability of persuasion of customers to use the port. The significance of NPM depends on various factors e.g. range of choices, availability of

[30] Here 'operational factors' mean factors which affect the technical operations of a port e.g. infrastructure, superstructure, port access, IT and advanced technology, etc.

information, personal talents, communication skill, etc. Effective NPM can significantly change the factors which make up exogenous and endogenous conditions which, in turn, can affect a port's overall PA. On the other hand, 'Values and Perceptions' involve psychological motivations of port service suppliers and users which are affected by various background factors e.g. education, personal beliefs, future perceptions, etc. Since making choice is a humanistic decision, Values and Perception should play significant roles in deciding port competitiveness. This is supported by Hibbs (1993) who argues that commodity value is often subjectively determined rather than inherent and so perceptive value should have a place in explaining and forecasting human decisions. Also, Values & Perceptions can include circumstances where port users pay extreme attention to one or more particular factor(s) in the Assessment Process e.g. if port users might regard locational efficiency as so strong that all other factors become insignificant.

Together Assessment Process, Values and Perceptions and NPM make up the complete picture of PA of a particular port, subject to the influence of Know-In Barrier, as well as the influences of Chance. In fact, one of the major objectives of PCM is to highlight the fact that, while not rejecting the importance of monetary costs, there are also many other methods in which a port could consider in order to enhance their attractiveness and competitiveness in getting more calls from their potential customers. However, here is to note that these three concepts of PA are interdependent with each other and a change in one particular aspect can affect others. For example, suppose Port A can provide very decent port services. However, if potential customers have special preferences to Port A's competitor, say, Port B, despite the fact that Port B's quality of service is significantly worse due to various reasons like inertia (i.e. Values and Perceptions), NPM can be affected because Port A may need significantly more efforts than expected in order to persuade these port users to choose it rather than Port B. Thus, here port competitiveness

can be understood as the ability of a particular port within a particular region, which possesses a certain degree of PA in persuading potential customers, where the latter have demands on port services and are given a certain number of choices, to use the services of that particular port more than its PA should allow, so as to enhance its initial market share based on PA within a particular region within a specific period of time, usually at the expense of other potential competitors.

The so-called specific period of time can vary depending on when port users review their port choices or whether they consider not using port services anymore. From the above, it implies that port competitiveness is meaningful only when two preconditions exist in the first place. Firstly, there must be potential customers which have demands on port services. If no demands exist, one would not even go through the decision-making process on whether to choose a port to call. Secondly, there must be choices available to these potential customers since otherwise they do not even need to go through the decision-making process in making a port choice. According to McCalla (1999), under contemporary shipping development, there is no shortage for liners needing to make port choices. Here 'choice' does not only include the choice of ports, but also the choice of whether a customer should use the services of a port and the choice of whether a customer should use a public port or build and use its own port. According to Robinson (2002), through making choices, it involves the process of *value delivery* to port users and forces ports to become more efficient and market-friendly.

From the above, PA distinguishes itself from 'Port Competitiveness'. PA is an absolute concept where it can be expressed in concrete figures like currency. As long as demands for port services exist within a region, ports with decent service quality within that region would likely to have certain levels of PA to port users. On the contrary, Port

Competitiveness is an expanded version of PA where relativity and comparison are included. As mentioned, the existence of PA within a port does not necessarily mean that port users will start using it, although Port Competitiveness cannot exist without the existence of PA. However, the most important difference these two concepts involves 'exclusivity'. Ports possessing attractiveness (i.e. PA) do not necessarily imply that their gains would lead to other's sufferings, while competition implies a struggle with others in order to win something or gain advantages[31]. For example, if a liner decides to use two ports for transhipment at the same time, say, using Ports A and B to serve Markets X and Y respectively, then the relations between them are not only competitive but also complementary. These two ports are called because they are able to attract calls due to the existence of respective PA, not necessarily because they are competitive to each other, although they can be competitive to another port, say Port C. From real world evidence, mutual existence between port competition and cooperation is not impossible, as illustrated between Hong Kong and Pearl River Delta in China (Wang and Slack, 2000 and Dong, 2002).

Although with fundamental difference, PA and Port Competitiveness are closely linked and their interactions act as the engine in providing the mechanism to PCM in interpreting port choices. The choice of potential customers can be the decision in choosing a port of call, whether to call at a public port or acquiring a dedicated port (or in the case of container shipping, usually a container terminal)[32], or whether potential customers should

[31] According to Longman Dictionary of Contemporary English, *competition* is defined as *a struggle with other people to win something or gain an advantage*, while Oxford Advanced Learner's Dictionary defines competition as *a contest of which skill, strength, knowledge, etc. is tested.* Both definitions imply an element of exclusivity and winning/losing between competitors.

[32] Here public port is defined as a port which can be called by the vessels of any liners while dedicated port is defined as a port which can only be used exclusively by one particular liner (and possibly also the vessels of member companies of the shipping alliance where this particular liner belongs to or vessels of particular companies with special contractual arrangements with this particular liner). In the case of dedicated port, the privileged liner usually owns or has invested heavily in the port. See Heaver (2002) and Slack and Frémont (2005).

ever choose to use port services. For example, if a new port with decent facilities has been constructed in a region, even if the PA of other ports within the region remains constant, because of the increase in choice to potential customers, it is possible that the market shares of these ports would decrease due to the increase of options for selection.

In this thesis, the case study is container transhipment involving the global shipping industry using mega-sized container vessels. Thus, in this study, the question on whether port users should use port service or not is rather theoretical because, no matter what, their vessels need at least one port to load/unload their cargoes. However, although not the focus of this study, it should be noted that the decision on whether to use port services or not can be seriously involved in some other aspects of shipping, notably SSS (shipping routes where the cargo origin and destination does not involve any ocean-crossing) and inland navigation, where much smaller sized vessels/barges could be used and loading and unloading could take place on vessel/barge itself and/or on 'floating terminals' like the mid-stream cargo stevedoring at Hong Kong.

All the core components discussed above are influenced by 'Chance' including unexpected events and its significance and duration of influence vary. Apart from the mentioned example of Kobe, a recent example is the introduction of ISPS and C-TPAT[33] in ports with effect from July 2004 (especially trans-Atlantic routes) aroused by the unexpected 9-11 tragedy. This has led to higher costs in using ports since more administrative measures have to be taken when vessels load and unload their containers.

[33] International Port and Shipping Facility Code (ISPS) requires member states of the International Maritime Organisation (IMO) to certify ships that fly their flag or facilities under their jurisdiction are code-compliant, while Custom-Trade Partnership Against Terrorism (C-TPAT) require transport companies to self-assess their operations and supply chains and put in place security measures to address any security vulnerabilities they find. Both measures have caused considerable cost increases in providing port services. For more information, see Flynn (2006).

Chance is situated along the border of the Know-In Barrier of PCM because port users, especially experienced ones, can possibly foresee some unexpected events taking place within the port which delay the smooth transition of loading/unloading. For example, between June and September, experienced users of the port of Hong Kong are likely to expect the risk of delays due to frequent occurrence of typhoons during this period. Enlargement of the 'Know-In Barrier' can reduce the 'unexpectability' of Chances while the occurrence of unexpected events can also enrich the knowledge and information about a port, although it has no direct role on the final decisions. The significance of Chance depends on how port users perceive it or whether they are even aware about it (i.e. the availability of information). Using the example of terrorist attack, if port user believes that a particular port has no such risk, they will not put the risk of terrorist attack into the equation when making their choices. Finally, the extent to which PA and Port Competitiveness is affected by port users depends on 'Port Users' Sphere of Influence' (PUSI). Port users often have some influences on port attractiveness and competitiveness, but not necessarily complete control. The extent of PUSI depends on several factors e.g. direction of global economic development, the nature of the shipping route (e.g. deep sea vs. short sea shipping), the types of cargoes being carried (e.g. container or bulk cargoes), limitations of liners themselves, etc.

PCM is a valuable reference to port planners in designing strategies and improve customer commitments and to attract new customers to use their ports. It does not only provide an eye-catching visual impression on different factors affecting port competitiveness, through applying appropriate operational research technique(s), PCM can also be used to explain and forecast current and future competitive positions of ports respectively.

CHAPTER THREE
STUDY AREA AND METHODOLOGY

After reviewing the implications of container shipping developments on the rise of transhipment traffic and the theoretical framework, the next step is to construct the research methodology. Here the methodology involves both quantitative and qualitative approaches, together with a combination of traditional modelling method and the introduction of mechanisms on how information obtained for less-quantifiable factors should be processed, estimated and analysed in a systematic way. To ensure that the outcome are sensible and can assess port competitiveness accurately, the process of data collection must be able to illustrate the dynamic relations between the core components of PCM.

There are four major sections in this chapter. Sections 3.1 and 3.2 introduce the study areas and approaches respectively, followed by Section 3.3 which discusses the analysis procedures, where the techniques used in this thesis will be discussed. Section 3.4 illustrates how data was collected including questionnaire survey and in-depth interviews. Finally, Section 3.5 presents the research process flowchart which summarises the research procedures.

3.1. THE CORE-SIX PORTS

The study area involves the comparison between major container ports within the Hamburg-Le Havre range in offering transhipment services to different European regions. According to Huybrechts et al. (2002), the existence of a port range implies that a significant portion of the hinterlands of the ports within this range would likely be shared,

as McCalla (1999) called it, *common hinterland*. Under this situation, port competition is likely to be tense.

Six North European ports are included in this study, namely Antwerp, Bremerhaven, Felixstowe, Hamburg, Le Havre and Rotterdam (hereafter called the 'Core-Six Ports'). Apart from North European ports, there must be final destinations available in order to allow transhipment to take place. Here three major European regions have been included for analysis, including the UK, Scandinavia-Baltic and the Iberian Peninsula[34]. Their geographical locations can be found in Figure 3.1., while the container throughputs, market shares and growth rates of the Core-Six Ports, together with five other minor ports within region, can be found in Table 3.1. These Core-Six Ports are widely regarded as the major ports in Western Europe not only due on their market shares[35] but also their international impacts, where they do not serve only as regional gateways, but also outreach their home regions, especially to the major trading regions, notably the Far East and North America (De Langen, 1998). The appropriateness of these regions in this study is further strengthened by previous studies on similar topics e.g. Baird (2002), Veldman and Bückmann (2003), etc.

[34] Here the Iberian Peninsula only implies Portugal and Spain along the Atlantic coast.
[35] Ports chosen for this study are also based on the fact that all of them sustain a minimum market share of 5% for the most recent past decade. See Table 3.1.

Figure 3.1. Geographical locations of Core-Six Ports and destined regions



Source: Constructed by the author with the base map provided by the University Library of University of Texas at Austin (2005)

Table 3.1. Container throughputs, annual growth rates and market shares in North Europe by ports, 1997 – 2004

PORT	2004	2003	2002	2001	2000	1999	1998	1997
Container Throughput (CT) (in '000 TEU)								
Antwerp	6,063	5,445	4,777	4,218	4,082	3,614	3,265	2,969
Bremerhaven	3,469	3,189	3,031	2,972	2,712	2,180	1,812	1,706
Felixstowe	2,700	2,500	2,750	2,800	2,853	2,696	2,461	2,222
Hamburg	7,003	6,138	5,373	4,688	4,248	3,738	3,546	3,337
Le Havre	2,150	1,977	1,720	1,525	1,464	1,378	1,319	1,185
Rotterdam	8,281	7,106	6,506	6,102	6,280	6,343	6,010	5,494
Dunkirk	200	161	160	150	148	107	81	65
Southampton	1,441	1,377	1,275	1,161	1,060	921	846	890
Thamesport	565	503	505	504	529	492	522	405
Tilbury	650	623	568	513	504	522	465	402
Zeebrugge	1,196	1,012	958	875	965	850	776	648
TOTAL	33,720	30,036	27,628	25,512	24,848	22,844	21,107	19,328
Annual Growth Rate (AGR) (in %)								
Antwerp	11.35	13.99	13.25	3.33	12.95	10.67	9.99	----
Bremerhaven	8.75	5.22	1.97	9.60	24.37	20.33	6.21	----
Felixstowe	8.00	-9.09	-1.79	-1.86	5.80	9.54	10.76	----
Hamburg	14.10	14.22	14.62	10.37	13.64	5.40	6.28	----
Le Havre	8.75	14.91	12.82	4.10	6.28	4.48	11.33	----
Rotterdam	16.52	9.23	6.63	-2.83	-1.00	5.54	9.39	----
Dunkirk	23.81	0.65	6.79	1.39	38.43	32.09	23.71	----
Southampton	4.59	8.03	9.79	9.52	15.14	8.89	-4.98	----
Thamesport	12.24	-0.32	0.20	-4.73	7.50	-5.76	28.83	----
Tilbury	4.22	9.66	10.81	1.85	-3.45	12.26	15.40	----
Zeebrugge	18.18	5.61	9.47	-9.26	13.55	9.51	19.75	----
AVERAGE	12.27	8.72	8.29	2.67	8.77	8.23	9.21	----
Market Share (MS) (in %)								
Antwerp	17.98	18.13	17.29	16.53	16.43	15.82	15.47	15.36
Bremerhaven	10.29	10.62	10.97	11.65	10.92	9.55	8.59	8.83
Felixstowe	8.01	8.32	9.95	10.98	11.48	11.80	11.66	11.50
Hamburg	20.77	20.44	19.45	18.38	17.10	16.36	16.80	17.27
Le Havre	6.38	6.58	6.23	5.98	5.90	6.03	6.25	6.13
Rotterdam	24.56	23.66	23.55	23.92	25.27	27.77	28.48	28.43
Dunkirk	0.59	0.54	0.58	0.59	0.60	0.47	0.38	0.34
Southampton	4.27	4.59	4.62	4.55	4.27	4.03	4.01	4.61
Thamesport	1.68	1.68	1.83	1.98	2.13	2.15	2.47	2.10
Tilbury	1.93	2.08	2.06	2.01	2.03	2.29	2.20	2.08
Zeebrugge	3.55	3.37	3.47	3.43	3.88	3.72	3.68	3.35
Summary of the 'Core-Six Ports'								
CT (in '000 TEU)	29,667	26,357	24,159	22,306	21,640	19,951	18,416	16,915
AGR (in %)	12.56	9.10	8.31	3.08	8.47	8.34	8.88	----
MS (in %)	87.98	87.75	87.44	87.44	87.09	87.34	87.25	87.52

Note: All percentage figures are corrected to two decimal places. Source: Containerisation International (2005).

Figures in Table 3.1 indicate that the TEU throughputs of the Core-Six Ports often occupy an agglomerate market share of nearly 90%[36] which supports the choices of study focus. In the following, the recent developments of the Core-Six Ports will be introduced.

3.1.1. Antwerp

Apart from its production and trade of diamonds, Antwerp is also famous for its port, where the port of Antwerp is the third largest container port in Europe (just behind Rotterdam and Hamburg).

The port is located near the border between Belgium and The Netherlands and the layout of the port can be found in Figure 3.2. In 2004, the port has handled more than five million TEU of containers, with container-handling services provided by five major terminals[37] including *Europa*, *Noordzee*, *Churchill*, *Deurganck* and *Home*[38]. These terminals are managed by *Hesse-Noord Natie* which is a subsidiary company of Singapore-based PSA, one of the Big Five Multinational Port Operators (Drewry, 1998)[39]. These terminals provide 300 container liner services to 800 destinations with special focus on trans-Atlantic followed by Far East cargoes (Port of Antwerp, 2005). According to Barba et al. (1998), the mission of Antwerp is to use the port as *a generator of wealth for Antwerp and the Flemish region.*

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[36] Of course, apart from these five minor ports, there are some even more minor ones within the region like Amsterdam and Gent. Their throughput volumes are so small that their presence is unlikely to affect the market share percentage in any significant sense.

[37] Port and terminals are different where one or more terminal(s) can exist within a port. In most circumstances in North Europe, the port authority administrates the public affairs of the whole port while private port operators are responsible for the operations of one or more terminal(s).

[38] *Home* Terminal is dedicated to MSC's vessels.

[39] Big Five Multinational Port Operators are ranked according to their global coverage and TEU throughput. The other four operators are HPH (Hong Kong), P&O Ports (Australia), International Container Terminal Services Inc. (Philippines) and Stevedoring Services of America (US).

Figure 3.2. Layout of Port of Antwerp and its access to the open sea



Source: Port of Antwerp (2005) (Enclosed map provided by ITMMA, 2004)

Antwerp seems to be an efficient port in container handling with about 30 containers being handled per hour in the port (Slack and Frémont, 2005). In terms of TEU throughput, Antwerp occupies a market share of slightly fewer than 20% within the Hamburg-Le Havre port range (see Table 3.1). However, a major problem of the port involves geography. As a river port, it is located along River Scheldt about 70 nautical miles from the open sea (see enclosed map in Figure 3.2). Moreover, due to its river port's

status, limitations on water depth (see Chapter Six) have restricted its convenience of port access especially to large container vessels. Such restrictions have resulted in various obstacles which could affect the competitiveness of Antwerp like the existence of considerable locks between the port and the access channel, access to the port by large container vessels is often restricted by tides. Although the problem of water depth can possibly be solved through dredging the river channel, such projects are complicated by the Dutch control of the Scheldt's river mouth while Antwerp is regarded as one of the potential competitors of Rotterdam, the major port of The Netherlands. Such difficulty was illustrated in the late 1990s when the Belgian and Dutch governments failed to agree on deepening of the Scheldt's channel, where the latter often seems uninterested to carry the issue further.

In port administration, Antwerp is operated under a system similar to *landlord port* which emphasises on striking a balance between public and private responsibilities (World Bank, 2000). Day-to-day operation is the responsibility of private stevedoring companies (as mentioned above, in container stevedoring, Antwerp is dominated by PSA), while the port authority is responsible for providing public services like emergency services, customs, regulatory procedures and security. The port authority of Antwerp, *Havenbedrijf Antwerpen*, is answerable to the city government of Antwerp as well as the regional government of the Flemish region, while the port's development strategies also follow the guidelines of the regional economic objectives of Antwerp and the Flemish region (Van Ham, 1998). Finally, port administration in Belgium is mainly a decentralised matter with little national scale of port planning involved.

3.1.2. Bremerhaven

The port of Bremerhaven was developed in the 1980s with its roots originated from Bremen, although currently most ocean-crossing vessels and container transhipment berth at Bremerhaven. Nevertheless, the port of Bremen permanently possesses the proud record that it is the first European port of which a container was discharged dating back to 1966 (Keyports, 2005).

The layout of the port can be found in Figure 3.3. With a navigation channel of -14 metres and 13 berths, *Wikhelm Kaisen* is Bremerhaven's most important container terminal with an average of about three million TEU of containers being handled annually (Keyports, 2005). In response to growing potential port competition in container traffic and to strengthen Bremerhaven's role as a container transhipment hub, several port expansion projects will take place within the port. After the opening of CT Phase IIIa (in November 2003), with an additional 340-metre berth, further expansion schemes are in planning, including the construction of CT Phase IV (with four berths), of which construction work should start by year 2006 (Keyports, 2005).

Figure 3.3. Layout of Port of Bremerhaven



Source: *Bremerports* (2005)

In terms of administration, there is a distribution of responsibilities between public and private sectors, although German ports are never granted either complete legal or economical independence from their respective regional governments, including Bremerhaven. Here is to note that port policies and development, including both Bremerhaven and Hamburg, are mainly the responsibilities of regional rather than national government (Van Ham, 1998). Interestingly, unlike their Benelux counterparts, German ports do not have autonomous port authorities and public functions are largely affiliated to different departments in general administrations of the regional government.

Like Antwerp, division of responsibilities between public and private sectors take place in Bremerhaven. The Free Hanseatic City of Bremen is responsible for managing shipping traffic and other public services like security and emergency services. Since 2002, a private limited company, *Bremerports*, was founded with part of its shares is owned by the Free Hanseatic City of Bremen[40]. According to the arrangement, *Bremerports* should manage Bremerhaven based on economic principles and have key responsibilities in port planning and construction, port marketing, system operation and maintenance, building and facilities maintenance and management (*Bremerports*, 2005). For example, it took a major role in constructing the port's CT Phase IIIa before it handed over to a port operator for its day-to-day management (to North Sea Terminal Bremerhaven, or NTB), while it is also taking a pivotal role in the planning and construction of CT Phase IV. Finally, day-to-day container stevedoring is the responsibility of private container terminal operators with NTB and Eurogate as the most important ones within the port.

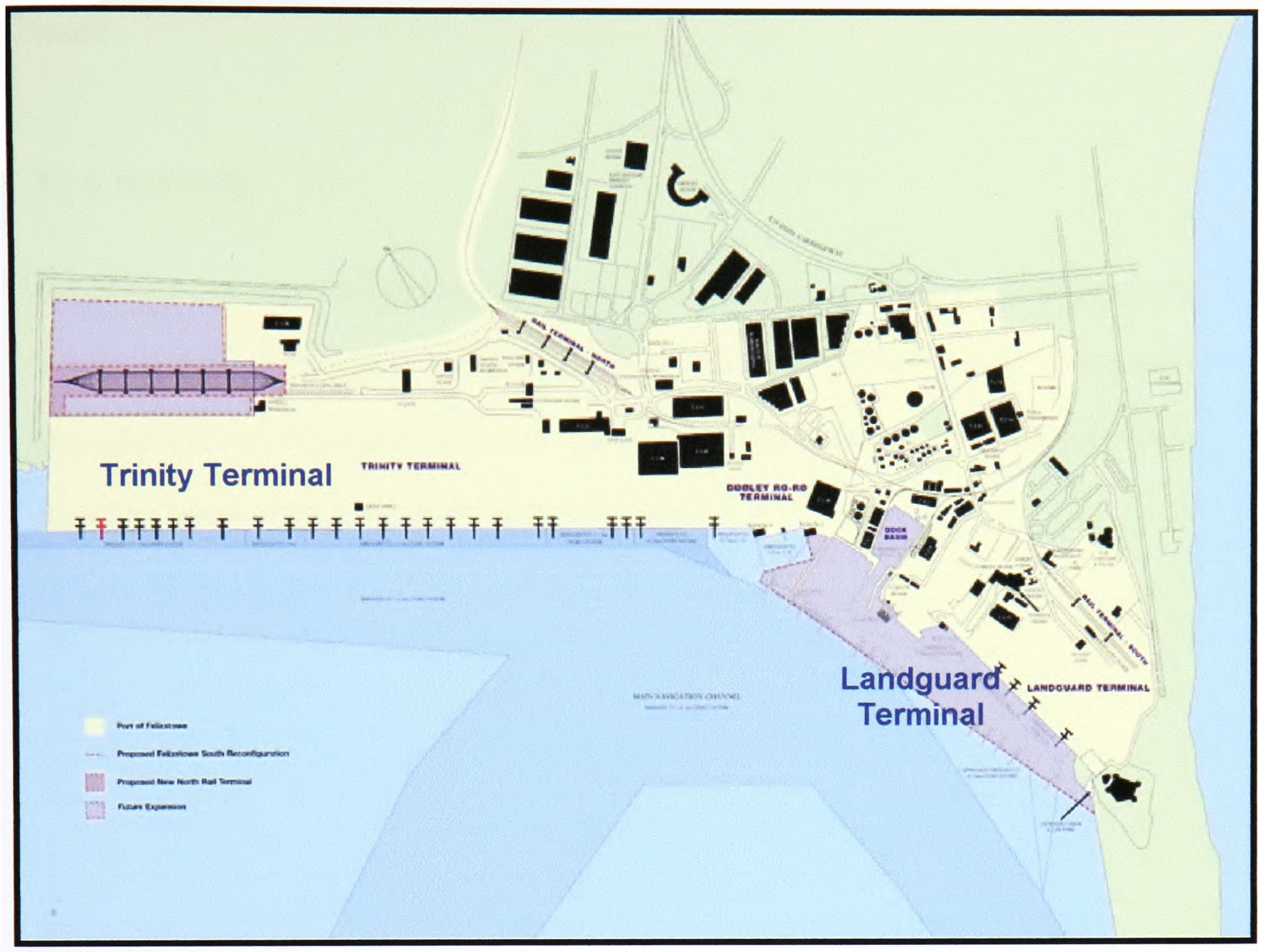
[40] The percentage of shares owned by Free Hanseatic City of Bremen is not available as such figure is not released to the public.

3.1.3. Felixstowe

Positioned on the British South East coast, Felixstowe is the largest container port in the UK. Until recently, there are about 60 liners using the port offering more than 100 services covering more than 360 ports around the world (Port of Felixstowe, 2004). In terms of TEU throughput, it is also the fifth largest port in Europe (see Table 3.1). The layout of the port can be found in Figure 3.4.

The objective of Felixstowe is *to win and retain customers by providing and developing services which offer value in terms of price and quality* (Port of Felixstowe, 2005). To achieve this, in the last few years, the port has invested heavily in container-handling facilities like the heightening of the container cranes and the purchase of new post-panamax container cranes. In 2004, the port has witnessed the completion of a 270 metre extension of its flagship terminal, *Trinity*, which enables Felixstowe to accommodate mega-sized vessels with container carrying capacity of 10,000 TEU. Also, a project on dredging water depth from -12 to -14.5 metres along the navigation and port access channels has taken place with the port being supported by railway networks and fully computerised Electronic Data Interchange (EDI) system. Its latest development plan, the *South Configuration*, involves converting the port's largely redundant old terminals, Dock Basin and Landguard Terminal, into a new deep-water container terminal with handling capacity of 46,800 TEU. The first phase of the new terminal is scheduled to commence operation by the end of 2007 (Port of Felixstowe, 2005).

Figure 3.4. Layout of Port of Felixstowe



Source: Port of Felixstowe (2005)

In port administration, Felixstowe distinguishes itself with a tradition of private ownership since the nineteenth century (Port of Felixstowe, 2005). Since 1994, the port's share was completely owned by HPH of which it states clearly that container stevedoring in Felixstowe is nothing but a business (Port of Felixstowe, 2004). More importantly, different from its counterparts, the public sector is virtually non-existent within the port where the docks and dockside activities are largely privatised (Preston, 1999). Apart from port security which is the responsibility of the British police[41], the private sector also undertakes various responsibilities like regulations, administrative procedures, emergency services and, to a certain extent, even customs. According to the World Bank (2000),

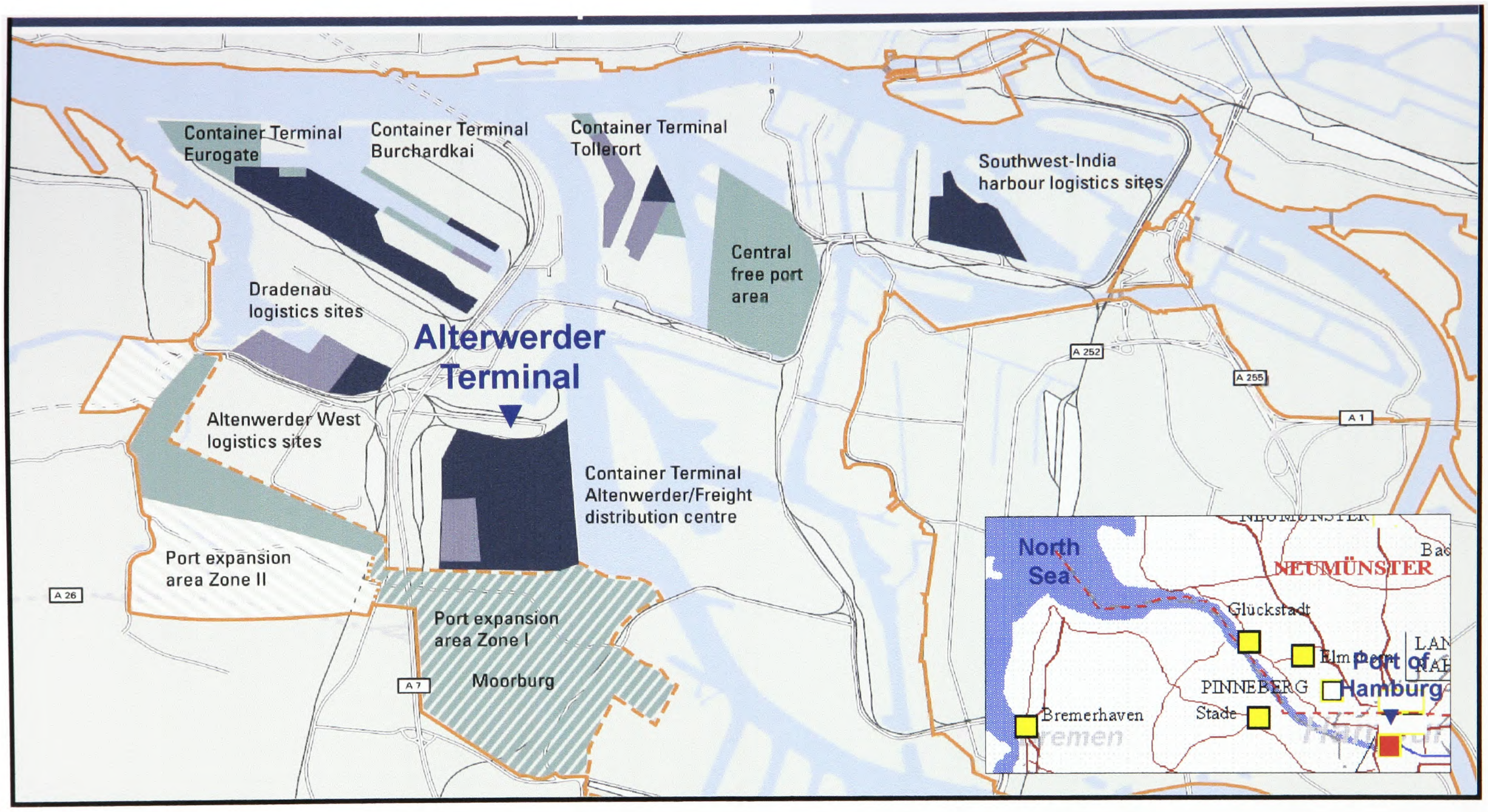
[41] According to the interviewee from Port of Felixstowe Ltd. (PoF), PoF can actually take up policing responsibility. However, they prefer to leave it to the British police mainly due to resource limitations and the lack of policing experiences.

Felixstowe is one of the few ports which adopt a *fully privatised port* system around the world.

3.1.4. Hamburg

In terms of container throughput, Hamburg is the largest port in Germany and the second largest in Europe. Locating along River Elbe, its recent annual growth in container throughput is very impressive with more than 10% in each of the last five years (see Table 3.1). The layout of the port can be found in Figure 3.5.

Figure 3.5. Layout of Port of Hamburg and its access to the open sea



Source: Port of Hamburg (2005)

Hamburg focuses on a port policy which can expand its capacity as a logistics and transhipment centre, with special focus acting as the interchange gateway between Western Europe and the Baltic region (Port of Hamburg, 2003) while also aims to ensure that the port is operating as a business with sound economic principles (Barba et al., 1998).

To achieve this, several investment projects have taken place including the opening of a new container terminal in July 2003, *Altenwerder*, and the continuance of its second phase construction. Modernisation of existing facilities had also taken place, including current docks and construction of longer wharfs. When these projects have finished (between 2006 and 2007), these new facilities are expected to triple the current overall container-handling capacity.

As a river port along River Elbe, Hamburg is located about 100 nautical miles away from the open sea (see enclosed map in Figure 3.5) and thus, like Antwerp, it often needs to address the problem of port access. Recognising it as an aspect which affects its competitiveness, Hamburg has taken initiatives in deepening the river to -14.5 metres so as to enable the navigation of mega-size container vessels and. Since the river section between the port and the open sea is under Germany's complete control, dredging projects are considerably easier to carry out than Antwerp as political obstacles are significantly less.

Traditionally, Hamburg has close linkages with the Far East. With the rapid development of China, the current biggest users of the port also come from there (Port of Hamburg, 2003). As China is now a large manufacturing base (see Chapter Six), it also implies that

many cargoes in Hamburg are for transhipment. According to statistics, an average of nearly 30% of all the containers coming to the port is for transhipment purpose (Port of Hamburg, 2003).

The administrative structure of Hamburg is very similar to that of Bremerhaven where both public and private sectors are involved. Day-to-day management is done by private terminal operators notably Eurogate and *Hamburger Hafen- und Lagerhaus Aktiengesellschaft* (HHLA), while the city government of Hamburg is responsible in providing public services e.g. regulations, customs, police, emergency services, etc. (Port of Hamburg, 2003). The public sector is also responsible for port planning and thus involved in various development projects, including *Altenwerder*.

3.1.5. Le Havre

Initially created by King François I of France in 1517 to strengthen the French Atlantic coast's security and to encourage international trade, Le Havre is currently the largest and the sixth largest container port in France and Europe respectively (see Table 3.1).

The layout of the port can be found in Figure 3.6. With a total area of about 135km^2, Le Havre has six terminals namely *Bougaiville*, *Les Amériques*, *L'Asie*, *L'Atlantique*, *L'Europe* and *Osaka*. By the end of 2004, container throughput of Le Havre reached 2.15 million TEU (see Table 3.1) which represented more than 60% of all other French ports combined (Port of Le Havre, 2005). Like all other major ports, Le Havre is supported by EDI system and all information generated by the actors in the port chain was computerised.

Figure 3.6. Layout of Port of Le Havre and the simulated outlook of *Port 2000*



Source: Port of Le Havre (2005)

Although beyond any doubt about its status as France's largest container port, Le Havre has failed to establish itself at a European scale with relatively small market shares compared to other members of the Core-Six Ports (see Table 3.1) and transhipment traffic is no exception. As Slack and Frémont (2005) have noted, no major liners have used Le Havre as a major transhipment hub except CMA-CGM, France's flagship liner. Apart from a few exceptions, most intra-European container liner routes from Le Havre are directly towards other French ports (Port of Le Havre, 2005) and its own survival also highly depends on the French market. Nevertheless, in terms of deep-sea container liner routes, due to its proximity from the Atlantic, Le Havre is frequently being used as the last port-of-call when vessels arrive at the European continent (see Tables 3.2, 3.3 and 3.4) which, according to in-depth interviewees (see later in this chapter), is a significant advantage for a transhipment hub.

Table 3.2 Major port rotations of Far East-European container liner services in North Europe

SHIPPING LINE/ALLIANCE	NAME OF LINER SERVICE	1st PORT	2nd PORT	3rd PORT	4th PORT	5th PORT
New World Alliance	JEX	RTM	HAM	SOT	LHV	--
	CEX	SOT	ANR	BRV	--	--
	AEX	LHV	RTM	HAM	SOT	--
Asian Alliance	PDS	LHV	HAM	RTM	FLX	--
	NEX	RTM	HAM	FLX	LHV	--
	China Express	RTM	HAM	FLX	--	--
	Japanese Express Service	RTM	HAM	ANR	FLX	--
	Asia Express Service	RTM	FLX	HAM	LHV	--
	China Service	RTM	FLX	HAM	ANR	--
Grand Alliance	Loop A/Japanese Express	SOT	RTM	HAM	RTM	LHV
	Loop B	LHV	RTM	ANR	BRV	--
	Loop C	RTM	HAM	SOT	--	--
	Loop D/China Express	SOT	HAM	RTM	--	--
	Loop E/Far-Middle East	HAM	RTM	SOT	--	--
	Loop G	SOT	RTM	HAM	--	--
CMA-CGM	FAL	LHV	RTM	HAM	ZEE	SOT
	NCX	SOT	HAM	RTM	ZEE	LHV
	Sundra	LHV	RTM	HAM	ZEE	--
Evergreen	CEM	RTM	HAM	TMP	--	--
	WAE	RTM	HAM	TMP	ZEE	LHV
China Shipping	AEX 1	FLX	HAM	RTM	ANR	--
	AEX 2	RTM	ANR	HAM	FLX	--
CSAV	RTW	FLX	RTM	HAM	--	--
Zim	Far East N. Europe Line	FLX	HAM	RTM	ANR	--
	Far East Europe Express Service II	RTM	ANR	HAM	FLX	--

Note: Last updated by April 2004. Source: ECT (2004)

Table 3.3 Major port rotations of trans-Atlantic container liner services in North Europe

SHIPPING LINE/ALLIANCE	NAME OF LINER SERVICE	1st PORT	2nd PORT	3rd PORT	4th PORT	5th PORT
New World Alliance	APX	RTM	BRV	FLX	LHV	--
Asian Alliance	TAS	ANR	BRV	FLX	RTM	LHV
Grand Alliance	ATX (Atlantic North)	HAM	RTM	ANR	SOT	--
	SGX (Atlantic South)	HAM	RTM	ANR	SOT	--
	PAX (Atlantic)	ANR	TMP	BRV	RTM	--
Evergreen	NUE	ANR	BRV	TMP	RTM	LHV
CSAV	Euroatlan: Loop 1	RTM	HAM	ANR	LHV	--
	Euroatlan: Loop 2	RTM	TIL	HAM	ANR	LHV
Zim	N. Europe America AUE Service	ANR	BRV	FLX	RTM	LHV

Note: Last updated by April 2004. Source: ECT (2004)

Table 3.4 Major port rotations of round-the-world container liner services in North Europe

SHIPPING LINE/ALLIANCE	NAME OF LINER SERVICE	1st PORT	2nd PORT	3rd PORT	4th PORT	5th PORT
CP Ships	Round the World	TIL	HAM	RTM	DNQ	LHV
Zim	Round the World	FLX	RTM	HAM	--	--

Note: Last updated by April 2004. Source: ECT (2004)

In explaining the unfavourable situation, the port authority put the blame on the lack of investments to replace the port's worn-out facilities in the last decade e.g. the newest container gantry in the port is ten years old while most others are 20 to 30 years old (Port of Le Havre, 2005). As a result, the port is undergoing a development project namely *Port 2000* (see enclosed picture of Figure 3.5) with the objective of providing safe and secure nautical access, enhancing rail and road network to the port and ensuring better container transfer between deep-sea and feeder vessels. With huge financial inputs which can finally cost one billion Euros, the port hopes to double global container traffic through the port to three million TEU by 2006 which, if successful, would double the throughput when the construction work began in 2001. Major works include the construction of 12 quayside berths with a total length of four kilometres, deepening the channel to -17 metres and the reconstruction of the port's back-up areas.

In port administration, Le Havre distinguishes itself from other ports. Although terminals are privately owned (Van Ham, 1998), according to the French Maritime Ports Code, *ports autonome*, applied to six major French ports since 1965 including Le Havre, should act like public corporations which are granted legal status and financial autonomy but answerable to the Minister in charge of ports and subject to the economic and financial control of the state (Port of Le Havre, 2005). Today, Le Havre's port authority, *Port Autonome du Havre*, operates as public corporation with industrial, commercial and administrative functions, of which the World Bank (2000) classifies such system as *tool port*. Another aspect which makes Le Havre distinguishable from other ports is that while container terminals are owned and operated by private companies, some of the container cranes are owned by the port authority while all container crane drivers are employed by the port authority as well (i.e. not employed and thus not answerable to the companies).

With the inception of *Port 2000* project, there are increasing pressures from future operators of these new terminals (A.P. Moller and CMA-CGM) to change the current situation (see Chapter Six).

The above illustrates that division of responsibilities between the private and public sectors is still not fully established in Le Havre and port administration is still rather centralised. As it is claimed that a clear division between private and public sectors is a key component for efficient and thus competitive port (World Bank, 2000), it would be interesting to compare Le Havre's performance with its counterparts and to assess the degree of relevance of such claim.

3.1.6. Rotterdam

Rotterdam is the largest container port in Europe in terms of both area size and TEU throughputs. Also, the port itself is a very important component of the city and even the Dutch economy. For example, in 2000, the port (and its related industries) generated a direct gross added value amounts to 6.2 billion Euros, or 1.7% of The Netherlands' GNP (Port of Rotterdam, 2005). Apart from container stevedoring, Rotterdam also plays a significant role in the European import and export markets, with significant percentage of the cargo coming into the port being processed at the same location e.g. oil refinery, production of synthetic materials, etc. The layout of the port can be found in Figure 3.7.

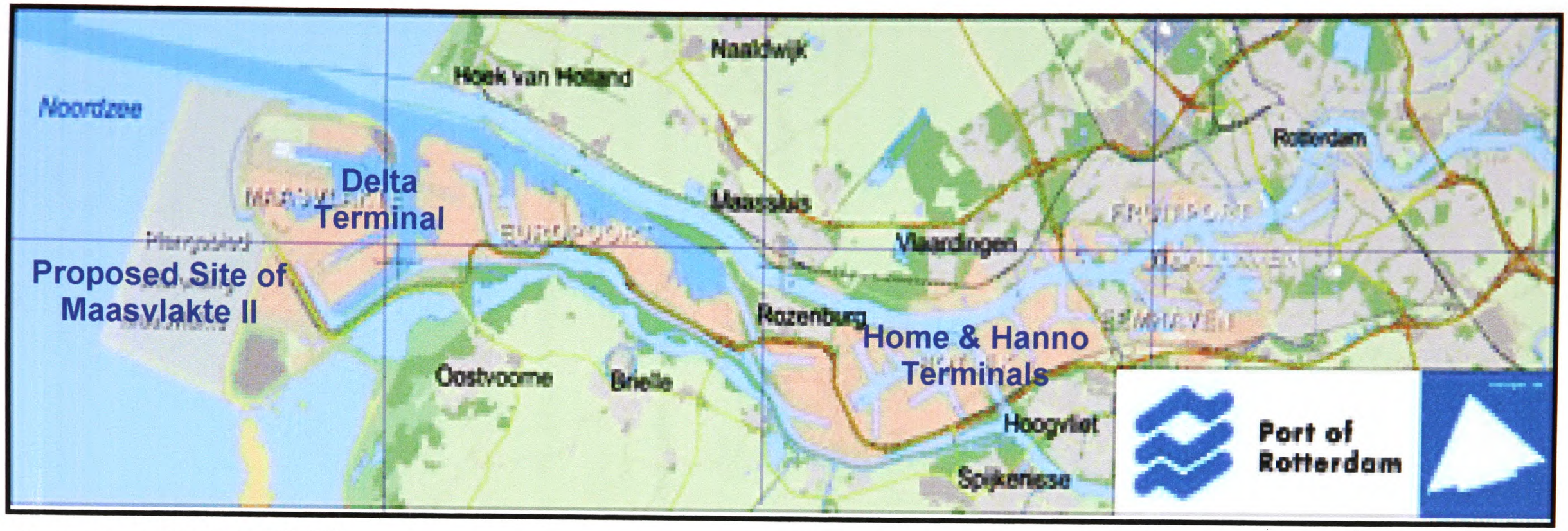
In terms of geographical location, Rotterdam is advantageous because its flagship container terminal, *Delta* (which is also responsible to handle most of major trunk routes and thus mega-sized vessels), is located next to the open sea (see Figure 3.7), while vessels usually require less than one hour to access to the port's secondary terminals,

Home and *Hanno* (ECT, 2004)[42]. Thus, port access has never really become a serious problem for Rotterdam.

For future development, Rotterdam aims to strengthen its position as the European transhipment hub and facilitates the port industry complex (Barba et al., 1998). To achieve this, the port is undertaking *Projections 2020*, an integrated project to offer further developments between 2010 and 2020 for transhipment, industry and distribution, as well as to investigate the implications for the use of land, traffic and transport, the environment, employment and add value to the port. The objective of *Projections 2020* is *to allow Rotterdam to continue playing significant role in improving the conflicts between increasing global competition and the rather stagnating economy taken place in Europe recently* (Port of Rotterdam, 2005), with its most important component being the construction of a 2.58 billion Euros container terminal – *Maasvlakte II*. Construction works expect to take place in early 2006.

[42] A further advantage of Rotterdam is that locks do not exist along the access channel between the terminals and the open sea.

Figure 3.7. Layout of Port of Rotterdam



Source: Port of Rotterdam (2005)

In port administration, World Bank (2000) classifies Rotterdam as a *landlord port*. Since the late 1990s, day-to-day operations have been managed by ECT and A.P. Moller Ports, subsidiaries of HPH and Maersk-Sealand respectively (Asian Shipping, 1999), while most other administrative duties are the responsibilities of the port authority while it is also responsible for port promotion and marketing (Ng, 2002). Like the German ports, the administration of the port of Rotterdam is decentralised to regional/local authorities and port coordination at the national level is virtually non-existent. Although recommendations have been proposed in transforming its semi-public port authority, *Havenbedrijf Rotterdam N.V.* (Rotterdam Municipal Port Management, or RPM), into a private company, still, considerable work is required to make it happen (Van Ham, 1998).

The situations of the Core-Six Ports indicate that different countries have different philosophies in port administration there is still no generally-accepted conclusion on the best approach in enhancing port competitiveness. Apart from the North European ports, successful cases can also be found in other continents of which ports apply different administrative philosophies, notably the difference between Hong Kong and Singapore[43]. Nevertheless, a common point can be recognised. Ports tend to focus on physical construction in their development plans e.g. terminal expansion, new terminals, river dredging, etc. and ports seem to perceive that physical construction is one of the most, if not the most, important aspects in enhancing their competitive positions. Also, from the above, as Palmer (1999) has noted, the long standing tradition of government backing for ports in North Europe still seems to continue.

[43] Until very recently, Hong Kong and Singapore are typical examples which have adopted *laissez-faire* and active-interventionist policies to port developments respectively.

3.2. STUDY APPROACHES

As mentioned in Chapter Two, there are two common approaches used in evaluating port performance. The first approach is known as the *engineering approach* (Talley, 1988) where performance is evaluated through calculating the maximum throughput that a port can physically handle under certain condition. In other words, the engineering approach assumes that port competition is negligible and different ports possess different *natural hinterlands*. As noted by Juhel (2001), the major objective of an *engineering approach* in port developments is to ensure that the port can be kept open so as to sustain trade flows.

The other approach is the *economic approach* (Talley, 1988) which argues that, rather than physical outputs, port performance should be based on a port's ability to compete for throughputs depending on the minimum costs[44] that ports provide. This approach assumes the existence of competitions and ports need to attract cargoes from common hinterlands and port effectiveness is determined by the port's growth in traffic *vis-à-vis* potential rivals (De Lombaerde and Verbeke, 1989). The difference between the engineering and economic approaches had also been highlighted by Song and Han (2004) who distinguish the differences between productivity and (economic) efficiency.

The debate between the two approaches has directly addressed the concern of Meersman and Van de Voorde (1998) who argue that the central questions facing contemporary port are the ways to sustain throughput growths and what strategies should be adopted with regard to their positioning on current and future markets. As discussed in Chapter Two, in North Europe, port competition is intensive and natural hinterland becomes increasingly rare (De Lombaerde and Verbeke 1989) of which this process has been accelerated by the

[44] Here 'cost' can be purely monetary or a combination of monetary and non-monetary factors.

increasing transhipment traffic since the final destinations of transhipment cargoes are not the immediate surrounding areas of the transhipment hubs. Under this situation, ports' common hinterlands have become even more common[45]. As Teurelincx (2000) has noted, port competition in North Europe is becoming more intense because of the drive for cost reduction in liner shipping and the geographical proximities between them. Moreover, since major trunk liner services always call at least three ports in Europe (see Tables 3.2, 3.3 and 3.4), liners' choice is perceived to be quite flexible and ports need to compete in order to establish themselves as transhipment hubs.

The above confirms the argument that *economic approach* is more appropriate in analysing port competitiveness in the North European container transhipment market. This is endorsed by Johnston et al. (2000) who convincingly argued that the study of transport nodes does not only involve the morphology of physical facilities but also the whole systems of different competing players. With the fact that the objective of continuing operation has been achieved within the Core-Six Ports, *engineering approach* in analysing port competition here is clearly obsolescent.

3.3. ANALYTICAL PROCEDURES

There is beyond doubt that port competitiveness is affected by its attractiveness. When an ocean-crossing vessel reaches North Europe, it has different port options to load/unload its containers and tranship them to final destinations and, theoretically, a port which can provide higher utility to port users are likely be called more frequently. As discussed in PCM, such utility is represented by the combination of various attributes within 'Port Attractivity' (PA) including 'Assessment Process' and 'non-Assessment Process' factors

[45] Of course, it is possible for certain ports to possess advantages to certain regions. However, in the overall

(see Chapter Two). In order to evaluate port attractiveness effectively, PA has to be expressed into more-readily analysable terms (usually monetary) and this section is going to introduce the procedures in achieving this objective, starting from expressing 'Assessment Process' factors into monetary terms.

3.3.1. Generalized Costs

The transformation of 'Assessment Process' into monetary terms can be achieved by calculating generalized costs[46] which will be done in Chapter Four. According to Powell (2001), generalized cost is a *perceived value* of using a particular option by users which is an important component in transport analysis because the cost to user is the key determinant of user's benefits which can help transport suppliers in understanding their strengths and weaknesses and how they are perceived by users. In other words, generalized cost reflects the degree of the overall utility that transport users have obtained from using a particular option and the lowest generalized cost is not necessarily the cheapest option. According to Polak and Heertje (2000), service quality can be quantified with reference to the generalized cost of transport, of which decisions of transport users depend on a linear combination of service quality and monetary cost considerations. Moreover, the use of generalized cost has made the estimation of non-cost factors in monetary terms possible and gives a clearer picture on the attractiveness of different options by bridging the gap between monetary and other factors. As discussed before, monetary cost is only one of the many factors when users make their choice decisions. As part of the transport system, generalized cost is a relevant indicator in helping to explain the choice decisions by port users.

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scenario including all three regions (see Figure 3.1), it is unlikely that any one of them will possess any advantages in serving all regions. See Chapter Five.

[46] The term can vary, most notably as 'real cost' or 'true cost' by economists and social scientists. Nevertheless, 'generalized cost' is used throughout this thesis.

Before illustrating the equation, it is necessary to note that several assumptions have been made when calculating the generalized costs. Firstly, apart from monetary cost, it is assumed that low port efficiency and poor quality port service are virtually extra costs for liners. On the other hand, high efficiency and/or good quality port service are virtually monetary discounts to the costs paid by port users. This is supported by Hibbs (1993) who notes that a supplier which provides service with better quality can actually lower the cost of using the commodity even when price remains constant, including transportation. This is also echoed by De Maeyer and Pauwels (2003) who notes that improvement in quality of service leads to a decrease in the generalized cost of using a particular transport service. When calculating generalized cost, port users are assumed to be 'rational choice-makers' who are ready to pay more for better quality of service e.g. better efficiency in container transhipment, port operator being more responsive to customer needs, etc. In other words, non-monetary costs are interrelated with monetary ones. In this study, the lower the generalized cost, the port is more attractive to users acting as container transhipment hub in North Europe.

Secondly, it is assumed that the higher the price a port user is required to pay in a particular port, the higher the expectations the user would have on the quality of that port's services and it is more difficult for a more expensive port to fulfil a certain level of customer satisfaction on port services when compared to cheaper ones. If a customer receives exactly the same level of satisfaction from two ports, the quality of services provided by the more expensive port should be higher than the cheaper one. Under the same level of positive satisfaction, the amount of monetary discounting should be higher for the more expensive port. Following this line of argument, it means that port users would have higher expectations on more expensive ports, when calling at these ports, they

would be easier to feel unsatisfied than calling at ports which offer lower monetary costs. Thus, if both the expensive and cheap ports offer the same level of poor quality of services, port users would likely feel more dissatisfied with the more expensive port. In other words, more expensive ports would have more risks in providing poor quality of services to port users than the cheaper ones.

From previous studies and various in-depth interviews, the general consensus is that, while quality of services would affect the overall attractiveness of ports, such factors would be unlikely to overshadow the significance of monetary cost, time and geographical location completely. With such understanding, the fourth assumption is that, when assessing port attractiveness, quality of services should be analysed at the same level with monetary cost, time and geographical location. In other words, all the factors which affect quality of service should be grouped together at a lower level under the category 'qualitative factors' (see later in this chapter for further illustration). Following this line of argument, this study assumes that there is no single factor which could overwhelmingly dominate the decision-making process of liners. Some factors could be more important than others depending on circumstances and personalities, but not completely dominating. When port users analyse different options, they would consider different 'packages' offered by ports, rather than just price-tags.

Finally, as discussed in Chapter One, while calculating generalized costs, monetary cost is assumed to have linear substitutable relations with other non-monetary factors. For example, if it was found that a particular factor is 50% as important as monetary cost, then the monetary value of this factor would also be 50% as expensive as the monetary cost itself. Of course, the sensibility of such assumption is open to discussion. However, as Bennathan and Walters (1979) have noted, the actual relation between price and quality

in ports is extremely difficult to establish and few (if any) researchers had ever tried to solve this problem. As discussed before, studies which investigate port attractiveness were extremely scarce, let alone its relation with monetary costs[47]. Nevertheless, based on numerous studies indicating port users are ready to pay more in return for better service quality, it is argued that such assumption should be a sensible one. Such assumption is further supported by academic support and careful questionnaire design, of which they will be further discussed later in this chapter.

Thus, the generalized cost equation of liners using 'Port A' to tranship containers to Destination X can be expressed as a linear function, as follows:

$$C_{(A\to X)} = M_{(A\to X)} + \beta_T * T_{(A\to X)} - \beta_Q * Q_{(A\to X)} \qquad \textbf{[3.1]}$$

Where $M_{(A\to X}$, $T_{(A\to X)}$ and $Q_{(A\to X)}$ represent the monetary cost, time cost, port performance discount/cost of Port A (directly towards Destination X) respectively, while β_T and β_Q represent the coefficient of time cost and the coefficient of port performance discount/cost respectively. In equation [3.1], C is expressed in Euro(s) per TEU. C is the estimated amount of which a port user believed that he has to pay through making a trade-off between money, time, geography and quality of services in return for using the port's transhipment services. For example, if the values of M are the same for all options, an option with a C value lower than the other options would be attractive because liners believe that they can gain more from choosing this particular option. The generalized cost

[47] This is not helped by the fact that the actual prices charged to different liners by same port operators are always different (the agreed price between a port and a particular liner usually results from closed-door negotiations) and such information is impossible to collect as most of such information are not publicly accessible. During the data collection process, even after repeated requests from related parties, the author still only managed to persuade ECT to provide the average prices of different ports charged to liners while detailed information on individual liners were denied. With data inaccessibility, the author simply cannot do anything to investigate the relations between monetary and non-monetary costs, leaving him no choice but to assume that monetary factor has a linear substitutable relation with non-monetary ones.

equation highlights the importance of the relations between geography and the competitiveness of port as the location of a port can significantly affect the cost (in terms of both monetary and time costs) of going from a particular port to a particular destination (Powell, 2001).

Note that equation [3.1] only includes the attributes within the 'Assessment Process' of PCM. In other words, equation [3.1] only includes factors of which ports themselves have complete control e.g. infrastructure improvements, efficiency, etc. Factors which also depend on customers' behaviour or exogenous factors like values and perceptions, global economic development, limitations of customers are not included here (see PCM in Chapter Two to distinguish such differences). Of course, here it does not mean that these factors are not taken into consideration, but rather than inputting them directly into equation [3.1], they are treated with alternative methods involving econometrics and modelling (see the following sections). However, for the sake of analysis, when calculating generalized costs, port users are assumed to be rational choice-makers and the 'non-Assessment Process' factors in PCM remains constant.

The components in deciding the attractiveness of a port can be further divided into different components in accordance to PCM. Thus, equation [3.1] should be further broken down as follows:

$$C_{(A\to X)} = M_{(J,A\to X)} + \beta_{MP} * M_{(P,A)} + \beta_{TJ} * T_{(J,A\to X)} + \beta_{TP} T_{(P,A)} - \left[\beta_{QT} * Q_{(T,A)} + \beta_{QG} * Q_{(G,A\to X)} + \beta_{QF} * Q_{(F,A)}\right] \quad \textbf{[3.2]}$$

Where $M_{(J,A\to X)}$, $M_{(A)}$, $T_{(J,A\to X)}$, $T_{(P,A)}$, $Q_{(T,A)}$, $Q_{(G,A\to X)}$ and $Q_{(F,A)}$ represent the monetary cost of the journey travelling from Port A to Destination X, the monetary cost of using Port A, the time cost in travelling from Port A to Destination X, the time cost in using Port A, the

time discount in efficiency in using Port A, the locational/cost discount between Port A and Destination X and the qualitative factor discount/cost in using Port A, while β represents the coefficients of different variables.

Equation [3.2] requires more explanations on discount and cost. Monetary cost will always be an extra cost to the port users as long as it decides to use Port A for transhipment. This is also true for time (T in equations [3.1] and [3.2]), where no matter how near between transhipment and feeder ports or how efficient a port can load/unload containers from vessels, a particular amount of time is always required and thus extra cost. Nevertheless, some ports can be more efficient than others, while other ports possess geographical advantages in serving particular regions. Thus, the existence of efficiency and geographical advantages of a particular port can also be virtual discounts, while poor efficiency and geographical disadvantage would imply an extra cost to the generalized costs of port users. This also applies to qualitative factors where, as mentioned in the assumptions earlier in this chapter, high quality services imply a discount to port users and *vice versa.*

Here the problem is how to estimate the monetary values of these non-monetary costs, especially when all these variables have different units (or no unit at all). It is necessary to transform all these variables into a common unit and, in this study, all factors were expressed into Euro(s) per TEU and the importance of these factors will be reflected by the values of their respective coefficients. The transformation process of non-monetary factors into monetary terms and the values of their respective coefficients will be illustrated in detail in Chapter Four, while the methodology in obtaining data to estimate coefficient values will be conducted through a questionnaire survey (will be discussed later).

Two points need clarification here. Firstly, all major liners are currently using mega size container vessels for ocean-crossing journeys (the average container vessels calling at major North European ports have carrying capacities of 6,000 TEU) in order to achieve economies of scale while ignoring the fact that there is no single port in North Europe which possesses enough cargoes to fill up a container vessel for each voyage (see Chapter Two). Understanding such dilemma, within Western Europe, it is sensible to assume that a vessel will call three to five ports in every journey, as supported by empirical evidence (Tables 3.2, 3.3 and 3.4). In fact, perfect hub-and-spoke shipping network is still not fully developed in North Europe and most liners, in their networking, still prefer using two or more ports as transhipment hubs serving different regions. Although some scholars, notably Baird (2002 and 2005), try to justify that perfect hub-and-spoke system (i.e. calling at only one port and use it as a transhipment hub while all others are feeder ports) can finally develop in North Europe, due to various reasons, such an ideal does not seem taking place in the foreseeable future[48].

Secondly, according to in-depth interviewees (see later in this chapter), they regard the ocean-crossing part of the journey as constant and liners charge the same price to shippers for this part of the journey, no matter which North European port was the destination of the shippers[49]. With such understanding, it means that the costs of the ocean-crossing part

[48] In fact, even Baird himself remains doubtful about the practicality of the development of a perfect hub-and-spoke system in North Europe. For example, in his paper in 2005, he calculates the vessel operation costs of using multi-port and hub-and-spoke systems for three types of services – Europe-Far East, trans-Atlantic and round-the-world services. However, after finding his idea does not work for Europe-Far East routes, he tries to justify his idea by concentrating his arguments on trans-Atlantic and round-the-world services. In terms of TEU throughputs and the number of liner services, Europe-Far East routes outnumber other the two types by significant margins (see Chapter Six). Moreover, even Baird himself also admits that excellent coordination between liners to allow his proposed system to flourish which is extremely difficult to achieve.

[49] Information provided by liners through in-depth interviews (see later in this chapter).

of the journey between the port of loading and unloading are kept constant. In other words, the costs of this part of the journey will not play any role in the final outcomes[50].

Finally, it is important to note that the inclusion of particular attributes in the generalized cost equation largely depends on what the researcher wants to achieve, even within similar topics. For example, on the issue of short sea shipping (SSS) development in Europe, Dall'Agata et al. (2003) included service frequency so as to assess the competitiveness of SSS *vis-à-vis* other modes, while Dougall (2002) included CO_2 emission because his objective was to analyse whether SSS could be an environmentally-friendly mode. Such example indicates that there is no general rule in telling researchers what attributes should be included and how significant a particular attribute should play in the calculation of generalized costs. As pointed out by Ben-Akiva and Lerman (2000), the particular values entering into the utility functions of Multinomial Logit Model (see next section) are defined by researchers themselves and methodology design greatly depends on perceptions, objectives and hypotheses.

3.3.2. Multinomial Logit Model

The estimation of port attractiveness would be meaningless if there is no implication on a 'more attractive' port to users. At least theoretically speaking, if a port possesses a lower generalized cost, it should be a more attractive option to liners which in turn also implies that it should be able to attract more users and thus its market share in the market should be higher than those which higher generalized costs. In other words, generalized cost should primarily focus on its 'power of reflection' i.e. to assess whether the calculated

[50] Of course, there is a question concerning whether the current system (using mega-sized vessels calling at least three North European ports) is the most effective/efficient port rotations within a liner route. However, this is not the focus of this study and thus assumption is based on the current empirical situation. Anyway, the major recent works which investigates this issue have struggled to justify that the current system should be changed in the

value, which is in fact a 'melting pot' including a mixture of different attributes with different degrees of significance, can reflect the empirical situation of the subject concerned. For example, the generalized cost of a port should be tested on whether it can reflect the real market share of that particular port in the North European transhipment market accurately. The estimation of market shares, based on calculated generalized cost, can also act as an indicator in testing to what extent money, time and port performance factors have affected the final decision-making of port users in their choices.

With such understanding, an estimation of market shares and compare it with real market shares is beneficial in enhancing our understanding of port attractiveness and its ability in persuading liners to choose them for container transhipment. This can be achieved by applying Multinomial Logit Model (MNL) which will be done in Chapter Five. MNL is a popular transport choice technique originated from mathematical psychology in estimating the probability of choosing a particular option based on the perceived utilities of alternative options (Ben-Akiva and Lerman, 2000). According to Taaffe et al. (1996), MNL attempted to fulfil several objectives, including *investigating the process that lies behind the decision of user, reflecting their preferences for different options, evaluating the attributes of options which decide their attractiveness, the role of personal preferences* and *the trade-offs between attributes which influence choice behaviour [p. 345 – 50]*. Based on such objectives, MNL fits well in complementing generalized cost because it can assess the role of PA's 'non-Assessment Process' factors in PCM (see Chapter Two). Finally, the application of MNL is more appropriate than the binary model because there are more than two ports studied here.

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foreseeable future e.g. Baird (2002 and 2005), etc.

However, when applying MNL, an important assumption has been made where the effects of disturbance are independently and identically distributed (IID) between different ports (Ben-Akiva and Lerman, 2000). Thus, when applying MNL here, liners are assumed to be objective decision-makers who have no subjective preferences on any ports and will choose the best option only based on the best 'package' (i.e. the lowest generalized costs) offered by different ports without any restrictions and, no doubt, this assumption is highly questionable. As shown in PCM, port competitiveness is unlikely to be determined only by 'Assessment Process', but also affected by 'Negotiations Process and Marketing' and 'Values and Perceptions'. This was supported by Washington et al. (2003) who noted that IID was rare in many choices because humanistic decision was not necessarily rational and objective. Their concern was shared by Taaffe et al. (1996) who warned that MNL assumed a *probabilistic* nature of users and there must be a direct correlation between the final choice and its utility without paying attention to some *unobserved random attributes and characteristics* of users. More importantly, MNL ignored the existence of circumstances which restricted user to make utility-maximisation decisions. Putting it in the context of PCM, MNL did not consider the influence of 'Port User Sphere of Influence' (PUSI) when estimating market shares. Thus, while MNL was useful in this context, further work should be done to evaluate the degree of discrepancy of MNL.

To address this problem, in this thesis, after constructing the estimated market shares (EMS), they will be compared to the real market shares (RMS). This process is useful to assess current port competitiveness in the North European transhipment market which also helps to assess how important port attractiveness is on deciding the competitive positions of ports as a transhipment hub. Through comparing estimated and real market shares, the agglomerated values of the above 'non-Assessment Process' factors and PUSI will be estimated. Apart from assessing the accuracy of modelled results, the comparison

between EMS and RMS also help in understanding factors other than port performance which also affect the current competitive positions of ports in North European transhipment market, which will be further discussed in Chapter Six.

3.3.3. Logistic Regression

Generalized cost and MNL can achieve the objective of understanding port's current competitiveness but not the future. Without the inclusion of future prospects, the contribution of this thesis will be greatly depreciated because its ability in giving practical solutions to the research problem also declines.

In this context, economic modelling can address the issue. According to Hensher and Button (2000), within academic and policy analysis, economic modelling was generally accepted that formal methods centred on some set of hypotheses testable could enhance understandings in various economic and social science disciplines, including transportation. This was supported by Flowerdew and Martin (1997) who argued that modelling was an important process to illustrate that a researcher understood his topic and shedding lights on different relations of the real world. Their opinions indicated that economic modelling could be an important step in helping this thesis to give significant contributions to future port and maritime transport researches.

Based on generalized cost, EMS and RMS, this task can be achieved through applying the econometrical technique of logistic regression which estimates the causal relationships between dependent and independent variables. Through logistic regression, it examines the trends within the data and how significant a variable would affect another variable becomes possible. In this sense, logistic regression is similar to linear regression where

both techniques aim at identifying the best fitting model which describes the relationship between a dependent variables and a set of independent variables. However, it is argued that logistic regression is better than linear regression for this study due the two reasons. First, it is due to the problem of linear regression itself. The linearity of linear regression implies that apart from random disturbances, the observations of dependent and independent variables (i.e. y and x respectively) are scattered about a straight line (Greene, 1990). In other words, the relationship on the line is not necessarily identical to variables between y and x. With such shortcomings, linear regression seems a bit too 'deterministic' in deciding the relations between y and x.

Also, the study nature has made logistic regression a better method. As mentioned before, the market shares of ports will be estimated with respect to their respective generalized costs. Since only six ports are included here, the sum of the market shares of these six ports would always equal to 1. In this sense, logistic regression is more relevant than linear regression as the former reflects the proportion of market shares of which a port would probably get based on its attractiveness out of a resulting outcome of 100%. Such relation between y and x is something of which linear regression is clearly lacking because while the probability of logistic regression ranges from 0 to 1, the probability of linear regression ranges from negative to positive infinity (Washington et al. 2003). Thus, as one of the methods in multiple regressions, it is clear that logistic regression is preferred and linear regression should be avoided when more suitable methods are available due to the above-mentioned disadvantages (Washington et al., 2003).

Through the above exercise, attempts will be made to investigate the most important attributes affecting future port competitiveness in the North European transhipment market and will construct a logistic regression model (LRM) to give insights on the future

port competitiveness through estimating own, cross and conditional elasticities of demand of different ports when they improve lower their respective generalized costs. Based on these results, some constructive recommendations can be made to port planners when they construct their development strategies for the foreseeable future.

3.4. DATA COLLECTION

The calculation of generalized costs is possible only when relevant data is available. While it might not be too difficult to collect quantitative data (although commercial confidentiality had made the issue a bit more complicated), it is not the case for qualitative data because the monetary values of such factors were extremely scarce and thus not readily available. It implies that further qualitative information is required for data analysis and interpretation of port competitiveness in the North European container transhipment market. As Teurelincx (2000) had noted, traffic analysis was usually insufficient to perform comprehensive port analysis and field research, usually in terms of a questionnaire survey, was needed to look into the causes of the identified trends. His argument was supported by Flowerdew and Martin (1997) who described questionnaire survey as *a quick, easy and painless way of recruiting people while researchers usually know something about their views on the topic [p. 120]* which could facilitate research analysis. Based on such support, in this study, the necessary qualitative data in assessing port attractiveness was collected through a questionnaire survey, conducted in the latter half of 2004.

3.4.1. Questionnaire Survey

To understand the generalized cost of using a particular transport option, the inclusion of non-monetary factors into considerations is necessary. As Powell (2001) had emphasised, transport analysts should be based on a large number of criteria, both monetary and non-monetary. He was echoed by Guiver (2004)[51] who argued that inputting qualitative elements into transport analysis could enhance understandings of travel choices.

Identification of survey participants

Before inviting survey participants, it was necessary to identify who they were. In this survey, the search of questionnaire respondents was based on non-probability sampling i.e. the author needed to target a particular type of survey respondents (Flowerdew and Martin, 1997). Since container transportation is mainly a business, probability sampling (or random sampling) was not an appropriate method because the most critical port choice decisions were usually made by one or few senior official(s) within the liner shipping companies (i.e. port users).

Thus, it is important to find out who were authorised in making such decisions. As mentioned before, liners were the major decision-makers in transhipment hub choices (see Chapter Two) which was confirmed by Heaver (2002) and Ha (2003) who argued that ports did not sell services directly to shippers and thus liners were their major customers and the contracts with them were the single largest determinant of business volumes. The argument that liners were the major decision-makers was further strengthened through various in-depth interviews (see later in this chapter) with various experts within the industry including port operators and liners themselves. According to them, once the top

[51] Guiver's ideas were quoted from Docherty (2005).

liners had made their port choices, in most cases, feeder vessels would likely follow and thus ports usually put their marketing focus on these major ocean-crossing liners.

Thus, this survey was directed towards these ocean-crossing liners. 30 container liners, all belonging to the global top 30, were identified and questionnaires were distributed to their headquarters/European regional headquarters[52] and targets consisted of CEOs, General Managers, Operation Managers, District Managers, Purchase Managers or Contract Managers of ports and terminals. Top 30 liners were identified because they were the dominant players of the North European transhipment market where in recent years, apart from dominating TEU throughputs (see Chapter Four), they also occupied more than 80% of all transhipment demands (ECT, 2004). The relevance of personnel, together with the relevance of the questions on the questionnaire, was further strengthened by reviewing interview targets with interviewees (see later in this chapter) and the author was guaranteed that all the targeted interviewees were the authorised decision-makers at the time when this survey took place.

During the survey, it was found that whether the author was trustworthy in fulfilling his promise to maintain information confidentiality was the major obstacle in persuading targeted interviewees to participate in the survey as many of them felt the pressure of being accused of releasing confidential information to third parties by their respective management hierarchy which could threatening their career. Their concern was understandable because while it was easy for interviewer to give confidentiality promises to participants, it was much more difficult to fulfil them and survey participants usually had little control on data processing and publications afterwards. Here the author was not

[52] In practice, after receiving the invitation letters, nearly all interviewees requested an electronic version of the questionnaire so that they could respond on the computer screen and returned to the author immediately by email. Given their tight work schedules, they consider this method as much better than mail questionnaires.

alone. For example, throughout the research process, Tiwari et al. (2003) had to keep the names of liners confidential as the latter worried that failing to do so would affect their business interests. Thus, the art of gaining trust and understanding from targeted interviewees and how to maintain confidentiality were the key factors in deciding the degree of the survey's success and considerable time was spent on how to acquire interviewee trust[53]. Apart from spending considerable time and efforts in explaining the significance of this study to targeted interviewees, the author promised that their names and personal information would never be shown on any publications, including this thesis. Moreover, instead of showing names, the names of liners were coded alphabetically (Liner "A" to "S").

Designing the questionnaire

Apart from persuading interviewees to participate in the survey, it was equally important to design a questionnaire which could be useful in fulfilling this study's objectives. Here three questions needed to be addressed. The first one is: what approach should be using? According to previous studies, survey questionnaire was mainly divided into two approaches – revealed preference e.g. Blauwens and Van de Voorde (1988), Tongzon (2002), etc. and stated preference e.g. Hensher and Button (2000), etc. The former analysed and collected information based on the actual behaviour of targeted interviewees, while the latter collected information based on hypothetical situations usually requesting interviewees to take a choice preference test. While there are pros and cons for both approaches, this study has chosen revealed preference approach because it was perceived that virtually all survey participants possessed vast experiences in using the Core-Six Ports for container transhipment. Also, using the revealed approach enabled the

[53] Being the senior representatives of commercial organisations, virtually all interviewees requested strict confidentiality guarantee from the author before they agreed to participate in the survey.

questionnaire to capture liner opinions based on their actual experiences and their perceptions on these ports acting as transhipment hubs were likely to be more accurate.

Also, this questionnaire used a Likert-style format (Flowerdew and Martin, 1997) which mainly consisted of closed-ended questions requesting respondents to give 'attitudes' and 'opinions' on various statements of factors affecting transhipment hub choices. According to Frankfort-Nachmias and Nachmias (1996), people with certain attitudes could reflect their inclination to act or react in a similar manner when confronted with certain stimuli and 'what they think' would play an important role on 'how they act'. This was very relevant here as all targeted interviewees here were experienced users of the Core-Six Ports. The advantage of attitude and opinion collections was also endorsed by Flowerdew and Martin (1997) who noted that such data *possessed the potential to predict how people might behave in the future, [including] transport decisions [p. 132]*.

Although admittedly data on attitudes could not be 100% reliable due to psychological uncertainty and the possibility of having different attitudes on the same issue under different circumstances (Flowerdew and Martin, 1997), as discussed before, perceptions and beliefs would often affect the final decisions of liners in most cases. Thus, it was sensible to believe that attitudes and opinions should be included in transhipment hub choice analysis. As Frankfort-Nachmias and Nachmias (1996) had noted, although attitude and opinions were the most difficult category of social survey data to collect and zero error was virtually impossible, the quality of such information could be improved through professional wordings, clear instructions and making respondents feel respected. More importantly, the inclusion of attitudes and opinions here also reflected an attempt to shed some lights in suggesting how the traditional positivism approach in transport research could be improved with the inclusion of more qualitative factors.

Another question involved guessing the expected problems from respondents when they filled in the questionnaire. Based on previous studies and the author's experiences, several problems could be expected. A questionnaire survey often posed the risk of biased responses. As warned by Blauwens and Van de Voorde (1988), when interviewees filled in questionnaires, special attention had to be made because intentions and actual behaviour could be different and that the validation of judgments of individuals could not be controlled easily. This is especially true for stated-preference approach as stated responses are hypothetical choices rather than actual decisions (Hensher and Button, 2000).

Also, there is a possibility that some interviewees might give relatively emotional answers at the time when they fill in the questionnaire. For example, if the survey was conducted at a time when some unhappy incidents happened between users and suppliers, there would possibly be a risk that the user would likely to give rather emotional response which did not reflect the realistic situation. Finally, of course, some interviewees might give responses without reading the instructions carefully, which in turn provided irrelevant and useless information.

To minimise these problems, certain measures had been carried out. Firstly, the author made special reminders to interviewees, through instructions on the survey questionnaire (see Appendix A) and phone calls, that they should give responses based on their experiences on the overall performance and expectation on the ports concerned in the last and forthcoming three years. Also, interviewees were reminded that they should only give opinions on the performance of ports of which their respective companies had actually used for transhipment before. Finally, in the questionnaire, instructions were clearly stated

and important words in the instructions are either bolded or in *italics* in order to catch survey participants' attention.

The third question involves the objective of the questionnaire survey, or what exactly does this questionnaire wanted to achieve. This question can be answered more easily by understanding the major problem of this study i.e. the difficulty to measure the monetary values of qualitative factors directly due to several reasons. Firstly, it is extremely doubtful whether respondents know the exact amounts that they were willing to pay for different qualitative factors due to the internalisation of the characteristics of ports by decision-makers (Tiwari et al., 2003)[54]. For example, it was very difficult to answer a question 'how much, in terms of Euros, would you describe your relations between you and the port operator of Port X?' In reality, many decisions were based on ambiguous information rather than precise quantitative figures. This problem highlighted the weakness of many previous studies which assumed that decision-makers were like robots and made decisions only based on quantitative figures (see Chapter Two).

Secondly, due to the above problem, it implied that a questionnaire which requested respondents to give the exact amounts on qualitative factors would be too complicated and bore the risks of poor response rate[55]. Given the not-so-high number of interview targets due to the study nature, this was something which simply could not afford to happen.

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[54] Shippers are the targeted interviewees of Tiwari et al. (2003). However, their idea of the *internalisation of port characteristics* can be well applied to liners as it is the *personnel* inside the company who make managerial decisions.

[55] At the beginning of year 2004, the author undertook a pilot survey to test the response rate of the questionnaire survey. The initial version of this questionnaire was designed in a way that respondents were required to give monetary values of different qualitative factors. 10 questionnaires were distributed to liners and, after one month, the response rate was still zero. When the author tried to contact two companies to discuss about the problems of the questionnaire, they noted that the questions were just too complicated and thus unable to finish the questionnaire. After the pilot survey, the questionnaire was redesigned to its current form.

Thirdly, even if respondents could give an answer to the above question, measuring the monetary values of qualitative factors bore the risk of falling into the trap where the shortcomings of stated-preference approach were best illustrated. Following the above example, possibly the respondent could give an answer of '10 Euros'. However, due to the abstractive nature of such questions (Flowerdew and Martin, 1997), it was highly doubtful whether the respondent would value the factor in this way when facing a similar real-world situation. It implies that, if questions were asked this way, it would be difficult to control the quality of respondents' answers.

The above queries have posed a question mark on whether directly measuring the monetary values of qualitative factors could realistically reflect the choice-making process of liners which implied that the only thing that could be done was to estimate the values of qualitative factors indirectly. Thus, the objective of this questionnaire was to estimate the relative significance of qualitative factors to monetary cost and the impression of port users on these qualitative factors offered by different North European ports. Evaluating the significance of qualitative factors and impression of these factors offered by different ports should be a more realistic reflection of the decision-making process as users should have some basic concepts in their minds about what factors they should pay more attention to when making their choices.

The layout of the questionnaire can be found in Appendix A. The author tried his best to make the questionnaire as 'respondent-friendly' as possible by keeping it reasonably short, easily understandable but at the same time professional. The questionnaire is divided into four sections which will be discussed here.

Section A

In this section, survey participants were required to give their (and their company) background information. Apart from keeping records, from assessing the information of the company background, the author also attempted to get a better understanding about the background and characteristics of liners. Questions included the current transhipment hub choices of liners to different European regions, the types of terminals that they are using and whether they had any plans to construct dedicated terminals for transhipment.

Section B

In this section, interviewees were requested to give opinions on the significance of different factors in affecting port's attractiveness acting as container transhipment hub to liners. Due to the very nature of the questions of this section, questions were listed using an *attitude battery* approach so that respondents would find the statements easy to read and answer (Flowerdew and Martin, 1997).

The next question was to decide what factors should be included. In transport analysis, the types of non-monetary factors greatly depended on the nature of the movement e.g. transportation of passengers vs. goods, choice between modes vs. choice within mode, etc. (Powell, 2001). Based on the nature of this study, a number of factors had been identified as the mostly likely criteria for port selection and thus port competition in North European transhipment market[56]. See Table 3.5. These factors were identified based on the belief that port competitiveness involved the effectiveness of inputs from different aspects of the 'port cluster' which included public and private sectors as well as

[56] Of course, there can also be other factors which can possibly affect port attractiveness. For example, Clark et al. (2001) have included organised crime in the equation, while Song and Yeo (2004) have proposed as many as 73 factors. The factors included in this questionnaire are finalised based on estimating the most likely factors that are considered by liners in their transhipment hub choices in North Europe which are strengthened by literature reviews and in-depth interviews.

supporting industries. As mentioned in Chapter Two, coordination and interactions within the cluster would decide the operational effectiveness and strategies of a particular industry, including ports. As shown in Table 3.6, the performance of a port should be based on various factors of which their qualities are based on the effectiveness of different sectors of the port as well as their interactions e.g. port authority policy and regulations (mainly the responsibility of public sector), port operator's speed in responding to new demands (mainly the responsibility of the container stevedoring company), supporting industries (mainly the responsibility of supporting industries), availability of professional personnel (mainly the responsibility of educational institutions), etc.

There were two queries requiring further explanations. Firstly, some previous studies have included *port management of private port operators* as an independent factor for consideration e.g. Clark et al. (2001), Lirn et al. (2004), etc. While it is undeniable that port management plays a significant role in port competitiveness, the effects of port management had already been directly reflected in various categories listed in Table 3.6 e.g. delays and damage in reliability, availability of professional personnel in personnel and facilities, relations with customers, response to changing customer demands and reputation in other qualitative factors, etc. An understanding of the significance of the categories listed in Table 3.5 would certainly give readers a clear idea on the significance in port management as well as management performance of different ports. Thus, there is not a necessity to include port management as a separate component anymore.

Table 3.5. Major factors in affecting container transhipment hub choices

PORT LOCATION FACTOR
A) Monetary aspect - Vessel operation monetary cost from transhipment to destination ports (journey cost) *B) Time aspect* - Average journey time from transhipment to destination ports (journey time) *C) Locational efficiency* - Location of port with respective to distance between transhipment and destination ports (locational efficiency)
PORT FACTOR
A) Monetary aspect - Port charge (terminal handling charge and port dues) *B) Time aspect* - Average time to load/unload containers from vessel - Efficiency of port in container-handling *C) Qualitative aspect* - Cases of delays in loading/unloading containers - Records of damage during container-handling - Custom procedures (e.g. inspection, documentary, etc.) - Port authority policy and regulations - Accession to port - Quality of port infrastructure for handling containers - Quality of port superstructure for handling containers - IT and advanced technology for port operations - Dedicated terminals and facilities for container transhipment - Supporting industries (e.g. warehousing, insurance, etc.) - Quality of other services (e.g. pilotage, towing, mooring, etc.) - Availability of professional personnel in port - Preference of shipping line clients/shippers - Personal contacts/relations between port operator and liner shipping companies - Efforts of marketing on the port by port authority - Reputation of port within the region - Port operator's speed in responding to liner shipping companies' new demands and requests

The second query involved whether geographical location should be included as the effects of geography were also reflected in monetary costs and time e.g. monetary costs travelling from Port A to Destination X, time required to travel from Port A to Destination X, etc. However, such an argument neglected the subjective nature of human mind in perceiving geography which was supported by Hayuth and Fleming (1994). Using the example of Los Angeles, they argued that, in deciding whether a point/region is well-located, individuals are often affected by subjective and perceptive-related attributes e.g. marketing, beliefs, individual objectives, etc. With such understanding, perception in geographical location should be included as a separate category, termed as 'Locational Efficiency' in this study.

Survey participants were required to assess the significance of these factors in affecting their transhipment hub choice by giving 'Significance Scores' (in agglomerate, Average Significance Score, of ASS). Scoring was preferred to other methods, notably ranking[57], because of various reasons. Firstly, if the method of ranking were used, problems might arise when interviewees consider that some of the factors are more or less similar in significance to each other. In reality, it is doubtful whether interviewees really make decisions through looking at a table of factors and rank them. As mentioned, liners usually make a choice through evaluating mixed sets of options consisting of different status of factors available from different ports for their choice. Also, using ranking bears a risk by assuming that all the factors identified would have at least some implications on port choice decision-making process by all interviewees which is not necessarily true, as reviewed in previous studies e.g. Tongzon (2002), Ha (2003), etc. Finally, recognising

[57] Here the concept of 'scoring' follows the idea of Nijkamp et al. (1990) which is a rating method of which the respondent gives a constant number of 'points' or 'marks' (e.g. a constant point between 0 and 10) among the distinguished objectives in a way that the number of points allocated to an objective reflects its relative importance. On the other hand, ranking means that, rather than giving marks, the respondent is asked to rank the criteria or objective in order of importance (i.e. $X_1 > X_2 > X_3$).

that such data were ordinal in nature, transforming data through scoring into cardinal terms (or 'cardinalisation') has more mathematical justifications than other available alternatives. Using the *expected value method*, Nijkamp et al. (1990) offered mathematical justifications on this issue:

> *"[An] approach to a qualitative evaluation...is to ask a respondent to express his information on impacts of alternatives in ordinal form (for example: [giving scores of] 1 = least attractive, 2 = one but least attractive...I = most attractive). Such ordinal information is in practice often treated as if it were cardinal: operations such as addition, subtraction and multiplication are used with cardinal data without paying attention to the ordinal character of the figures...Is there a justification for such an approach?...It is interesting to note that the expected value method, when applied to ordinal project effects, yields a justification [for this approach]...if a uniform distribution is assumed for project effects on a range between 0 and I...[using expected value method], the expected cardinal value of the i-th number is i/I. For example, the quantitative values assigned to '1 to 4' are: ¼, ½, ¾, 1, respectively. It is not difficult to see that...these expected values fully correspond to the original numbers...[of which its] statistical distribution lies on a linear cardinalisation curve."[p. 75]* [58]

The argument of Nijkamp et al. (1990) is also supported by Frankfort-Nachmias and Nachmias (1996) who argued that mathematical and statistical operations on such data are sensible as long as the researcher does not change the order of the data during the transformation process. Considered that cardinalisation of such data is necessary in order to inscribe it into the generalized cost equation, it makes sense to use the scoring method here since it is better-supported mathematically.

Also, fully appreciated the fact that the cardinalisation of ordinal data was a very tricky task, apart from getting the best academic support, the author also put a lot of efforts in questionnaire design to make such operation as sensible as possible. Apart from choosing scoring rather than ranking (see above), instructions were designed carefully to request

[58] On the other hand, Nijkamp et al. (1990) indicate that such equal values cannot be expected in a ranking approach. See Nijkamp et al. (1990) for further explanations on the expected value method.

survey respondents to try their best to give scores based on a 'rational cardinal scale' (Appendix A). For example, if a respondent gave a score of '4' and '2' to Factors A and B respectively, then this respondent should regard that Factor A is twice as important as Factor B in affecting port attractiveness acting as container transhipment hub in North Europe. While limitations could still exist, the above has clearly illustrated the author's intention and efforts to make the conversion process as rational and academically acceptable as possible.

The ASS scale table can be found in Table 3.6. A score of zero was necessary to avoid the mistakes of previous scholars who assumed that the factors identified must necessarily have implications to all targeted interviewees.

Table 3.6. Significance score scale

SCORE	DEGREE OF SIGNIFICANCE
5	Very Significant
4	Significant
3	Some Significance
2	Little Significance
1	Minimum/Nearly No Significance
0	No Significance At All

The zero score requires more explanations. Respondents were expected to give zero score to any factors of which they believed that no consideration was required. Without the necessity of even minimum significance, zero score ensured that this particular factor did not affect the generalized costs of using a port for transhipment no matter how good or bad that particular port performed in this factor. In other words, a particular factor with zero score could not change the values of the generalized costs. This ensured that the transformation of qualitative factors into monetary terms was conducted sensibly.

Section C

To compare the service quality between the Core-Six Ports, this section consisted of an evaluation exercise asking survey participants to give their opinions on the performance of the Core-Six Ports. Here only port performance factors were included for analysis. Monetary costs, as well as average time cost in loading and unloading containers and average time cost travelling between port and destination i.e. $T_{(P,A)}$ and $T_{(J,A\rightarrow X)}$ respectively in equation [3.2], were excluded because these factors possessed numerical figures which could be readily inscribed into calculating generalized cost. Again, similar to significance scores, scoring was preferred due to the reasons discussed before.

In this section, respondents gave 'Appreciation Scores' (in agglomerate, Average Appreciation Score, or AAS) to assess the performance of ports in different factors in Table 3.5. Appreciation scoring was an effective way to observe the quality of services offered by the ports concerned since respondent experience in using the services was very important in deciding whether liners would use a particular port for transhipment. As one could easily identify the factors which give negative impacts to port performance, AAS is a valuable indictor in evaluating what factor(s) a particular port should improve in enhancing its attractiveness as it measures respondent's viewpoint to a particular issue.

Different from significance score, opinions on the performance of service quality could be positive or negative (or neutral) and thus both positive and negative scores should be available for selection. Here there is an issue about deciding the score scale i.e. scores that should be used for maximum and minimum points. The AAS scale is based on what had been discussed in Chapter Two about PCM, that if a port user regards one or more factors as extremely important, it implies that it has already affected 'Values & Perceptions'. In this study, the word 'very' is regarded as the ceiling for rather 'objective-subjective

judgements of the significance of different factors and performance of ports. Scores higher than 'very' are regarded as part of 'subjective-subjective judgements'. In fact, during the survey and in-depth interviews, some interviewees indicated that they had special preferences to some ports even though they know that the services offered by those particular ports were significantly worse than other available options[59]. The AAS scale table can be found in Table 3.7.

Table 3.7. Appreciation score scale

SCORE	PERFORMANCE OF PORT
+3	Very positive
+2	Quite positive
+1	Somewhat positive
0	Neutral
-1	Somewhat negative
-2	Quite negative
-3	Very negative

Although AAS gave immediate impressions on the strengths and weaknesses of different ports, it was inadequate to conclude whether a port performed better than others because the significance of different factors was yet to be inscribed. This step was very important as there were circumstances where a port might perform well in many insignificant factors while another port performed well in relatively few but very significant ones and under such circumstance, wrong conclusions might be drawn. Understanding this, in Chapter Four, ASS and AAS will be merged to form Port Performance Indices (PPI). PPI reflects ports' attractiveness acting as transhipment hubs with reference to their performance on different factors with varying significance.

[59] Through this research process, it is found that some subjective judgments are possible to evaluate while some are not. For example, according to a senior official of ECT, he mentioned his experience that a CEO of a particular liner once explains about choosing Rotterdam as its port of call was because this CEO had a good first impression when he first visited Rotterdam and thus had a 'special feeling' to the city, rather than any scientific evaluation and trade-off between different options. Such kind of judgment which is extremely difficult, if not impossible, to assess is also regarded as a kind of 'subjective-subjective judgment'.

Nevertheless, non-monetary factors have to be analysed together with monetary cost so as to know the 'packages' offered by different North European ports to potential customers. As mentioned before, this problem can be addressed by transforming PPI into monetary terms and inscribe them into the generalized cost equation. These transformed monetary figures are termed as Port Performance Discount/Cost (PPD/C) which is equivalent to $Q_{(A \to X)}$ (as laid down in equation [3.1]) and can either be a discount or extra costs depending on port performances. ASS, AAS, PPI and PPD/C will be further discussed in Chapter Four.

Section D

Overemphasis on close-ended questions might bear the risk of missing out some aspects like specific preference of individuals, especially since closed-ended questions could possibly neglect the reasons why respondents arrived at a particular point of view (Frankfort-Nachmias and Nachmias, 1996). Recognising such deficiency, the final part of the questionnaire consisted of several open-ended questions which allowed survey respondents to give their opinions on the issue freely. Some open-ended questions in the questionnaire included reasons why ports give particular scores to particular aspects of port performance, any particular ports of which interviewees especially like or hate (possibly without any specific reasons and purely perception) and any further comments on the questionnaire or the North European container transhipment market.

3.4.2 In-Depth Interviews

Mathematical modelling and closed-ended questionnaires might not be able to cover all aspects of port competition in transhipment due to complexity within the industry. This was supported by Frankfort-Nachmias and Nachmias (1996) who noted that qualitative research could yield rich information that cannot be attained through quantitative one. Although this problem had been partly addressed by open-ended questions in the questionnaire, it was by no means addressing the core issue completely because respondents were still being 'imprisoned' by the researcher's beliefs and expectations reflected in the questionnaire. Indeed, in many cases, questionnaire was usually standardised and untailored to individual's circumstances which made responses not completely 'respondent-friendly'.

Thus, conducting qualitative in-depth interviews was necessary. Apart from addressing the problems of the questionnaire, through in-depth interviews, the author also tried to obtain further detailed information about port operator strategies and the decision-making process of liners in transhipment hub choice. Furthermore, in-depth interviews were necessary to check the plausibility of the modelling assumptions (see Appendix B). Between 2004 and 2005, 15 interviews with various experts within the North European container transhipment market had been conducted successfully (hereafter called 'interviewees'), as follows:

- A senior official from Europe Container Terminals B.V. (ECT), Rotterdam
- A senior official from PSA Corporation, Antwerp
- A senior official from Port of Felixstowe Ltd. (PoF), Felixstowe
- A senior offical from Municipal Port Management, Rotterdam (RPM)

- A senior official from Port Authority of Antwerp
- A senior official from Trade Promotion Council of Hamburg
- A senior consultant from an Antwerp-based transport consulting company
- A senior consultant from a London-based shipping consulting company
- A senior editor from Containerisation International, London
- A senior editor from Lloyd's List Shipping Journal, London
- Senior officials from five liner shipping companies

These interviews, mainly consisted of semi-structured dialogues, were conducted in pleasant and relaxed environments, usually at interviewees' offices. Under such arrangements, they could offer opinions in a detailed and more critical manner while the author could exert better control on the interview situation (Frankfort-Nachmias and Nachmias, 1996) of which, according to the author's experiences, proved to be quite true.

Like the questionnaire survey, the major problem here involved confidentiality with considerable potential participants refused to accept interview requests. Even those who accepted they were sometimes reluctant to offer key information citing confidentiality. This is understandable since keeping information closed to the outside world was an important strategy to sustain the competitive advantages of firms (Porter, 1985). Also, as Frankfort-Nachmias and Nachmias (1996) had noted, the lack of anonymity could prove problematic in enhancing response quality because many potential respondents felt that personal lives could be threatened and intimidated by the interviewer because the latter usually got hold of much personal information of the interviewees e.g. correspondence address, telephone numbers, etc. Thus, once again, the author had to guarantee confidentiality with them and so their personal details could not be released in this thesis.

During these interviews, three major aspects have been discussed, namely the strategies of port/multinational port operators, the decision-making process of liners in transhipment hub choices and general questions. In the following, these aspects will be discussed one by one.

For strategies of port/multinational port operators, four major issues were discussed. Firstly, interviewees were asked to give opinions on the strengths and weaknesses of the Core-Six Ports (and opinions on some ports which were not studied here e.g. Southampton, Zeebrugge, etc.) acting as container transhipment hubs. As interview targets did not only compose of liners, it was anticipated that more diverse and objective views could be obtained from them.

Secondly, interviewees were requested to evaluate the major strategies of these ports in attracting customers and businesses. The major focus was on the approaches of different ports during port promotion, marketing and negotiation with liner shipping companies, since it has been noted before that the competitive position of a port also depends on factors belonging to the 'non-Assessment Process' of PCM.

Thirdly, interviewees were asked to give opinions on the major similarities and differences in port promotion, marketing and negotiation styles between different ports. The author also discussed with them whether the strategies of ports were persuasive enough to convince liners to choose them for transhipment.

The final issue involves strategies of multinational port operators. Questions were raised over whether liners negotiate with ports individually or, in some cases, negotiate 'port packages' with multinational port operators. For example, when negotiating for the prices

and terms of using of the ports of Rotterdam and Felixstowe, will liners negotiate with ECT and PoF individually, or would they negotiate with HPH directly for using both ports at the same time? Interviewees needed to explain briefly the current negotiation pattern between the two parties and the problems and issues which arose within the current pattern.

For the decision-making process of liners, it was divided into five issues. Firstly, interviewees were asked about the major concerns of liners when making transhipment hub choices. Apart from the factors mentioned in the survey questionnaire, special attention has been given to three other aspects, namely inland connection between port and hinterland, opinions/preferences of shippers and freight forwarders (or customers of liners) and subjective impression/perception of the ports by liners. Although not the focus of this study due to various reasons (see Chapter One), the issue of hinterland was highlighted as it would be interesting to understand how direct imports/exports affect the competitive positions of ports acting as transhipment hubs. Interviewees were asked to explain the importance of these factors in the decision-making process of liners.

The second issue involved the relations between liners and their obligations in strategic alliances. Interviewees were asked to give their opinions on whether a particular liner would often be constrained by alliance obligations and thus flexibility when choosing transhipment hubs. The objective of this question was to investigate whether the port demand for container transhipment was as elastic as Bennathan and Walters (1979) claimed to be. Through this, the author also tried to investigate whether the bargaining power of ports (i.e. service provider) could be enhanced through enhancing the obligations of liners in using particular ports.

Thirdly, interviewees were asked to give opinions on whether the balance of negotiating power between liners (i.e. service users) and ports/multinational port operators (i.e. service suppliers) has greatly favoured the former since containerisation, the formation of shipping alliances and the rising importance of container transhipment in global liner shipping. Interviewees were requested to give some real-world case examples in supporting their responses.

The network issue was also addressed. Interviewees were also asked to give opinions on whether liners preferred choosing one single port within North Europe or whether they prefer using two or more ports for container transhipment. For example, would they prefer using Rotterdam for British transhipment market, while using Hamburg for Scandinavian-Baltic transhipment market? Interviewees were also asked to give opinions on how the Core-Six Ports could improve their attractiveness and competitiveness in terms of any aspects e.g. physical infrastructure, port services, marketing, management, etc.

Finally, the author had discussed with them on some general questions concerning the North European container transhipment market e.g. which of the port-pairs are directly competing with each other (i.e. gaining market shares at the expense of their counterparts), which of them were cooperating with each other, any extra remarks and comments that interviewees would like to make for the North European container transhipment market but had not been mentioned in interview questions posed before, etc.

3.4.3. Other Information

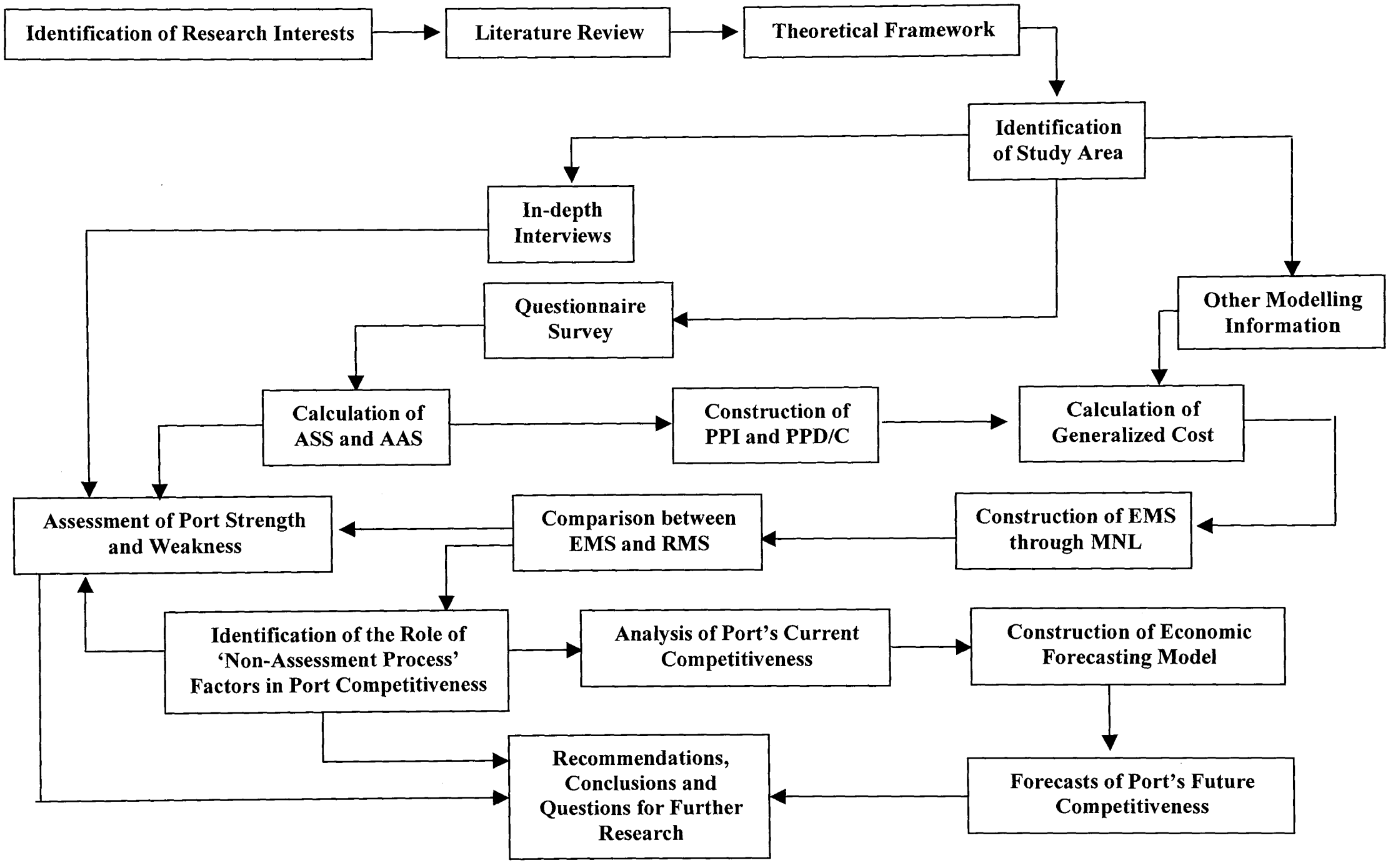
Throughout the research period, the author paid close attention to the most updated news and information about global and European port and shipping developments and attended various seminars related to transport geography and economics, especially in maritime transport. The opinions of different scholars and experts within the industry have given important supplementary insights to this study e.g. study approach, research design, theoretical framework, arguments, etc. On the other hand, the assumption figures for calculating generalized costs can be found in Appendix B.

3.5. RESEARCH PROCESS FLOWCHART

Figure 3.8 summarises the research process of this study. From the process, it shows that some steps are not necessarily independent from each other. Rather than existing independently, in fact, many procedures through the research process are mutually dependent on each other.

Finally, through the steps as indicated in this chapter, this thesis has shed some lights on the process of transforming PCM into an economic forecasting model. Here the author is confident that this study has provided a 'benchmark' procedure to help port researchers in applying PCM in port competitiveness modelling.

Figure 3.8. Research Process Flowchart



CHAPTER FOUR
EMPIRICAL RESULTS AND PORT ATTRACTIVENESS

After the methodology, this chapter discusses the empirical results obtained from the survey and the procedures of data processing. This chapter is divided into four sections. After presenting the empirical information from the survey, Section 4.2 calculates the indices in assessing port performance. After then, Section 4.3 illustrates the 'monetarisation' process of non-monetary factors and finally, Section 4.4 calculates the generalized costs of using the Core-Six Ports for transhipping containers to different European regions.

4.1. EMPIRICAL INFORMATION OBTAINED FROM QUESTIONNAIRE SURVEY

4.1.1. Response Rate and Current Transhipment Hub Choices of Major Liners

Survey respondents were requested to fill in and return the questionnaire in the latter half of year 2004. The author receives back 19 filled-questionnaires representing 20 liners[60], with a response rate of about 63%. Among these responses, they represent the opinions of the major players in the North European transhipment market since, in terms of TEU and number of container vessels, these respondents represent more than 80% and 70% of the top 30 and total container liner shipping markets respectively (see Table 4.1). These figures strongly strengthen the argument that the findings and analysis of this thesis are well-supported by a highly reliable database.

[60] The respondent from Liner D is, in fact, managing two top 30 liners.

Table 4.1. Shares of interviewed liners compared to the global total and top 30 liners

CATEGORY	TOTAL CARRYING CAPACITY (TEU)	TOTAL VESSELS	SHARE OF CAPACITY	SHARE OF VESSELS
All Liners	7,689,264	5,002	100.00%	100.00%
Top 30 Liners (% share to All Liners)	6,336,968	2,598	82.41%	51.94%
IL (% share to All Liners)	5,444,942	2,189	70.81%	43.76%
IL vs. Top 30 Liners	----	----	85.92%	84.26%

Note: IL – Interviewed liners. Percentage shares of throughputs and vessels are corrected to two decimal places. Figures above and rankings of liners are dated from May 2004 and only include the carrying capacities of existing vessels Source: Alphaliner (2004).

Using the information provided from Section A of the questionnaire (see Appendix A), Tables 4.2, 4.3 and 4.4 are constructed to give a general idea about the current transhipment hub choices by liners. As mentioned in Chapter Three, to respect confidentiality, liners are only coded alphabetically.

Tables 4.2, 4.3 and 4.4 indicate that Antwerp, Felixstowe and Rotterdam are popular choices in transhipping containers to the UK among liners, while Rotterdam is also a popular choice in container transhipment to Iberian Peninsula. For Scandinavia-Baltic, the situation is more different, with Hamburg as the most popular choice. Here it is not difficult to find that Rotterdam enjoys many exclusive calls from liners while most of the other calls are joint calls except Hamburg and Bremerhaven where they often enjoy calls excluding Rotterdam in serving Scandinavia-Baltic. Finally, very few liners choose Le Havre as a transhipment hub. In many cases, it seems that no matter what ports they choose, the companies of survey respondents prefer to include Rotterdam as a transhipment hub, especially in the UK and the Iberian Peninsula. As mentioned in Chapter Three, the existence of joint-calls indicates that the hub-and-spoke shipping network is yet to be fully developed in North Europe.

Table 4.2. Container transhipment hub choices of interviewed liners between North Europe and the UK

PORT	LINER SHIPPING COMPANIES						
	A	**B**	**C**	**D**	**E**	**F**	**G**
Antwerp	X		X		X	X	
Bremerhaven							
Felixstowe			X	X	X	X	X
Hamburg							
Le Havre					X		
Rotterdam	X	X	X	X	X	X	X
Other	X						

PORT	LINER SHIPPING COMPANIES						
	H	**I**	**J**	**K**	**L**	**M**	**N**
Antwerp					X		
Bremerhaven							
Felixstowe							X
Hamburg							
Le Havre					X		
Rotterdam		X	X		X	X	
Other							

PORT	LINER SHIPPING COMPANIES				
	O	**P**	**Q**	**R**	**S**
Antwerp			X		X
Bremerhaven				X	
Felixstowe				X	X
Hamburg					X
Le Havre		X			
Rotterdam	X	X	X	X	
Other					

Note: "X" indicates that the liner concerned has chosen that particular port as the transhipment hub in serving the UK.

Table 4.3. Container transhipment hub choices of interviewed liners between North Europe and Scandinavia-Baltic

PORT	LINER SHIPPING COMPANIES						
	A	**B**	**C**	**D**	**E**	**F**	**G**
Antwerp	X					X	
Bremerhaven	X		X	X	X	X	
Felixstowe	X					X	X
Hamburg	X	X	X	X	X	X	
Le Havre							
Rotterdam	X	X	X			X	
Other							

PORT	LINER SHIPPING COMPANIES						
	H	**I**	**J**	**K**	**L**	**M**	**N**
Antwerp							
Bremerhaven	X						
Felixstowe							
Hamburg	X	X		X	X	X	X
Le Havre					X		
Rotterdam			X		X		
Other							

PORT	LINER SHIPPING COMPANIES				
	O	**P**	**Q**	**R**	**S**
Antwerp					X
Bremerhaven			X	X	X
Felixstowe					
Hamburg	X	X	X	X	X
Le Havre					X
Rotterdam					
Other		X			

Note: "X" indicates that the liner concerned has chosen that particular port as the transhipment hub in serving Scandinavia-Baltic.

Table 4.4. Container transhipment hub choices of interviewed liners between North Europe and the Iberian Peninsula

PORT	LINER SHIPPING COMPANIES						
	A	**B**	**C**	**D**	**E**	**F**	**G**
Antwerp	X					X	
Bremerhaven							
Felixstowe							
Hamburg							
Le Havre					X		
Rotterdam	X		X	X	X	X	X
Other							

PORT	LINER SHIPPING COMPANIES						
	H	**I**	**J**	**K**	**L**	**M**	**N**
Antwerp						X	
Bremerhaven							
Felixstowe							
Hamburg							
Le Havre					X	X	
Rotterdam	X	X	X	X	X	X	X
Other							

PORT	LINER SHIPPING COMPANIES				
	O	**P**	**Q**	**R**	**S**
Antwerp	X				X
Bremerhaven					
Felixstowe				X	
Hamburg					
Le Havre					
Rotterdam	X			X	
Other					

Note: "X" indicates that the liner concerned has chosen that particular port as the transhipment hub in serving the Iberian Peninsula.

Most respondents indicate that their vessels are using multi-user terminals and most of them have no plans in investing dedicated/liner-owned terminals in the foreseeable future. This implies that 'choice of ports' by port users in PCM (see Chapter Two) will still be a major force in deciding port competitiveness in offering transhipment services in North Europe in the foreseeable future. Results here also support the findings of Slack and Frémont (2005) who argue that ports in Europe have more involvements by multinational port operators than any other major trade regions[61], with such companies controlling more than 70% of the total container-stevedoring market in North Europe[62].

Only three liners within the top 30 indicate that they possess dedicated container ports/terminals of any kinds[63]. Nevertheless, there are also several liners, all belonging to the top ten, which indicate that they do have plans/do consider the option of constructing dedicated terminals in North Europe for their own vessels in the near future. The major reasons for such companies to build and invest dedicated terminals are either to guarantee berths available for their vessels or alliance commitments[64].

In Sections B, respondents should give scores on the significance of different factors in affecting the attractiveness of a port for transhipment. In Section C, they should give scores to assess the performance of the Core-Six ports in serving such purpose. In the questionnaire, the category 'time required to load and unload containers' is set at 13 hours in handling about 2,000 TEU based on the assumption that 30 containers (or 51 TEU) can

[61] Here major trade regions include North Europe, North America and the Far East.
[62] These companies include HPH, PSA and Eurogate. See Slack and Frémont (2005).
[63] As mentioned in Chapter Two, dedicated container port/terminal means that this particular port/terminal is reserved for the exclusive use of the vessels of a particular liner (and possibly their allies). These dedicated terminals are mainly concentrated in Antwerp and Hamburg. Also, attention needs to be paid to France where, due to various issues like labour union and ownership structure, significant investments from multinational terminal operators in French ports are not yet visible.
[64] Further updated information and discussions on dedicated terminals can be found in Slack and Frémont (2005).

be handled by each gantry crane per hour[65] in port (see Appendix A). This assumption is supported by Slack and Frémont (2005) who indicate that crane efficiency of ports along the Hamburg-Le Havre range ranges between 25 and 35 containers per hour. To strengthen this assumption, further discussions had taken place with various interviewees asking for their verification of its sensibility.

[65] This study assumes that one container move is equivalent to 1.7 TEU and three container cranes are employed to unload one vessel.

4.1.2. Average Significance and Appreciation Scores

The aggregated results of ASS are presented in Table 4.5. For easy understanding, the layout is divided into different aspects and factors. Results from Table 4.5 show that liners still regarded money, time and geographical location as important factors in deciding their choices. However, here it also illustrates that the significance of qualitative factors should not be ignored as interviewees also indicated that they would be taken into considerations before making their transhipment hub choices. Such results confirm the works by Clark et al. (2001) and Tongzon (2002) where port choice is a mixture of different factors and that only monetary and time factors are not enough to explain the final decisions of liners. Such breakdown also indicates that, although money and time play significant roles in port choice, still, the significance of port performance within the port choice decision-making process in container transhipment cannot be ignored. Among qualitative factors, survey respondents are most concerned about delays, port access and port operator's speed in responding to their new demands, while port infrastructure, advanced technology, availability of dedicated facilities for container transhipment and the availability of professional personnel in ports are also other important factors in their choices.

On the other hand, AAS of different factors of the ports are presented in Table 4.6. To facilitate comparison, a league table based on the AAS scored by the Core Six Ports has been constructed. See Table 4.7.

Table 4.5. Average significance score of different factors in affecting the attractiveness of the Core-Six Ports in providing container transhipment services

PORT LOCATION FACTOR	SCORE
A) Monetary aspect	
- Vessel operation monetary cost from transhipment to destination ports (journey cost)	4.37
B) Time aspect	
- Average journey time from transhipment to destination ports (journey time)	4.47
C) Locational efficiency	
- Location of port with respective to distance between transhipment and destination ports	4.00

PORT FACTOR	SCORE
A) Monetary aspect	
- Port charge (terminal handling charge and port dues)	4.26
B) Time aspect	
- Average time to load/unload containers from vessel	4.26
- Efficiency of port in container-handling	4.34
C) Qualitative aspect	
- Cases of delays in loading/unloading containers	4.42
- Records of damage during container-handling	2.89
- Custom procedures (e.g. inspection, documentary, etc.)	3.26
- Port authority policy and regulations	3.05
- Accession to port	4.47
- Quality of port infrastructure in container-handling	3.89
- Quality of port superstructure in container-handling	3.42
- IT and advanced technology for port operations	3.74
- Dedicated terminals and facilities for container transhipment	3.53
- Supporting industries (e.g. warehousing, insurance, etc.)	2.74
- Quality of other services (e.g. pilotage, towing, mooring, etc.)	2.95
- Availability of professional personnel in port	3.89
- Preference of shipping line clients/shippers	3.21
- Personal contacts/relations with port operator and liner shipping companies	3.37
- Efforts of marketing on the port by port authority	2.79
- Reputation of port within the region	3.11
- Port operator's speed in responding to liner shipping companies' shipping line new demands and requests	4.05
- Qualitative factors (average)	3.46

Note: All figures are corrected to two decimal places. Scores range between 5 and 0.

Table 4.6. Average appreciation scores of the Core-Six Ports in providing container transhipment services

FACTOR	PORT SCORES					
	ANR	BRV	FLX	HAM	LHV	RTM
Efficiency of a Port in Container-Handling	0.73	0.93	-0.43	1.00	-1.14	0.47
Locational Efficiency (U.K.)	1.20	-0.93	1.21	-1.00	0.71	1.47
Locational Efficiency (Scandinavia-Baltic)	-0.47	1.93	-0.29	2.06	-1.64	0.47
Locational Efficiency (Iberian Peninsula)	0.80	-1.57	0.43	-1.44	1.71	1.27
Cases of Delays in Loading/Unloading Vessel	0.67	0.93	-0.86	0.81	-1.71	0.07
Records of Damage during Container-Handling	0.67	0.71	0.57	0.75	-0.64	0.73
Custom Procedures (e.g. Inspection, Documentary, etc.)	0.73	1.00	1.07	1.19	0.43	0.13
Port Authority Policy and Regulations	0.73	0.57	0.29	0.75	-0.57	0.87
Accession to Port	1.33	1.50	0.79	1.19	0.14	1.80
Quality of Port's Infrastructure for handling containers	1.60	1.50	0.64	1.50	-0.71	1.53
Quality of Port's Superstructure for handling containers	1.27	1.29	0.57	1.31	-0.64	1.47
IT & Advanced Technology for Port Operations	1.33	1.21	0.64	1.00	-0.14	1.27
Dedicated Terminals and Facilities for Container Transhipment	0.47	0.43	0.21	0.69	-0.79	0.73
Supporting Industries (e.g. Warehousing, Insurance, etc.)	0.73	0.36	0.57	0.63	-0.14	1.07
Quality of Other Services (e.g. Pilotage, Towing, Mooring, etc.)	0.47	0.86	0.86	0.88	0.21	0.93
Availability of Professional Personnel in Port	1.40	1.43	0.43	1.63	-0.07	1.47
Preference of Liner Shipping Companies' Clients/Shippers	0.67	0.57	0.50	1.06	-0.57	1.13
Personal Contacts/Relations with Port Operator and Liner Shipping Companies	1.13	1.07	1.00	1.50	-0.43	1.33
Efforts of Marketing on the Port by Port Authority	0.60	0.21	-0.29	0.56	-0.79	1.47
Reputation of Port within the Region	0.87	0.86	-0.14	1.25	-0.86	1.13
Port Operator's Speed in responding to Liner Shipping Companies' New Demands and Requests	1.00	0.64	0.07	1.06	-0.50	0.93

Note: All figures are corrected to two decimal places and range between +3 and –3.

Table 4.7. Average appreciation score league table

FACTOR	PORT RANKINGS					
	1st	2nd	3rd	4th	5th	6th
Efficiency of a Port in Container-Handling	HAM	BRV	ANR	RTM	FLX	LHV
Locational Efficiency (U.K.)	RTM	FLX	ANR	LHV	BRV	HAM
Locational Efficiency (Scandinavia-Baltic)	HAM	BRV	RTM	FLX	ANR	LHV
Locational Efficiency (Iberian Peninsula)	LHV	RTM	ANR	FLX	HAM	BRV
Cases of Delays in Loading/Unloading Vessel	BRV	HAM	ANR	RTM	FLX	LHV
Records of Damage during Container-Handling	HAM	RTM	BRV	ANR	FLX	LHV
Custom Procedures (e.g. Inspection, Documentary, etc.)	HAM	FLX	BRV	ANR	LHV	RTM
Port Authority Policy and Regulations	RTM	HAM	ANR	BRV	FLX	LHV
Accession to Port	RTM	BRV	ANR	HAM	FLX	LHV
Quality of Port's Infrastructure for handling containers	ANR	RTM	BRV	BRV	FLX	LHV
Quality of Port's Superstructure for handling containers	RTM	HAM	BRV	ANR	FLX	LHV
IT & Advanced Technology for Port Operations	ANR	RTM	BRV	HAM	FLX	LHV
Dedicated Terminals and Facilities for Container Transhipment	RTM	HAM	ANR	BRV	FLX	LHV
Supporting Industries (e.g. Warehousing, Insurance, etc.)	RTM	ANR	HAM	FLX	BRV	LHV
Quality of Other Services (e.g. Pilotage, Towing, Mooring, etc.)	RTM	HAM	BRV/FLX		ANR	LHV
Availability of Professional Personnel in Port	HAM	RTM	BRV	ANR	ANR	FLX
Preference of Liner Shipping Companies' Clients/Shippers	RTM	HAM	ANR	BRV	FLX	LHV
Personal Contacts/Relations with Port Operator and Liner Shipping Companies	HAM	RTM	ANR	BRV	FLX	LHV
Efforts of Marketing on the Port by Port Authority	RTM	ANR	HAM	BRV	FLX	LHV
Reputation of Port within the Region	HAM	RTM	ANR	BRV	FLX	LHV
Port Operator's Speed responding to Liner Shipping Companies' New Demands and Requests	HAM	ANR	RTM	BRV	FLX	LHV

Note: Bremerhaven and Felixstowe have the same ranking in 'quality of other services'.

4.1.3. Statistical Testing on Survey Results

At first glance, survey respondents do have significant opinion differences on the performances between the Core-Six Ports. However, to confirm this objectively, statistical testing is needed. As more than two sample groups are available here, ANOVA is used to test such differences through calculating the *F*-values. Various previous studies have also applied ANOVA in assessing the port attractiveness scores given by questionnaire respondents e.g. Ha (2003), Lirn et al. (2004), etc. In the test, if *F* is lower than the critical value i.e. null hypothesis, significant difference does not exist between the quality of the concerned factor(s) offered by different ports to liners and major potential difference is mainly driven by chance. If *F* is higher than the critical value, it implies that significant differences exist and the null hypothesis will be rejected.

As it is assumed that time efficiency, locational efficiency and all other qualitative factors are the three 'pillars' of port performance factors (see Chapter Three), factors in Table 4.4 will be analysed by dividing them into time efficiency (i.e. efficiency of a port in container handling), locational efficiency (of different regions) and qualitative factors (all other remaining factors). As it is assumed that all the factors which affect quality of service (except time and locational efficiency) should be grouped together under the category 'qualitative factors' (see Chapter Three), when applying ANOVA, except time and locational efficiencies, all other qualitative factors illustrated in Table 4.6 will also be agglomerated and analysed together. The values of *F* are presented in Table 4.8.

Table 4.8. The ANOVA *F*-values of different categories

CATEGORY	VALUE OF *F*
Time Efficiency	5.82
Locational Efficiency (UK)	10.52
Locational Efficiency (Scandinavia-Baltic)	23.46
Locational Efficiency (Iberian Peninsula)	23.47
Qualitative Factors	8.32

Note: The critical value is 2.33 (with a significance level of 0.05). All figures are corrected to two decimal places.

The F values in Table 4.8 indicate that significant differences exist in all categories with their respective *F* all significantly higher than the critical value of 2.33 which indicate that respondents do have different opinions on the performance of the Core-Six Ports acting as transhipment hubs in North Europe. However, here only half of the question is answered because the relations between different port-pairs are still unknown i.e. whether significant difference exists between all ports or just certain binary port-pairs. This can be solved by applying the *t*-test. As AAS of the Core-Six Ports are not directly related to each other, the unrelated *t*-test is used. Like ANOVA, factors in Table 4.4 and be divided into time efficiency, locational efficiency and qualitative factors. The *t*-test results in time efficiency between different North European ports are presented in Table 4.9. Figures in Table 4.9 (also Tables 4.10, 4.11, 4.12 and 4.13) are bolded if *t* is larger than their corresponding critical values.

Table 4.9. *t*-test matrix of time efficiency between the Core-Six Ports

PORT	ANR	BRV	FLX	HAM	LHV	RTM
ANR	-	0.47	**2.70**	0.46	**3.43**	0.55
BRV	0.47	-	**3.17**	0.01	**3.78**	0.97
FLX	**2.70**	**3.17**	-	**3.05**	1.01	**1.89**
HAM	0.46	0.01	**3.05**	-	3.73	0.95
LHV	**3.43**	**3.78**	1.01	**3.73**	-	**2.70**
RTM	0.55	0.97	**1.89**	0.95	**2.70**	-

Note: The critical values are 1.70 (with a significance level of 0.05). All figures are corrected to two decimal places.

For time efficiency, the Core-Six Ports can be divided into two groups. The first group consists of Antwerp, Bremerhaven, Hamburg and Rotterdam with better time efficiency, while Felixstowe and Le Havre belong to the worse performing group. It is clear that significant difference exists between these two groups which suggest that the relatively higher *F*-value was due to the difference between these two groups of ports. According to Table 4.6, the difference between the two groups is that the former group consists of much higher quality ports in terms of time efficiency in container loading/unloading.

The *t*-test results in locational efficiencies of the UK, Scandinavia-Baltic and the Iberian Peninsula between different North European ports are presented in Tables 4.10, 4.11 and 4.12 respectively.

Table 4.10. *t*-test matrix of locational efficiency (UK) between the Core-Six Ports

PORT	ANR	BRV	FLX	HAM	LHV	RTM
ANR	-	**4.52**	0.22	**4.98**	1.11	0.73
BRV	**4.52**	-	**3.76**	0.12	**3.08**	**5.13**
FLX	0.22	**3.76**	-	**4.04**	1.05	0.31
HAM	**4.98**	0.12	**4.04**	-	**3.31**	**5.68**
LHV	1.11	**3.08**	1.05	**3.31**	-	**1.74**
RTM	0.73	**5.13**	0.32	**5.68**	**1.74**	-

Note: The critical values are 1.70 (with a significance level of 0.05). All figures are corrected to two decimal places.

Table 4.11. *t*-test matrix of locational efficiency (Scandinavia-Baltic) between the Core-Six Ports

PORT	ANR	BRV	FLX	HAM	LHV	RTM
ANR	-	**4.90**	0.32	**5.67**	**2.35**	**1.96**
BRV	**4.90**	-	**5.52**	0.21	**8.50**	**3.69**
FLX	0.32	**5.52**	-	**6.81**	**3.17**	**1.95**
HAM	**5.67**	0.21	**6.81**	-	**10.14**	**4.56**
LHV	**2.35**	**8.50**	**3.17**	**10.14**	-	**5.14**
RTM	**1.96**	**3.69**	**1.95**	**4.56**	**5.14**	-

Note: The critical values are 1.70 (with a significance level of 0.05). All figures are corrected to two decimal places.

Table 4.12. *t*-test matrix of locational efficiency (Iberian Peninsula) between the Core-Six Ports

PORT	ANR	BRV	FLX	HAM	LHV	RTM
ANR	-	**5.70**	0.90	**5.64**	**2.15**	1.25
BRV	**5.70**	-	**5.11**	0.42	**7.36**	**7.20**
FLX	0.90	**5.11**	-	**5.03**	**3.07**	**2.30**
HAM	**5.64**	0.42	**5.03**	-	**7.42**	**7.23**
LHV	**2.15**	**7.36**	**3.07**	**7.42**	-	1.11
RTM	1.25	**7.20**	**2.30**	**7.23**	1.11	-

Note: The critical values are 1.70 (with a significance level of 0.05). All figures are corrected to two decimal places.

For the UK, locational efficiency can be classified into three groups. The first group consists of ports which have the best potentials (Antwerp, Felixstowe and Rotterdam), closely followed by the second group consisting of Le Havre. Bremerhaven and Hamburg belong to the final group which are also regarded as the worst candidates by respondents. Since significant difference between Antwerp, Felixstowe and Rotterdam does not exist, competition between them is likely to be tense.

For Scandinavia-Baltic, locational efficiency can be classified into two groups. The first group consists of Bremerhaven and Hamburg and the second group consists of all other four ports. Apart from two port-pairs (Bremerhaven-Hamburg and Antwerp-Felixstowe), there is significant difference between all other port-pairs. When Table 4.11 is analysed together with Table 4.6, it seems that survey respondents regard Bremerhaven and

Hamburg as especially good choices in serving the Scandinavia-Baltic transhipment market. Such similar perception is likely to pose fierce competitions between the German ports in grabbing market shares for this region. Although Rotterdam is just behind the German ports, their geographical difference is still significant.

For the Iberian Peninsula, locational efficiency can be divided into three groups, namely Le Havre-Rotterdam, Antwerp-Felixstowe and Bremerhaven-Hamburg, with the last group significantly worse from others. There is no significant difference between Antwerp and Felixstowe, while there is also little difference between Le Havre and Rotterdam. Interestingly, the null hypothesis cannot be rejected between the Rotterdam and Antwerp. Although Le Havre and Rotterdam possess the best geographical location in serving the Iberian Peninsula and closely followed by Antwerp, the geographical advantages of Le Havre and Rotterdam in serving this region are not as clear-cut as in the case of Bremerhaven and Hamburg in serving Scandinavia-Baltic.

The *t*-test results in other qualitative factors between different North European ports are presented in Table 4.13.

Table 4.13. *t*-test matrix of qualitative factors between the Core-Six Ports

PORT	ANR	BRV	FLX	HAM	LHV	RTM
ANR	-	0.13	**1.83**	0.42	**4.55**	0.51
BRV	0.13	-	**1.79**	0.54	**4.50**	0.64
FLX	**1.83**	**1.79**	-	**2.00**	**3.09**	**2.18**
HAM	0.42	0.54	**2.00**	-	**4.49**	0.06
LHV	**4.55**	**4.50**	**3.09**	**4.49**	-	**4.71**
RTM	0.51	0.64	**2.18**	0.06	**4.71**	-

Note: The critical values are 1.70 (with a significance level of 0.05). All figures are corrected to two decimal places.

For other qualitative factors, ports can be classified into two groups. The first group consists of ports which provide decent quality of service including Antwerp, Bremerhaven, Hamburg and Rotterdam, whilst the second group consists of Felixstowe and Le Havre which offer significantly worse quality of services. Although Felixstowe and Le Havre are worse than the Benelux and German ports, Table 4.13 indicates that significance difference also exists between them. Such results clearly illustrate the significant difference in service quality between Le Havre and other Core-Six Ports of which the former is a very poor performing port.

Through applying *t*-test, two observations can be identified. Firstly, in terms of time efficiency and other qualitative factors, respondents do not find significant differences between the Benelux and German ports. They are all quite decent options in terms of service quality which has distinguished them their Anglo and French counterparts. Felixstowe and Le Havre should make some dramatic improvements if they want to enhance their attractiveness, especially Le Havre.

Secondly, in terms of locational efficiency, Bremerhaven and Hamburg are virtually the same (the *t*-values between them never exceed more than 0.5) and both of them are

regarded as ideal locations in serving Scandinavia-Baltic but poor in other regions. There is no significant difference between Antwerp and Felixstowe in terms of geography as they belong to the same group although not as significant as the pair between Bremerhaven and Hamburg (the *t*-values between Antwerp and Felixstowe never exceed one). Although both Antwerp and Felixstowe do not have especially favourable locational advantages in serving any one of the destined regions, their locations are rather intermediate between the three regions and both of them possess certain potential in competing for transhipment business, especially directed towards the UK and the Iberian Peninsula. Here the case of Rotterdam is especially interesting. Results from the *t*-test indicate that Rotterdam is perceived by survey respondents as a good location for virtually any European region studied here. Apart from Scandinavia-Baltic, virtually no significant difference exists between Rotterdam and the best ports in serving the other two regions. Finally, Le Havre would hope that its locational advantage in serving Iberian Peninsula can compensate its own poor service, although it is likely that it would expect tense competition from Rotterdam.

4.1.4. General Observations on the Performance of the Core-Six Ports

Antwerp

Generally speaking, respondents are satisfied with Antwerp's transhipment services with the indication that the AAS of all factors are positive and the quality of most of the services offered by Antwerp lie within the top three of the port performance league table, although they also point out the port's poor location in serving Scandinavia-Baltic. Results indicate that Antwerp's port performance from the perspective of liners is quite decent, although possibly not the best. However, liners complain about the scarcity of dedicated facilities for transhipment, pilotage, towing and mooring and inadequate marketing by the port authority. Although liners are generally satisfied with port access, it is still significantly

worse than nearby ports like Rotterdam and Bremerhaven, notably due to its inland location and its difficulty in getting access to the sea through River Scheldt because of limitations in water depths and the existence of numerous locks.

Bremerhaven

As mentioned, Bremerhaven possesses locational advantages acting as the transhipment hub for Scandinavia-Baltic, although it is rather poor in serving the UK and the Iberian Peninsula. Also, Bremerhaven performs well in container-handling efficiency, cases of delays, custom procedures, port infrastructure, advanced technology and the availability of professional personnel. However, like Antwerp, Bremerhaven suffers from the lack of dedicated facilities for transhipment, while supporting industries are also inadequate. Most importantly, it seems that Bremerhaven is not a port which is much preferred by the customers of liners due to port promotion and marketing. Finally, liner opinions on the overall performance of Bremerhaven tend to be mixed with an approximate equal number of port performance factors shared between the top and bottom three. Such diverse view seems that Bremerhaven still cannot create a very clear image as a transhipment hub in North Europe and thus its reputation is not as good as Hamburg and Rotterdam.

Felixstowe

Except Le Havre, Felixstowe is the worst performer among the Core-Six Ports with most listed factors lying in the bottom three. Unsurprisingly, as a British port, Felixstowe understandably possesses geographical advantages in serving transhipment to the UK. However, although its relation with liners is okay, quality is rather poor and thus respondents are generally not satisfied with its services. Despite such disappointing performance, the only consolation is that Felixstowe does not possess any worst performing

factors while performing quite well in custom procedures. In order to remain competitive in the market, it seems necessary for Felixstowe to improve its performance with its AAS significantly lower than most of the other ports.

Hamburg

The survey indicates that respondents are content with Hamburg. Among the 21 factors investigated, Hamburg performed best in eight while 16 of them are lying within the top three in the league table and nine factors obtain AAS higher than one. Also, Hamburg possesses an extremely favourable geographical location acting as a transhipment hub to Scandinavia-Baltic. However, like Bremerhaven, survey respondents do not believe that Hamburg is a good choice in serving the UK and the Iberian Peninsula, with AAS of locational efficiency to both regions lying below zero. Thus, German ports may struggle to compete for transhipment business other than Scandinavia-Baltic which suggests that, while Hamburg can be a significant regional leader, it may be more difficult for it to become an overall leader in the North European transhipment market.

Le Havre

No other port's performance is as poor as Le Havre. Except possessing geographical advantages to the Iberian Peninsula, all other factors lie within the bottom three, whilst the port suffers from being the worst performer in most factors. Another poor record shows that more than half of the port performance factors of Le Havre possess negative AAS values with custom procedures, access to port and pilotage, towing and mooring being the only exceptions. This complements Slack and Frémont (2005) who argue that French ports face a decline in service quality and thus few liners choose them as their major European hub, especially due to the fact that its facilities are outdated and the French government

does little to encourage port improvements. Under such circumstance, in the foreseeable future, it is unlikely that Le Havre can become a strong competitor in the market. In general, survey respondents indicate their huge dissatisfaction with its service, of which one of them even describes its service as *terrible*. Understandably, this is likely to affect its reputation as a transhipment hub in North Europe.

Rotterdam

According to survey respondents, Rotterdam is quite decent as a transhipment hub with no factors possessing negative AAS which is something no other ports can achieve. The port is the best performer in nine of the 21 factors investigated and another nine in the top three. Furthermore, Rotterdam possesses considerable advantages in geographical location and is the only port which achieves top three rankings in serving all three European regions. Rotterdam is also the most preferred choice of the customers of liners and possesses decent reputation within the region, assisted by the fact that it maintains good relations with its customers and the availability of a pool of professional personnel in the port. Finally, another factor which is worth special attention is the effort of port promotion and marketing by the port authority where Rotterdam scores a significantly higher AAS than any other ports (1.47, whilst second-placed Antwerp is only 0.60). All these illustrate the potential of Rotterdam as a leader in the North European transhipment market. Nevertheless, the port does have its critics, notably in terms of time efficiency and cases of delays. Moreover, although Rotterdam port authority performs very well in terms of regulations and marketing and is the worst performer in custom procedures (even significantly worse than its next worst performer i.e. Le Havre). More importantly, when comparing Rotterdam's ASS with AAS, several of the port's strong factors are not that

important from a port user's perspective, whilst Rotterdam achieves weak performance in some important factors like cargo-handling efficiency and delays.

4.2. CONSTRUCTING THE PORT PERFORMANCE INDICES

The main advantage of AAS is that readers can easily identify how ports perform. However, AAS is raw data of which the significance of difference factors is not taken into consideration. So, how significance can be taken into account? By combining ASS and AAS, this problem can be addressed by introducing Port Performance Index (PPI). The objective of PPI is to combine factors to form a composite measure in assessing the overall performance of ports acting as transhipment hubs in North Europe. Similar previous works have been done on assessing port attractiveness including Lirn et al. (2004) and Dong and Yeo (2004) and their methodologies have affected the construction process of PPI here.

In accordance to the above section, PPI is made up of time efficiency (*TE*), locational efficiency (*LE*) and other qualitative factors agglomerated together (*QF*). Mathematically, PPI can be expressed as:

$$PPI_{(A)} = TEI_{(A)} + LEI_{(A \to X)} + QFI_{(A)} \qquad \textbf{[4.1]}$$

Where $TEI_{(A)}$, $LEI_{(A \to X)}$ and $QFI_{(A)}$ represent the time efficiency index, locational efficiency index (directed towards Destination X) and qualitative factors index of Port A respectively. As mentioned in Chapter Two, these three components form the three 'pillars' of port performance. TEI of Port A can be expressed as:

$$TEI_{(A)} = \left\lfloor AAS_{(TE,A)} \right\rfloor * \left\lfloor ASS_{(TE)} \right\rfloor \qquad \textbf{[4.2]}$$

Where $AAS_{(TE,A)}$ and $ASS_{(TE)}$ represent the average appreciation score and average significance score of time efficiency of Port A respectively. *LEI* can be expressed as:

$$LEI_{(A\rightarrow X)} = \left\lfloor AAS_{(LE,A\rightarrow X)} \right\rfloor * \left\lfloor ASS_{(LE)} \right\rfloor \qquad \textbf{[4.3]}$$

Where $AAS_{(LE,A\rightarrow X)}$ and $ASS_{(LE)}$ represent the average appreciation score and average significance score of locational efficiency of Port A directed towards Destination X respectively. *QFI* can be expressed as:

$$QFI_{(A)} = \left\lfloor AAS_{(QF,A)} \right\rfloor * \left\lfloor ASS_{(QF)} \right\rfloor \qquad \textbf{[4.4]}$$

Where $AAS_{(QF,A)}$ and $ASS_{(QF)}$ represent the average appreciation score and average significance score of other qualitative factors of Port A respectively. By applying these equations, PPI of North European ports acting as transhipment hubs are presented in Table 4.14.

Table 4.14. Port Performance Indices of the Core-Six Ports in providing container transhipment services

PORT	U.K.	SCAN-BALTIC	IBERIAN PEN.	OVERALL	Excl. LE
Antwerp	11.22	4.55	9.62	8.46	6.42
Bremerhaven	3.48	14.91	0.91	6.43	7.19
Felixstowe	4.34	-1.66	1.20	1.29	-0.52
Hamburg	3.97	16.22	2.22	7.47	7.97
Le Havre	-3.71	-13.14	0.29	-5.52	-6.57
Rotterdam	11.53	7.53	10.73	9.93	5.66

Note: LE – locational efficiency. All figures are corrected to two decimal places.

To give better illustrations on port performances, based on the ASS given by respondents, Table 4.15 presents different 'thresholds' of PPI. For example, in the UK, PPI value will be 35.39 if respondents give Appreciation Score of +3 to all the factors of a particular port listed in the questionnaire. By comparing Tables 4.14 and 4.15, it is possible to assess liners' degree of satisfaction towards the quality of services provided by different ports.

Table 4.15. Thresholds of Port Performance Indices

AAS	U.K.	SCAN-BALTIC	IBERIAN PEN.	OVERALL	Excl. LE
+3 (Best)	35.39	35.39	35.39	35.39	23.39
+2	23.60	23.60	23.60	23.60	15.60
+1	11.80	11.80	11.80	11.80	7.80
0 (Neutral)	0.00	0.00	0.00	0.00	0.00
-1	-11.80	-11.80	-11.80	-11.80	-7.80
-2	-23.60	-23.60	-23.60	-23.60	-15.60
-3 (Worst)	-35.39	-35.39	-35.39	-35.39	-23.39

Note: AAS – average appreciation score, LE – locational efficiency. All figures are corrected to two decimal places.

Results in Table 4.14 indicate that liners are rarely fully satisfied with the services provided by a particular port. This is reflected by the fact that, except Bremerhaven and Hamburg in serving Scandinavia-Baltic, there are no other ports which can give score higher than the threshold of +1 (see Tables 4.14 and 4.15). Through PPI, the poor performances of Felixstowe and Le Havre have been exposed as both of them give significantly overall negative images to customers (except Felixstowe in serving the UK). For other ports, though not necessarily completely satisfied with every single aspect, they are at least able to avoid giving overall negative images to their customers (except Felixstowe in serving Scandinavia-Baltic). PPI of Hamburg and Bremerhaven are especially impressive in serving Scandinavia-Baltic region, while Antwerp seems to be an attractive transhipment hub choice in serving the UK and the Iberian Peninsula. For Rotterdam, the situation seems to be quite balanced in all regions.

More importantly, Tables 4.14 and 4.15 also reflect the importance of geography in deciding the port attractiveness acting as transhipment hubs. Although Rotterdam has the highest overall PPI, if locational efficiency were removed i.e. PPI only based on time efficiency and other qualitative factors, its value declines sharply and lags behind Antwerp and the German ports. Such decline is less significant in Antwerp and for the German ports,

their PPI even improve when geographical influence is removed. This suggests that geography is actually playing an important role to the attractiveness of Rotterdam acting as transhipment hub in North Europe. The German ports, on the hand, are suffering geographical disadvantages to all regions but Scandinavia-Baltic, while the impacts of geography on Antwerp is not very significant. For Felixstowe and Le Havre, results suggest that both ports have benefited from geography, especially Felixstowe as its PPI has fallen from positive to negative figures when locational efficiency is excluded.

4.3. CONSTRUCTING THE PORT PERFORMANCE DISCOUNTS/COSTS

After calculating PPI, the next step is to 'monetarise' them so that they can be inscribed into the generalized cost equation. In this section, the detailed procedures of this 'monetarisation process' are illustrated by introducing Port Performance Discount/Cost (PPD/C). PPD/C is the estimated monetary amount that the cost of a port user discounts or increases when using the service offered by a port depending on the level of performance offered by the latter. As indicated in Chapter Three, various researchers support the notion that non-monetary factors can actually be discounts or extra cost on the original monetary cost depending on the level of performance. Based on the assumptions in where the value of port performance is interrelated to monetary costs (see Chapter Three), PPD/C in using Port A for transhipment to Destination X can be expressed as:

$$PPD/C_{(A\rightarrow X)} = \left[TED/C_{(A)}\right] + \left[QFD/C_{(A)}\right] + \left[LED/C_{(A\rightarrow X)}\right] \qquad \textbf{[4.5]}$$

Where $TED/C_{(A)}$, $QFD/C_{(A)}$ and $LED/C_{(A\rightarrow X)}$ represent the time (cargo-handling) efficiency discount/cost, qualitative factor discount/cost, locational efficiency discount/cost of Port A (directed towards Destination X) respectively. Like PPI, equation [4.5] indicates that PPD/C consists of three major components including time efficiency discount/cost

(*TED/C*), qualitative factor efficiency discount/cost (*QFD/C*) and locational efficiency discount/cost (*LED/C*). Based on the assumption that qualitative factors have linear substitutable relations with monetary cost (see Chapter Three), *TED/C* can be expressed as:

$$TED/C_{(A)} = \left[PC_{(A)}\right] * \left[AAS_{(TE,A)}\right] * \left[\frac{ASS_{(TE)}}{ASS_{(PC)}}\right] \qquad \textbf{[4.6]}$$

Where $PC_{(A)}$, $AAS_{(TE,A)}$, $ASS_{(TE)}$ and $ASS_{(PC)}$ represent the monetary cost (port charge), average appreciation score of time (cargo-handling) efficiency, average significance score of time (cargo-handling) efficiency and average significance score of monetary cost (port charge) of Port A respectively. *QFD/C* can be expressed as:

$$QFD/C_{(A)} = \left[PC_{(A)}\right] * \left[AAS_{(QF,A)}\right] * \left[\frac{ASS_{(QF)}}{ASS_{(PC)}}\right] \qquad \textbf{[4.7]}$$

Where $PC_{(A)}$, $AAS_{(QF,A)}$, $ASS_{(QF)}$ and $ASS_{(PC)}$ represent the monetary cost (port charge), average appreciation score of other qualitative factors, average significance score of other qualitative factors, average significance score of monetary cost (port charge) of Port A respectively. The calculation of *LED/C* is a bit different from *TED/C* and *QFD/C* because geographical advantage/disadvantage of a port does not depend on port's service quality but the distance between the transhipment and feeder ports. Thus, rather than depending on port charge, the calculation of *LED/C* should be related to the operation cost of container vessels going from transhipment to destination ports as geographical location has nothing to do with fees charged to customers by ports. Thus, *LED/C* can be expressed as:

$$LED/C_{(A\to X)} = \left[OC_{(A\to X)}\right] * \left[AAS_{(LE,A\to X)}\right] * \left[\frac{ASS_{(LE)}}{ASS_{(OC,A\to X)}}\right] \qquad \textbf{[4.8]}$$

Where $OC_{(A\to X)}$, $AAS_{(LE,A\to X)}$, $ASS_{(LE)}$ and $ASS_{(OC)}$ represent the vessel operation monetary cost, average appreciation score of locational efficiency, average significance score of

locational efficiency and average significance score of vessel operation monetary cost of Port A (directly towards Destination X) respectively. Before calculating PPD/C, assumptions have to be made for fees charged by ports (hereafter called 'port charge') which mainly include container handling charge (or commonly known as terminal handling charge or THC, charged by container stevedoring company) and port dues (charged by port authority). The port charges of the Core-Six Ports are presented in Table 4.16.

Table 4.16. Average prices charged to liners in handling transhipment containers by the Core-Six Ports

PORT	CHARGE
Antwerp	€ 66.00/TEU
Bremerhaven	€ 83.00/TEU
Felixstowe	€ 77.00/TEU
Hamburg	€ 94.00/TEU
Le Havre	€ 66.00/TEU
Rotterdam	€ 85.00/TEU

Note: Both terminal-handling charge (charged by terminal operator) and port dues (charged by port authority) had been included in port charge. Source: ECT (2004)

According to Table 4.16, Hamburg is the most expensive port to use, while Antwerp and Le Havre are the cheapest options. Bremerhaven and Rotterdam are charging similar prices, while the charge of Felixstowe lies somewhere between the cheap and expensive ports. Under the assumption that customers would have higher expectations on more expensive ports (see Chapter Three), it implies that customers should be more demanding on the services provided by Bremerhaven, Hamburg and Rotterdam.

As this study is divided into three regions, the costs of travelling to these regions are calculated based on the average of their respective major feeder ports. Here Grangemouth (UK), Immingham (UK), Gdansk (Scandinavia-Baltic), Gothenburg (Scandinavia-Baltic), St. Petersburg (Scandinavia-Baltic), Bilbao (Iberian Peninsula) and Porto (Iberian Peninsula) are chosen to represent their respective regions. According to information

provided by ECT (2004), these ports should be chosen since they usually occupy more than 50% of the total transhipment container throughputs of their respective regions[66]. Moreover, according to interviewees, it is widely accepted that these ports are the most important feeder ports of their respective regions, both currently and in the foreseeable future. Thus, PPD/C of the UK, Scandinavia-Baltic, Iberian Peninsula and the overall scenario can be expressed as equations 4.9, 4.10, 4.11 and 4.12 respectively.

$$PPD/C_{(UK)} = \mu[PPD/C_{(Grangemouth)} + PPD/C_{(\text{Im min } gham)}] \quad \textbf{[4.9]}$$

$$PPD/C_{(Scandinavia-Baltic)} = \mu[PPD/C_{(Gdansk)} + PPD/C_{(Gothenburg)} + PPD/C_{(St.Petersburg)}] \quad \textbf{[4.10]}$$

$$PPD/C_{(IberianPeninsula)} = \mu[PPD/C_{(Bilbao)} + PPD/C_{(Porto)}] \quad \textbf{[4.11]}$$

$$PPD/C_{(Overall)} = \mu[PPD/C_{(UK)} + PPD/C_{(Scandinavia-Baltic)} + PPD/C_{(IberianPeninsula)}] \quad \textbf{[4.12]}$$

Thus, by applying the equations, the calculated results of PPD/C are presented in Tables 4.17.

Table 4.17. Port performance discount/cost of the Core-Six Ports in providing container transhipment services between North Europe and different European regions

PORT	U.K.	SCAN-BALTIC	IBERIAN PEN.	OVERALL
Antwerp	120.03	79.09	139.31	107.99
Bremerhaven	123.23	208.95	49.04	138.77
Felixstowe	9.27	-23.98	9.24	-4.99
Hamburg	147.80	240.42	85.91	169.81
Le Havre	-87.42	-185.09	-24.73	-111.37
Rotterdam	136.11	128.92	175.33	144.23

Note: All figures are expressed in Euros per TEU and corrected to two decimal places. A positive and negative figure indicates a discount and an extra cost to the generalized cost respectively.

[66] The figure 'higher than 50%' is provided by interviewees during in-depth interviews. According to interviewees, detailed figures on this issue are usually unavailable because very few ports collect such detailed statistical figures on transhipment while most liners do not release them to the public. The relevance of these feeder ports is also strengthened with intense discussions with the Customer & Sales Department of ECT (Port of Rotterdam).

4.4. CALCULATING THE GENERALIZED COSTS

With PPD/C available, the calculation of generalized cost becomes possible. As discussed before, generalized cost is a method in quantifying port attractiveness, or Port Attractivity (PA) in PCM (see Chapter Two). As the attributes in equation [3.2] can be transformed into monetary terms, the attributes in equation [3.2] (see Chapter Three) can be transformed as:

$$C_{(A\to X)} = PC_{(A)} + OC_{(A)} + DC_{(A)} + JC_{(A\to X)} - PPD/C_{(A\to X)} \qquad \textbf{[4.13]}$$

Where $C_{(A\to X)}$, $PC_{(A)}$, $OC_{(A)}$, $DC_{(A)}$, $JC_{(A\to X)}$ and $PPD/C_{(A\to X)}$ represent the generalized cost, port monetary cost, vessel monetary operation cost, cost of duration, cost of journey duration and port performance discount/cost of Port A (directed towards Destination X) respectively. With Grangemouth, Immingham, Gdansk, Gothenburg, St. Petersburg, Bilbao and Porto chosen as the destined ports, the generalized costs of the UK, Scandinavia-Baltic, Iberian Peninsula and the overall scenario can be expressed in equations 4.14, 4.15, 4.16 and 4.17 respectively.

$$C_{(UK)} = \mu[C_{(Grangemouth)} + C_{(\mathrm{Im\,min\,}gham)}] \qquad \textbf{[4.14]}$$

$$C_{(Scandinavia-Baltic)} = \mu[C_{(Gdansk)} + C_{(Gothenburg)} + C_{(St.Petersburg)}] \qquad \textbf{[4.15]}$$

$$C_{(IberianPeninsula)} = \mu[C_{(Bilbao)} + C_{(Porto)}] \qquad \textbf{[4.16]}$$

$$C_{(Overall)} = \mu[C_{(UK)} + C_{(Scandinavia-Baltic)} + C_{(IberianPeninsula)}] \qquad \textbf{[4.17]}$$

Here generalized cost requires more explanations. Transport, especially freight, is mainly a type of disutility (Hanson, 2000) and thus its cost should be minimised especially in freight transportation and generalized cost should be regarded as the indicator which reflects such disutility. With such understanding, it means that the lower the generalized cost, the more attractiveness a particular port should be.

With reference to equation [4.9], there are two attributes which are yet to be resolved namely Port Duration Cost (*DC*) and Journey Cost (*JC*) (see PCM in Chapter Two). As discussed in Chapter Two, a certain amount of time will always be incurred during the transportation process no matter how efficient a port can achieve. Thus, the fact that *DC* and *JC* are always 'extra costs' to port users in the generalized cost equation will not change under any circumstances, no matter whether port performance is good or not (as discussed before, any possible discounts to *DC* and *JC* due to good performance have been included in PPD/C). Thus, the monetary values of *DC* and *JC* are calculated only based on its significance to their respective monetary factors (i.e. ASS).

Here a question would be asked here on what types of monetary costs *DC* and *JC* should be associated with. As discussed in Chapter Two, *DC* is the time required staying in a port, while *JC* is the time required to travel between the transhipment and feeder ports. Based on the assumptions of calculating generalized costs (see Chapter Three), it makes sense that *DC* and *JC* can be associated with port monetary cost (i.e. port charge) and vessel operation cost (between transhipment and destined ports) respectively. Thus, *DC* can be expressed as:

$$DC_{(A)} = \left[PC_{(A)}\right] * \left[\frac{ASS_{(DC)}}{ASS_{(PC)}}\right] \qquad \textbf{[4.18]}$$

Where $PC_{(A)}$, $ASS_{(DC)}$ and $ASS_{(PC)}$ represent the monetary cost (port charge), average significance score of *DC*, average significance score of monetary cost (port charge) of Port A respectively. *JC* can be expressed as:

$$JC_{(A \to X)} = \left[OC_{(A \to X)}\right] * \left[\frac{ASS_{(JC)}}{ASS_{(OC)}}\right] \qquad \textbf{[4.19]}$$

Where $OC_{(A\rightarrow X)}$, $ASS_{(JC)}$ and $ASS_{(OC)}$ represent the vessel monetary operation cost, average significance score of *JC*, average significance score of vessel monetary operation cost of Port A (directly towards Destination X) respectively. Thus, by applying the above equations, the generalized costs can be calculated (see Tables 4.18).

Table 4.18. Generalized costs of the Core-Six Ports in providing container transhipment services between North Europe and different European regions

PORT	U.K.	SCAN-BALTIC	IBERIAN PEN.	OVERALL
Antwerp	37.34	134.48	90.62	94.19
Bremerhaven	66.10	19.47	228.32	92.46
Felixstowe	165.56	247.47	231.84	219.60
Hamburg	72.91	8.84	212.87	85.44
Le Havre	247.12	417.53	241.40	318.52
Rotterdam	53.75	105.90	90.32	86.55

Note: All figures are expressed in Euros per TEU and correct to two decimal places.

Similar to the results obtained from *t*-tests before, Antwerp, Bremerhaven, Hamburg and Rotterdam all belong to the same group i.e. ports with relatively low generalized costs due to decent service quality and should be attractive acting as container transhipment hubs in serving the UK. Felixstowe, due to its rather poor quality of port services, does not seem to be a very attractive option for liners. For Scandinavia-Baltic, the German ports are the most attractive options, while the Benelux ports possess slight advantages in the Iberian Peninsula. In overall, Hamburg and Rotterdam have the lowest generalized costs, closely followed by Antwerp and Bremerhaven. Felixstowe and Le Havre are generally poor performers acting as transport hubs in North Europe with high generalized costs.

Generalized cost reflects port attractiveness based on the 'Assessment Process' factors in PCM (see Chapter Two). As mentioned in Chapter Three, when calculating the generalized costs, all 'non-Assessment Process Factors' are assumed to be constant i.e. liners are rational choice-makers who have no specific preferences to any of the ports and they have

no restrictions when making choice decisions so that they are always ready to change with the availability of better options. Of course, it is questionable whether liners were really rational decision-makers and the next chapter will address this question by focusing on the significance of 'Non-Assessment Process' factors in PCM (see Chapter Two) and the current competitive positions of ports in the North European transhipment market.

CHAPTER FIVE
CURRENT COMPETITIVE POSITIONS OF PORTS IN NORTH EUROPEAN CONATINER TRANSHIPMENT MARKET: AN ILLUSTRATION

After calculating the generalized costs in Chapter Four, this chapter focuses on forecasting the market shares of ports in North European transhipment market. Also, in order to test whether the competitive position of a port is solely based on port attractiveness, the estimated market shares (EMS) will be compared to the real market shares (RMS). This chapter is divided into three sections. By applying the Multinomial Logit Model (MNL), EMS will be constructed and compared with RMS. Since port attractiveness is not solely based on port performance (as illustrated later in this chapter), Section 5.2 estimates the redistribution of wealth between different ports due to these 'non-Assessment Process' factors in PCM (see Chapter Two). Finally, Section 5.3 summarises the findings and set the stage for further analysis in Chapter Six.

5.1. ESTIMATED AND REAL MARKET SHARES OF PORTS

5.1.1. Multinomial Logit Model and Estimated Market Shares

Here it is necessary to identify the indicator in assessing port competitiveness i.e. market share. Although Porter (1985) questions whether market shares truly reflect the competitiveness of a particular firm within a particular industry, according to in-depth interviews conducted by the author, most ports regard market shares as the most important indicator in assessing port competitiveness. This is supported by De Lombaerde and Verbeke (1989) who argue that, in general, most port managers and port authorities regard market share as the most reliable indicator in assessing the degree of utility of its customers

and thus its competitiveness. Other scholars who support the use of market shares in evaluating port competitiveness include Veldman and Buckmann (2003) who argue that the selection of a good port for transhipment implies that the port is rewarded with a higher market share and thus reflects its competitiveness. Liners would like to know whether port service is arranged according to their wishes and prevailing standards. If not, they are likely to look for other options.

Based on this understanding, using the generalized costs, port competitiveness can be assessed through estimating the transhipment market shares of these ports which can be estimated by applying MNL. As a behavioural model, MNL can be understood as the probability of liners in using one of the ports studied here in transhipping containers to different regions which also directly reflects the market share of that particular port. The model assumes that liners are rational choice-makers according to the maximisation of utilities. According to Taaffe et al. (1996), such utilities do not necessarily only include monetary costs, but also other observable and less-readily observable factors. Such assumption makes MNL highly suitable here because the calculation of generalized cost assumes that customers make their choices based on the degree of utility that they obtained from different ports (see Chapter Three). MNL is also widely regarded as a relevant forecasting tool within the transport discipline, as supported by its frequent use in studying mode choices e.g. Taaffe et al. (1996), Veldman and Buckmann (2003), etc. MNL can be expressed as follows:

$$E_{(A\to X)} = \frac{e^{U_{(A\to X)}}}{\sum_{r=1}^{r=k} e^{U_{(r\to X)}}} \qquad \textbf{[5.1]}$$

Where $E_{(A\to X)}$ and $U_{(A\to X)}$ represent the probability (in this case it means EMS) and the utility of using Port A (directly towards Destination X) respectively, while r and k represent

all possible choices of ports for transhipment and the total transhipment hub choices respectively. According to Veldman and Buckmann (2003), the dependent variable, $E_{(A \to X)}$, applies to all transhipment flows from Port A to Destination X, which can also be interpreted as the market share of Port A.

The necessity of a positive relation between cost and probability of using a port creates a problem here. Generalized costs are expressed in monetary terms and are inversely related to attractiveness i.e. the higher the generalized cost a port possesses, the lower the probability of liners in choosing it. To 'sensiblise' the relation between utility and attractiveness, generalized costs must be transformed into figures which can directly reflect the concept of utilities in equation [5.1]. This can be achieved through the introduction of 'Generalized Cost Comparative Index' (GCCI). Using Rotterdam as the benchmark[67], GCCI of a particular port (say, Port A) $[Z_{(A)}]$ can be expressed as:

$$Z_{(A)} = \frac{1}{\left(\frac{C_{(A)}}{C_{(RTM)}} \right)} \qquad [5.2]$$

Where $C_{(A)}$ and $C_{(RTM)}$ represent the generalized costs of Port A and Rotterdam respectively. By applying equation [5.2], the values of GCCI are presented in Table 5.1.

[67] Rotterdam is chosen as the benchmark because, at the moment, it is the most frequently used port for transhipment. However, in fact, no matter which port is used as the benchmark, the estimated market shares of all the ports will still be the same.

Table 5.1. Generalized cost comparative indices of the Core-Six Ports in providing container transhipment services between North Europe and different European regions

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA	OVERALL
Antwerp	1.44	0.79	1.00	0.92
Bremerhaven	0.81	5.44	0.40	0.94
Felixstowe	0.32	0.43	0.39	0.39
Hamburg	0.74	11.98	0.42	1.01
Le Havre	0.22	0.25	0.37	0.27
Rotterdam	1.00	1.00	1.00	1.00

Note: All figures are corrected to two decimal places. Rotterdam is set as the benchmark.

With the availability of GCCI, it is now possible to apply equation [5.1] and the values of EMS can be found in Table 5.2.

Table 5.2. Estimated market shares of the Core-Six Ports in providing container transhipment services between North Europe and different European regions

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA	OVERALL
Antwerp	30.34%	0.001%	23.83%	18.81%
Bremerhaven	16.21%	0.144%	13.06%	19.14%
Felixstowe	9.95%	0.001%	12.98%	11.13%
Hamburg	15.03%	99.852%	13.44%	20.67%
Le Havre	8.94%	0.001%	12.78%	9.85%
Rotterdam	19.54%	0.002%	23.90%	20.40%

Note: All figures except Scandinavia-Baltic are corrected to two decimal places. In Scandinavia-Baltic, figures are corrected to three decimal places so as to illustrate that the EMS of ports other than the German ports are not zero percent.

Results from Table 5.2 illustrate some interesting forecasts where Rotterdam and Hamburg should be the players with the highest overall market shares, closely followed by Antwerp and Bremerhaven. Due to their relatively poor service quality, the market shares of Felixstowe and Le Havre in the transhipment market should be small. Also, Table 5.2 suggests that competitions between ports studied here should be quite intense and the top four ports should have similar chances to become the overall leader in North European transhipment market. From a regional perspective, however, it seems that oligopoly exists with the top two players occupying at least half of the total market shares i.e. Antwerp and

Rotterdam in the UK, Bremerhaven and Hamburg in Scandinavia-Baltic, as well as Rotterdam and Antwerp in the Iberian Peninsula. This is mainly due to the fact that, when analysis becomes more focused on specific and local regions, geographical location becomes more significant. On the contrary, in the 'overall' scenario (with all three regions combined), with different regions lying on multi-directions from the Core-Six Ports, geographical (dis)advantages become self-defeating.

5.1.2. Comparing Estimated and Real Market Shares

Here the predictability accuracy of EMS must be tested so as to assess the applicability of the methodology of this study. Testing EMS is also critical in assessing whether the weight percentages of different port factors are able to reflect the realistic situation as well as to identify other potential factors affecting liners' behaviour in transhipment hub choice.

Here it is necessary to obtain concrete information on the real market share (RMS) on liners' choices. Information sources of the calculation of RMS of different ports in the North European transhipment market are based on the information provided by interviewees during the questionnaire survey (see Table 4.2) where their reliability is justified with some empirical evidence provided by ECT and the official websites of liners. RMS of a particular port (say, Port A) [$P_{(A)}$] can be expressed as:

$$P_{(A)} = \frac{T_{(A)}}{T_{(ALL)}} \qquad \textbf{[5.3]}$$

Where $T_{(A)}$ and $T_{(ALL)}$ represent the total number of times Port A is being chosen as transhipment hub and the total number of times the Core-Six Ports is being chosen as

transhipment hub respectively[68] (see Table 4.2). By applying equation [5.3], RMS can be calculated and are presented in Table 5.3[69].

Table 5.3. Real market shares of the Core-Six Ports in providing container transhipment services between North Europe and different European regions

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA	OVERALL
Antwerp	20.00%	7.50%	20.83%	15.15%
Bremerhaven	2.86%	22.50%	0.00%	10.10%
Felixstowe	22.86%	7.50%	4.17%	12.12%
Hamburg	2.86%	42.50%	0.00%	18.18%
Le Havre	8.57%	5.00%	12.50%	8.08%
Rotterdam	42.86%	15.00%	62.50%	36.36%

Note: All figures are corrected to two decimal places.

From Table 5.3, none of the major liners use Bremerhaven and Hamburg as the transhipment hubs to the Iberian Peninsula. Their virtual non-existence implies that the two German ports are not even players in the Iberian Peninsula transhipment market which also illustrate their regionalised nature, especially Hamburg[70]. By comparing Tables 5.2 and 5.3, the variations between EMS and RMS can be observed. See Table 5.4.

[68] Here a limitation exists as the container volume for each liner when calling a port each can be different. However, due to inaccessibility of necessary information because of commercial confidentiality of liners (while ports usually do not collect such information), this is the only sensible method of which the author can use to calculate RMS. Fortunately, according to various in-depth interviewees from port operators, the transhipment volume differences between major liners are usually not really very significant and thus it is anticipated that RMS in Table 5.3 can still give a quite accurate picture of the current situation of the North European transhipment market.

[69] Although the data has its limitations, the figures themselves are actually quite similar to the figures proposed by Teurelincx (2000). According to his paper, towards the turn of the century, the market shares of container transhipment traffic of Antwerp, Bremerhaven, Hamburg, Le Havre and Rotterdam are 18%, 11%, 21%, 7% and 37% respectively. Similar patterns can also be found from the data provided by Containerisation International.

[70] For example, Gunnar Uldall, Minister of the State Ministry for Economic Labour Affairs of Hamburg, describes Hamburg as having special affinity for East European markets, while Jurgen Sorgenfrei, Chairman of Port of Hamburg Marketing Association, admits that the most important infrastructure investments currently taken place in Hamburg are mainly directed towards Scandinavia-Baltic (Port of Hamburg, 2003).

Table 5.4. Variations between estimated and real market shares of the Core-Six Ports in providing container transhipment services between North Europe and different European regions

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA	OVERALL
Antwerp	-10.34%	7.50%	-2.99%	-3.66%
Bremerhaven	-13.36%	22.36%	-13.06%	-9.04%
Felixstowe	12.91%	7.50%	-8.82%	0.99%
Hamburg	-12.17%	-57.35%	-13.44%	-2.49%
Le Havre	-0.36%	5.00%	-0.28%	-1.77%
Rotterdam	23.31%	15.00%	38.60%	15.96%

Note: All figures are corrected to two decimal places. A positive figure indicates that RMS is higher than EMS, *vice versa*.

From Table 5.4, it is possible to investigate whether EMS correspond with RMS. In the 'overall' scenario, in general, EMS of Antwerp, Felixstowe, Hamburg and Le Havre correspond closely to RMS, with Felixstowe slightly being overused but the contrary for Antwerp, Hamburg and Le Havre, although the possibility of respondent errors in the questionnaire survey (see Chapter Three) suggests that such differences can be negligible.

As expected, due to better performance, Hamburg and Antwerp have overall large market shares of 18% and 15% respectively, while lower performing ports possess comparative low market shares, with 12% and 8% for Felixstowe and Le Havre respectively. Furthermore, although Rotterdam is the leader in the market at the moment, results in Table 5.3 suggest that competitions between other ports are still intense with most other ports still possessing approximately equal market shares. Although Rotterdam has a higher RMS, the degree of market dominance is still not too significant, with its RMS still significantly lower than 40% (see Table 5.3). Such results strongly favour the argument that port performance factors, together with money and time, have directly affected the choice behaviour of liners. In fact, the variations between EMS and RMS are especially small for Felixstowe and Le Havre which suggests that liners are especially sensitive to poor service quality offered by ports which will be further discussed in the next section. In summary, the

transhipment market of the UK is dominated by Antwerp, Felixstowe and Rotterdam while the German ports and Rotterdam are the major players in Scandinavia-Baltic. For the Iberian Peninsula, it is dominated by Rotterdam, with the rest of the market mainly shared by Antwerp and Le Havre. Geographical proximity to the Iberian Peninsula mainly explains why Le Havre is able to gain a more significant market share despite its poor quality of port service.

Some further interesting observations on individual ports can be found in Felixstowe. As a British port, Felixstowe enjoys a much larger RMS in serving the UK while its RMS to the Iberian Peninsula is rather small (see Table 5.3). On the other hand, its RMS to Scandinavia-Baltic is quite according to what its generalized cost deserves (see Table 5.4). The case of Felixstowe suggests that, in seeking to become a strong competitor within the North European transhipment market as a whole, it is not appropriate for port to expect its competitiveness being maintained purely by values and perceptions from liners. As illustrated in Felixstowe, liners may use a low-performing port to a particular region due to its 'nationality' but such specific preference will ultimately be compensated as port users will not use it for other destinations because of its poor services. Felixstowe must alter such an approach and improve its service quality significantly in order to maintain its competitiveness in the long term.

Good performance, however, also does not guarantee competitiveness. For example, from Table 5.4, Bremerhaven is largely ignored by liners due to their disbeliefs that the port can become an ideal choice in serving the UK and the Iberian Peninsula. As a result, its overall RMS is also affected which becomes considerably lower than its EMS. Despite its ability in providing high quality services, the port is even underused by liners to the Scandinavia-

Baltic region. Of course, sceptics can argue that the relative high port charge possibly discourages liners from using the port. However, as shown in Chapter Four, in the case of Bremerhaven, where its port charge (and its journey monetary cost between the port and the UK) is comparable to Rotterdam and Felixstowe, as well as the fact that Hamburg is highly competitive in serving Scandinavia-Baltic despite its high port charge suggest that using monetary cost alone as the cause of overall low RMS of the German port is a rather weak excuse.

However, Rotterdam's figures are the most interesting. In the overall scenario, liners choose it as transhipment hub much more frequently than its generalized cost should allow and a 15% gap exists between RMS and EMS. The regional perspective of the port of Rotterdam is even more dramatic, with RMS and EMS percentage differences of about 23% and 39% for UK and the Iberian Peninsula respectively, despite the fact that Antwerp, Felixstowe and Le Havre are all significantly cheaper in port charges. This is also contrary to the *t*-test results (see Chapter Four) which suggest that competitions between Rotterdam and other ports in serving these regions should be quite tense. However, in serving Scandinavia-Baltic region, where Rotterdam lost its geographical advantages to the German ports, Rotterdam's RMS becomes more corresponding to its EMS, although the gap between RMS and EMS is still significant.

Results from Tables 5.3 and 5.4 suggest that the competitive position of a port in transhipment requires the equilibrium of a 'chemical mixture' between the interactions and mutual dependence of monetary cost, time, geographical location and qualitative factors provided by a port and, in most cases, the market share of a port does correspond to port performance. Such results also confirm Robinson (2002) who argues that contemporary

ports are unlikely to compete simply on *engineering efficiency* and *geographical advantages*, but also on quality of service because it offers additional values to the vessels of liners. However, possessing quality service does not automatically imply that a port would automatically become competitive and possesses high market shares, of which this argument will be further strengthened in the next section.

5.1.3. Value of Generalized Costs in explaining Port Competitive Positions

Although the simulated results above support the hypothesis that generalized cost a decent indicator which largely explains port competitiveness, a fundamental question is yet to be answered i.e. whether it is a better indicator than the *traditional* approach where only monetary cost was considered in estimating market shares and competitive position. The most effective method of investigating this question is to compare its simulated EMS with those simulated EMS where only monetary cost attributes are considered. Thus, using the same methodology, the EMS of ports with monetary cost as the only attribute (hereafter called the *monetary scenario*) is estimated and presented in Table 5.5. Here 'monetary cost' means the total monetary amount that liners have to pay for using a port in transhipping containers to a particular destination. In other words, only $M_{(A)}$ and $M_{(J,A\rightarrow X)}$ in equation [3.2] are considered here.

Table 5.5. Estimated market shares of the Core-Six Ports in providing container transhipment services between North Europe and different European regions under the monetary scenario

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA	OVERALL
Antwerp	19.27%	18.12%	18.18%	18.44%
Bremerhaven	15.64%	16.66%	15.07%	15.92%
Felixstowe	16.99%	17.11%	17.32%	17.20%
Hamburg	13.59%	15.25%	14.03%	14.46%
Le Havre	18.96%	16.65%	19.67%	18.04%
Rotterdam	15.56%	16.21%	15.73%	15.94%

Note: All figures are corrected to two decimal places.

From Table 5.5, it shows that virtually all ports have rather equal EMS. What is worth noting here is that, with only monetary cost considered, Hamburg and Rotterdam, two high performing ports, have significantly lower EMS than Felixstowe and Le Havre, two low performing ports. Figures in Table 5.5 can be compared to RMS in Table 5.3 and the variations between them are presented in Table 5.6.

Table 5.6. Variations between estimated and real market shares of the Core-Six Ports in providing container transhipment services between North Europe and different European regions under monetary scenario

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA	OVERALL
Antwerp	0.73%	-10.62%	2.65%	-3.29%
Bremerhaven	-12.78%	5.84%	-15.07%	-5.81%
Felixstowe	5.87%	-9.61%	-13.15%	-5.07%
Hamburg	-10.73%	27.25%	-14.03%	3.72%
Le Havre	-10.39%	-11.65%	-7.17%	-9.96%
Rotterdam	27.29%	-1.21%	46.77%	20.42%

Note: All figures are corrected to two decimal places. A positive figure indicates that RMS is higher than EMS, *vice versa*.

By comparing Tables 5.4 and 5.6, the behaviour of liners in choosing transhipment hubs becomes clear. Although similar patterns exist for high performing ports in both scenarios, where Rotterdam and Bremerhaven have significantly higher and lower RMS than EMS while EMS of Antwerp and Hamburg somehow match their respective RMS (although variations between EMS and RMS of Antwerp and Hamburg suggest that the inclusion of non-monetary factors enables generalized cost to have a slight advantage over monetary scenario), the inclusion of non-monetary factors has made it a better indicator in explaining Felixstowe and Le Havre, with EMS highly corresponding to their respective RMS and their low market share was better explained by generalized costs, especially Le Havre. On the contrary, in the monetary scenario, the EMS of Felixstowe and Le Havre is

significantly overestimated in all three regions, except Felixstowe in serving the UK. See Table 5.6.

Such differences illustrate a diminishing return relation between port improvements and its competitive position. Initially, improvements in port (like infrastructure and facilities) are perceived to have direct positive effects on competitiveness. However, once a certain level of satisfaction (hereafter called 'satisfaction threshold') has been reached, such positive effect will become less significant. Such observation illustrates that, like shippers (Slack, 1985 and Tongzon, 2002), liners are conservative decision-makers and are more ready to criticise than appreciate port performances. Once they are satisfied with the service of a particular port, they are not always ready to change. Such implication is enormous because it means that port users consider decent quality of port services as something 'taken for granted' and apart from only massive capital investments, ports should also consider new approaches. Indeed, once the 'satisfaction threshold' is achieved, physical improvement only acts as the supporting base while effective management and governance become the keys in deciding port competitiveness. With decent quality of services guaranteed, Antwerp, Bremerhaven, Hamburg and Rotterdam have already entered a new developmental stage and new strategies should be used to ensure their respective prosperities. This also implies that, quality of service is a base in achieving potential competitiveness and liners need to know that such service is available and their behaviours need to be changed by ports.

Results here also illustrate the importance of the ability of sustaining competitive edges of ports and such importance is noted by Porter (2000) and Robinson (2002). Since a particular strategy is unlikely to sustain forever, ports should often review and redefine

their strategies in their future development. Competitive edge in port operation does not only based on monetary cost, time, location and qualitative factors, but also on strategic positioning which led to the creation of added values to attract customers in using their facilities, especially container transhipment.

Also, results here pose another implications about whether the fate of a port can rely completely on its own hands, as indicated by Meersman and Van de Voorde (1998) who argue that the success of a port does not only dependent upon its own performance but also other factors out of the control of port itself. This hypothesis seems to be mixed. From Table 5.6, it suggests that initially, the success of a port really lies on port's own hands through improving its own performance (i.e. lowering its generalized cost). Nevertheless, as its performance reaches a certain stage which gives certain degree of satisfaction to customers, it becomes more difficult, although arguably not impossible, for a port to control its own fate because of the decreasing effectiveness of using *operational efficiency* (Porter, 2000) or *engineering approach* (Talley, 1988) in attracting customers to use its services.

5.1.4. General Observations

Using MNL, some behaviour of liners in transhipment port choice can be observed. Firstly, in North European transhipment market, 'oligarchies' exist in different European regions, with the top two players always occupying more than 50% of the market shares (this is the case for both EMS and RMS, see Tables 5.2 and 5.3) which are especially prominent in a regional perspective. On the other hand, in the overall scenario, with the diminishing influence of geographical location, the existence of oligarchy is less significant (see Tables

5.3). Nevertheless, the IID assumption (see Chapter Three) of MNL is clearly problematic in explaining transhipment hub choice by liners.

Secondly, it is found that the significance of qualitative factors in port choice becomes more visible in the overall scenario. Results in Table 5.4 suggest that variations between RMS and EMS under such scenario are much less significant than from a regional perspective which implies that port choices are complicated with the inputs of different factors and that the significance of different factors vary under different circumstances and scopes. Such differences, together with the cases of Hamburg and Felixstowe, have clearly illustrated an interesting fact that, in an overall, a particular favourable geographical location for a particular region is not necessarily good because such proximity to a particular region would lead a mutual self-destructive effect, here termed as 'Locational Efficiency Cancellation Effect' (LECE), where advantages and thus market shares due to geographical advantage for a particular region can be compensated by particularly geographical disadvantage of another region. For example, under the influence of LECE, despite the low service qualities offered by Felixstowe and Le Havre, Hamburg cannot take advantages from them because Hamburg's location means that it fails to provide an attractive option in serving transhipment to all regions but Scandinavia-Baltic. As shown in Table 5.3, decent market share gains of Bremerhaven and Hamburg in Scandinavia-Baltic have been largely compensated by their virtual non-existence in other regions. Results in Tables 5.2, 5.3 and 5.4 show that the reason why Hamburg has a higher transhipment percentage market share than Le Havre is not because the former has a significantly higher ability in extracting market shares at the expense of other ports, but only because it is more attractive due to its higher generalized cost, so that Hamburg is more appealing to liners than Le Havre.

LECE does not only decrease a port's ability in strengthening its competitive position, but also affects the perceptions of liners on the ability of a port acting as transhipment hub to other regions, even if this port possesses decent quality of services, as illustrated by the German ports. On the contrary, Rotterdam, although not necessarily providing liners the lowest generalized cost in any regions, often seems to be the major beneficiary in exploiting the weaknesses of other competitors. Results here indicate that as the overall transhipment market becomes more multi-directional, the role of geography in deciding a port's competitiveness diminishes and other non-locational-bounded factors become more important. A particular good geographical location in serving particular region(s) allows a port to serve as a regional leader, but not the overall leader. A port must at least possess certain degree of *intermediacy* (Hayuth and Fleming, 1994) and decent quality of services as the basic elements in supporting itself to become the overall leader in the transhipment market.

Thirdly, it seems that Rotterdam is the most competitive transhipment hub in North Europe. As mentioned, while the German ports have relatively low generalized costs, they are not as competitive as one might think they should be notably due to their geographical disadvantage in all regions but Scandinavia-Baltic. Antwerp is another port which suffers from Rotterdam's strong position and, while Felixstowe is competitive in gaining substantial market share for the UK, it suffers from the inability of attracting customers to use its services to the Iberian Peninsula due to its poor performance. For Le Havre, its poor port performance explains everything for its low RMS despite is lower port charge and geographical advantages to the UK and the Iberian Peninsula.

Another implication here is that geographical advantage and decent service quality are not enough to decide port competitiveness because while liners are sensitive to poor performances, they are not necessarily as sensitive to good ones. More importantly, by comparing RMS and EMS, it shows that even values and perceptions (or 'non-Assessment Process' factors in PCM, see Chapter Two) have to be well supported by decent port performance. If a port performs badly, its attractiveness is minimal and geographical advantages and values and perceptions offer little help which usually results in a small market share. Results here raise doubts on Song and Han (2004) who claim that port performance is only a *relative concept*. Perhaps partially true, but surely, performance also has an absolute aspect. This is supported by an interviewee (from a port operator) who noted that *getting transhipment business nowadays does not only involve good service, but also needs to make potential customers believe that the port is always willing and ready to address their new demands*.

On the contrary, when a port reaches the 'satisfaction threshold', the positive effect on the port's competitive position through port performance will not be as straightforward, as shown in the case of Bremerhaven. As service quality improves and reaches the satisfaction threshold, 'non-Assessment Process Factors' in PCM become more important in the decisions of liners. The cases of Bremerhaven and Rotterdam clearly indicate that the port competitive structure in North European transhipment market is not only decided by factors belonging to the Assessment Process, but also non-Assessment Process factors in PCM, which will be further discussed in Chapter Six.

Overall, as indicated in Chapter Three, although all ports studied here took active initiatives to improve their attractiveness to potential customers, Rotterdam and Bremerhaven are the

biggest winner and loser respectively. It is necessary to investigate why liners have special positive and negative preferences on Rotterdam and Bremerhaven respectively.

5.2. THE CURRENT SITUATION

This chapter illustrates some interesting observations. Firstly, although 'Assessment Process' factors in PCM (i.e. port attractiveness) largely explain transhipment hub choices by liners, it is by no means complete. As illustrated by the cases of Rotterdam and Bremerhaven, user-initiative factors and exogenous conditions, or 'non-Assessment Process' factors in PCM, may also influence their final decisions and some ports may benefit or suffer from the decision-making process of liners.

Secondly, results indicate that the degree of importance of geography varies in deciding the competitive position of a port in container transhipment tends to be mixed. With the influence of LECE, a port with particularly favourable location towards a particular region, no matter how high quality of service its port could provide, it remains a regional leader where, the prestige of becoming the leader in the combined overall scenario rests to ports with intermediate locations and decent, but not necessarily the best, performance. With more multi-directional destinations added to the overall pattern, qualitative factors become more important in deciding the competitive position of a port in container transhipment. Here is to argue that it is possible to overcome the limitations of LECE of which, however, requires a dramatic perspective shift from current conventional approaches where most ports are planning their business strategies mainly focusing on capital investments and independent marketing with minimum contacts with its counterparts.

Finally, this chapter shows that, in terms of strengthening its competitive position, when a port continues self-improvements, the positive significance of port's improvement in quality starts to decline after reaching a particular 'satisfaction threshold' when liners start feel satisfied with port's quality of service. It is important for port managers to understand that the advantages of undertaking an *engineering approach* (see Chapter Three) cannot last forever. It seems clear that Antwerp, Bremerhaven, Hamburg and Rotterdam have already reached the satisfaction threshold and so they have reached a new level of port competition.

So what is the implication here? The answer is that the traditional approach of strengthening port competitive position through geographical advantages and self-improvements are not enough to address the issue. The provision of transhipment service has become a complicated business requiring effective strategic management, especially those which already achieve providing high quality of port services. Emphasis on using traditional approaches as mentioned above to maintain port competitiveness can only, at best, become local leaders, whilst regional/international transhipment hubs require both decent service quality and effective management strategies. From this chapter, it clearly demonstrates 'Mismatch in Anticipation' (MiA) (see Chapter Two) between the Core-Six Ports when they fight for transhipment markets where Rotterdam is an overachiever while Bremerhaven is an underachiever.

Here it is important to understand why some ports enjoy significant benefits while some others suffer and this involves several questions. What are the major components of these 'non-Assessment Process' factors in North European container transhipment market? What are the major strengths and weaknesses of different North European ports? Why do liners

like particular ports? Are such preferences unique to particular region(s) or also apply to other regions? These questions will be addressed in the next chapter.

CHAPTER SIX
CURRENT COMPETITIVE POSITIONS OF PORTS IN NORTH EUROPEAN CONTAINER TRANSHIPMENT MARKET: AN EXPLANATION

Chapter Five leaves several questions yet to be answered. Firstly, why does the real market share (RMS) not necessarily corresponding to the estimated market share (EMS)? Secondly, from the six ports studied, why do Rotterdam and Bremerhaven benefit and suffer respectively from competing for North European transhipment market shares? Finally, has our common knowledge about the port and shipping industries based on existing studies changed since the turn of the century? While Chapter Five illustrates the current competitive positions of ports in the market, this chapter aims to explain the current situation. This chapter is divided into three sections. In Section 6.1, the strengths and weaknesses of different ports in affecting their respective competitive positions will be assessed, followed by Section 6.2 where the role of other factors in affecting liners when they make their transhipment hub choices in North Europe will be investigated. Finally, Section 6.3 consists of the verdict where the major arguments and implications constructed from the analysis will be summarised.

6.1. STRENGTHS AND WEAKNESSES OF THE CORE-SIX PORTS

Empirical results show that, while RMS of most ports correspond to EMS based on their respective generalized costs, Rotterdam and Bremerhaven stand out as the major exceptions. Here two questions can be raised. Firstly, why are Rotterdam and Bremerhaven different from the 'orthodox' pattern? Secondly, apart from their opinions, what are the major factors in affecting the decisions of liners in transhipment hub choice? This section

attempts to answer these questions by assessing the strengths and weaknesses of different ports, followed by investigating how the systems of liners and other factors affect the current competitive structure of the North European container transhipment market.

6.1.1. Antwerp

Despite its reputation for high container-handling efficiency, most interviewees agree that Antwerp is not, and will unlikely become, a top-class transhipment hub in North Europe. Although being the cheapest major port in container-handling (see Chapter Four) and rather high productivity with above 30 container moves per hour (Slack and Frémont, 2005), its shallow port access channels (compare Table 6.1 with Table 2.3) leading to the existence of numerous locks and the fact that the port was situated about 70 nautical miles from the open sea and vessels need to travel six hours before reaching the port have effectively paralysed the potential of Antwerp as a transhipment hub as mega-sized ocean-crossing vessels cannot get access to the port conveniently.

Table 6.1. Minimum access channel depths of the Core-Six Ports

PORT	MINIMUM CHANNEL DEPTH
Antwerp	-12.00 metres
Bremerhaven	-14.50 metres
Felixstowe	-14.50 metres
Hamburg	-13.50 metres
Le Havre	-14.00 metres
Rotterdam	-16.00 metres

Source: ECT (2004)

In theory, access channel problem can be relieved by dredging. Nevertheless, the problem of Antwerp was that the lower stream of River Scheldt is within Dutch jurisdiction (see Figure 3.2) and the Dutch authority regards any channel dredging as a serious threat to Rotterdam. Thus, in terms of geographical location, although Antwerp is rather

intermediate in North Europe, it does not provide any significant advantages compared to ports like Le Havre and Rotterdam. Problematic water channel implies that Antwerp has difficulty even serving Panamax vessels. Even it does, the port cannot achieve 24-hours a day port access to such vessels (which need to wait for tides). Such restrictions have partly explained Antwerp's concentration on trans-Atlantic traffic. This is disadvantageous to Antwerp's development as the Far East is now the region where cargo volume growth is the most prominent (see Table 6.2).

Table 6.2. Comparisons between Far East-Europe and trans-Atlantic container shipping routes, 2000 – 04

Year	FAR EAST-EUROPE				TRANS-ATLANTIC			
	Eastbound (in TEU)	A.G. (in %)	Westbound (in TEU)	A.G. (in %)	Eastbound (in TEU)	A.G. (in %)	Westbound (in TEU)	A.G. (in %)
2000	2,678,000	10.50	4,077,000	6.00	1,516,000	0.60	2,101,000	11.10
2001	2,822,000	5.40	4,075,000	0.00	1,543,000	1.80	2,124,000	1.10
2002	2,987,000	5.90	4,432,000	8.80	1,546,000	0.20	2,181,000	2.70
2003	3,255,000	9.00	5,206,000	17.50	1,583,000	2.40	2,207,000	1.20
2004	3,701,000	13.70	6,064,000	16.50	1,698,000	7.30	2,298,000	4.10

Note: A.G. – Annual Growth. Source: Drewry (2005)

Since the turn of the twentieth century, Far East-Europe shipping routes have possessed significant advantages over trans-Atlantic ones in terms of both absolute volumes and percentage growths, especially westbound traffic mainly due to the growing importance of China in the world economy. By 2004, the total container volume (East and Westbound routes combined) of Far-East European container shipping routes reaches 10 million TEU, compared to only 4 million TEU possessed by trans-Atlantic routes. With such difference, it also implies that there were no significant demands for trans-Atlantic routes to use mega-vessels and thus transhipment services, where by 2005, the average container carrying capacity of vessels serving trans-Atlantic routes is forecasted to be about 4,000 TEU, compared to between 5,000 and 6,500 TEU for Far East-European ones (Ocean Shipping

Consultants, 2004). Predictably, such development also implies that the focus of transhipment growth would lie on Far East cargoes and gives a clear disadvantage to ports which are trans-Atlantic-oriented, where Antwerp falls into this category (see Table 6.3). This implies that Antwerp finds itself difficult to reap significant benefits from the new lucrative market and thus negatively affected its development as a transhipment hub in Europe.

Table 6.3. Selected origins/destinations of container throughputs of Antwerp, Bremerhaven, Hamburg and Rotterdam, 2003

Origin/Destination	Antwerp	Bremerhaven	Hamburg	Rotterdam
China (incl. Hong Kong) in TEU	(N.A.)	228,886	1,358,978	1,058,596
N. America (US and Canada) in TEU	(N.A.)	888,284	345,303	884,867
% Share of Chinese (incl. HK) throughputs	*20.30	7.18	22.14	14.90
% Share of N. American throughputs	#24.90	27.85	5.63	12.45

* Figure includes cargoes from other Mid- and Far-East destinations.
# Figure includes cargoes from other North and Central American destinations.
Source: Figures calculated by the author based on information provided by respective ports.

According to interviewees, the only reason to explain Antwerp's recent strong growth in container traffic (see Table 3.1) is its decent barge connection to the Rhine/German hinterland rather than benefiting from the increasing rate of transhipment traffic and the existence of considerable freight forwarders and shippers in the port. Such opinion is complementary to the modelled results of this study where, in general, the RMS is a bit smaller than the EMS. Analysis shows that, within the shipping industry in general, Antwerp is not perceived as a decent transhipment hub by any means. To a certain extent, such subjective perceptions also partly explain why Antwerp can only maintain its deserved market shares according to its generalized costs but difficult to enhance its position to compete for more market shares.

6.1.2. Bremerhaven

As a port located at the North Sea coast, Bremerhaven possesses geographical advantages in serving Scandinavia-Baltic. According to the opinions of liners, similar to Antwerp, the port also achieves very high productivity, with an average of about 30 container moves per hour[71], while port access channel is wide enough for the currently largest container vessels to pass through (see Tables 2.3 and 6.1). Facilities are new and liners generally find its quality of service satisfying (see Chapter Four), although customers complain that Bremerhaven is an expensive port with high port charges (see Table 4.19) mainly due to high labour costs and the presence of strong labour union agreements (although still significantly cheaper than Hamburg). While especially good in serving Scandinavia-Baltic, Bremerhaven suffers geographical disadvantages in other regions, especially the Iberian Peninsula. As mentioned, liners often complain about the lack of feeder services between Bremerhaven and these regions.

Nevertheless, it is clear that there are something more than conventional weaknesses (or strengths of other ports) since Chapter Five indicates that Bremerhaven is a clear underachiever in the market, despite the fact that the port possesses decent quality of port services. Here the author found that such a problem is related to its nearest rivals, notably Hamburg and Rotterdam. In this sub-section, the focus is on the disadvantages of Bremerhaven, while the strengths of Hamburg and Rotterdam will be discussed in their respective sub-sections later.

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[71] Nevertheless, some in-depth interviewees also indicate that variations existed between terminals within a port. For example, in Bremerhaven, an interview claims that the terminal run by NTB is more productive than the one run by Eurogate, despite the fact that both of them have similar quality in terms of physical facilities and the terminals are right next to each other (e.g. while NTB use four straddle carriers for each crane, Eurogate only uses three, for the sake of saving money. The productivities of NTB and Eurogate terminals are 33 and 25 moves per hour respectively). Liners generally perceive that terminals which are being run by liners tend to be more efficient because their objective to run terminals was *to save money and serve liners* while the objective of port operators in

It is not difficult to find that there is an important factor explaining the current situation of Bremerhaven which is extremely difficult to be captured in any surveys i.e. historical accidents. Throughout the post-war period (1945 – 1991), West Germany was regarded by the US as the frontline to obstruct the USSR and Communist expansions into Western Europe. With deep water draught and convenient access to the North Sea, Bremerhaven (together with Bremen) was chosen as the US naval base in Western Europe and this has posed a significant consequence on the port. With strong American presence, throughout the post-war period and even until now, Bremerhaven has been widely regarded by both Americans and Europeans as 'another American port' and this also explains why Bremerhaven has focused on trans-Atlantic shipping market throughout the years. For example, in 2003, 27.85% and 7.18% of Bremerhaven's TEU throughputs are North American (US and Canada) and Chinese cargoes (China and Hong Kong) respectively, compared to 5.63% and 22.14 % respectively for Hamburg and 12.45% and 14.90% respectively for Rotterdam (see Table 6.3).

However, such trans-Atlantic focus has created the current problematic situation for Bremerhaven due to the changing global economic environment. Since the 1960s, many industrial bases had shifted from Europe-US to Asia-Pacific and this process had accelerated rapidly with the Open Door Policy of China and its recent admittance to the WTO (see Table 6.2). The figures in Table 6.3 also provide good indicators in highlighting this problem. While the absolute figure of Bremerhaven's 27.85% of North American-oriented cargo is little more than 888,000 TEU, the absolute figure of Rotterdam's 12.45% of the same cargo is nearly 885,000 TEU.

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running terminals is *to make money and exploit liners*. Such belief also illustrates the existence of mutual distrusts between port service users and suppliers.

Despite the world economy increasingly favours the Far East it is somewhat surprising that Bremerhaven does not insert any real efforts in altering its competitive position as it does not have any significant physical restrictions on its development to become a transhipment centre. As an interviewee has noted, *in terms of quality of port services, Bremerhaven has no significant disadvantages when compared to ports like Hamburg and Rotterdam*[72]. *However, it is somewhat mystifying that they do not make any attempts trying to compete for their deserved shares in the lucrative Asian market*, possibly due to the lack of long term visions and inertia.

The above seems to suggest that Bremerhaven has fallen into the QWERTY paradox which originated from the paradox that people got stuck to using the *established* QWERTYUIOP-type keyboard dated back to the 1880s despite the later introduction of better alternatives like DSK[73]. According to David (1985), the QWERTY paradox comes into place since investment costs in producing hardware (the cost of producing keyboards) and software components (the cost of training typists, here including non-monetary costs) throughout the last century have decreased and increased respectively. While historical accidents dictate the QWERTY standard, producers, who do not want to be left behind, follow the *general but irreversible trend* of producing QWERTY keyboards and thus people find it increasingly difficult to change their habits of using keyboards with alternative arrangements, thus generating inertia and stubbornness to change. In Bremerhaven's case, most of the existing connections, personnel and facilities are dedicated to trans-Atlantic routes and the port finds itself difficult to get away from its traditional frame after being

[72] In fact, this interviewee further indicates that Bremerhaven can be an even better option than Hamburg due to its direct access to the open sea and Hamburg's increasingly serious problem of congestion within the port.
[73] According to an experiment by the US Navy, the increased efficiency of DSK can amortise the cost of re-training a group of typists within the first ten days of their subsequent full-time employment, while Apple Computer claims that DSK allows typists to type 20 % to 40% faster than QWERTY keyboard. See David (1985).

'another American port' for so long. In fact, since the turn of the century, despite raipd developments from the Far East and the opening of Eastern Europe, Bremerhaven's growth has been virtually a standstill (see Table 3.1).

As a consequence, other ports, notably Hamburg and Rotterdam, are able to benefit from such circumstance which further weakens Bremerhaven's competitive position where it now becomes a bit late for the port to establish itself as a transhipment hub due to the concentration of transhipment and feeder schedules to Scandinavia-Baltic regions in Hamburg and Rotterdam of which it also significantly but negatively affects perceptions of port users on the value of Bremerhaven as a transhipment hub. Thus, Bremerhaven suffers from the fact that it does not only fail to extract market shares from competitors, but also fails to maintain the deserved share of which its generalized costs should allow (see Chapter Five). The case of Bremerhaven also illustrates that clustering/geographical concentration of economic activities takes place in North European transhipment market, where the industry also found itself beneficial to concentrate on a few locations, notably Hamburg and Rotterdam.

Finally, most interviewees agree that, Bremerhaven should put more efforts on software components, especially marketing to Far East as being a real alternative to Hamburg and a more progressive vision in long term strategies. Current Bremerhaven's development strategy is too hardware-oriented and historically-bounded and such an approach has to undergo dramatic change if the port does not want to be left out from the rising prominent North European transhipment market, especially with the increasing opportunities by EU expansion and increasing interactions with Russia and Eastern Europe. As an interviewee mentioned, the only real problem of Bremerhaven is its *wrong approach in facing new*

opportunities. Unlike Antwerp, with appropriate change in strategic approaches, Bremerhaven has the potential to develop itself into a top-class transhipment hub in North Europe.

6.1.3. Felixstowe

Interviewees generally agree that Felixstowe possesses advantages on access channels where no significant problems exist on getting access to the port (see Tables 2.3 and 6.1) while there are no real problems on tides and water draught. Also, although not as cheap as Benelux ports, the monetary cost of using the port of Felixstowe for transhipment is not very expensive.

However, Felixstowe also has many weaknesses to list. Geographically, the port is not especially well-located when compared to other continental ports for transhipment market. According to liners, they do not feel that it is significantly more beneficial to use British ports in transhipping containers to British destinations, in terms of virtually any aspects including monetary cost[74], time and quality of port services. As shown in Chapter Four, the quality of port service by Felixstowe, when compared to Benelux and German ports, is significantly worse. Thus, as illustrated later in Chapter Seven, provided that no significant improvement is made, Felixstowe is likely to face further competitions from continental ports in serving the British transhipment market.

Another problem about Felixstowe lies in its management philosophy. Various interviewees, especially liners, complain about the outdated beliefs within the management

[74] According to interviewees from liners, experience suggested that even from a purely monetary perspective, Felixstowe could even be the most expensive transhipment hub in serving British and Irish ports, depending on how liners arrange port rotations of their routes.

hierarchy. As indicated in the questionnaire survey, quality of service of Felixstowe is not considered to be decent in any sense and liners complain about various problems like port congestion, low productivity, poor connection between port and inland regions[75] and thus bad reputations. According to the author's knowledge, Felixstowe has already been warned on this issue. In a consultancy report submitted to the port by Ocean Shipping Consultants (2004), it writes:

> *"An inhibition of transhipment activities would bring risks that liner shipping companies will concentrate their business to those ports which are likely to be in the North Continent region. This would impede shipping to and from the UK generally because some import/export traffic would have followed the liners and this would adversely affect the range of markets covered from the UK ports, including Felixstowe [Appendix 2 – p. 1]."*

In fact, during the interview, the PoF interviewee even admitted that several liners have described Felixstowe as *stagnant where the management hierarchy is stubborn and often give false promises to customers*. However, despite such warnings, this interviewee still seems quite convinced that Felixstowe has no real difficulties to grab significant transhipment business for the UK because 'Felixstowe is a British port'. According to an interviewee (from Port of Felixstowe Ltd.), he believed that *as the largest container port in UK, there is no reason why Felixstowe cannot sustain itself as one of the major, if not the overwhelmingly dominating, player in the British container transhipment market*. From such comments, it seems that the management hierarchy has not overcome traditional belief which is contrary from what Baird (1999) had claimed[76]. In fact, Felixstowe's problems

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[75] Sometimes inland connection matters for Felixstowe especially when Ireland is involved. Some ocean-crossing vessels unloaded their containers at Felixstowe and then being transported to minor ports (like Liverpool) and loaded on feeder vessels for Dublin/Cork. Using this method, however, it implies that public roads will be involved and thus further congestion and delays become possible. Thus, another option for liners is to unload their containers at a continental port (like Antwerp, Le Havre and Rotterdam) and use feeder vessels to tranship containers to British and Irish ports directly and avoid potential congestion problems on public roads.

[76] Baird (1999) argued that traditional belief existed within British port industry where certain particular ports should handle particular liners to certain destinations. He argued that Felixstowe had overcome this problem due to its lack of historical burden. However, findings here indicate that the management hierarchy of Felixstowe suggest otherwise, only in terms of different scale.

have actually been reflected by empirical evidence of which it has suffered in TEU throughput growth in recent years (see Table 3.1).

Thus, apart from hardware improvements, a change in management philosophy seems to be the key to enhance the competitiveness of Felixstowe in North European transhipment market. Such traditional belief possibly also explains its poor port performance and reputation because the hierarchy does not believe that reforms are necessary.

6.1.4. Hamburg

In many aspects, the strengths and weaknesses of Hamburg are similar to those of Bremerhaven e.g. geographically advantageous and disadvantageous to Scandinavia-Baltic and other European regions respectively, high container-handling charges and port dues due to labour problems, etc. Nevertheless, Hamburg also suffers further weaknesses in providing transhipment services due to the lack of space for further development as the port is located just next to the city centre (and thus causes frequent congestion), the existence of numerous outdated and worn-out container-handling facilities needed for maintenance and the need for frequent dredging of the Elbe's access channel (see Figure 3.5).

In general, as suggested in Chapter Four, there are no significant differences between Hamburg, Bremerhaven and Rotterdam in terms of quality of port services in serving transhipment traffic. This is especially true between Hamburg and Bremerhaven, where they are serving similar markets and have similar pros and cons. Nevertheless, as illustrated in Chapter Five, Hamburg has a much higher market share in transhipment traffic than Bremerhaven and given their similar background, it is interesting to investigate the reasons behind.

As discussed before, the historical burden of Bremerhaven and its indolence to shift its trans-Atlantic focus has benefited the development of Hamburg as a transhipment hub in serving Scandinavia-Baltic market. Coincidentally, history also explained the strength of Hamburg. While Bremerhaven has been regarded as 'another American port' since the 1950s and most trans-Atlantic cargoes would pass through there, in order to survive, Hamburg had few alternatives but to focus on other markets and this largely explains why Hamburg is more Far East-oriented throughout the post-war period. Nevertheless, how time and circumstances have changed and now Hamburg clearly benefits from such 'desperate survival strategy'. The Far East-orientation nature of Hamburg also justifies the influence of 'chance' in PCM in affecting the success and failure of a port[77].

As noted by various interviewees, being a traditionally important trading city of Germany and Europe, Hamburg has long established a much stronger local cargo base than Bremerhaven. In turn, it implies that both liners and their customers (i.e. shippers and freight forwarders) have better 'first impressions' on Hamburg. As illustrated in the questionnaire survey, liners' customers greatly favour Hamburg rather than Bremerhaven. Thus, clustering has taken place in Hamburg. For example, by 2003, 217 freight forwarding companies have set up their offices in Hamburg (Port of Hamburg, 2003), compared to only 130 in Bremerhaven (together with Bremen) by 2005 (Keyports, 2005). Also, by year 2004, about 30% of the top 30 liners[78] locate their respective European headquarters in Hamburg, compared to only one such company located its European headquarter in Bremerhaven.

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[77] To a certain extent, the Far East-orientation of Hamburg is also partly affected by the QWERTY paradox. However, given the economic boom of East Asia and the success of Hamburg, such paradox is not significant since such orientation does not pose a problem to the port.

[78] It is according to their rankings by May 2004 (Alphaliner, 2004).

Although shippers and freight forwarders have no direct influence on the choice of transhipment hub, their preference and agglomeration on Hamburg do affect such a choice indirectly through their preference for ports in non-transhipment containers. With such strong presence, it implies that more feeder vessels follow their counterparts and set up frequent feeder services there to various destinations in the Scandinavia-Baltic region, further strengthening the clustering effect. Together with the indolence of Bremerhaven to undertake serious marketing efforts, it implies that decent alternatives for the establishment of new shipping centres do not exist. The attraction of Hamburg can be illustrated by the fact that even Maersk-Sealand has a few transhipment routes using Hamburg, despite its possession of dedicated terminals in Bremerhaven (Port of Hamburg, 2003).

However, here is to note that, although the clustering effect benefits Hamburg, on the other hand, it has also posed some negative consequences. The unfavourable location of Hamburg in serving UK and the Iberian Peninsula mean that feeder services towards regions other than Scandinavia-Baltic virtually do not exist in Hamburg. Thus, although the overall transhipment market share in Hamburg is still impressive (see Chapter Five), like Bremerhaven, the port suffers from virtually zero percent of market shares for other regions.

Finally, most interviewees agree that port promotion and marketing efforts of Hamburg are much more progressive than Bremerhaven with the former undertaking a lot of initiatives in getting new customers. As mentioned in its yearbook, Hamburg notes that port promotion to customers worldwide is *vital to its prosperity* (Port of Hamburg, 2003). For example, HHLA, the virtual port authority of the port, set up its own independent port

promotion organisation, HHM, as the main point of contact between the port and its customers, with the objectives of presenting the port of Hamburg to external audience and make them aware of the wide range of port services Hamburg has to offer and to develop marketing strategies based on obtained information and research on competing ports (Port of Hamburg, 2003). Also, HHM is active in setting up port promotion offices in various important cities including Asia, America and Europe. With the opening of Eastern Europe and thus new transhipment opportunities, HHM also has plans in setting up similar offices in Russia and the Baltic states and such efforts are clearly lacking in Bremerhaven.

6.1.5. Le Havre

The major strengths of Le Havre are that it has no significant problems on water draught and tides (see Tables 2.3 and 6.1) and its geographical location is good for serving the UK and the Iberian Peninsula markets, although understandably not so good in serving Scandinavia-Baltic. Under the current shipping routes, the location of Le Havre is also ideal for being the last loading port, of which liners traditionally have preferences of choosing last loading port for export transhipment due to convenience and savings in transit time and monetary costs (see Table 6.4). However, despite such advantages, as illustrated in Chapter Five, it is clear that the transhipment market in the Iberian Peninsula is dominated by Rotterdam, while Rotterdam and Felixstowe share the major slices of the UK. To say the least, currently, Le Havre only plays a peripheral role in the market.

Table 6.4. Summary of the abilities of the Core-Six Ports in attracting calls from major liners

SERVICE ROUTE	CATEGORY	ANR	BRV	FLX	HAM	LHV	RTM	OTHER PORTS
Far East-Europe	First Port of Call	0	0	3	1	5	11	5
	Last Port of Call	3	2	5	2	6	1	6
	No. of Times being called	8	2	11	23	11	25	16
	Total No. of Liner Services	25	25	25	25	25	25	25
Trans-Atlantic	First Port of Call	4	0	0	2	0	3	0
	Last Port of Call	0	0	0	0	6	1	2
	No. of Times being called	8	5	3	4	6	9	4
	Total No. of Liner Services	9	9	9	9	9	9	9
Round-the-World	First Port of Call	0	0	1	0	0	0	1
	Last Port of Call	0	0	0	1	1	0	0
	No. of Times being called	0	0	1	2	1	2	2
	Total No. of Liner Services	2	2	2	2	2	2	2
TOTAL	First Port of Call	4	0	4	3	5	14	6
	Last Port of Call	3	2	5	3	13	2	8
	No. of Times being called	16	7	15	29	18	36	22
	Total No. of Liner Services	36	36	36	36	36	36	36

Note: Figures are calculated based on the information in Tables 3.2, 3.3 and 3.4.

There must be a reason to explain such a phenomenon. Results from the survey in Chapter Four indicate that Le Havre is a poor port to use for transhipment due to various problems including poor physical and management quality. However, results from the survey only reflect the consequences which give a negative impression of the port to liners rather than the reason behind them.

By conducting in-depth interviews, some lights have been shed on the underlying reasons behind. Although not a particularly expensive port, Le Havre is characterised by low efficiency and poor quality in providing transhipment services due to two major reasons. Firstly, it is due to its berth arrangements, where ocean-crossing and short sea vessels are often moored far away from each other (in some cases, even located in different terminals). Since transhipment involves the transfer of containers from large to smaller vessels, such arrangement implies that, during the transhipment process, a rather complicated process is involved with the use of container trucks commuting between one terminal to another, where in many cases it involves the use of public roads outside the control of the port itself. With longer transhipment routes and the unpredictability of public road congestion, it greatly jeopardises the efficiency of transhipment within the port and thus its reputation. As one interviewee has noted, he found it *difficult to understand why Le Havre arranges berthing in such a strange formation as it does transhipment no favour at all.*

However, an even more serious problem has hindered Le Havre in becoming an attractive choice to liners namely public-private relations. As mentioned in Chapter Three, clear separation of entity is still not fully developed in French ports, including Le Havre. Crane maintenance is the responsibility of the port authority while more importantly, one of the most important groups of employees in ensuring service quality and efficiency i.e. crane

drivers for the movement of containers between vessels, are not employed by the terminals but by the port authority under the influence of stevedoring labour unions. In other words, crane drivers are civil servants rather than private employees and a strange phenomenon exists – civil servants employed by the public sector but work for private companies – and it is not difficult to imagine the uneasy relations between them in terms of work culture and expectations e.g. unpaid overtime work, bureaucracy, etc. For example, an interviewee from a liner, while sharing his experience with the author, has addressed his grievance of his company's vessels calling at Le Havre last year. While his company's vessel was unloading at the port, the crane driver found some technical problems in controlling one of the container cranes. In response to this, instead of finding a solution to solve the problem or contacting the port authority or the terminal concerned, he simply left the crane and took the day off because they believed that the crane was simply too risky to use!

Such work attitude has deteriorated the efficiency and reputation of Le Havre and thus increased the generalized cost of using the port for loading/unloading and transhipment. This problem is not helped by poor public-private relationships. As indicated by various interviewees, when a complaint is received from customers about the port's inefficiency and poor quality, it often results in a fiasco where the public and private parties start to blame each other, not to mention any possibility of cooperation or any form of strategic-partnership. Thus, a 'mutual-blaming culture' between the two sectors is firmly established within the port which, predictably, usually results in doing nothing to improve service quality.

Apart from the difficulty in the current situation, Le Havre also has problems in improving the situation, both financially and politically. Unlike other ports, two of the three existing

container terminals within the port are held by private families with no public shares but these families have limited investment funds to finance any significant terminal expansions. However, these families seem uninterested to sell their shares to any foreign parties with better financial resources and such unwillingness has been endorsed by the French government (while the only non-family-owned terminal is owned by CMA CGM, the French flagship liner). In fact, French national authorities often try to ensure that all *national strategic assets*, including ports, are strictly under French control. Contrary to the frequent activities of investments and privatisation elsewhere, throughout the last decade, the French government never allows any acquisition of port ownership by non-French companies, nor does it encourage them to insert any significant investments in French port projects. In fact, from past experiences, it is not really surprising that the French government has sacrificed lucrative financial investments and potential port improvements in return for preserving the ports' *French* identity[79].

Even with the availability of serious investments, it seems that solving public-private tensions and a change in management philosophy are necessary to improve Le Havre which can prove difficult due to political problems. A recent example is the *Port 2000* project, where A.P. Moller and CGA-CGM, the two companies which will operate the newly built terminals, insist that they must be responsible to employ crane drivers to ensure that they are not employing civil servants anymore and crane drivers have to be accountable to companies rather than labour unions. The consequence is that the issue became highly

[79] Intervention by the French government in major enterprises is not an uncommon practice and, to a certain extent, an evolved system. For example, some years ago, the government bought shares of EDF, one of the largest French electricity companies, to prevent it from falling into foreign hands while until very recently, Air France has been heavily subsidised by the French government to ensure its competitiveness in the air transport market (Graham, 1995). In fact, the French government has adopted a system in preventing major enterprises to fall and maintain the elegant phrase that France is always present in all major industries. This has been done through maintaining a major government shareholding in key companies so that they can always pump in more money should a company begins to fail (BBC, 2005). In this sense, it should not be surprising that the French authority does not welcome foreign investments in their ports.

politicised characterised by numerous strikes and further deteriorations in the port's service quality and reputation.

In fact, the situation of Le Havre is quite common among other European ports during the 1960s and 70s, including Benelux, British and German ports. However, while most other ports have moved forward, it seems that the French political culture, characterised by strong labour unions and suspicions of foreign investments, has hindered its development in tackling new challenges because the French government often seems ready to sacrifice efficiency, reputation and free and fair competition in return for ensuring labour employment security, immune from external challenges and the preservation of the French identity of its national assets, including ports.

6.1.6. Rotterdam

There should not be any doubts that one of the major strengths of Rotterdam is that the port possesses good facilities and decent quality of transhipment services to liners, as illustrated in the questionnaire survey in Chapter Four. Also, like Le Havre, the port has no significant problems on water draughts and tides and thus can accommodate mega-sized vessels (see Tables 2.3 and 6.1), although it is a more expensive port to use.

Such advantages are likely to guarantee the transhipment market shares of Rotterdam. Also, between the Core-Six Ports, in an overall scenario, only Rotterdam possesses port competitiveness of any significant sense i.e. the ability to possess a real market share higher than its generalized cost should allow. As illustrated before, while other ports which possess potential can only maintain what their respective generalized costs allow (like

Hamburg and Le Havre), some ports simply suffer (like Bremerhaven). As a result, it is extremely interesting to investigate the reasons behind Rotterdam's success story.

Apart from conventional factors like money, time and quality of services, there are further incentives to explain the competitiveness of Rotterdam in the North European transhipment market. Firstly, it involves Rotterdam's favourable geographical location. As illustrated in the survey, Rotterdam obtains favourable scores in serving all the European regions studied here. In other words, its location is rather intermediate. According to interviewees from liners, it is very convenient to include Rotterdam into a port rotation schedule arrangements because of its intermediate location which, together with its relative freedom from physical restrictions, gives the port an especially attractive destination as the first port-of-call. In other words, Rotterdam enjoys the unique privilege that container vessels can largely avoid route duplication by using it for transhipment. Rather than locating particularly near to a specific region, Rotterdam enjoys the advantages of *intermediacy* (Fleming and Hayuth, 1994) between the major European regions.

As a consequence, Rotterdam enjoys the advantage of being a very popular first port-of-call which is especially advantageous for in competing for transhipment businesses. Under the current situation, virtually all deep-sea container vessels come to North Europe through the English Channel. On the other hand, under such routings, choices for the first port-of-call are relatively rare for the German ports (see Table 6.4).

According to Table 6.4, Rotterdam is the overwhelming choice for first port-of-call while Le Havre is the most popular choice for last port-of-call. However, as mentioned before, Le Havre's poor performance excludes its opportunity to reap such benefits. On the other hand, Rotterdam does not have any access restrictions and thus able to benefit from its intermediate location. Under such circumstance, Rotterdam has largely avoided the cancellation effect of geographical location (i.e. LECE, see Chapter Five) where a favouring a particular region will likely lead to setbacks from other regions. With such convenience, it implies that nearly all ocean-crossing vessels call at Rotterdam for container loading/unloading which, predictably, has attracted feeder services to follow suit. Again, like Hamburg, the effects of clustering took place which further consolidate the perception of Rotterdam's status as North Europe's transhipment centre within the port and shipping industries which is further strengthened by the weaknesses of several of its potential competitors especially towards the Iberian Peninsula market. Currently, nearly all major liners use Rotterdam as a transhipment hub (see Tables 4.2, 4.3 and 4.4) and the port possesses feeder services of various frequencies to nearly all major European destinations.

Also, another important factor contributing to the success story of Rotterdam is the progressive visions and excellent public-private partnership. Interviewees generally agree that RPM, the port's public sector, has put considerable efforts and initiatives in port promotion and marketing and such efforts are simply impossible to be matched by other port authorities. Here the major significant difference between RPM and other port authorities is that RPM does not only regard itself as a 'public' sector to ensure the smooth-running of the port, but also a real 'market' player and understands the importance to make customers feel that they

are 'being valued as customers' when using Rotterdam. For example, according to interviewees, RPM officials often take the initiative to approach liners and pays frequent visits to their offices to persuade them to call Rotterdam, while meetings with the port authority officials of any other Core-Six Ports usually do not take place unless liners pay a visit to them! Under such circumstances, together with decent quality of services offered by the port, it is understandable that liners have preferences to choose Rotterdam as their transhipment hub. After all, container port operation is a business and it is important to ensure that customers are willing and happy to use the services available.

Moreover, formal communication systems and frequent information exchange between public and private sectors have been firmly established within Rotterdam and, as interviewees have indicated, during meetings the port's personnel, it seems that the representatives from both sectors are often well-prepared with excellent consensus between each other, contrary to other ports (notably Le Havre) where information and opinions between the two sectors often seem to be confusing and contradictory.

Furthermore, both public and private sectors of Rotterdam are very visionary and willing to invest heavily in long-term and highly speculative projects like *Maasvlake II* and *Euromax* (a joint venture between ECT and P&O Nedlloyd). Apart from physical investments, what distinguishes Rotterdam from other ports is its willingness to spend substantial efforts on software aspects which is something not many of its competitors can achieve. As early as the late 1990s, Rotterdam had already initiated studies on investing in new transhipment markets, including the UK and Scandinavia-Baltic. Various strategic studies take place annually

including a study on Rotterdam's competitiveness *vis-à-vis* other ports in 2004, of which such attention on research and development is neglected by many of its counterparts. As many interviewees have noted, Rotterdam always acts as the *dragonhead* in the exploiting the market. Where on many occasions when Rotterdam has involved in investigating in particular new opportunities for several years, most other ports have not even started to think about it. In short, Rotterdam has taken a very decent (if not the best) approach to thoroughly understand the North European container transhipment market.

Finally, Rotterdam has been the biggest beneficiary of a factor largely outside its control, namely the lack of decent challengers. Although situated at a rather intermediate location, decent alternatives with attractive geographical locations do exist like Antwerp and Le Havre, especially the latter due to its lack of water draught constraints. However, as mentioned earlier, various factors (as discussed in previous sections) have prevented these ports from posing any serious threats to Rotterdam, especially to the UK and the Iberian Peninsula. Thus, as most interviewees agreed, the number of transhipment hub choices available to liners is actually not as many as many outside the industry believe (the disadvantageous location of other decent ports, Bremerhaven and Hamburg, is simply too significant to pose any real threats to Rotterdam for the British and the Iberian Peninsula transhipment markets). With such understanding, it is not insensible to argue that Rotterdam's current competitive position is largely a result of exploiting the weaknesses of its competitors. Actually, Rotterdam's current competitive position confirms PCM's argument where the availability of decent choices is an important component to ensure that the port competition game is really 'competitive'. Without decent choices, together with the rapid increase of transhipment

demands recently, liners are left with few options but to comply with Rotterdam and even the perceived poor custom procedures (see Chapter Four) cannot stop liners from using the port as a transhipment hub[80].

In terms of future prospect, most interviewees note that, in the immediate future, as long as Rotterdam can maintain its current service level, liners will continue to use the port frequently for transhipment and maintain its market share, although some interviewees do note that the port should take note about the potential price the port paid for its own success, notably increasing congestion within the port. However, in the long term, it will be more difficult for Rotterdam to maintain/enhance the strong competitive position that it enjoys at the moment. As mentioned above, except Scandinavia-Baltic market, there is a lack of real alternatives to challenge Rotterdam's position as the best transhipment hubs within the region. In other words, with better improvements and marketing strategies by other ports, perceptions of liners on their choices may change and whether Rotterdam can still maintain its current position is yet to be seen.

[80] During an interview with a senior official from RPM, he noted that the problem of inefficient custom procedure had already significantly improved by the summer of 2004. Nevertheless, by the time when the survey was taken (latter half of 2004), the impression of Rotterdam's custom procedures to liners was still regarded as the worst among the Core-Six Ports. This reflects the difficulty in removing human perceptions, especially negative ones, despite the fact that RPM had already outperformed other ports in terms of port promotion and marketing.

6.2. OTHER FACTORS IN AFFECTING THE CURRENT COMPETITIVE POSITIONS OF THE CORE-SIX PORTS

The strengths and weaknesses of ports are not enough in explaining their current competitive positions because not everything is under port's control and this section is going to address this issue further. This study has identified three major factors, namely effects of local market bases and cargo orientations, 'own goal' effects of vertical integration and strategic alliances and the role of the EU.

6.2.1. Effects of Local Market Bases and Cargo Orientations

Being the traditional trading centres of Western Europe, both Hamburg and Rotterdam are ports with strong local market bases and most liners regard these two ports as *must calls* in most of their liner routes, serving the industrial regions of North West Germany and Benelux respectively. From Table 6.4, it is clear that the two ports have enjoyed the advantage of being a popular port which is called most frequently where among a total of 36 major liner services, Hamburg and Rotterdam had been called 29 and 36 times respectively while these two ports have occupied a share of nearly 50% in North European handling market.

Such a traditionally strong market base is helped by the orientation of Hamburg and Rotterdam towards the Far East market. As mentioned above, Far East is the region where cargo volume is increasingly most rapidly, especially after the participation of China into the WTO, which ensures that its volume growth becomes even more intensive, mainly due to the rapid increase of FDI in the country's manufacturing sector. Since the turn of the century, FDI into China's manufacturing sector has increased by 150% (see Table 6.5).

Table 6.5. Contracted FDI into China's manufacturing sector, 2000 – 04

YEAR	FDI IN MANUFACTURING SECTOR	ANNUAL GROWTH RATE	PORTION OF MANUFACTURING SECTOR IN TOTAL FDI IN CHINA
2000	€ 36,960,000,000	----	71%
2001	€ 40,796,000,000	10.38%	71%
2002	€ 49,501,000,000	21.34%	72%
2003	€ 67,438,000,000	36.24%	70%
2004	€ 91,652,000,000	35.91%	72%

Note: Figures were initially expressed in USD and converted to Euros using the exchange rate: 1USD = 0.835 Euros. Source: COSCO (2005)

Such impressive growth also implies the rapid increase and export and thus increasing demand in containerised trade. As shown in Table 6.6, between 1995 and 2004, TEU throughput growth in Chinese ports has always been double figures (even in 2001 when 9-11 terrorist attack took place) and has occupied a much more important position in global container throughput than ever.

Table 6.6. Container throughputs in Chinese ports, 1995 – 2004

YEAR	TEU THROUGHPUT	ANNUAL GROWTH RATE	CHINESE PORTS' SHARE IN GLOBAL CONTAINER THROUGHPUT
1995	5,200,000	----	4.00%
1996	7,400,000	42.31%	5.00%
1997	10,800,000	45.95%	6.00%
1998	13,100,000	21.30%	7.00%
1999	18,300,000	39.69%	9.00%
2000	23,500,000	28.42%	10.00%
2001	26,500,000	12.77%	11.00%
2002	37,000,000	39.62%	14.00%
2003	48,000,000	29.73%	16.00%
2004	61,600,000	28.33%	17.00%

Note: Figures exclude Hong Kong, Macau and Taiwan. Source: Drewry (2005)

With China being the most significant container liner source, in terms of container volumes, trans-Pacific and Far East-European routes are the most important *trunk routes* nowadays in

container liner shipping (Drewry, 2005). Under such circumstances, the focus on the Far East has ensured that both Hamburg and Rotterdam could maximise their benefits from the changing global economy. Apart from being twice the size of trans-Atlantic routes in container volumes (see Table 6.2), further evidence can be identified from Table 6.4, where container shipping routes from the Far East are nearly three times the number of trans-Atlantic routes. In fact, the implication of the 'China Revolution' is best illustrated in Table 3.1 where its admittance into the WTO had led to a sudden massive container throughput increase at Rotterdam in 2004. As Far East-oriented ports, Hamburg and Rotterdam have clearly benefited from such trend (see Table 6.3).

Thus, strong local market base and Far East-oriented approach have affected the competitive position of ports in container transhipment. As discussed in Chapter Two, employing large container vessel makes economic sense only if it is often fully utilised. Thus, it is understandable that liners prefer to choose ports which do not only offer decent prices and services, but also possess a market size of which they can fill up as many containers as possible on their vessels (both port-to-port and transhipment). On the other hand, although customers of liners, shippers and freight forwarders, have no direct interest in transhipment hub choices, they are interested in choosing ports which are proximate to local markets to ensure that their cargoes can arrive just-in-time. Under such circumstances, they have *de facto* influenced transhipment hub choices since they expect their service suppliers to share their concerns and make a port choice decision which suits their interests. With the increasing vigorous competition between liners, it is little surprise that liners would answer their demands, while the employment of mega-size container vessels also ensures that containers

for transhipment are also loaded in the same vessels. After all, shippers and freight forwarders are the customers of liners and the latter also worries that about losing their customers (Ocean Shipping Consultants, 2004). In such case, Hamburg and Rotterdam have become the major beneficiaries. As shown in the survey, the two ports are also the most popular ports among customers of liners.

Under this situation, companies operating feeder vessels can virtually ensure that there would be a lot of business opportunities in these ports. With the arrival of more feeder vessels, the availability of choices becomes even better which further accelerates clustering. Lesser ports, on the other hand, find it more difficult to attract feeder vessels to come to their ports due to the shortage of cargo sources. Although it is a sensible assumption that feeder vessels follow deep sea ones, according to in-depth interviewees from liners, due to financial constraints, in the real world, experience suggests that feeder companies will consider introducing a new feeder route/change their destined transhipment hub only if at least 30 to 40 containers are being loaded on their vessels for each journey, something that most ports other than Hamburg and Rotterdam cannot always guarantee. It implies that most feeder companies prefer establishing their businesses at these two ports. Thus, liners also find Hamburg and Rotterdam as more attractive options as they have more frequent feeder services and choices available there (for Hamburg, it only refers to Scandinavia-Baltic market). Such interdependent relation between deep and short sea shipping companies has further strengthened the status of Hamburg and Rotterdam in North European transhipment market.

6.2.2. 'Own Goal' Effects of Vertical Integration and Strategic Alliances

From Chapter Two, virtually all existing studies in container shipping agree that, with the increasingly capital-intensive nature of the shipping industry and the formation of strategic shipping alliances, the bargaining power of liners become so strong that it has left ports in a limbo position in terms of competitive intensity. However, information obtained from the survey and in-depth interviews seem to indicate that the heyday of liners in their bargaining positions is undergoing gradual change and the balance of power has increasingly shifted towards the service suppliers.

Apart from the strength of competitors which had been discussed before, there are two further reasons in explaining such change. Firstly, it involves the demand for ports and transhipment services. Apart from its cargo volumes, the 'China Revolution' has also posed considerable transhipment hub choice limitations on liners through altering the global shipping landscape. For example, according to economic forecasts, China's garment production increases so dramatically that its current global proportion of 20% will rise to 40% towards the end of this decade (BBC, 2005). Actually, such effects have already been felt in the autumn of 2005, where vast amounts of Chinese garments being agglomerated at the major North European ports due to quota and custom clearance problems between China and the EU and this has an extremely significant implication on transhipment demands. Since vast capital investments and substantial time for construction are required, the supply of container stevedoring and transhipment facilities is increasingly becoming difficult to keep pace with increased demands, signified by the fact that most major transhipment hubs in North Europe have experienced a certain degree of congestion in the last few years. As mentioned before,

container throughput growth of Rotterdam in 2004 serves as a good example in showing how the port has benefited from the increase exports from China (see Table 3.1) despite the existence of various problems within the port notably congestion. Unlike the beginning of the millennium, now most major North European ports hardly have any more berthing slots to accommodate any significant increase in container throughputs.

Although several new terminals will be unveiled in the next few years (like Antwerp, Le Havre and Rotterdam), with the perceived sustained growth of the East Asian market in this coming decade, it seems that these increased supplies can be fully absorbed by increased demands quickly. Under such circumstance, a more permanent trend of a more balanced power between port service suppliers and users is going to take place. In fact, some liners also sense this change and this partly explains the increasing number of liners undertaking vertical integration (i.e. constructing dedicated terminals) or forming *strategic-partnerships* between them and port operators. A good example is the joint project of Rotterdam's *Euromax* between ECT and P&O Nedlloyd. As a senior official of a liner put it, *the future strategies of liners have to be more creative than before since the effectiveness of conventional bargaining methods is declining year after year*. In this sense, *hub-hopping* (World Bank, 2000) is no longer the invincible bargaining weapon of port users and prompted them to be more cooperative with service suppliers.

Secondly, liners have also dropped into the QWERTY paradox where their self-created strategies in the form of strategic shipping alliances and vertical integration have seriously backfired. As nobody wants to be left behind, virtually all liners have introduced container

services and purchased large vessels, of which these hardware components were followed by software ones e.g. changes in management philosophy, mergers, alliances, etc. According to interviewees, the initial objectives of forming strategic shipping alliance were to enhance efficiency for vessel deployment, to increase frequency and to increase geographical coverage and port choice was never really a serious consideration. Such ignorance has created a serious problem. Within an alliance, due to contractual agreements, common agreement between members is needed before moving to another port can take place. A notable example is the Grand Alliance, where the contractual arrangement aims at creating a very close integrated alliance system with close integration between members, notably the fact that alliance members must use certain member-run container ports/terminals unless there are 'very good reasons'. Such obligation has created significant inflexibility in port choices. Another example can also be found in the New World Alliance. According to a senior official of APL, as an alliance member, in 2004, APL planned to move a substantial portion of its transhipment containers away from Rotterdam to Bremerhaven. However, this has been fiercely opposed by alliance members and conflicts had arisen and this finally led to the abandonment of the plan due to pressure from other alliance members. Thus, it becomes a significant factor in decreasing the bargaining power of port users when negotiating with service suppliers, not helped by the fact that ports no longer possess enough empty berthing slots to accommodate large-scale changes in transhipment hub choices by strategic shipping alliances.

Apart from inflexibility, relationship within alliance is increasingly becoming difficult to manage due to the expansion of strategic alliances. It is not uncommon that four to five

members exist within an alliance or even more. Predictably, differences and conflicts between members have increased, as various interviewees from liners have admitted, that *getting consensus within alliance members is becoming more and more difficult*, while one interviewee even goes further and argues that *strategic alliance is likely to lose its strong bargaining status without reducing the number of members within itself.* This is especially true since a company which belongs to a particular alliance usually design their liner routes and port rotation with the objective of complementing other members in order to achieve wider geographical coverage and a change of heart of one member stimulates changes in the whole routing network structure within the alliance and can involve significant adjustment costs e.g. vessel deployment, explaining the new arrangements to customers, etc. Thus, rather than catalyst, the increase of membership in strategic alliance is increasingly becoming a burden to effective negotiations and bargaining with ports. Simply speaking, the cost of altering the software components has increased significantly. While the establishment of the shipping alliances was initially supposed to enhance the bargaining power of port users, empirical evidence suggests that shipping alliances have both pros and cons because alliance commitments have restricted the individualities of the actions of its members.

The problems of strategic alliances have also been found in vertical integration by liners mainly due to the existence of sunk costs. As discussed in Chapter Two, container liner industry has become increasingly capital-intensive and any investment decisions on port facilities could involve millions or even billions of Euros which implies the significant increase of sunk costs (Brooks, 2000). Under such circumstances, the adjustment costs of

changing port choice can increase significantly because leaving a particular port also implies giving up the facilities of which the liner has invested heavily there.

In some cases, the interests between vertical integration and strategic alliances have even led to conflicts, as illustrated in the following clash between P&O Nedlloyd and the Grand Alliance on the choice of transhipment hub in Western Europe. Despite the attractiveness of alternative ports, P&O Nedlloyd has an inertia to use Rotterdam as transhipment hub because the company also operates the freight railway line, the ERS, which connects Rotterdam with the landlocked regions in Europe (containers destined for inland and transhipment are usually loaded on the same mega-sized vessels), while its joint *Euromax* project with ECT is perceived to boost its obligation in using Rotterdam even further. However, as a member of the Grand Alliance, where members were required to use terminals operated by other members, P&O Nedlloyd faces increasing pressures from other alliance members to change its transhipment hub choice to Amsterdam, where NYK is currently operating a terminal there. This has led to a serious dilemma for P&O Nedlloyd because substantial cash has been injected in ERS and *Euromax* while they found few economic justifications from shifting its transhipment hub choice. Nevertheless, its allies have overwhelmingly rejected such vast capital investments as a *good reason* to exempt P&O Nedlloyd from fulfilling its obligations. Negotiations have carried on for some time and a compromising deal had finally struck, with P&O Nedlloyd shifting some of its liner services to Amsterdam in exchange for its allies to accept its otherwise exemptions from using ally-operated terminals.

The above cases illustrate that, on the one hand, while liner decisions in achieving economies of scope had made their market less contestable (Haralambides, 2004), on the other hand, they cannot always make profit-maximising decisions in transhipment hub choice even if they want to. Especially for the major liners, the choice of transhipment hubs has become a 'quasi-political process' and final outcomes often reflect the tough negotiations and compromises between different allies rather than just the economic interests of individual ones which have been further complicated by the increasing cooperation between liners and port/terminal operators. As an interviewee has noted, although *liners are not necessarily profit satisfiers, they know that they have virtually no chance to maximise their gains under such circumstances. Thus, what they can do is to 'play politics' and undergo the process of pork-barrelling.* To a certain extent, it makes sense to argue that strategic alliances and vertical integration had made liners 'scoring own goals' in terms of their choice flexibilities and bargaining positions.

Interestingly, such inflexibilities due to strategic alliances and vertical integration have also led to winners and losers between different ports, where traditional ports of Rotterdam and Hamburg are the major beneficiaries while other decent competitors, notably Antwerp and Bremerhaven, suffer. As mentioned before, agglomeration effects have enabled Rotterdam and Hamburg to form clusters with the presence of a large number of ocean-carriers and frequent feeder services. With increased costs in altering software components, inertia has been created which means that most liners have firmly signified their presences in these two ports.

Moreover, in the cases of Hamburg and Rotterdam, such agglomeration of players related to port and shipping industries have made 'network effects' come to the surface, where heterogeneous industries with strong interplay between component networks become possible. According to Laird et al. (2005), the establishment of transport networks create further chances in the transport market and likely to create all sorts of transactions and human behaviours which are unlikely to be captured in a conventional economic system model, termed as *positive consumption externalities*. For example, as agreed by many interviewees, liners would like to locate their vessels at ports where their containers can be loaded on feeder vessels virtually at any time they like and they would also like to have close contacts with companies which provide such services. In this sense, they agree that, at the moment, only Rotterdam and Hamburg (only Scandinavia-Baltic market) can fulfil customers with such advantages. Facing with similar quality of services provided by Antwerp, Bremerhaven, Hamburg and Rotterdam, it should not be too surprising that most liners would prefer the latter two as their transhipment hubs. In this case, the effects of 'port clustering' have affected the competitive position of ports.

The own-goal effects of strategic alliances and vertical integration and the implications of network effects have further strengthened the perceptions of liners in transhipment port choices favouring the major ports. The above factors have largely explained the dominance of traditional ports on the North European transhipment market while minnows like Southampton, despite significant improvements in transhipment facilities, still cannot benefit much in the market[81]. The above also explains clearly the reasons behind Rotterdam's

[81] In year 2004, transhipment traffic occupies only 3% of all container throughputs within the port (SCT, 2004). According to interviewees, although the port has recently improved its transhipment facilities significantly, it seems

domination and competitiveness in North European transhipment market, as well as why Bremerhaven suffers in this aspect.

From this sub-section, it shows that liners are actually widely restricted when making their choices. The presence of QWERTY paradox, strategic alliances, vertical integration, quasi-political process, network effects and perceptions implies that liners are further 'locked-up' in just one or two port(s), despite the fact that decent alternative choices are available. Also, analysis here supports the notion that economies of scale do not only have a hardware aspect, but also a software aspect. While some scholars, like Cullinane and Khanna (2000), are still arguing among themselves about the maximum vessel size that a port can possibly handle, in fact, they have clearly neglected the fact that diseconomies of scale have seem to take place already due to the increasing difficulty to maintain the software components created by liners themselves.

6.2.3. The Role of the European Union

The role of the public sector in contributing to the competitive position of different North European ports in container transhipment has been largely discussed above. However, there is a supra-national organisation should be mentioned here namely the EU. In theory, given the anarchic nature of the liner shipping industry (since liners are free to design their port rotations according to their wishes as the open sea is largely free from any governmental influence), the EU should not play any significant role in this aspect. As an interviewee has claimed, *container transhipment is just based on corporate policy and had nothing to do with*

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that it does not make much difference since most liners perceive Southampton as a not-so-good transhipment hub.

Brussels. However, deeper investigations seem to suggest otherwise, albeit in a limited rather than a pivotal role.

With a traditional negligence of port and maritime transport by EU statesmen (Pallis, 2002), it is necessary to explain briefly why the EU became interested in European port policy recently. Since the late 1990s, the EU statesmen has actively promoted SSS as an alternative for other transport modes, notably road vehicles and they believe that port performance is a critical factor in deciding its success[82]. Thus, since the turn of the millennium, EU statesmen attempted to propose common port policies among EU members with the objectives of modernising port capacity, ensuring free and fair competition between ports, integrating ports into the EU's Common Transport Policy and socially accepting port development (Chlomoudis and Pallis, 2002). These objectives, especially the second one, have posed some significant implications on the competition for container transhipment.

Due to the presence of EU policies, certain co-operation and possibly even communications between ports can be deemed as distorting free and fair competitions and should be disallowed. For example, according to an interviewee from PoF, any substantial information exchange between Felixstowe and other ports, especially Rotterdam, can be regarded as anti-competitive behaviour and probably possibly face legal challenges from the EU. In fact, although some cooperative measures still exist between ECT and PoF, the EU's rigidity on this issue has limited many cooperative strategies them. According to the same interviewee,

[82] According to the EC, SSS is defined as 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 (European Shortsea Network, 2004). In other words, SSS here includes both feeder and direct intra-European shipping routes.

since the millennium, Felixstowe has put considerable efforts to *convince* EU statesmen that *they are competing vigorously in container stevedoring business with competitors, especially Rotterdam* (as they were both under HPH and EU statesmen often fear the possibility of market dominance). Such a view is shared by its counterpart. According to the interviewee from ECT, apart from exploring new opportunities, creating a *competitive showcase* to the EU is another *hidden* reason in explaining why Rotterdam is so keen to undertake various studies on the British transhipment market in order to show that *ECT is even willing to compete with ports owned by the same operator, notably PoF.*

Another example of the influence of EU on port and transhipment hub competition can be given from the negotiations of the *Euromax* project between ECT and EU. It was virtually an open secret within the industry that Brussels is concerned with the continuing presence and perceived dominance of multinational port corporations in Europe since the European Commission (EC) fears that this process contradicts EU's objective of promoting free and fair port competition. Such fear was best illustrated in 1999, when HPH attempted to buy ECT which led to complaints and intervention from liners and EU respectively (Asian Shipping, 1999). Thus, the EU is rather sensitive to any investment projects by HPH and the latter is all too clear to understand this, notably with the *Euromax* project which can significantly increase Rotterdam's container-handling capacity and thus transhipment abilities.

Negotiation on the issue was taken place between ECT and EU in 2004 and the former was required to submit a report in order to evaluate the project's necessity, with the main issue

being Rotterdam's market share as many conventional published figures indicated that its share was at an EU unacceptable level[83]. To ensure that the project could go through, in the report, the project team of ECT was asked by the senior hierarchy to try every possible method to 'tune down' the recent TEU throughputs and transhipment's market share of Rotterdam (notably ECT) within North Europe so that it would go down to the EU acceptable level[84]. This case illustrates that it is wrong to assume that Brussels has no influence on competition between ports within the EU.

With the EU having an eye on competitive issues, it implies that cooperation and communication become limited and so lead to a lack of decent information exchange and thus mutual understanding between most ports. Thus, many ports construct their respective strategies purely based on guessing the strengths and weaknesses of their competitors. Possibly with a few exceptions, achieving a win-win situation is rarely the their objectives and multinational port operators are forced to operate their ports more or less similar to a franchise system where the perceived rewards of horizontal integration, like cost internalisation and information exchange, cannot be maximised.

Under such circumstance, some newer and lesser ports cannot enjoy maximum benefits from 'being under the same roof' with some traditional bigger ports. In other words, apart from improving their own attractiveness, 'alternative fast tracks' in enhancing the competitive

[83] According to interviewees, EU's acceptable level of market share should be significantly lower than 25% and ideally lower than 20%. As shown in Table 3.1, throughout the last decade, Rotterdam's market share in Europe has always been marginal to EU's acceptable level.

[84] Here it is unable to tell how much the figure concerned has finally been tuned down since the final report submitted to Brussels is confidential and thus inaccessible to the author. Nevertheless, the author knows that the report is finally accepted by EU and ECT is given the green light to get on with the project.

position of these lesser ports become difficult e.g. collective negotiations with liners, compromises on container-handling charge, etc. As a capital-intensive industry and the presence of perceptions of liners (see above), traditional bigger ports, notably Hamburg and Rotterdam, found that maintaining *status quo* would be favourable to them, while lesser ones, notably Bremerhaven, found themselves more difficult to enhance their unfavourable position.

The presence of the EU has two implications here. Firstly, EC's objective of creating free and fair port competition has ironically become less free and fair because the traditional bigger ports found it easier to maintain their dominating positions. Secondly, port competition also has a political aspect, and being used as a tool by both the EU and the private sector to fulfil their respective interests and objectives.

6.3. DISCUSSIONS

This chapter has investigated further reasons in explaining current port competitiveness the North European transhipment market and has discussed why the estimated market shares of some ports are not necessarily always equivalent to the real market shares. As illustrated in Chapter Five, while RMS of most ports is corresponding to their respective EMS, it is not the case for Bremerhaven and Rotterdam because of the existence of factors which affect customer decisions but not easily being reflected in their opinions. While it is not difficult to link the quality of port services with some factors e.g. poor public-private relations of Le Havre, water draught restrictions of Antwerp, etc., such cause-and-effect relationship of port performance can be more ambiguous with some other factors. For example, while the

implications of port efficiency on port user's choice can be easily captured through survey, it is more difficult to capture the implications of the traditional close ties between Bremerhaven and North America because historical reason is not necessarily linked to worse quality of port services. Moreover, although liners usually make their choices with reference to quality of service offered by different ports, decisions are not necessarily completely at their will due to various reasons, notably inertia and limitations. In other words, while some factors affect customer opinions, attractiveness of ports and thus choices, some others have similar implications on the final choice but less significance on opinions and port attractiveness.

The existence of these factors also explains the inability of the survey in capturing the implications of such factors is not due to the poor design of the questionnaire, but because the survey's primary objective is to estimate the attractiveness of ports through capturing customer opinions. This has exposed the potential limitations of the closed-ended questionnaire and this study illustrates how such limitations can be compensated through qualitative methodologies. Also, this chapter shows that making choice is not just a mathematical game and factors which reflect the very nature of humans (e.g. subjectivity, inertia, convenience, mistakes, emotions, etc.) and restrictions to rational decisions (e.g. history, policies, bargaining power, etc.) should not be excluded.

Also, this chapter shows that the bargaining power of liners is not as strong as most previous studies suggest due to increases in transhipment demand and adjustment costs in changing choices. Significant sunk costs, the QWERTY paradox, self-defeating effects from strategic alliances and vertical integration have led to compromising between liners and so decisions

are often made illustrating a balance between rational analysis and the outcomes of compromises and negotiations. This has deteriorated their flexibilities and has affected the competitive position of ports (where traditional ports are usually the beneficiaries). Thus, it means that 'availability of choices' in PCM (see Chapter Two) has become smaller for liners when compared to several years ago and, in many cases, they have to stick to their current transhipment hub choices. As a consequence, these factors have made liners becoming conservative when making their decisions. As empirical evidence has shown, the relations between liners and ports, especially traditional hubs, become more co-operative which also explains why the market shares of major ports like Hamburg and Rotterdam continue to be significantly higher than others. Such evidence may suggest that diseconomies of scale have already started to take place within container liner shipping.

Rather than existing independently, factors affecting transhipment hub choices are interdependent with each other. The objective conditions (i.e. attributes within generalized cost, see PCM) are the results from various factors including government policies and public-private relationships, while the final competitive position of a port is also affected by 'non-Assessment Process' factors (see Chapter Two), notably marketing and negotiations. Container transhipment is, in fact, just another business and port users like to feel respected and well-treated as customers when making their choices.

Moreover, any positive perceptions on ports is not just a direct result of monetary cost, location, efficiency and service quality, but also depends on how successfully a port can persuade its potential customers that it possesses the ambition and desire to amend its current

disadvantages and move forward. As illustrated earlier, the inability to adjust to new circumstances and progressive visions has largely explained the failure and success of Bremerhaven and Rotterdam respectively, despite the fact that both ports possess similar quality in providing transhipment services to customers. On the other hand, poor relations between different sectors within the port do not only result in poor performance, but also negative perception by customers by doubting its ability to handle containers effectively, as illustrated by the poor public-private relationship of Le Havre. As a consequence, together with the restrictions mentioned above, despite the existence of strong wordings or even threats from them (as in-depth interviewees from port operators have noted), liners are not always ready to stimulate mass exodus, at least in the short term. In this aspect, the traditional bigger ports have benefited from such commitments by their counterparts.

However, this chapter also suggests that a port can possibly benefit from perceptions and inertia only if it possesses decent quality of service to its customers. As illustrated from Felixstowe and Le Havre, marketing efforts are unlikely to remove the negative opinions by liners on poor port performance. Poor services have played significant roles in ensuring the rather low RMS of Felixstowe and Le Havre in the North European transhipment market. More importantly, low RMS is usually due to poor port performance rather than perceptions or factors outside port's control. For example, for Le Havre, it is due to its failure to resolve the conflicting relations between public-private sectors while for Felixstowe, it is mainly due to the unwillingness to change the philosophy of the management hierarchy. As an interviewee (from port authority) has noted, *as long as they are satisfied, customers are not always ready to change with better alternatives available, but they are always ready to*

change if they are dissatisfied. The difference between EMS and RMS and analysis in this chapter suggests that MNL may have a tendency to overestimate the probability of changing transhipment hub choices as it fails to capture disturbances (see Chapter Seven). The above factors imply that liners do not always behave as profit maximisers.

Low performing ports like Felixwstowe and Le Havre fail to achieve high shares in the North European transhipment market are mainly due to their failures in satisfying port users. There are few excuses for poor port performance and the improvement prospect of these ports completely lies in their own hands. Before these poor performing ports finally give liners some overall positive impressions, factors like perceptions and history do not really matter in their competitive positions. In short, a port which possesses decent quality of services can only ensure that it qualifies to be considered by port users in 'the game', while its final competitive position also depends on negotiations between port users as well as the strategies, marketing efforts and bargaining skills between ports and their potential customers. Such results fully correspond to the explanations of PCM (see Chapter Two) where it argues that port performance only acts as one of the many factors in deciding the port competitiveness.

Although liners have their restrictions, port personnel should understand that competitiveness comes only if they are alerted to the needs of their customers. With the rise in transhipment traffic, the traditional belief that ports can guarantee users due to geographical advantages becomes obsolescent and maintaining such belief will only make the 'Mismatch in Anticipation' (MiA) problem (see Chapter Two) even worse between suppliers and users. From the success of Rotterdam, one can also find that ports can become more competitive if

they actively take the initiative to understand their customers rather than just sitting in their offices and guessing what customers need. The vision in understanding customer needs is especially important for lesser ports like Bremerhaven and Felixstowe if they want to move forward as inertia, port clustering and increasingly inflexibility of liners mean that it is now more difficult to lure significant transfer of container traffic from one port to another.

Furthermore, the question about the most important factors in affecting the competitive position of a port has been resolved. This study shows that, while there are several important attributes in explaining the decisions, there is no single factor which can dominate others. Quoting the editor from Containerisation International, port choice decision-making process is *often based on the attractiveness of packages offered by different ports consisting of various components including both quantifiable and less-readily quantifiable factors under individual circumstances. No single factor can always stand out under every scenario.*

Furthermore, analysis suggests that the extra competitive edge of Rotterdam is not just based on its advantageous geographical location or much better quality of services, but largely thanks to customer perceptions, port clustering, better port promotion and marketing, better public-private coordination, progressive vision and market focus and, perhaps most importantly, the lack of real alternatives to customers due to various problems of other ports. Here it seems clear that vast investments and hardware improvements are not the only ways to improve port competitiveness. Although dramatic changes in port competitiveness do not seem very likely in the short term due to restrictions of liners, through improving software aspects e.g. changing management philosophy, improving public-private relations, better

promotion and marketing strategies, better communications with customers, etc., it is still a realistic possibility that other ports can gradually improve their competitiveness in the foreseeable future.

Also, the case study here finds that port competitiveness has no direct relations with the structure of port administrative systems but depends on 'how to execute' the system and makes it work. As indicated by Felixstowe and Le Havre, they adopt very different administrative systems but both fail to compete effectively due to different reasons. On the other hand, the cases of Hamburg and Rotterdam suggest that good coordination between different sectors is an important factor which allows a port to enhance its PA in PCM (see Chapter Two) and thus enhances its chance to compete successfully. Such results support the introduction of effective 'governance' (see Chapter Two) into port administration which can be a good catalyst in strengthening the competitive positions of ports[85].

Finally, this chapter fully justifies the arguments of PCM in deciding port competitiveness where 'Assessment Process', 'Values and Perceptions' and 'Negotiation Process and Marketing' (NPM) mostly explain the decisions of liners in transhipment hub choices (see Chapter Two). However, the Assessment Process, which includes factors in deciding port performance, is only the 'qualifying round' for ports to achieve competitiveness. Once they have qualified, ports still need to get through further stages in terms of NPM and achieving positive Values and Perceptions (e.g. positive consumption externalities from network effects, convincing port users to concluding agreements with ports, etc.). All these three components of the 'Endogenous Condition' are mutually dependent on each other, while 'Chance' and

'Exogenous Condition' will also affect the final outcome in some cases. In the North European transhipment market, both Felixstowe and Le Havre fail to qualify due to poor performance, whilst Antwerp and Bremerhaven are typical examples failing to play the game to their interests[86]. Under this situation, it leaves Hamburg and Rotterdam as the major beneficiaries in the North European transhipment market.

[85] See Ng (2002) and Wang and Slack (2002) on the application of the concept of governance into port administration.
[86] To a certain extent, Antwerp fails to qualify fully in playing the game mainly due to physical constraints. However, throughout the years, it tries hard to improve the situation, despite various political constraints and other comparatively unfavourable aspects as mentioned in this chapter.

CHAPTER SEVEN
FUTURE PROSPECTS OF PORTS IN NORTH EUROPEAN CONTAINER TRANSHIPMENT MARKET: AN ECONOMIC FORECAST

Apart from understanding the current competitiveness of ports, it is also important to predict their future competitiveness. This does not only give ideas on the problems and challenges that ports are likely to anticipate in the foreseeable future but also enhances their chances of making better decisions and effective development strategies and this usually involves the construction of a forecasting model through applying econometric technique. Also, the calibration of forecasting models is beneficial for academic research because forecasting model yields important information on the nature of relationships between variables (Flowerdew and Martin, 1997). As mentioned in Chapter Three, a Logistic Regression Model (LRM) will be constructed for such purpose.

This chapter is divided into four sections. Section 7.1 discusses the strategies in constructing the LRM and tests its reliability of forecasting. In Section 7.2, the future anticipated prospects of different ports will be forecasted. Finally, Section 7.3 offers some recommendations on the development strategies of the Core-Six Ports in the North European container transhipment market.

7.1. LOGISTICS REGRESSION MODEL

7.1.1. Construction Strategies

According to Hensher and Button (2000), an economic forecasting model is not to replicate the entire structure but seeks to isolate key relationship so as to help explain behaviours. Such view is supported by Vickerman (2004) who argues that forecasting model is not required if the reality is simple enough to be understood entirely. In other words, rather than searching the perfect fit, one should construct a model which best fits the issue concerned. This implies the need of a good strategy when constructing the LRM.

In constructing the LRM, two approaches are most commonly used, both with pros and cons (Washington et al., 2003). The first approach is called *stepwise regression* where user selects various criteria to decide the LRM in terms of its goodness of fit and significance of the regression results e.g. R^2 [87], Adjusted R^2, *F* statistic[88], etc. The second approach is called *best subsets regression* which is a procedure to fit all permutations of the *p*-value[89]. With such understanding, both methods are included for consideration when constructing the criteria in determining the LRM.

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[87] R^2 is the square value of Pearson's product-moment correlation coefficient which measures associations between interval variables. The size of R^2 is decided by the spread of the actual observations around the regression model. See Frankfort-Nachmias and Nachmias (1996) and Washington et al. (2003).

[88] *F* statistic measures the loss of fit that results when all the coefficients of the LRM except the intercept are zero. The null hypothesis is rejected when *F* is larger than the critical value. See Greene (1990).

[89] The *p*-value tests the probability of which the coefficient values of the LRM's attributes is obtained only due to chance. In other words, the *p*-value is the smallest level of significance which leads to the rejection of the null hypothesis. Usually, the *p*-value should not exceed 0.05 in order to reject the hypothesis. See Greene (1990) and Washington et al. (2003).

The author has decided that the best LRM should possess four criteria. Firstly, it should possess the highest coefficient of determination i.e. the highest Adjusted R^2 (see Appendix C1)[90] compared to all other simulated LRMs. Secondly, *F* should be higher than the critical value of 2.69. Thirdly, all its coefficients must possess *t* values higher than the critical value of +/-2.03. Finally, all its coefficients must possess *p*-values smaller than 0.05.

With the strategy being discussed, it comes to the model-building procedure. With rapid developments in computational technology, the use of computers in LRM-construction has increased since the most problematic part i.e. the daunting task of iterating model-construction manually has been minimised and models can be simulated within a short period. According to Washington et al. (2003), modern researchers benefit remarkably from computing capability especially given the usual pressures to produce reliable results quickly. In fact, the use of computers in regression is not something new which has been well-documented e.g. Greene (1990), Kitchin and Tate (2000), etc. With such understanding, here LRM is also constructed with the assistance of the data analysis package included in Microsoft Excel. The remaining of this section will illustrate the results of the LRM-construction process, while the detailed computational process can be found in Appendix C1.

Among the simulated LRMs, two binary combinations fulfil all the mentioned criteria including ANR-BRV-LHV and HAM-BRV-LHV. With Adjusted R^2 values are being 0.6637 and 0.6479 respectively. Although HAM-BRV-RTM achieve a higher Adjusted R^2 value, it

[90] Adjusted R^2 is preferred to R^2 because the value of the latter always rises when another variable is added to the LRM until it reaches one. In contrast, the value of Adjusted R^2, based on DF, can rise or fall when a variable is added depending on the *t* ratio of the variable concerned which is, a more accurate indicator in measuring the LRM's fit.

does not achieve the *t*-statistic and *p*-value requirements. The modelled results of ANR-BRV-LHV, HAM-BRV-LHV and HAM-BRV-RTM are presented in Tables 7.1, 7.2 and 7.3 respectively. Apart from binary LRMs, various multinomial LRMs have also been constructed with ANR-BRV-FLX-LHV (see Table 7.4) possessing the highest Adjusted R^2 while fulfilling all the criteria outlined. Nevertheless, its Adjusted R^2 value cannot match ANR-BRV-LHV while its coefficients and sum of squares (*SS*) do differ significantly from ANR-BRV-LHV (see Tables 7.1 and 7.4), not helped by the problem that multinomial model always gives uniform cross elasticities of demand values to different ports (see Section 7.2.2). Thus, the binary combination of ANR-BRV-LHV is selected as the LRM. With reference to Table 7.1, the final LRM can be expressed as:

$$Ln\left\{\frac{N_{(B)}}{\left[1-N_{(B)}\right]}\right\} = \qquad \textbf{[7.1]}$$
$$1.5214+(-1.1815)*\left[\varepsilon_{(ANR)}\right]+(-1.1319)*\left[\varepsilon_{(BRV)}\right]+(-0.9417)*\left[\varepsilon_{(LHV)}\right]+0.2778*\left[Z_{(B)}-Z_{(A)}\right]$$

Where N, ε and Z represent the new estimated market share, dummy variable/disturbance (see Appendix C1) and utility (i.e. GCCI) respectively.

Table 7.1. Logistic regression model – ANR-BRV-LHV binary combination

Regression Statistics	
Multiple R	0.8379
R^2	0.7022
Adjusted R^2	0.6637
Standard Error	0.8226
Observations	36

ANOVA	Df	SS	MS	F	Sig. F
Regression	4	49.4518	12.3630	18.2698	0.0000
Residual	31	20.9773	0.6767		
Total	35	70.4291			

LRM	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	1.5214	0.2150	7.0758	0.0000	1.0829	1.9599
Antwerp	-1.1815	0.3140	-3.7627	0.0007	-1.8219	-0.5411
Bremerhaven	-1.1319	0.4531	-2.4980	0.0180	-2.0560	-0.2077
Le Havre	-0.9417	0.3140	-2.9991	0.0053	-1.5821	-0.3013
GCCI Diff.	0.2777	0.0369	7.5277	0.0000	0.2025	0.3530

Note: All figures are corrected to four decimal places except those under the categories of observations (under regression statistics) and degrees of freedom (Df) (under ANOVA) which are corrected to the nearest unit.

Table 7.2. Logistic regression model – HAM-BRV-LHV binary combination

Regression Statistics	
Multiple R	0.8295
R^2	0.6881
Adjusted R^2	0.6479
Standard Error	0.8418
Observations	36

ANOVA	Df	SS	MS	F	Sig. F
Regression	4	48.4621	12.1155	17.0975	0.0000
Residual	31	21.9670	0.7086		
Total	35	70.4291			

LRM	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.9212	0.2006	4.5915	0.0001	0.5120	1.3304
Antwerp	1.3579	0.3900	3.4819	0.0015	0.5625	2.1532
Bremerhaven	-1.7712	0.4754	-3.7254	0.0008	-2.7409	-0.8016
Le Havre	-0.8655	0.3229	-2.6806	0.0117	-1.5239	-0.2070
GCCI Diff.	0.3270	0.0443	7.3882	0.0000	0.2367	0.4173

Note: All figures are corrected to four decimal places except those under the categories of observations (under regression statistics) and degrees of freedom (Df) (under ANOVA) which are corrected to the nearest unit.

Table 7.3. Logistic regression model – HAM-BRV-RTM binary combination

Regression Statistics	
Multiple R	0.8489
R^2	0.7207
Adjusted R^2	0.6846
Standard Error	0.7966
Observations	36

ANOVA	Df	SS	MS	F	Sig. F
Regression	4	50.7554	12.6889	19.9940	0.0000
Residual	31	19.6737	0.6346		
Total	35	70.4291			

LRM	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.1746	0.2122	0.8229	0.4169	-0.2582	0.6074
Antwerp	1.5385	0.3677	4.1840	0.0002	0.7885	2.2884
Bremerhaven	-1.1223	0.4591	-2.4446	0.0204	-2.0586	-0.1860
Le Havre	1.0036	0.2942	3.4113	0.0018	0.4036	1.6036
GCCI Diff.	0.3150	0.0422	7.4605	0.0000	0.2289	0.4011

Note: All figures are corrected to four decimal places except those under the categories of observations (under regression statistics) and degrees of freedom (Df) (under ANOVA) which are corrected to the nearest unit.

Table 7.4. Logistic regression model – ANR-BRV-FLX-LHV multinomial combination

Regression Statistics	
Multiple R	0.8401
R^2	0.7058
Adjusted R^2	0.6568
Standard Error	0.8311
Observations	36

ANOVA	Df	SS	MS	F	Sig. F
Regression	5	49.7085	9.9417	14.3939	0.0000
Residual	30	20.7206	0.6907		
Total	35	70.4291			

LRM	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	2.4922	0.3841	6.4878	0.0000	1.7077	3.2767
Antwerp	-1.6706	0.3374	-4.9511	0.0000	-2.3597	-0.9815
Bremerhaven	-1.0548	0.3531	-2.9870	0.0056	-1.7760	-0.3336
Felixstowe	-0.9819	0.3317	-2.9604	0.0060	-1.6592	-0.3045
Le Havre	-1.2429	0.3313	-3.7518	0.0008	-1.9195	-0.5663
GCCI Diff.	0.2887	0.0371	7.7798	0.0000	0.2129	0.3644

Note: All figures are corrected to four decimal places except those under the categories of observations (under regression statistics) and degrees of freedom (Df) (under ANOVA) which are corrected to the nearest unit.

7.1.2. Forecasting Reliability Testing

Before getting on to forecasting, it is necessary to test the LRM's predictive reliability since one of the most important criteria for a good model is its ability in making sensible predictions (Hensher and Button, 2000). A good way to achieve this is to re-estimate the market shares of different ports (New EMS) and then test the results with statistical techniques. By inserting the figures of $Z_{(A)}$, $Z_{(B)}$, $\varepsilon_{(ANR)}$, $\varepsilon_{(BRV)}$ and $\varepsilon_{(LHV)}$ into equation [7.1], the newly estimated market shares (binary port-pair) (New EMS) are illustrated in Tables 7.5. To facilitate comparison, the figures of RMS and old estimated market shares (Old EMS) are also presented in the same table. In Table 7.5 (also Table 7.6), RMS, New EMS and Old EMS are expressed as P, N and E respectively.

Note that figures in Table 7.5 are adjusted figures for 'binary port-pairs' i.e. $N_{(A)} + N_{(B)} = E_{(A)} + E_{(B)} = P_{(A)} + P_{(B)} = 1$. To re-estimate the market shares, these binary figures need to be converted into agglomerate figures i.e. $N_{(ANR)} + N_{(BRV)} + N_{(FLX)} + N_{(HAM)} + N_{(LHV)} + N_{(RTM)} = 1$. The procedures of this conversion process can be found in Appendix C2, while the New EMS is presented in Tables 7.6. To facilitate analysis, New EMS is re-arranged into percentages and compared with RMS and Old EMS (see Table 7.7). To facilitate comparisons, the differences between EMS (old and new) and RMS have been calculated and presented in Table 7.8.

Table 7.5. Comparisons between new estimated market shares, old estimated market shares and real market shares (binary port-pair comparisons)

PORT A	PORT B	REGION	RMS			NEW EMS			OLD EMS		
			$Ln\{P_{(B)}/[1-P_{(A)}]\}$	$P_{(A)}$	$P_{(B)}$	$Ln\{N_{(B)}/[1-N_{(B)}]\}$	$N_{(A)}$	$N_{(B)}$	$Ln\{E_{(B)}/[1-E_{(B)}]\}$	$E_{(A)}$	$E_{(B)}$
HAM	ANR	U.K.	1.95	0.13	0.88	1.72	0.15	0.85	0.70	0.33	0.67
HAM	BRV	U.K.	0.00	0.50	0.50	0.41	0.40	0.60	0.08	0.48	0.52
HAM	FLX	U.K.	2.08	0.11	0.89	1.41	0.20	0.80	-0.41	0.60	0.40
HAM	LHV	U.K.	1.10	0.25	0.75	0.44	0.39	0.61	-0.52	0.63	0.37
HAM	RTM	U.K.	2.71	0.06	0.94	1.59	0.17	0.83	0.26	0.43	0.57
ANR	BRV	U.K.	-1.95	0.88	0.13	-0.97	0.72	0.28	-0.63	0.65	0.35
ANR	FLX	U.K.	0.13	0.47	0.53	0.03	0.49	0.51	-1.12	0.75	0.25
ANR	LHV	U.K.	-0.85	0.70	0.30	-0.94	0.72	0.28	-1.22	0.77	0.23
ANR	RTM	U.K.	0.76	0.32	0.68	0.22	0.45	0.55	-0.44	0.61	0.39
BRV	FLX	U.K.	2.08	0.11	0.89	1.39	0.20	0.80	-0.49	0.62	0.38
BRV	LHV	U.K.	1.10	0.25	0.75	0.41	0.40	0.60	-0.60	0.64	0.36
BRV	RTM	U.K.	2.71	0.06	0.94	1.57	0.17	0.83	0.19	0.45	0.55
FLX	LHV	U.K.	-0.98	0.73	0.27	0.55	0.37	0.63	-0.11	0.53	0.47
FLX	RTM	U.K.	0.63	0.35	0.65	1.71	0.15	0.85	0.68	0.34	0.66
LHV	RTM	U.K.	1.61	0.17	0.83	1.74	0.15	0.85	0.78	0.31	0.69
HAM	ANR	Scan-Baltic	-1.73	0.85	0.15	-1.59	0.83	0.17	-11.20	1.00	0.00
HAM	BRV	Scan-Baltic	-0.64	0.65	0.35	-1.43	0.81	0.19	-6.54	1.00	0.00
HAM	FLX	Scan-Baltic	-1.73	0.85	0.15	-1.69	0.84	0.16	-11.56	1.00	0.00
HAM	LHV	Scan-Baltic	-2.14	0.89	0.11	-2.68	0.94	0.06	-11.73	1.00	0.00
HAM	RTM	Scan-Baltic	-1.04	0.74	0.26	-1.53	0.82	0.18	-10.98	1.00	0.00
ANR	BRV	Scan-Baltic	1.10	0.25	0.75	0.50	0.38	0.62	4.65	0.01	0.99
ANR	FLX	Scan-Baltic	0.00	0.50	0.50	0.24	0.44	0.56	-0.36	0.59	0.41
ANR	LHV	Scan-Baltic	-0.41	0.60	0.40	-0.75	0.68	0.32	-0.53	0.63	0.37
ANR	RTM	Scan-Baltic	0.69	0.33	0.67	0.40	0.40	0.60	0.21	0.45	0.55

(Table 7.5 continued)

PORT A	PORT B	REGION	RMS			NEW EMS			OLD EMS		
			$Ln\{P_{(B)}/[1-P_{(A)}]\}$	$P_{(A)}$	$P_{(B)}$	$Ln\{N_{(B)}/[1-N_{(B)}]\}$	$N_{(A)}$	$N_{(B)}$	$Ln\{P_{(B)}/[1-P_{(A)}]\}$	$P_{(A)}$	$P_{(B)}$
BRV	FLX	Scan-Baltic	-1.10	0.75	0.25	0.13	0.47	0.53	-5.01	0.99	0.01
BRV	LHV	Scan-Baltic	-1.50	0.82	0.18	-0.86	0.70	0.30	-5.19	0.99	0.01
BRV	RTM	Scan-Baltic	-0.41	0.60	0.40	0.29	0.43	0.57	-4.44	0.99	0.01
FLX	LHV	Scan-Baltic	-0.41	0.60	0.40	0.53	0.37	0.63	-0.17	0.54	0.46
FLX	RTM	Scan-Baltic	0.69	0.33	0.67	1.68	0.16	0.84	0.57	0.36	0.64
LHV	RTM	Scan-Baltic	1.10	0.25	0.75	1.73	0.15	0.85	0.75	0.32	0.68
ANR	FLX	Iberian Pen.	-1.61	0.83	0.17	0.17	0.46	0.54	-0.61	0.65	0.35
ANR	LHV	Iberian Pen.	-0.51	0.63	0.38	-0.77	0.68	0.32	-0.62	0.65	0.35
ANR	RTM	Iberian Pen.	1.10	0.25	0.75	0.34	0.42	0.58	0.00	0.50	0.50
FLX	LHV	Iberian Pen.	1.10	0.25	0.75	0.58	0.36	0.64	-0.02	0.50	0.50
FLX	RTM	Iberian Pen.	2.71	0.06	0.94	1.69	0.16	0.84	0.61	0.35	0.65
LHV	RTM	Iberian Pen.	1.61	0.17	0.83	1.70	0.16	0.84	0.63	0.35	0.65

Note: All figures are corrected to two decimal places.

Table 7.6. Comparisons between new estimated market shares, old estimated market shares and real market shares (six-port comparisons)

PORT A	PORT B	REGION	RMS		NEW EMS		OLD EMS	
			$P_{(A)}$	$P_{(B)}$	$N_{(A)}$	$N_{(B)}$	$E_{(A)}$	$E_{(B)}$
HAM	ANR	U.K.	0.03	0.20	0.05	0.30	0.15	0.30
HAM	BRV	U.K.	0.03	0.03	0.05	0.08	0.15	0.16
HAM	FLX	U.K.	0.03	0.23	0.05	0.22	0.15	0.10
HAM	LHV	U.K.	0.03	0.09	0.05	0.08	0.15	0.09
HAM	RTM	U.K.	0.03	0.43	0.05	0.26	0.15	0.20
ANR	BRV	U.K.	0.20	0.03	0.30	0.08	0.30	0.16
ANR	FLX	U.K.	0.20	0.23	0.30	0.22	0.30	0.10
ANR	LHV	U.K.	0.20	0.09	0.30	0.08	0.30	0.09
ANR	RTM	U.K.	0.20	0.43	0.30	0.26	0.30	0.20
BRV	FLX	U.K.	0.03	0.23	0.08	0.22	0.16	0.10
BRV	LHV	U.K.	0.03	0.09	0.08	0.08	0.16	0.09
BRV	RTM	U.K.	0.03	0.43	0.08	0.26	0.16	0.20
FLX	LHV	U.K.	0.23	0.09	0.22	0.08	0.10	0.09
FLX	RTM	U.K.	0.23	0.43	0.22	0.26	0.10	0.20
LHV	RTM	U.K.	0.09	0.43	0.08	0.26	0.09	0.20
HAM	ANR	Scan-Baltic	0.43	0.08	0.52	0.11	1.00	0.00
HAM	BRV	Scan-Baltic	0.43	0.23	0.52	0.13	1.00	0.00
HAM	FLX	Scan-Baltic	0.43	0.08	0.52	0.10	1.00	0.00
HAM	LHV	Scan-Baltic	0.43	0.05	0.52	0.04	1.00	0.00
HAM	RTM	Scan-Baltic	0.43	0.15	0.52	0.11	1.00	0.00
ANR	BRV	Scan-Baltic	0.08	0.23	0.11	0.13	0.00	0.00
ANR	FLX	Scan-Baltic	0.08	0.08	0.11	0.10	0.00	0.00
ANR	LHV	Scan-Baltic	0.08	0.05	0.11	0.04	0.00	0.00
ANR	RTM	Scan-Baltic	0.08	0.15	0.11	0.11	0.00	0.00

(Table 7.6 continued)

PORT A	PORT B	REGION	RMS		NEW EMS		OLD EMS	
			$P_{(A)}$	$P_{(B)}$	$N_{(A)}$	$N_{(B)}$	$E_{(A)}$	$E_{(B)}$
BRV	FLX	Scan-Baltic	0.23	0.08	0.13	0.10	0.00	0.00
BRV	LHV	Scan-Baltic	0.23	0.05	0.13	0.04	0.00	0.00
BRV	RTM	Scan-Baltic	0.23	0.15	0.13	0.11	0.00	0.00
FLX	LHV	Scan-Baltic	0.08	0.05	0.10	0.04	0.00	0.00
FLX	RTM	Scan-Baltic	0.08	0.15	0.10	0.11	0.00	0.00
LHV	RTM	Scan-Baltic	0.05	0.15	0.04	0.11	0.00	0.00
ANR	FLX	Iberian Pen.	0.21	0.04	0.25	0.29	0.24	0.13
ANR	LHV	Iberian Pen.	0.21	0.13	0.25	0.11	0.24	0.13
ANR	RTM	Iberian Pen.	0.21	0.63	0.25	0.35	0.24	0.24
FLX	LHV	Iberian Pen.	0.04	0.13	0.29	0.11	0.13	0.13
FLX	RTM	Iberian Pen.	0.04	0.63	0.29	0.35	0.13	0.24
LHV	RTM	Iberian Pen.	0.13	0.63	0.11	0.35	0.13	0.24

Note: All figures are corrected to two decimal places.

Table 7.7. Re-estimation of the market shares of the Core-Six Ports

PORT	U.K.			SCANDINAVIA-BALTIC			IBERIAN PENINSULA		
	RMS	New EMS	Old EMS	RMS	New EMS	Old EMS	RMS	New EMS	Old EMS
Antwerp	20.00%	29.88%	30.34%	7.50%	10.67%	0.00%	20.83%	24.67%	23.83%
Bremerhaven	2.86%	8.09%	16.21%	22.50%	12.53%	0.14%	0.00%	(N.A.)	13.06%
Felixstowe	22.86%	21.92%	9.95%	7.50%	9.66%	0.00%	4.17%	29.28%	12.98%
Hamburg	2.86%	5.37%	15.03%	42.50%	52.24%	99.85%	0.00%	(N.A.)	13.44%
Le Havre	8.57%	8.30%	8.94%	5.00%	3.59%	0.00%	12.50%	11.37%	12.78%
Rotterdam	42.86%	26.44%	19.54%	15.00%	11.32%	0.00%	62.50%	34.69%	23.90%

Note: RMS – real market share, New EMS – new estimated market share based on equation [7.1], Old EMS – old estimated market share. All figures are corrected to two decimal places.

Table 7.8. Differences between EMS and RMS: a comparison between new and old EMS

PORT	U.K.		SCANDINAVIA-BALTIC		IBERIAN PENINSULA	
	New EMS	Old EMS	New EMS	Old EMS	New EMS	Old EMS
Antwerp	-9.88%	-10.34%	-3.17%	7.50%	-3.84%	-2.99%
Bremerhaven	-5.24%	-13.36%	9.97%	22.36%	(N.A.)	-13.06%
Felixstowe	0.94%	12.91%	-2.16%	7.50%	-25.11%	-8.82%
Hamburg	-2.51%	-12.17%	-9.74%	-57.35%	(N.A.)	-13.44%
Le Havre	0.27%	-0.36%	1.41%	5.00%	1.13%	-0.28%
Rotterdam	16.41%	23.31%	3.68%	15.00%	27.81%	38.60%

Note: All figures are corrected to two decimal places. A positive figure indicates that the value of EMS is larger than that of RMS.

Table 7.7 indicates that the New EMS is significantly more accurate than the old EMS. This is especially significant for Scandinavia-Baltic, where the extreme figures derived from the MNL have largely been replaced by much more sensible ones. Significant improvements can also be found in the UK, where LRM gives much better forecasts than MNL, especially for Bremerhaven, Felixstowe and Hamburg. Although the improvement is less dramatic in the Iberian Peninsula, the LRM is still able to highlight Rotterdam as the dominating container transhipment hub towards this region.

Apart from direct comparisons, the forecasting reliability of the LRM can also be measured through more objective means namely Mean Absolute Error (MAE), a technique in summary statistics measuring the absolute difference between a particular element and a given point. According to Greene (1990), MAE would *reflect {LRM's} ability to track turning points in the data.* MAE can be expressed as:

$$MAE = \frac{\sum |(E - R)|}{\sum (R)} \qquad \textbf{[7.2]}$$

Where R and E represent RMS and EMS (either new or old) respectively. The smaller the MAE value, the better the LRM's forecasting power. By applying equation [7.2], the MAE values can be found in Table 7.9.

Table 7.9. Comparisons of absolute deviations between new and old EMS

REGIONS	NEW EMS	OLD EMS
U.K.	0.35	0.72
Scandinavia-Baltic	0.30	1.15
Iberian Peninsula	0.58	0.77
All Regions Combined	0.41	0.88

Note: All figures are corrected to two decimal places

Table 7.9 indicates that equation [7.1] is significantly better than MNL in predicting the future competitive positions of ports in North European transhipment market with the MAE of all regions strongly in favour of the New EMS.

7.2. FORECASTING THE FUTURE PROSPECTS OF PORTS

LRM-construction is an important step to forecast the future prospects of North European ports in the transhipment market as prediction is one of the most important functions of regression (Greene, 1990). As mentioned before, predicting the future prospects of ports is necessary so as to strengthen the value of contribution of this study to the transport discipline. Understanding that the Core-Six Ports often strive to improve their attractiveness nowadays, it is useful to forecast the implications on market shares when ports lower their generalized costs. As supported by Song and Han (2004), this step is necessary because it provides important benchmarks so that the competitive positions of ports can be assessed relative to others. The future competitive positions of ports can be assessed through three scenarios:

1) Implications on its own market share when a particular port lowers its generalized cost i.e. own elasticity of demand;
2) Implications on other ports' market shares when a particular port lowers its generalized cost i.e. cross elasticity of demand.
3) Implications on ports when all the ports studied here lower their generalized costs i.e. conditional elasticity of demand.

In the following scenarios, two types of elasticities will be calculated, namely point and average elasticities. The former method estimates elasticity on a particular point which is usually used when only relative small changes in utility/price occur, whilst the latter method estimates market share changes when more significant improvements are made.

7.2.1. Scenario One: Own Elasticity of Demand

This scenario investigates the implications on its own market shares if a port improves itself. Based on equation [7.1], the point own elasticity of demand (η_{op}) can be expressed as equation [7.3]. The procedures of getting the equation [7.3] (and equation [7.5], see next sub-section) can be found in Appendix C3. Note that the elasticity values calculated from equations [7.3] (and equation [7.5]) uses multinomial rather than binary approach.

$$\eta_{op} = -\beta * [1 - N_{(A)}] * \frac{C_{(RTM)}}{C_{(A)}} \qquad \textbf{[7.3]}$$

Where $N_{(A)}$ and $C_{(A)}$ represent the market share and generalized cost of Port A[91] respectively, while $C_{(RTM)}$ represents the generalized cost of the port of Rotterdam. By applying equation [7.3], the η_{op} values are presented in Table 7.10.

Table 7.10. Point own elasticities of demand of the Core-Six Ports in serving container transhipment to different regions

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA
Antwerp	-0.32	-0.20	-0.22
Bremerhaven	-0.22	-1.17	(N.A.)
Felixstowe	-0.07	-0.11	-0.10
Hamburg	-0.20	-1.91	(N.A.)
Le Havre	-0.06	-0.07	-0.09
Rotterdam	-0.16	-0.24	-0.10

Note: All figures are corrected to two decimal places.

The following example indicates how Table 7.10 can be understood. When Antwerp lowers its generalized cost by one percent while all other ports remain constant, its market share in the UK is anticipated to increase about 0.32%. Here some observations on the immediate futures of the Core-Six Ports can be identified[92]. For the UK, the relations between market share and generalized costs are inelastic with the η_{op} values of all ports under one, Antwerp seems have the best prospects for future developments which is followed by the German ports and Rotterdam, while Le Havre and, interestingly, Felixstowe, benefit little from such slight improvements. Such observations suggest that these low-performing ports need to undertake dramatic reforms to address these unfavourable circumstances. The situation is

[91] Note that equation [7.1] is based on utility rather than generalized cost. However, generalized costs should be used in forecasting because it is a monetary term while GCCI is only an expression which helps to 'sensiblise' the relation between market shares and utility. Nevertheless, a percent increase in GCCI is actually nearly equivalent to the same percent decrease in generalized cost (see Appendix C4).

[92] Of course, one percent changes in generalized costs between two ports are not necessarily the same e.g. in this case, one percent change in Rotterdam's generalized cost is certainly different from that of Le Havre. However, in accordance with the calculation of elasticity, this sub-section (and the following sub-sections) focuses on how market share changes when ports lower their generalized costs by the same percentage.

quite similar for the Iberian Peninsula, with Antwerp a frontrunner and Felixstowe, Le Havre and Rotterdam lagging behind, although in a rather inelastic fashion. Results here suggest that, in the foreseeable future, port competition in transhipment in these two regions should be rather stable. Port competition is likely to be more intensive in the Scandinavia-Baltic transhipment market, although the contenders for leadership in this region are likely between the German ports. Although Benelux ports also possess some competitive edges, they are significantly less than their German counterparts. Similar to the UK and the Iberian Peninsula, without dramatic changes taking place, the competitive positions of Felixstowe and Le Havre should remain stagnant.

However, here poses a big question mark on Rotterdam. Although Rotterdam is a current leader in the market, it is anticipated that it will become increasingly difficult to sustain such status, with Antwerp and the German ports snapping at its heels in different regions. Rotterdam is facing serious challenges from all three fronts and some new development strategies seem necessary. While Antwerp possesses decent potential in gaining British and the Iberian Peninsula transhipment business, the German ports, especially Hamburg, seem to further consolidate their positions in Scandinavia-Baltic, although they seem to have bright prospects acting as transhipment hubs directed towards the UK too.

The major weakness of point elasticity is that it only estimates the immediate future of ports while more significant changes are not considered. As discussed before, in reality, many port projects involve massive capital investments of which their objectives are unlikely just to improve their attractiveness marginally. To address this problem, average elasticity can be

used. The implications on their own market shares when ports their respective generalized costs in the UK, Scandinavia-Baltic and the Iberian Peninsula transhipment markets are presented in Figures 7.1, 7.2 and 7.3 respectively where the details of their linear functions are presented in Table 7.11.

Using Table 7.11, the average own elasticity of demand (η_{oa}) for a linear function ($Y = \beta^* X + C$, where Y and X represent market share and generalized cost respectively) of Port A can expressed as:

$$\eta_{oa} = \frac{\Delta Y_{(A)}}{\Delta X_{(A)}} * \frac{X_{(A)}}{Y_{(A)}} = \beta * [\frac{X_{(A)}}{Y_{(A)}}] \qquad \textbf{[7.4]}$$

By applying equation [7.4], the ε_{oa} values of different ports are presented in Table 7.12.

Figure 7.1. Implications on their own Market Shares when Ports lower their respective Generalized Costs (U.K.)

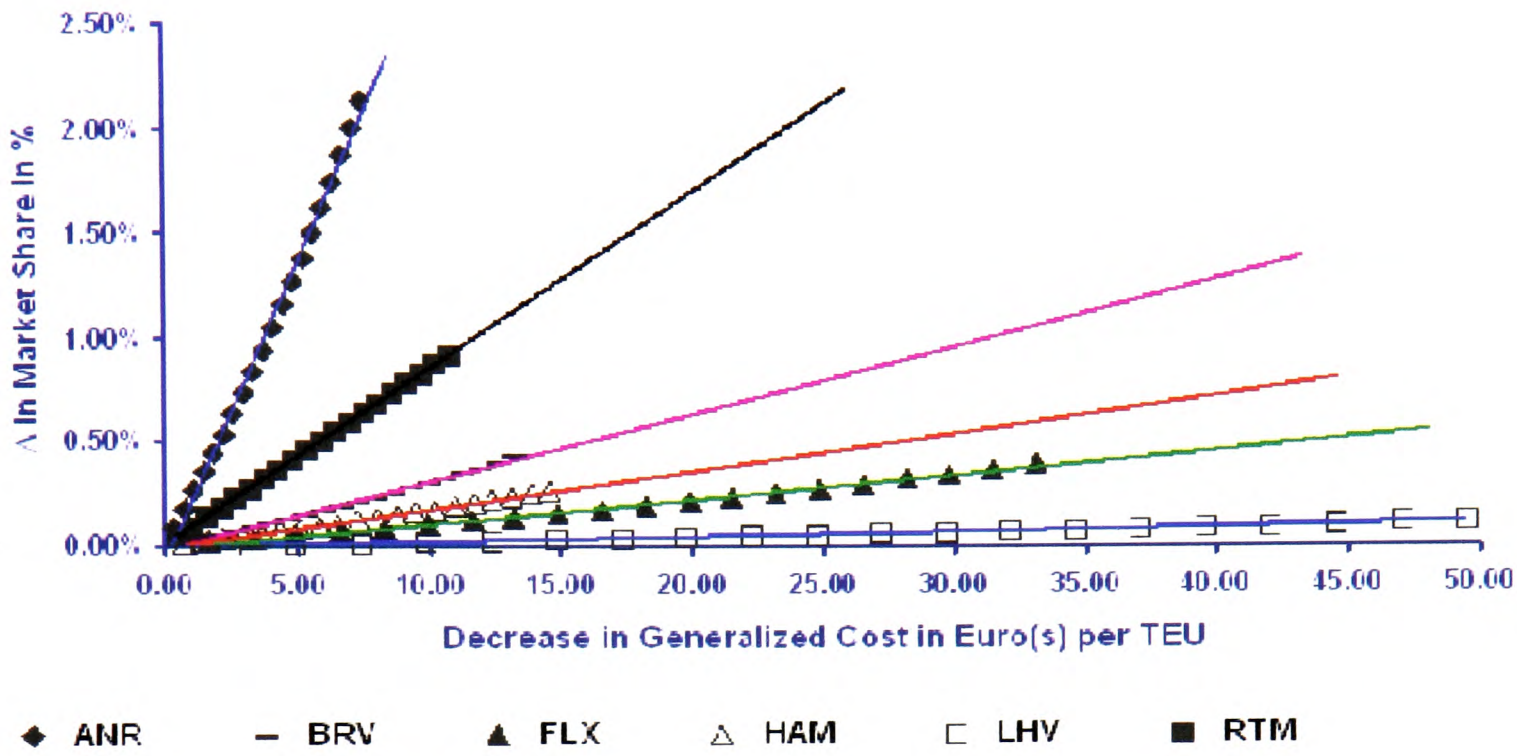


Figure 7.2. Implications on their own Market Shares when Ports lower their respective Generalized Costs (Scandinavia-Baltic)

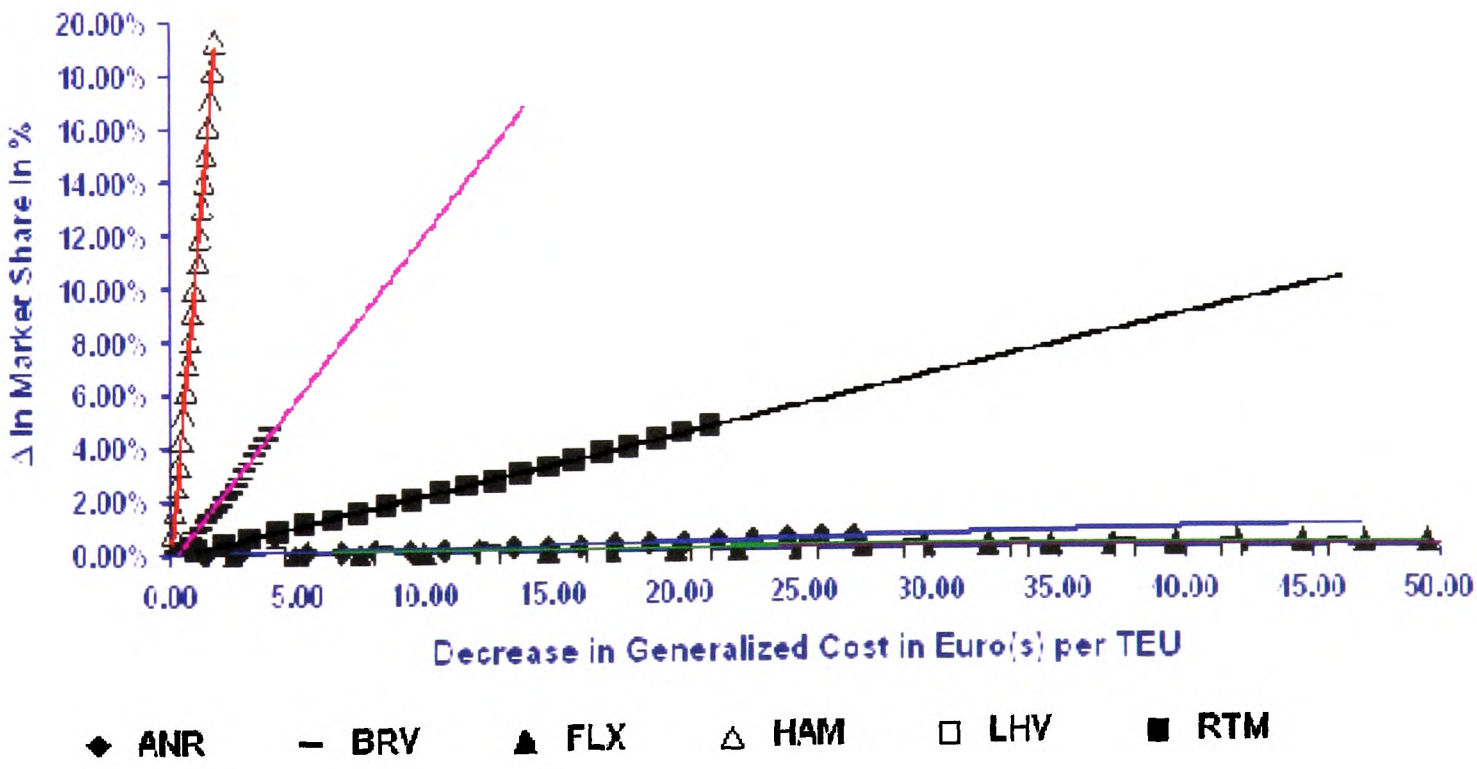


Figure 7.3. Implications on their own Market Shares when Ports lower their respective Generalized Costs (Iberian Peninsula)

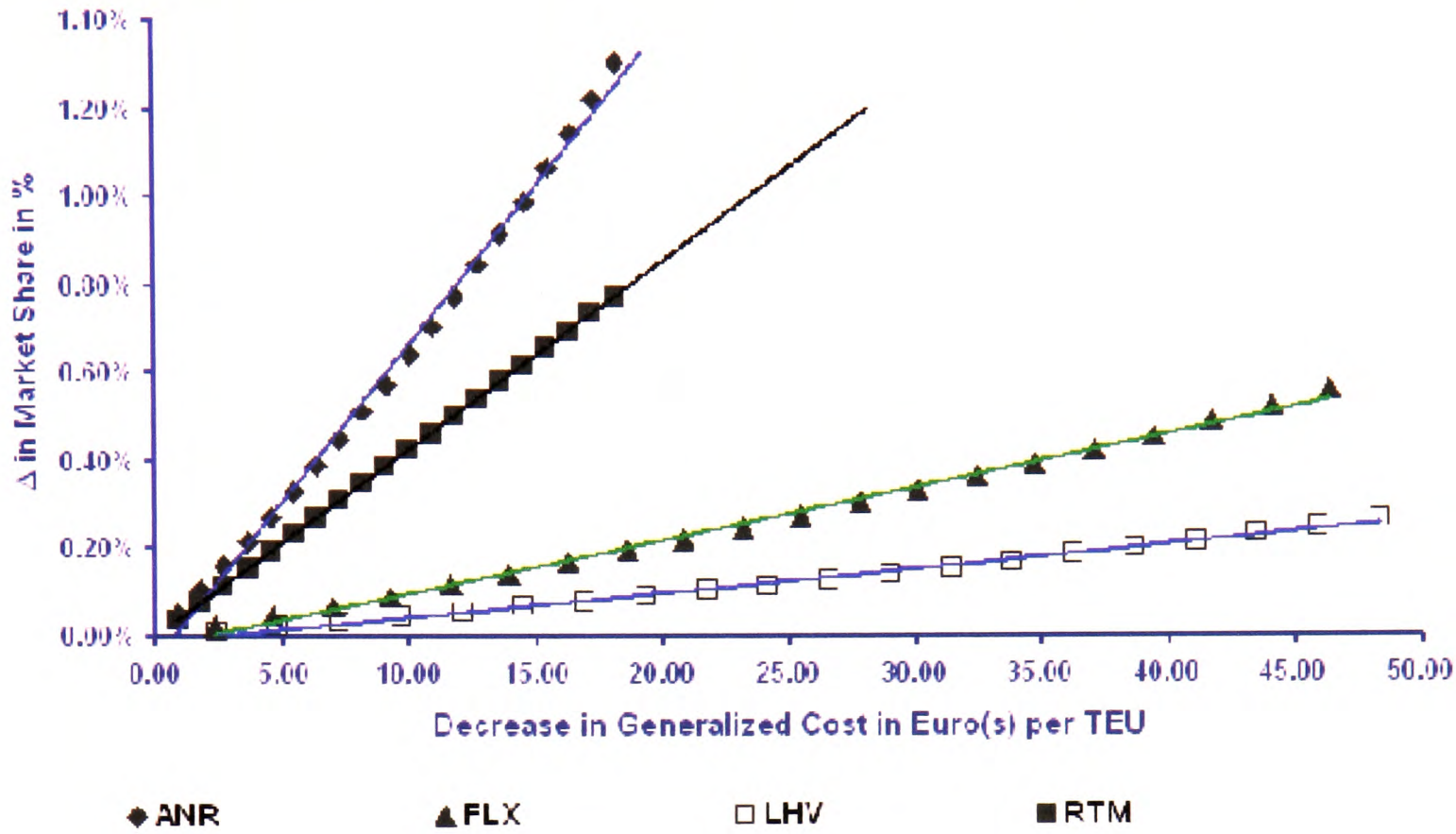


Table 7.11. Slopes, intercepts and R^2 values of the functions of Figures 7.1, 7.2 and 7.3

PORT	U.K.			SCANDINAVIA-BALTIC			IBERIAN PENINSULA		
	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2
Antwerp	0.0029	-0.0009	0.9961	0.0002	-0.0002	0.9960	0.0007	-0.0006	0.9962
Bremerhaven	0.0003	-0.0002	0.9959	0.0123	-0.0030	0.9916	(N.A.)	(N.A.)	(N.A.)
Felixstowe	0.0001	-0.0002	0.9965	5.E-05	-0.0001	0.9963	1.E-04	-0.0002	0.9965
Hamburg	0.0002	-0.0001	0.9960	0.1103	-0.0050	0.9990	(N.A.)	(N.A.)	(N.A.)
Le Havre	2.E-05	-5.E-05	0.9965	7.E-06	-3.E-05	0.9964	6.E-05	-1.E-04	0.9964
Rotterdam	0.0009	-4.E-06	1.0000	0.0022	-5.E-04	0.9999	0.0004	-2.E-06	1.0000

Table 7.12. Average own elasticities of demand of the Core-Six Ports in serving container transhipment to different regions

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA
Antwerp	-0.54	-0.36	-0.30
Bremerhaven	-0.69	-1.06	(N.A.)
Felixstowe	-0.07	-0.16	-0.56
Hamburg	-0.51	-2.29	(N.A.)
Le Havre	-0.06	-0.06	-0.12
Rotterdam	-0.11	-1.55	-0.06

Note: All figures are corrected to two decimal places.

In general, η_{oa} follows the similar pattern that that of η_{op}, with Antwerp becoming even increasingly competitive in the UK and the Iberian Peninsula, whilst the German ports consolidate their positions in Scandinavia-Baltic. For Rotterdam, in the longer term, its market shares in the UK and the Iberian Peninsula are perceived to drop, although its competitive position will strengthen in Scandinavia-Baltic. While Le Havre largely remains stagnant, with more significant improvements, Felixstowe actually has rather good prospects in becoming a competitive player in serving the Iberian Peninsula.

7.2.2. Scenario Two: Cross Elasticity of Demand

Different from attractiveness, competitiveness must involves one's gain at the expense of others i.e. exclusivity (see Chapter Two). Apart from knowing the implications of port improvement on its own market share, it is perhaps even more important to know how it affects others and this can be addressed by calculating the point cross elasticity of demand (η_{cp}). Based on equation [7.1], η_{cp} (implications on other ports when Port A's attributes change) can be expressed as:

$$\eta_{cp} = \beta * N_{(A)} * \frac{C_{(RTM)}}{C_{(A)}} \qquad \textbf{[7.5]}$$

Where $N_{(A)}$ represents the quantity demand (i.e. market share) and $C_{(A)}$ represent the generalized cost of Port A, while $C_{(RTM)}$ represent the generalized cost of the port of Rotterdam. By applying equation [7.5], the η_{cp} values are presented in Tables 7.13. Here is to note that, as a property of MNL, the values of η_{cp} are uniform on different ports.

Table 7.13. Point cross elasticities of demand of the Core-Six Ports in serving container transhipment to different regions

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA
Antwerp	0.08	0.02	0.06
Bremerhaven	0.01	0.34	(N.A.)
Felixstowe	0.02	0.01	0.00
Hamburg	0.01	1.41	(N.A.)
Le Havre	0.01	0.00	0.01
Rotterdam	0.12	0.04	0.17

Note: All figures are corrected to two decimal places.

Tables 7.13 can be understood using this example. If Antwerp lowers its generalized cost by 1%, the market shares of other ports in the UK are perceived to decrease by 0.08%. Results here suggest that Antwerp and Rotterdam are the strong competitors in the UK and the Iberian Peninsula, whilst the German ports dominate Scandinavia-Baltic. It implies that, unless other ports can suddenly lower their generalized costs significantly more than their German counterparts, Bremerhaven and Hamburg will further consolidate their competitive positions in the Scandinavia-Baltic transhipment market.

In general, ports are competing with each other where, with a few exceptions, the implications on others on port improvements are often negative. Another interesting point is that all the zero η_{cp} values belong to Felixstowe or Le Havre which indicate that their competitive strengths are fragile and their roles in the North European transhipment market are at best peripheral. Finally, in the immediate future, Rotterdam's leading position in the UK and the Iberian Peninsula is unlikely to be seriously challenged.

However, like own elasticity, η_{co} only predicts what will happen when ports improve slightly/marginally. Also, using this approach in estimating cross elasticity is problematic due to *independence from irrelevant alternative property* (IIA) which assumes that the ratio of choice probabilities is independent of the systematic utility of any other alternatives in the choice set i.e. all disturbances are assumed to be independent on each other (Ben-Akiva and Lerman, 2000). From Chapter Six, it is clear that many such disturbances do not exist independently. Thus, ε_{cp} does not seem to be a very reliable forecasting indicator here.

This shortcoming can be addressed with an alternative method namely average cross elasticity (η_{ca}). As an illustration, the implications on the market shares of other ports when Antwerp lowers its generalized costs in the UK, Scandinavia-Baltic and the Iberian Peninsula are presented in Figures 7.4, 7.5 and 7.6 respectively. Using similar method, the functions which represent the relations between other ports can be constructed and presented in Tables 7.14, 7.15, 7.16, 7.17, 7.18 and 7.19.

Figure 7.4. Implications on Other Ports when Antwerp lowers its Generalized Cost (U.K.)

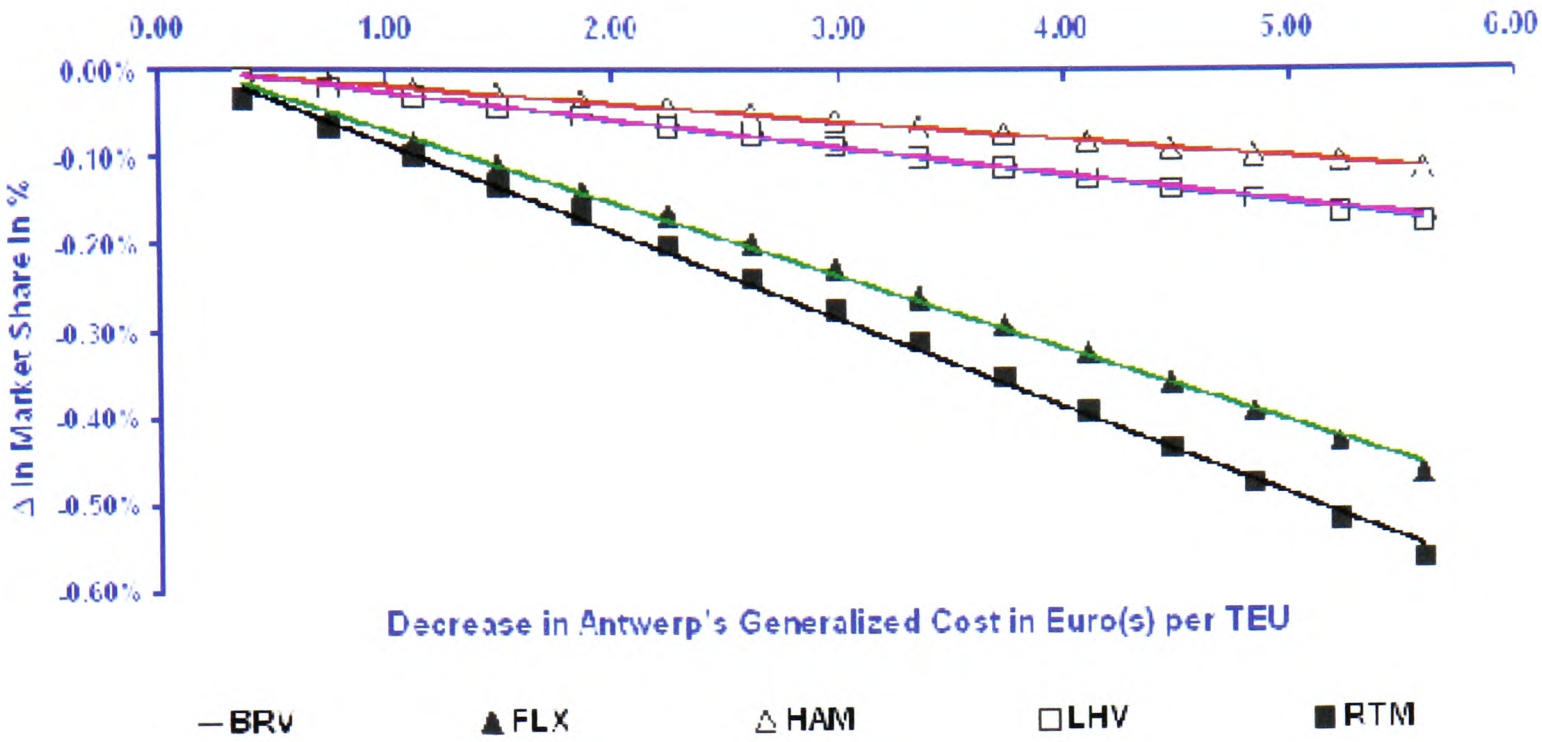


Figure 7.5. Implications on Other Ports when Antwerp lowers its Generalized Cost (Scandinavia-Baltic)

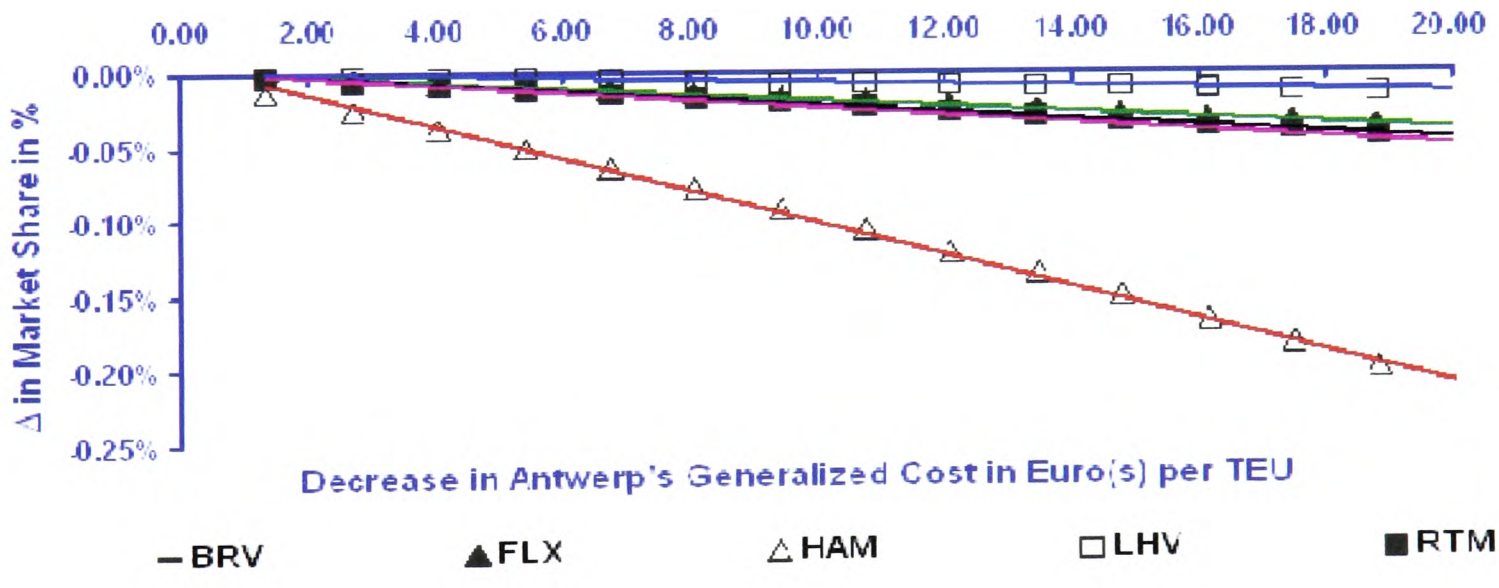


Figure 7.6. Implications on Other Ports when Antwerp lowers its Generalized Cost (Iberian Peninsula)

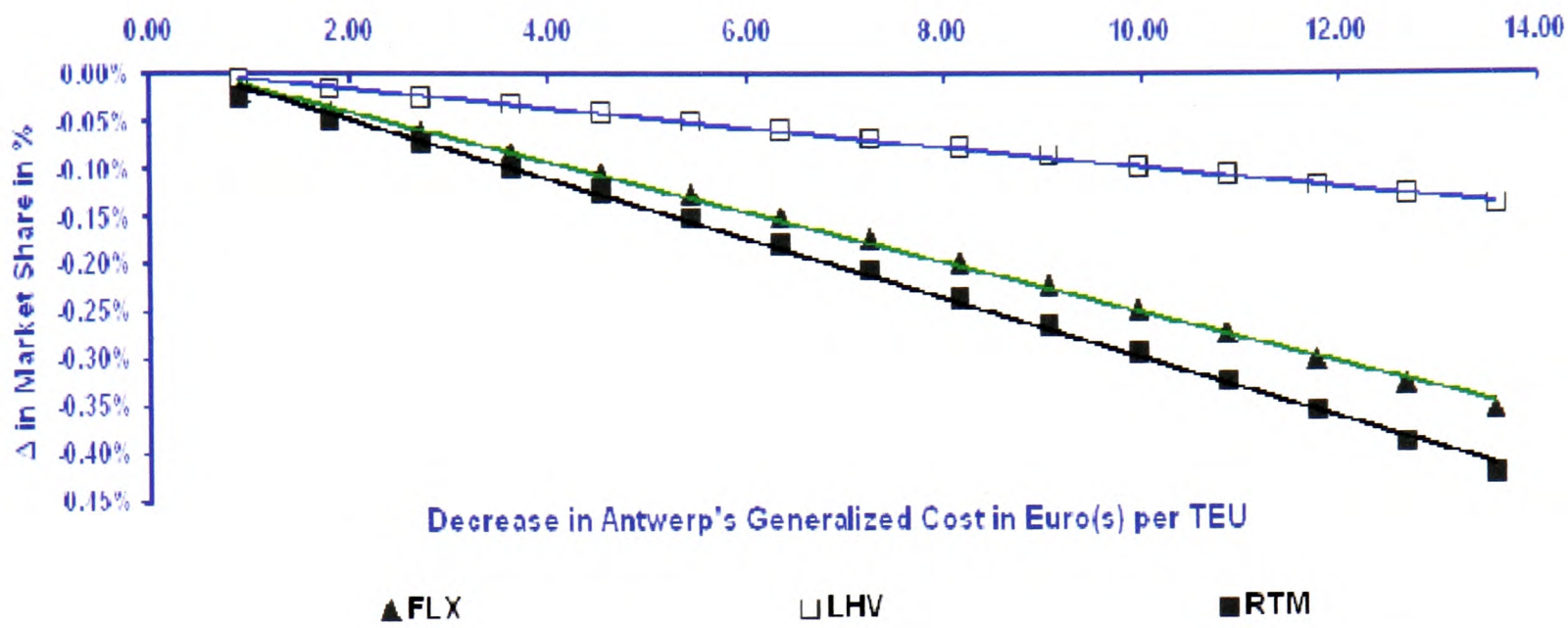


Table 7.14. Slopes, intercepts and R^2 values of the functions illustrating the relations between changes in Antwerp's generalized cost and other ports' market shares

PORT	U.K.			SCANDINAVIA-BALTIC			IBERIAN PENINSULA		
	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2
Bremerhaven	-0.0003	6.E-05	0.9979	-3.E-05	2.E-05	0.9979	(N.A.)	(N.A.)	(N.A.)
Felixstowe	-0.0008	0.0002	0.9979	-2.E-05	1.E-05	0.9979	-0.0003	0.0001	0.998
Hamburg	-0.0002	4.E-05	0.9979	-0.0001	7.E-05	0.9979	(N.A.)	(N.A.)	(N.A.)
Le Havre	-3.E-04	6.E-05	0.9979	-8.E-06	5.E-06	0.9979	-1.E-04	5.E-05	0.9980
Rotterdam	-0.001	2.E-04	0.9979	-2.E-05	2.E-05	0.9979	-0.0003	1.E-04	0.9980

Table 7.15. Slopes, intercepts and R^2 values of the functions illustrating the relations between changes in Bremerhaven's generalized cost and other ports' market shares

PORT	U.K.			SCANDINAVIA-BALTIC			IBERIAN PENINSULA		
	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2
Antwerp	-1.E-04	3.E-05	0.9979	-0.0014	0.0002	0.9956	(N.A.)	(N.A.)	(N.A.)
Felixstowe	-7.E-05	2.E-05	0.9979	-1.E-04	0.0000	0.9979	(N.A.)	(N.A.)	(N.A.)
Hamburg	-2.E-05	6.E-06	0.9979	-0.0067	0.0009	0.9956	(N.A.)	(N.A.)	(N.A.)
Le Havre	-3.E-05	9.E-06	0.9979	-5.E-04	6.E-05	0.9956	(N.A.)	(N.A.)	(N.A.)
Rotterdam	-9.E-05	3.E-05	0.9979	-0.0014	2.E-04	0.9956	(N.A.)	(N.A.)	(N.A.)

Table 7.16. Slopes, intercepts and R^2 values of the functions illustrating the relations between changes in Felixstowe's generalized cost and other ports' market shares

PORT	U.K.			SCANDINAVIA-BALTIC			IBERIAN PENINSULA		
	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2
Antwerp	-4.E-05	3.E-05	0.9982	-6.E-06	0.0000	0.9981	-4.E-05	4.E-05	0.9982
Bremerhaven	-1.E-05	9.E-06	0.9982	-7.E-06	0.0000	0.9981	(N.A.)	(N.A.)	(N.A.)
Hamburg	-8.E-06	6.E-06	0.9982	-3.E-05	0.0000	0.9981	(N.A.)	(N.A.)	(N.A.)
Le Havre	-1.E-05	9.E-06	0.9982	-2.E-06	2.00E-06	0.9981	-2.E-05	2.E-05	0.9982
Rotterdam	-4.E-05	3.E-05	0.9982	-6.E-06	8.00E-06	0.9981	-6.E-05	6.E-05	0.9982

Table 7.17. Slopes, intercepts and R^2 values of the functions illustrating the relations between changes in Hamburg's generalized cost and other ports' market shares

PORT	U.K.			SCANDINAVIA-BALTIC			IBERIAN PENINSULA		
	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2
Antwerp	-5.E-05	2.E-05	0.9979	-0.0239	0.0007	0.9993	(N.A.)	(N.A.)	(N.A.)
Bremerhaven	-1.E-05	5.E-06	0.9979	-3.E-02	0.0008	0.9993	(N.A.)	(N.A.)	(N.A.)
Felixstowe	-4.E-05	1.E-05	0.9979	-0.0216	0.0006	0.9993	(N.A.)	(N.A.)	(N.A.)
Le Havre	-2.E-05	6.E-06	0.9979	-0.0080	2.E-04	0.9993	(N.A.)	(N.A.)	(N.A.)
Rotterdam	-5.E-05	2.E-05	0.9979	-0.0254	8.E-04	0.9993	(N.A.)	(N.A.)	(N.A.)

Table 7.18. Slopes, intercepts and R^2 values of the functions illustrating the relations between changes in Le Havre's generalized cost and other ports' market shares

PORT	U.K.			SCANDINAVIA-BALTIC			IBERIAN PENINSULA		
	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2
Antwerp	-7.E-06	9.E-06	0.9982	-8.E-07	2.E-06	0.9981	-1.E-05	2.E-05	0.9981
Bremerhaven	-2.E-06	2.E-06	0.9982	-9.E-07	2.E-06	0.9981	(N.A.)	(N.A.)	(N.A.)
Felixstowe	-5.E-06	6.E-06	0.9982	-7.E-07	1.E-06	0.9981	-2.E-05	2.E-05	0.9981
Hamburg	-1.E-06	2.E-06	0.9982	-4.E-06	8.E-06	0.9981	(N.A.)	(N.A.)	(N.A.)
Rotterdam	-6.E-06	8.E-06	0.9982	-8.E-07	2.E-06	0.9981	-2.E-05	2.E-05	0.9981

Table 7.19. Slopes, intercepts and R^2 values of the functions illustrating the relations between changes in Rotterdam's generalized cost and other ports' market shares

PORT	U.K.			SCANDINAVIA-BALTIC			IBERIAN PENINSULA		
	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2
Antwerp	-0.0012	2.E-05	1.0000	0.0018	0.0001	1.0000	-0.0004	-9.E-06	1.0000
Bremerhaven	-8.E-05	4.E-06	0.9999	3.E-04	0.0006	0.9771	(N.A.)	(N.A.)	(N.A.)
Felixstowe	0.0003	1.E-05	1.0000	0.0017	0.0002	1.0000	9.E-06	7.E-06	0.9939
Hamburg	-3.E-05	3.E-06	0.9998	-0.0068	3.E-06	1.0000	(N.A.)	(N.A.)	(N.A.)
Le Havre	0.0002	3.E-06	1.0000	0.0007	7.E-05	0.9999	9.E-06	3.E-06	0.9991

($Y = \beta^* X + C$, where Y and X represent market share and generalized cost respectively) between two ports (say, implications on Port A's market share by Port B's change in generalized cost) can expressed as:

$$\eta_{oa} = \frac{\Delta Y_{(A)}}{\Delta X_{(B)}} * \frac{X_{(B)}}{Y_{(A)}} = \beta * [\frac{X_{(B)}}{Y_{(A)}}] \qquad [7.6]$$

By applying equation [7.6], the η_{ca} values of the Core-Six Ports in serving different European regions are presented in Tables 7.20, 7.21 and 7.22.

Table 7.20. Average cross elasticities of demand of the Core-Six Ports in serving container transhipment to the UK

PORT		CHANGE IN GENERALIZED COST					
		ANR	BRV	FLX	HAM	LHV	RTM
CHANGE IN MARKET SHARE	ANR	-	0.03	0.03	0.02	0.01	0.32
	BRV	0.39	-	0.01	0.03	0.02	0.15
	FLX	0.13	0.02	-	0.01	0.01	-0.07
	HAM	0.26	0.05	0.01	-	0.01	0.06
	LHV	0.13	0.02	0.01	0.02	-	-0.13
	RTM	0.09	0.01	0.03	0.01	0.00	-

Note: All figures are corrected to two decimal places.

Table 7.21. Average cross elasticities of demand of the Core-Six Ports in serving container transhipment to Scandinavia-Baltic

PORT		CHANGE IN GENERALIZED COST					
		ANR	BRV	FLX	HAM	LHV	RTM
CHANGE IN MARKET SHARE	ANR	-	0.04	0.02	2.82	0.00	-2.54
	BRV	0.02	-	0.01	1.10	0.00	-0.14
	FLX	0.04	0.03	-	2.55	0.00	-2.40
	HAM	0.03	0.31	0.02	-	0.00	1.69
	LHV	0.02	0.19	0.01	1.41	-	-1.48
	RTM	0.02	0.18	0.01	1.50	0.00	-

Note: All figures are corrected to two decimal places.

Table 7.22. Average cross elasticities of demand of the Core-Six Ports in serving container transhipment to the Iberian Peninsula

PORT		CHANGE IN GENERALIZED COST					
		ANR	BRV	FLX	HAM	LHV	RTM
CHANGE IN MARKET SHARE	ANR	-	(N.A.)	0.04	(N.A.)	0.01	0.17
	BRV	(N.A.)	-	(N.A.)	(N.A.)	(N.A.)	(N.A.)
	FLX	0.65	(N.A.)	-	(N.A.)	0.12	-0.02
	HAM	(N.A.)	(N.A.)	(N.A.)	-	(N.A.)	(N.A.)
	LHV	0.07	(N.A.)	0.04	(N.A.)	-	-0.01
	RTM	0.04	(N.A.)	0.02	(N.A.)	0.01	-

Note: All figures are corrected to two decimal places.

Some observations can be identified from the above tables, notably uniform η_{cp} values being replaced by individual ones dedicated to binary port-pairs. For the UK, Antwerp and Rotterdam are the major players and so changes in their generalized costs also have the most significant implications on other ports. The situation is similar in the Iberian Peninsula where Antwerp and Rotterdam are also the major players. In both regions, the influences of Felixstowe and Le Havre are limited, although results here indicate that Le Havre can take advantages of the weak competitive position of Felixstowe in the Iberian Peninsula. For Scandinavia-Baltic, Hamburg is clearly the most competitive port with very high η_{ca} values. Bremerhaven and Rotterdam are other important players here, albeit less significant than Hamburg, while Antwerp, Felixstowe and Le Havre only play peripheral roles in this market.

Here another difference from η_{cp} can be found in Rotterdam where cost reduction by the port does not necessarily lead to a loss of market shares of its potential competitors. This is especially the case for Felixstowe and Le Havre where the negative impacts on them due to Rotterdam's improvement is minimal and this has two interesting implications. Firstly, these figures justify that the orthodox hub-and-spoke shipping network is yet to be fully developed in North Europe and many liners still prefer calling multi-ports for

transhipment. Secondly, the fact that both ECT and PoF (Rotterdam and Felixstowe's major terminal operators respectively) belong to the same terminal operator (i.e. HPH) indicates that the mutual existence of their competitive-but-also-complementary relation is not necessarily a coincidence despite the influences of EU on port competition. Although whether such relation is really due to port co-operation needs to be confirmed by further research, results here strengthen the view that multinational port operator is a supplier response to counterbalance the powers of liners e.g. Meersman and Van de Voorde (1997), Rimmer (1998), Heaver (2002), etc.

7.2.3. Scenario C: Conditional Elasticity of Demand

In reality, it is unlikely that a port improves itself while others always remain constant. As indicated in Chapter Three, the Core-Six Ports often improve themselves through various means. Thus, further investigation is necessary to assess the scenario when all the ports lower their generalized costs. By combining the values of own and cross elasticities, the conditional elasticity of demand (η_t) can be calculated which reflects the 'redistribution of market shares' between ports when they lower their respective generalized cost by the same percentage. As it is argued that point cross elasticity is not a reliable forecasting indicator here (see last section), η_{oa} and η_{ca} are used instead. η_t of Port A can be expressed as:

$$\eta_{t(A)} = \varepsilon_{oa(A)} + \sum_{i \neq A}^{N} \varepsilon_{ca(A,i)} \qquad [7.7]$$

By applying equation [7.5], the η_t values are presented in Table 7.23.

Table 7.23. Conditional elasticities of demand of the Core-Six Ports in the North European container transhipment market

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA
Antwerp	-0.13	-0.02	-0.07
Bremerhaven	-0.10	-0.07	(N.A.)
Felixstowe	0.03	0.05	0.19
Hamburg	-0.13	-0.24	(N.A.)
Le Havre	0.00	0.10	-0.01
Rotterdam	0.03	0.16	0.02

Note: All figures are corrected to two decimal places.

In Table 7.23, positive and negative figures indicate losses and gains in market shares respectively. For the UK, when all ports improve at the same pace, Antwerp and the German ports are the ultimate winners and they are anticipated to increase their market shares increase, leaving Felixstowe and Rotterdam to suffer, whilst Le Havre's market share remains unchanged. For Scandinavia Baltic, the redistribution of market shares can be quite dramatic with Hamburg clearly the winner and is likely to consolidate its position. Other ports which are perceived to gain are Bremerhaven and Antwerp with Rotterdam being the biggest loser, although the situations of Felixstowe and Le Havre are not much better. Results here clearly illustrate that Hamburg is clearly at the driver's seat in the Scandinavia-Baltic transhipment market. For the Iberian Peninsula, again, Antwerp gains mainly at the expense of Felixstowe and Rotterdam. η_t clearly illustrates that, although Rotterdam is the current leader in the North European transhipment market, it is quite vulnerable from future challenges provided that Antwerp and the German ports improve their conditions significantly. Results here suggest that Rotterdam's leading position in UK and the Iberian Peninsula transhipment market is likely to be under serious challenges from Antwerp (for the UK, possibly even the German ports) while the German ports are anticipated to strengthen its already-strong position in Scandinavia-Baltic, especially Hamburg. Furthermore, interestingly, results indicate that the German ports are

not just decent competitors for Scandinavia-Baltic but also possess the potential to compete for the British transhipment market.

Further insights on future port competitiveness can be given here. The case of Felixstowe and Rotterdam illustrates there is no guarantee that ports can sustain their future competitive positions even when they are under the same protective umbrella, with both HPH-owned ports under vulnerable situations in the transhipment markets of all regions and so they need to improve faster (in terms of percentage) than other ports if they want to avoid market share losses. If owning various ports within a region were the strategy of multinational port operators to maintain its own competitive position, results here suggest that such strategy is not a good one. Secondly, results indicate that Antwerp, contrary to many in-depth interviewees, possesses decent potentials in becoming a leader in the North European transhipment market. This is, of course, subject to the condition that Antwerp's improvement can really keep pace with its counterparts especially given its restrictions along the River Scheldt. Under such situation, it is the German ports which possess the most potential in replacing Rotterdam and become the leaders in the market in the foreseeable future (except the Iberian Peninsula). For Le Havre, its situation is likely to remain stagnant unless dramatic measures in improving its competitive position are taken, notably its public-private sector relations.

7.3. RECOMMENDATIONS

Several implications can be identified from this chapter. Firstly, the focus of port competition in the North European transhipment market lies on the interactions between Antwerp, Bremerhaven, Hamburg and Rotterdam. Due to their poor performances, Felixstowe and Le Havre are too weak in offering any significant influences within the

competitive 'battlefield'. Nevertheless, in the foreseeable future, port competition in the UK and the Iberian Peninsula tend to be rather stable while the situation is more intense in Scandinavia-Baltic with the German ports further consolidating their competitive positions there.

Also, some recommendations to the future prospects ports in the North European transhipment market can be made. The German ports, as expected, under the current circumstances and routing system of liners, it should consolidate their status as regional ports and should put their focus in serving Scandinavia-Baltic since they are likely to gain significant market shares in this region even with relatively minor improvements in their performances. However, they should also consider putting more focus on the British market as they do have decent potentials there. This is especially true for Bremerhaven, given its current disadvantageous position *vis-à-vis* Hamburg in Scandinavia-Baltic. A similar situation is also found in Antwerp where, in the long term, it may become one of the leaders in serving the UK and the Iberian Peninsula, although such potential is not as significant as the German ports due to the restrictions mentioned before.

Undeniably, Rotterdam is currently the leader in the North European transhipment market, especially in the UK and the Iberian Peninsula. However, after so many years of development, the port is finding itself increasingly difficult to sustain its leading position. As shown in Table 3.1, since the beginning of the 21st century, Rotterdam's TEU throughput growth has been limited while Hamburg remains strong[93]. If Rotterdam's development keeps the same pace of development with its competitors, its current

[93] Rotterdam's rather impressive growth in 2004 (see Table 3.1) should not be misinterpreted which is mainly due to a sudden massive rise in port service demand because of the admittance of China into the WTO and thus massive increase of cargo imports from the Far East, rather than due to Rotterdam's competitive strengths. Nevertheless, here it is also interesting to see that many port users still have special preference to use Rotterdam rather than its counterparts.

competitive position is unsustainable where Antwerp and the German ports are already snapping at its heels. Although it may have some good prospects in competing for transhipment traffic in Scandinavia-Baltic, at the moment, such 'good prospect' is by no means comparable to the German ports. To enhance its future prospects, apart from the need to improve itself faster than others, Rotterdam should also pay even more attention in its public relations with clients, especially towards liners' still poor perception on custom procedures (see Chapter Four) like port marketing, negotiations with liners and client networking (although already significantly better than its competitors). Also, as mentioned above, Rotterdam should also pay more attention to develop its business in Scandinavia-Baltic as it is the only region of which the port still seems to have decent development prospects. In other words, Rotterdam's future success depends on whether the port can alter the current status to its favour.

For the low performing ports of Felixstowe and Le Havre, if they do not want to end the status as 'also-runs' in the market, they must improve themselves significantly faster than their competitors. At the moment, due to their poor performance, perceptions by customers on them are quite bad and thus image-improving strategies as well as intensive reforms in management philosophy are necessary. As discussed in Chapter Six, problematic management philosophies e.g. Felixstowe's belief that 'a British port always guarantees cargoes directed towards the UK', Le Havre's 'mutual-blaming culture' between public and private sectors, etc. must change. Such weaknesses also partly explain the relative stability of port competition in the UK and the Iberian Peninsula. Also, the cases of Felixstowe and Rotterdam indicate that owning multiple ports within a region under the same port operation company is not necessarily a good strategy to sustain the competitive positions of the ports.

Finally, one can foresee that Bremerhaven and Hamburg are in favourable competitive positions to challenge Rotterdam's fragile market dominance. Apart from Scandinavia-Baltic, in fact, these German ports can also become decent players in the British transhipment market. Antwerp is another potential threat to Rotterdam, although not necessarily a serious contender challenging Rotterdam's dominance in the foreseeable future. Given the recent changes in international circumstances like the joining of new members into the EU, it is extremely interesting to see whether there will be a significant redistribution of market shares between the Core-Six Ports in the foreseeable future.

CHAPTER EIGHT

CONCLUSIONS

After detailed analysis, this chapter summarises the major findings and contributions and give future researchers a decent platform in maritime transport research. This chapter is divided into three sections. In Section 8.1, the objectives and hypotheses are revisited. Here the major findings and arguments will be summarised and see if they can answer the issues and questions aroused from the hypotheses and fulfil the objectives. After then, in Section 8.2, the major achievements will be re-emphasised. Finally, Section 8.3 will provide some foods for thought to future researchers.

8.1. OBJECTIVES, HYPOTHESES AND MAJOR FINDINGS REVISITED

To ensure that this thesis has made a significant contribution to the transport discipline, it is necessary to review whether the objectives and hypotheses have been achieved. While reviewing them, the major findings of this thesis are also summarised.

Refer back to Chapter One. The first objective is achieved in Chapter Two. Recent development of container liner shipping does not only lead to a change in the geography of shipping networks, but also ensure that ports now need to pay more attention to performances due to intensified port competition and increasing importance in transhipment traffic. Also, the construction of PCM is a pioneer effort in creating a port competition model diagrammatically. In this thesis, using North European transhipment market as the case study, PCM is proved as a relevant illustration on how users make their port choices and thus port competitiveness. PCM does not only act as a decent theoretical framework to this study, but also to future researchers who are interested in undertaking

quantitative modelling to forecast port competition. For example, in Europe, PCM can be a valuable tool to help researchers to analyse how port competitiveness can be linked to the viability of SSS as an alterative to other transport modes, as port is widely regarded by the EU as a critical component to ensure its success (Pallis, 2002).

The second objective has been achieved in Chapter Three. A methodology inscribing both quantitative and qualitative research methods has been introduced in estimating the monetary value of less-quantifiable factors and its inscription into the generalized cost equation. The research process, including analytical procedures and data collection, is also clearly elaborated and explained here. In other words, while PCM is an ideological concept, Chapter Three has added the practical tools to allow the concept to work.

The third objective has been achieved in Chapter Four. Different factors in affecting port competitiveness have been identified and their significance being assessed. Survey results indicate that, while money and time are still important attributes, other less-readily quantifiable factors also cannot be ignored. With the calculation of generalized costs, it is clear that the author has attempted to bridge the gap between quantitative and qualitative factors into a 'package' to explain port competitiveness. According to survey respondents, German ports are very good performers, especially in serving the Scandinavia-Baltic market. The performance of the Benelux ports is also decent and possesses certain attractiveness acting as transhipment hubs in serving various European regions. Finally, Le Havre and Felixstowe need significant improvements to ensure that they will not remain peripheral in the transhipment market.

The fourth objective has been achieved in Chapter Five. Through applying MNL based on generalized costs, the estimated market shares of ports largely correspond to the real market shares in most regions which illustrate that quality of services provided by ports does matter port choice by liners. Rotterdam and Bremerhaven serve as the major exceptions as they are clear overachievers and underachievers respectively, while Hamburg also underachieves in regions other than Scandinavia-Baltic. Currently, Rotterdam is clearly the overall dominating player, while Hamburg is a regional leader in Scandinavia-Baltic. Antwerp and Bremerhaven have the potential to develop as transhipment hubs, while Felixstowe and Le Havre still have a long way to go.

The fifth objective has been achieved in Chapter Six. It is found that several loopholes exist in the current approach in ports' strategic management. Ports are too passive in their dealings with their potential customers and usually their only strategy to enhance competitiveness is through expensive capital investments in physical infrastructure, while they seem to regard their counterparts as competitors and dismiss chances of cooperation (or to achieve a win-win situation). Also, apart from physical restrictions, many ports do not seem to fully understand the significance of software components in affecting competitiveness, notably marketing, management philosophy, historical reasons, public-private sector relations, the role of the EU, cargo orientations, 'quasi-political process', customer inertia and the limitations of liners themselves. While low performing ports (i.e. Felixstowe and Le Havre) should try their best to improve their performance, the high performing ones actually have considerable alternatives in enhancing their current competitiveness. Evidence in Chapter Six contrasts with 'common sense knowledge' because liners are not always very ready to change their port choice and their bargaining power *vis-à-vis* ports is not as strong as many previous studies believe. The key to success

does not depend on port's administrative system, but depends on how to execute the system and makes it work.

The final objective has been achieved in Chapter Seven. Through logistic regression, a LRM has been constructed to forecast future port competitiveness in the North European transhipment market. Regressed results indicate that competitions in the UK and the Iberian Peninsula are relatively stable with Rotterdam likely to maintain its dominance in the immediate future. In Scandinavia-Baltic, the German ports are likely to consolidate their leading positions, although results also indicate that they can be decent competitors in serving the British transhipment market while Rotterdam can explore new opportunities towards German ports' current sphere of influence. However, although Rotterdam is currently a leader, simulated results also indicate that, in the long run, it faces an uphill task to sustain its competitiveness unless huge efforts can be done to alter the *status quo*. Based on the calculated generalized costs, it is anticipated that Rotterdam will suffer market share loss in all European regions when all ports lower their cost at the same percentage, with Antwerp and the German ports snapping under its heels. The situation of Le Havre will largely remain stagnant while Felixstowe is another sufferer under the current situation which suggests that ports operating under the same multinational port operator do not necessarily guarantee that their long term competitiveness.

After the objectives, the rest of this section reviews the hypotheses based on the findings of this thesis. The first hypothesis states that the competitive position of a port in the North European transhipment market mainly depends on the decisions of liners. In general, this is true. Until now, liners are the ultimate decision-makers in transhipment hub choice and thus the competitive position of port also largely depends on their

decisions. Some other players, notably government and supra-national institutions (like the EU) can also play some part, but their significance is still rather limited as liners are the ultimate users of ports for transhipment services, although in the foreseeable future, other players, notably shippers, may want to play a greater role in this aspect.

The second hypothesis indicates that while monetary cost and time efficiency are important components, other less-readily quantifiable factors are also critical attributes in deciding the competitiveness of ports in the transhipment market and liners are likely to consider these factors when make their transhipment hub choices. Also, this study shows that, while the above mentioned factors are all important, it is by no means complete. The above mentioned factors, which have formed the components of the 'Assessment Process' in PCM, only ensure that a port possesses enough potential to attract potential customer's attention while the port competitiveness also depends on whether the port can play the game of 'Negotiations Process and Marketing' (NPM) successfully and to give positive 'Values and Perceptions' to potential customers. Liners do not make their decisions solely based on their own interests, but also have to tackle the interests of their sister companies (due to vertical integration), interests of other liners (usually within the same strategic shipping alliance), the implications of the QWERTY paradox and network effects, the possible influence of other players (like the influence of the EU in the market) and, in some cases, 'Chances'. Decent port performance, notably hardware investments, only ensures a port gets through the 'qualifying round' in searching for competitiveness while the real competitive stages depend on whether ports can develop strategies which ensure this 'quasi-political process' can be bent towards their own interests.

Also, this study justifies the third hypothesis, where liners have different reactions between good and poor port performance. As discussed in Chapter Five, port users are more sensitive to poor port services and poor performing ports are likely to possess small market shares in the transhipment market. However, this does not imply that good performance automatically leads to high market shares. The important message here is that if a port wants to achieve competitiveness in the transhipment market, it must not isolate itself from customers and think that investing in new facilities and improving service quality can guarantee success (as the success of improving port performance solely lies within port's own hands, while negotiations, marketing and the creation of perceptions also depend on liners and possibly other players within the port and shipping industries). Better communications and interactions with customers can also lower the risk of minimising MiA by ports.

Finally, the above has given a positive confirmation to the final hypothesis, where it is argued that ports can take a more proactive approach in enhancing their competitiveness in the future. Here ports should not just concentrate on building new facilities and improving service quality, but should also take the initiative to contact customers and listen to their needs and alter their perceptions to different ports, while they should develop more progressive visions in planning for the future and search for new opportunities. In this sense, except Rotterdam (and to a certain extent, Hamburg), the Core-Six Ports are still too passive in this aspect where their competitiveness are usually dependent on how their customers perceive them rather than controlling their perceptions. Although negotiations and marketing for ports like Bremerhaven can be difficult given that Hamburg and Rotterdam have already created a highly extensive shipping network, findings here also suggest that the port has not yet developed a long-term strategy in

establishing itself as a competitive transhipment centre in North Europe. In other words, these ports have not even made any serious attempts to ensure that the outcome of the 'quasi-political process' between liners in transhipment hub choices would favour itself.

8.2. MAJOR ACHIEVEMENTS

Apart from giving a clear view of the current and future situations of port competition in North European transhipment market, this thesis has made considerable significant contributions to maritime transport by playing its role in addressing the current dilemmas within the field.

Firstly, as mentioned before, with the introduction of PCM, this thesis is a pioneer attempt to provide a real theoretical framework in explaining port competitiveness. This diagram, as illustrated in the methodology of this thesis, can become a 'benchmark' model for future researchers in undertaking port competitiveness modelling through applying different econometrical techniques in PCM.

Secondly, this thesis indicates that transport choice analysis should not only be based on readily-quantifiable factors (notably money and time) and less-readily quantifiable factors, including personal preferences and negotiations, should be put into account. Decision-making is a humanistic process being affected by subjectivity, negotiations and limited information so that final decisions are not always rational or completely objective. When making their choices, port users are based on 'packages' rather than just 'price-tags' offered by various suppliers.

Another achievement of this study is that some 'common sense' knowledge within the maritime transport discipline has been examined and sensibly challenged. For example, through this study, it is found that the bargaining position of the port user is not as strong as it seems to be. Concerning port competition itself, although Rotterdam looks very comfortable as a leader in transhipment by many (including players within the industry), it is actually in a peril position which is prone to challenges, while the common perception that 'possessing more is always better' does not always work, as indicated in the cases of Felixstowe and Rotterdam under HPH.

Thirdly, this thesis is a pioneer attempt to investigate the macro structure of port competition in the North European transhipment market. Although previous researches on port competition and transhipment exist, most of them investigate the competitive positions of individual ports but few (if any) of them pay real attention to the overall circumstance. Here the author uses a football match as an illustration. While most previous studies only focus on player attributes when choosing their starting line-ups, this thesis also pays attention to other performance-related conditions but not necessarily under their full control e.g. weather, grass condition, pitch size, system-of-play of opponents, referee style, etc. More than that, this thesis also concerns whether the manager can choose and apply the appropriate players and strategies respectively to make the progress of the game favouring his team. In fact, the ignorance of other performance-related conditions by previous studies also largely explains why many of them fail to recognise the recent changing circumstances within the port industry.

Fourthly, through applying econometrical technique, this thesis has successfully calculated the elasticities of demand between different ports in the North European

container transhipment market. Under current literature, empirical figures in estimating the implications of a particular port on its competitors are scarce, not to mention specific figures on transhipment. The author is confident that this study has shed some lights on an increasingly important issue in global and European port and shipping industries.

Finally, this thesis should be regarded as an achievement by providing future insights on the transhipment market and port competitions in North Europe. Through this thesis, the Core-Six Ports should now be much clearer about their respective current competitive positions and know what they should do to improve/sustain their positions in the near future. This thesis is not just a valuable academic contribution, but also an extremely useful companion to those who are directly involved in the port and shipping industries, whether they are the major ports who want to sustain their positions, or minor ports who want to challenge their stronger counterparts, or liners who want to strengthen their bargaining positions when making port choices.

8.3. QUESTIONS FOR FURTHER RESEARCH

Before ending this thesis, a few questions related to port competition and container transhipment for further researches have been proposed, as follows:

1) This thesis focuses on container transhipment i.e. feeder routes. However, there is important port competition in serving direct intra-continental shipping routes. For example, the EU argues that SSS is an important component in ensuring sustainable transport development in Europe (Pallis, 2002) and considers serious funding to port development for such purpose (EIB, 2004). Here the structure of port competition becomes more complicated as other transport modes become

realistic alternatives to shipping and thus the use of ports is not obligatory. Under such circumstances, what strategies should ports undertake?

2) In this thesis, the roles of minor ports (e.g. Southampton, Zeebrugge, etc.) are not considered. How will port competition differ if minor ports are included and what will be the current and future prospects of these ports in the North European container transhipment market?

3) This thesis has identified liners as the major decision-makers in transhipment hub choices while other potential decision-makers are generally not interested to participate in this decision-making process. Will this change in the long term? Will these potential decision-makers, notably shippers, remain anonymous when their cargo volumes increase significantly in the future, especially given the rapid increased production in manufacturing in the Far East? As one interviewee has noted, very recently, *shippers seem to be more insistent to fight for their rights from liners so that their opinions on the transhipment hub choice process will not be ignored.*

4) Currently, ports mainly regard their counterparts as competitors. Will it be possible to collaborate and achieve win-win solutions? If so, how can it be achieved? What agreements should be made for such collaborations? For example, will it be possible for ports join together to negotiate with liners so as to make it possible for ports to have a more active voice in the network-routing process? As illustrated in Chapter Seven, can the non-competitive relation between Rotterdam and Felixstowe serve as the starting point for further research on port collaboration and business strategies of multinational port operators?

5) Apart from major liners, what are the roles of minor ones in the transhipment market? Do they possess the strengths for using the major ports for transhipment,

or do they have to concede and use minor ports? If so, what will be the geographical implications?

6) Last but not least, as stated in Chapter One, what is the role of hinterland in affecting the potential of a port in becoming a region's transhipment hub? Acting as the continent's traditional economic powerhouse, how important do these surrounding regions of the North European ports affect their attractiveness and thus competitiveness?

Through identifying these questions, the author is confident that this thesis can act as a useful platform for researchers to conduct further studies and make significant contributions to the progress of port, liner shipping, transhipment and maritime transport. It would surely be the author's greatest satisfaction if readers find this thesis interesting, informative and, most importantly, a valuable reference to the progression of the transport discipline.

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SUPPLEMENTARY INFORMATION

Apart from the Bibliography, the author also received unpublished supplementary information for this thesis from the following organisations (all in 2004), as follows:

- Department of Transport and Regional Economics, University of Antwerp (Antwerp)
- Drewry Shipping Consultants Ltd. (London)
- Europe Container Terminals B.V. (ECT) (Rotterdam)
- European Investment Bank (Luxembourg)
- I.T.M.M.A., University of Antwerp (Antwerp)
- Policy Research Corporation Ltd. (Antwerp)

APPENDIX A:
LAYOUT OF THE SURVEY QUESTIONNAIRE

Significance and Performance of Different Factors in Affecting Ports Acting as Container Transhipment Hubs in North Europe

Survey Questionnaire

DISCLAIMER:

The objective of this questionnaire is to acquire the opinions of port users on the performance of different ports acting as container transhipment hubs in North Europe. All obtained information from this questionnaire will be kept ***absolute confidential***.

==========

INSTRUCTIONS:

This questionnaire consists of six pages (including this page) and four sections (A, B, C and D).

Please answer ALL questions in Sections A, B and D. For Section C, please give answers to all the ports that your company has experiences in calling. Here if there were a factor that you do not know or do not have any opinions, just leave the box blank.

In Sections B and C, please try your best to give scores to different factors based on a *rational cardinal scale*. For example, in Section B, if you give a score of "4" and "2" for Factors A and B respectively, you are likely to regard that Factor A is about twice as more important than Factor B. In Section C, if you give a score of "+3" and "+1" to Factor A for ANR and RTM respectively, you are likely to regard that, for Factor A, ANR is performing about three times better than that of RTM.

==========

IMPORTANT REMARKS:

Please give responses based on your (and your company's) experience on the *overall* performance and perceptions of different North European ports acting as transhipment hubs in the last and forthcoming several years (3 years), NOT just the current status of these ports. Your concern in reading and answering the questions carefully is highly appreciated since sensible answers are extremely important with regard to the accuracy of the analysis and outcome.

CONTACTS:

After filling in the questionnaire, please return it to **Koi Yu Adolf NG** by mail or email to your earliest convenience. For any enquiries, please contact **Koi Yu Adolf NG** by phone. Detailed contacts are as follows:

Mailing Address:
Transport Studies Unit, University of Oxford, 11 Bevington Road, Oxford, OX2 6NB, U.K.
Email: koi.ng@sant.ox.ac.uk
Tel: +44 – (0)1865 274 709

Thank you very much for spending your time to participate in this survey!

SECTION A: BASIC INFORMATION

1. **Name of Company:** _____

2. **Contact Person and Correspondence:**

Name & Position: _____

Tel: _____ Fax: _____ Email: _____

Correspondence Address: _____

_____

3. **Which port(s) is/are your company's current major port(s) in transhipping containers to different European regions?** Please put "X" in the appropriate box(es) below. If your company does not provide any feeder services (or any contractual agreements with liner shipping companies providing container feeder services) to any of the region(s) illustrated below, please just leave the box(es) blank.

		United Kingdom	Scandinavia-Baltic	Iberian Peninsula (Atlantic Coast)
Port of ANTWERP	**(ANR)**	☐	☐	☐
Port of BREMERHAVEN	**(BRV)**	☐	☐	☐
Port of FELIXSTOWE	**(FLX)**	☐	☐	☐
Port of HAMBURG	**(HAM)**	☐	☐	☐
Port of LE HAVRE	**(LHV)**	☐	☐	☐
Port of ROTTERDAM	**(RTM)**	☐	☐	☐
Other Port (*Pls. specify*):	_____	☐	☐	☐

4. **In the transhipment port(s) that you have indicated in Question 3, what kind(s) of container terminal is/are that?** Please put "**X**" in the appropriate box below.

☐ **Public Terminal** (can be called by any vessels owned by any companies)

☐ **Dedicated Terminal** (can be called *exclusively* by your company's vessels)

☐ **Liner-Owned Terminal** (not only being called exclusively, but your company also owns shares and/or had invested in this terminal)

5. **If you answer *public terminal* in Question [4], does your company have any plans to acquire *dedicated terminal* and/or invest in *liner-owned terminals* for transhipment in the coming *five* years?** Please put "**X**" in the appropriate box below. If your answer is "**YES**", please briefly explain what kind of terminal(s), where and why you company is going to invest.

☐ **YES** **What kind of terminal?** ☐ **Dedicated Terminal** ☐ **Liner-Owned Terminal**
(You can tick both boxes, if necessary)

In which port? _____

Why? _____

☐ **NO**

SECTION B: SIGNIFICANCE OF FACTORS AFFECTING THE ATTRACTIVENESS OF PORTS IN CONTAINER TRANSHIPMENT

Instructions: With reference to your experiences, please **rate the Significance of Different Factors** in affecting the attractiveness of port for container transhipment by putting "**X**" in the appropriate boxes below. If there were other factor(s) that you deem as important but do not appear here, please specify it/them under the category "Any Other Factors" and indicate its/their significance.

Score Scale

5	**Very Significant**	**1**	**Minimum/Nearly No Significance**
4	**Significant**	**0**	**No Significance At All**
3	**Some Significance**	**?**	**Not Sure/No Opinion**
2	**Little Significance**		

FACTOR	**SIGNIFICANCE SCORE**						
	5	**4**	**3**	**2**	**1**	**0**	**?**
Port Monetary Factor							
Port Charge (Terminal-Handling Charge and Port Dues)	☐	☐	☐	☐	☐	☐	☐
Port Time Factor							
Time Required to Load/Unload Containers[94]	☐	☐	☐	☐	☐	☐	☐
Efficiency of a Port in Container-Handling[95]	☐	☐	☐	☐	☐	☐	☐
Punctuality and Reliability:							
Cases of Delays in Loading/Unloading a Vessel	☐	☐	☐	☐	☐	☐	☐
Records of Damage during Container-Handling	☐	☐	☐	☐	☐	☐	☐
Governmental:							
Custom Procedures (e.g. Inspection, Documentary, etc.)	☐	☐	☐	☐	☐	☐	☐
Port Authority's Policy and Regulations	☐	☐	☐	☐	☐	☐	☐
Geographical/Locational							
Location of a Port (Your "Feeling of Proximity" between the Transhipment and Feeder Ports)	☐	☐	☐	☐	☐	☐	☐
Vessel Operation Monetary Cost from Transhipment to Destination Ports	☐	☐	☐	☐	☐	☐	☐
Average Journey time travelling from Transhipment to Destination Ports	☐	☐	☐	☐	☐	☐	☐

[94] Assume that 13 hours is required to handle about 2,000 TEU

[95] Here you should give scores based on whether a port can achieve the '13-hour' target in handling 2,000 TEU.

(SECTION B CONTINUES...)

FACTOR	SIGNIFICANCE SCORE						
	5	4	3	2	1	0	?
Operational:							
Accession to the Port	☐	☐	☐	☐	☐	☐	☐
Quality of Port's Infrastructure for handling containers	☐	☐	☐	☐	☐	☐	☐
Quality of Port's Superstructure for handling containers	☐	☐	☐	☐	☐	☐	☐
IT and Advanced Technology for Port Operations	☐	☐	☐	☐	☐	☐	☐
Dedicated Terminals and Facilities for Transhipment	☐	☐	☐	☐	☐	☐	☐
Supporting Industries (e.g. Warehousing, Insurance, etc.)	☐	☐	☐	☐	☐	☐	☐
Quality of Other Services (e.g. Pilotage, Towing, Mooring, etc.)	☐	☐	☐	☐	☐	☐	☐
Commercial:							
Availability of Professional Personnel in Port	☐	☐	☐	☐	☐	☐	☐
Preferences of Shipping Line's Clients/Shippers	☐	☐	☐	☐	☐	☐	☐
Personal Contacts/Relations between Port Operator and Shipping Line	☐	☐	☐	☐	☐	☐	☐
Effort of Marketing on the Port by Port Authority	☐	☐	☐	☐	☐	☐	☐
Reputation of Port within the Region	☐	☐	☐	☐	☐	☐	☐
Port Operator's Speed in Responding to Shipping Line's New Demands and Requests	☐	☐	☐	☐	☐	☐	☐
Any Other Factors:							
Factor 1 (please specify): _____	☐	☐	☐	☐	☐	☐	☐
Factor 2 (please specify): _____	☐	☐	☐	☐	☐	☐	☐

Further Comments on Section B (if any):

_____

_____

SECTION C: PERFORMANCE OF NORTH EUROPEAN PORTS IN CONTAINER TRANSHIPMENT

Instructions: With reference to your experiences, please give your opinions on different North European ports on the service quality of different factors (as indicated in Section B) provided by them by giving **Appreciation Scores**. ***Note that there are three destinations for Geographical/Locational Factor*** (*United Kingdom*, *Scandinavia-Baltic* and *Iberian Peninsula*) and please fill in **ALL** destinations.

Score Scale

+3	**Very Positive**	**-1**	**Somewhat Negative**
+2	**Positive**	**-2**	**Negative**
+1	**Somewhat Positive**	**-3**	**Very Negative**
0	**Neutral/Neither Positive nor Negative**	**?**	**Not Sure/No Opinion**

FACTOR	**APPRECIATION SCORE**					
	ANR	**BRV**	**FLX**	**HAM**	**LHV**	**RTM**
Time Efficiency						
Efficiency of the Port in Container-Handling						
Punctuality and Reliability						
Case of Delays in Loading/Unloading Vessels						
Records of Damage during Container-Handling						
Governmental						
Custom Procedures (e.g. Inspection, Documentary, etc.)						
Port Authority's Policy and Regulation						
Geographical/Locational						
Location of the Port to United Kingdom						
Location of the Port to Scandinavia-Baltic						
Location of the Port to Iberian Peninsula (Atlantic Coast)						
Operational						
Accession to the Port						
Quality of Port Infrastructure for Handling Containers						
Quality of Port Superstructure for Handling Containers						
I.T. and Advanced Technology for Port's Operations						
Dedicated Terminals and Facilities for Transhipment						
Supporting Industries (e.g. Warehousing, Insurance, etc.)						
Quality of Other Services (e.g. Pilotage, Towing, Mooring, etc.)						
Commercial						
Availability of Professional Personnel in the Port						
Preference of Shipping Line's Clients/Shippers to the Port						
Personal Contacts/Relations between Port Operator and Shipping Line						
Efforts of Marketing on the Port by Port Authority						
Reputation of the Port within the Region						
Port Operator's Speed in responding to Shipping Line's New Demands and Requests						

SECTION D: OPEN-ENDED QUESTIONS

1. Please briefly explain why you have given scores of "+3" (very positive) and/or "-3" (very negative) to certain factor(s) of certain port(s). If possible, please offer some examples and/or cases so as to enhance our understanding on the reason(s) behind your decision(s).

2. Are there any port(s) in North Europe that you (or someone in your company who has the authority in deciding transhipment port choice) specifically prefer/does not prefer? Reasons behind specific preference/non-preference to a particular port can be subjective factors like first impression, personal beliefs, concern on frequent occurence of unexpected events in port which would delay container's date of arrival (e.g. accidents, labour strikes, etc.) or, in some cases, even without a specific reason at all.

   If you answer "*Yes*", please indicate the name of the port(s) below and explain why you have such *specific preference/non-preference* to that particular port(s) (If you do not have a specific reason, just write "*no specific reason*"). Otherwise, please answer "*No*".

3. If you have any further comments, please put them down in the space provided below.

Please return the filled questionnaire to **KOI YU ADOLF NG** by mail or email:
Address: Transport Studies Unit, University of Oxford, 11 Bevington Road, Oxford, OX2 6NB, U.K.
Email: koi.ng@sant.ox.ac.uk

THANK YOU VERY MUCH FOR YOUR KIND ASSISTANCE!

APPENDIX B:
ASSUMPTIONS FOR THE CALCULATION OF GENERALIZED COSTS

Table B1. Nautical distances between the Core-Six and feeder ports

PORT	U.K.		SCANDINAVIA-BALTIC			IBERIAN PENINSULA	
	Immingham	Grangemouth	Gothenburg	St. Petersburg	Gdansk	Bilbao	Porto
Antwerp	256	463	598	1,384	960	755	1,753
Bremerhaven	333	456	377	1,163	739	965	1,963
Felixstowe	154	357	537	1,323	899	687	1,685
Hamburg	366	566	412	1,199	775	1,021	2,019
Le Havre	317	521	689	1,475	1,651	561	1,559
Rotterdam	201	399	507	1,293	869	760	1,758

Note: All figures are expressed in nautical miles. Source: Dataloy (2004)

Table B2. Personnel structure on a typical feeder container vessel in North Europe

GRADE	NO. OF PERSONNEL	WEEKLY NET INCOME
Captain	1	€ 705.00
Chief Engineer	1	€ 680.00
1st Grade Officer or 2nd Grade Engineer	1	€ 562.00
2nd Grade Officer or 3rd Grade Engineer	1	€ 582.00
3rd Grade Officer and/or 4th Grade Engineer	6	€ 468.00
Assistant (Grade A) and Chef	2	€ 397.00
Assistant (Grade B)	5	€ 190.00

Note: Based on the pay scale towards the end of 2003. Source: ITMMA (2004)

Table B3. Average bunker prices at the Core-Six Ports

PORT	AVERAGE PRICE
Antwerp	€ 120.66
Bremerhaven	€ 124.91
Felixstowe	€ 130.63
Hamburg	€ 124.91
Le Havre	€ 127.48
Rotterdam	€ 120.20

Note: Figures reflect the average price of IFO380 between March 2003 and February 2004. Le Havre's price is based on the price along the French Atlantic coast. Source: Bunkerworld (2004)

Table B4. Assumptions for the operation of a typical feeder container vessel

CATEGORY	ASSUMPTION	
Loading size of feeder vessel	500	TEU
Fuel consumption rate of feeder vessel when travelling at service speed at maximum carrying capacity	0.92	Tonnes/hr
Service speed of feeder vessel	16	Knots
Waiting time at Kiel Canal	2	Hrs
Deadweight tonnage of feeder vessel	6,750	Dwt
Time charter rate	3,676	Euros/day

Source: Drewry (2004) and ECT (2004)

Other Assumptions:

1) In travelling to Scandinavia-Baltic from the Core-Six Ports, all vessels pass through the Kiel Canal where the vessel service speed is 50% of the normal service speed.
2) When crossing the Kiel Canal, a feeder vessel is charged 7.23 Euros per TEU. This figure is calculated using the calculation software provided by Kiel Canal's official website: www.kiel-canal.org.

APPENDIX C:
EXPLANATIONS ON VARIOUS ECONOMIC MODELLING AND FORECASTING PROCEDURES

C1. COMPUTATIONAL PROCEDURES OF THE CONSTRUCTION OF THE LRM

In the Excel worksheet, the utility values (Z) (i.e. GCCI), estimated market shares (E) and real market shares (P) are arranged in a coherent way like the one found in Table C1. To justify the y variable of the LRM i.e. $P_{(B)}/[1-P_{(B)}]$, the values of E and P are adjusted from into binary forms so that $E_{(A)} + E_{(B)} = P_{(A)} + P_{(B)} = 1$.

Table C1. An example of the Excel worksheet layout

Port A	Port B	Region	$Z_{(B)} - Z_{(A)}$	$Z_{(A)}$	$Z_{(B)}$	Ln$\{P_{(B)}/[1-P_{(B)}]\}$	$P_{(A)}$	$P_{(B)}$	$E_{(A)}$	$E_{(B)}$
ANR	BRV	U.K.	-0.63	1.44	0.81	-1.95	0.88	0.12	0.65	0.35

Regions are divided into UK, Scandinavia-Baltic and the Iberian Peninsula. Bremerhaven and Hamburg are excluded from the Iberian Peninsula while the 'Overall Scenario' (see Chapters Four and Five) is excluded so as to avoid double counting. From Chapter Five, 'disturbance' clearly exists when liners make their transhipment hub choices and so 'dummy variables' (ε) should be taken into consideration when constructing the LRMs. This can be done by adding ε tables like Table C2 (in Table C2, Antwerp is set as entirely 'Port A').

Table C2. An example of dummy variable worksheet table setup for logistic regression

DISTURBANCE OF PORT A [$\varepsilon_{(A)}$]					DISTURBANCE FOR PORT B [$\varepsilon_{(B)}$]				
ANR	BRV	FLX	HAM	LHV	BRV	FLX	HAM	LHV	RTM
1	0	0	0	0	1	0	0	0	0
1	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0	1

Ports are arranged in different ways so that each of the Core-Six Ports has a chance to become entirely 'Port A' (or 'non-existent as Port B'). With six ports included here, it means that there are six sets of such data. For example, when Antwerp is entirely as 'Port A', the port-pairs directed towards different European regions are as follows:

ANR-BRV (U.K.)

ANR-FLX (U.K.)
ANR-HAM (U.K.)
ANR-LHV (U.K.)
ANR-RTM (U.K.)
BRV-FLX (U.K.)
BRV-HAM (U.K.)
BRV-LHV (U.K.)
BRV-RTM (U.K.)
FLX-HAM (U.K.)
FLX-LHV (U.K.)
FLX-RTM (U.K.)
HAM-LHV (U.K.)
HAM-RTM (U.K.)
LHV-RTM (U.K.)
ANR-BRV (Scandinavia-Baltic)
ANR-FLX (Scandinavia-Baltic)
ANR-HAM (Scandinavia-Baltic)
ANR-LHV (Scandinavia-Baltic)
ANR-RTM (Scandinavia-Baltic)
BRV-FLX (Scandinavia-Baltic)
BRV-HAM (Scandinavia-Baltic)
BRV-LHV (Scandinavia-Baltic)
BRV-RTM (Scandinavia-Baltic)
FLX-HAM (Scandinavia-Baltic)
FLX-LHV (Scandinavia-Baltic)
FLX-RTM (Scandinavia-Baltic)
HAM-LHV (Scandinavia-Baltic)
HAM-RTM (Scandinavia-Baltic)
LHV-RTM (Scandinavia-Baltic)
ANR-FLX (Iberian Peninsula)
ANR-LHV (Iberian Peninsula)
ANR-RTM (Iberian Peninsula)
FLX-LHV (Iberian Peninsula)
FLX-RTM (Iberian Peninsula)
LHV-RTM (Iberian Peninsula)

After then, regression can take place. Data analysis has been taken through comparing various binary port-pairs [i.e. $\varepsilon_{(A)}$ and $\varepsilon_{(B)}$] against $[Z_{(B)} - Z_{(A)}]$ and $\{P_{(B)}/[1-P_{(B)}]\}$ (see Tables C1 and C2). Using this method, many LRMs can be constructed and it is necessary to choose the best LRM. This task can be made easier by paying attention to the values of the Adjusted R^2 of different simulated LRMs where only models with values higher than 0.50 will be considered since a lower value implies that the model fails to explain half of the dependent variables from any changes of the independent variables. The Adjusted R^2 values of the LRMs of Core-Six Ports are presented in Tables C3, C4, C5, C6, C7 and C8. Those with values higher than 0.50 are bolded while those higher than 0.60 are also shaded.

Table C3. Adjusted R^2 values with Antwerp as entirely Port A

ADJUSTED R^2		PORT B					
		ANR	BRV	FLX	HAM	LHV	RTM
PORT A	ANR	-	0.1322	0.1256	0.3639	0.1846	0.4580
	BRV	-	-	0.0333	0.2657	0.0651	0.4910
	FLX	-	0.0233	-	0.1554	0.0145	0.3932
	HAM	-	0.0674	0.0283	-	0.0883	0.4257
	LHV	-	0.0454	0.0121	0.1632	-	0.3720
	RTM	-	-	-	-	-	-

Table C4. Adjusted R^2 values with Bremerhaven as entirely Port A

ADJUSTED R^2		PORT B					
		ANR	BRV	FLX	HAM	LHV	RTM
PORT A	ANR	-	-	0.3010	**0.5620**	0.3330	**0.5308**
	BRV	0.2338	-	0.2403	**0.5006**	0.2625	**0.5358**
	FLX	0.2333	-	-	0.4753	0.2586	0.4936
	HAM	0.2781	-	0.2684	-	0.3101	**0.5113**
	LHV	0.2681	-	0.2636	0.4707	-	0.4765
	RTM	-	-	-	-	-	-

Table C5. Adjusted R^2 values with Felixstowe as entirely Port A

ADJUSTED R^2		PORT B					
		ANR	BRV	FLX	HAM	LHV	RTM
PORT A	ANR	-	0.2992	-	0.3862	0.2428	**0.5544**
	BRV	0.1833	-	-	0.3715	0.2026	**0.5269**
	FLX	0.2008	0.2783	-	0.3727	0.2130	**0.5165**
	HAM	0.2391	0.3200	-	-	0.2573	**0.5741**
	LHV	0.2342	0.3071	-	0.3613	-	**0.5149**
	RTM	-	-	-	-	-	-

Table C6. Adjusted R^2 values with Hamburg as entirely Port A

ADJUSTED R^2		PORT B					
		ANR	BRV	FLX	HAM	LHV	RTM
PORT A	ANR	-	**0.5797**	**0.5449**	-	**0.6087**	**0.6318**
	BRV	0.3982	-	0.3817	-	0.4513	**0.5197**
	FLX	0.3778	0.4311	-	-	0.4309	**0.5078**
	HAM	0.4606	**0.5798**	0.4604	-	**0.5061**	**0.6356**
	LHV	0.3954	0.4331	0.3807	-	-	**0.5018**
	RTM	-	-	-	-	-	-

Table C7. Adjusted R^2 values with Le Havre as entirely Port A

ADJUSTED R^2		PORT B					
		ANR	BRV	FLX	HAM	LHV	RTM
PORT A	ANR	-	0.2291	0.1998	0.4296	-	**0.5148**
	BRV	0.1577	-	0.1667	0.4236	-	**0.5091**
	FLX	0.1360	0.1860	-	0.3552	-	**0.5005**
	HAM	0.2063	0.2482	0.2045	-	-	0.4898
	LHV	0.1360	0.1852	0.1443	0.3651	-	0.4835
	RTM	-	-	-	-	-	-

Table C8. Adjusted R^2 values with Rotterdam as entirely Port A

ADJUSTED R^2		PORT B					
		ANR	BRV	FLX	HAM	LHV	RTM
PORT A	ANR	-	0.2664	0.2521	0.3058	0.3068	-
	BRV	0.3416	-	0.3455	0.4523	0.4202	-
	FLX	0.2554	0.2721	-	0.3194	0.3075	-
	HAM	0.2971	0.3165	0.3181	-	0.3395	-
	LHV	-	-	-	-	-	-
	RTM	0.4176	0.4194	0.4172	**0.5187**	0.4379	-

Apart from binary port-pairs, better LRMs can possibly be simulated from triple, quadruple and even quintuple port-pairs. However, with six ports included here, a lot of LRMs can be simulated. In order not to complicate the simulation process, only the most potential combinations will be further considered.

The above tables indicate that most of the highest Adjusted R^2 values are concentrated in Table C6. Thus, further analysis on non-binary port pairs will concentrate on regression setup for Table C6 i.e. results are the most significant when either Antwerp or Hamburg is set as Port A. With such understanding, only the data set which has led to the values in Table C6 is used for further analysis. Apart from binary port-pairs, regression analysis has

also been taken place for the port-pair combinations in Table C9. Finally, LRMs are simulated by Microsoft Excel and the best-fit models are presented in Section 7.1.1.

Table C9. Different port-pair combinations for further logistic regression

PORT A	PORT B (1)	PORT B (2)	PORT B (3)	PORT B (4)
ANR	BRV	FLX	LHV	RTM
ANR	BRV	FLX	LHV	
ANR	BRV	FLX	RTM	
ANR	BRV	LHV	RTM	
ANR	FLX	LHV	RTM	
ANR	BRV	FLX		
ANR	BRV	LHV		
ANR	BRV	RTM		
ANR	FLX	LHV		
ANR	FLX	RTM		
ANR	LHV	RTM		
HAM	ANR	BRV	FLX	LHV
HAM	BRV	FLX	LHV	RTM
HAM	ANR	FLX	LHV	RTM
HAM	ANR	BRV	LHV	RTM
HAM	ANR	BRV	FLX	RTM
HAM	ANR	BRV	FLX	
HAM	ANR	BRV	LHV	
HAM	ANR	BRV	RTM	
HAM	BRV	FLX	LHV	
HAM	BRV	FLX	RTM	
HAM	ANR	FLX	LHV	
HAM	ANR	FLX	RTM	
HAM	ANR	LHV	RTM	
HAM	BRV	LHV	RTM	
HAM	ANR	BRV		
HAM	ANR	FLX		
HAM	ANR	LHV		
HAM	ANR	RTM		
HAM	BRV	FLX		
HAM	BRV	LHV		
HAM	BRV	RTM		
HAM	FLX	LHV		
HAM	FLX	RTM		
HAM	LHV	RTM		

C2. CONVERSION PROCESS OF MARKET SHARE RE-ESTIMATION: FROM BINARY TO MULTIPLE PORT-PAIRS

Before undergoing the conversion process, anti-logarithm is taken for the y variables of New EMS {i.e. $N_{(B)}/[1-N_{(B)}]$} in Table 7.4 (see Table C10).

Table C10. Exponential values of various binary port-pairs

PORT A	PORT B	REGION	$N_{(B)}/[1-N_{(B)}]$
Hamburg	Antwerp	U.K.	5.57
Hamburg	Bremerhaven	U.K.	1.51
Hamburg	Felixstowe	U.K.	4.08
Hamburg	Le Havre	U.K.	1.55
Hamburg	Rotterdam	U.K.	4.93
Antwerp	Bremerhaven	U.K.	0.38
Antwerp	Felixstowe	U.K.	1.03
Antwerp	Le Havre	U.K.	0.39
Antwerp	Rotterdam	U.K.	1.24
Bremerhaven	Felixstowe	U.K.	4.00
Bremerhaven	Le Havre	U.K.	1.51
Bremerhaven	Rotterdam	U.K.	4.82
Felixstowe	Le Havre	U.K.	1.73
Felixstowe	Rotterdam	U.K.	5.52
Le Havre	Rotterdam	U.K.	5.69
Hamburg	Antwerp	Scandinavia-Baltic	0.20
Hamburg	Bremerhaven	Scandinavia-Baltic	0.24
Hamburg	Felixstowe	Scandinavia-Baltic	0.18
Hamburg	Le Havre	Scandinavia-Baltic	0.07
Hamburg	Rotterdam	Scandinavia-Baltic	0.22
Antwerp	Bremerhaven	Scandinavia-Baltic	1.65
Antwerp	Felixstowe	Scandinavia-Baltic	1.27
Antwerp	Le Havre	Scandinavia-Baltic	0.47
Antwerp	Rotterdam	Scandinavia-Baltic	1.49
Bremerhaven	Felixstowe	Scandinavia-Baltic	1.14
Bremerhaven	Le Havre	Scandinavia-Baltic	0.42
Bremerhaven	Rotterdam	Scandinavia-Baltic	1.33
Felixstowe	Le Havre	Scandinavia-Baltic	1.70
Felixstowe	Rotterdam	Scandinavia-Baltic	5.37
Le Havre	Rotterdam	Scandinavia-Baltic	5.63
Antwerp	Felixstowe	Iberian Peninsula	1.19
Antwerp	Le Havre	Iberian Peninsula	0.46
Antwerp	Rotterdam	Iberian Peninsula	1.41
Felixstowe	Le Havre	Iberian Peninsula	1.78
Felixstowe	Rotterdam	Iberian Peninsula	5.42
Le Havre	Rotterdam	Iberian Peninsula	5.45

With the exponential values available, the conversion process is as follows:

U.K.

Let Hamburg be an unknown value h. From Table 7.13 (see Chapter Seven), the following relations can be observed: Antwerp (a) = $5.57h$, Bremerhaven (b) = $1.51h$, Felixstowe (f) = $4.08h$, Le Havre (l) = $1.55h$, Rotterdam (r) = $4.93h$.

Since:

$a + b + f + h + l + r = 1$

$5.57h + 1.51h + 4.08h + h + 1.55h + 4.93h = 18.63h = 1$

Therefore, $h =$ **0.05**

Scandinavia-Baltic

Let Hamburg be an unknown value h. From Table 7.14, the following relations can be observed: Antwerp (a) = $0.20h$, Bremerhaven (b) = $0.24h$, Felixstowe (f) = $0.18h$, Le Havre (l) = $0.07h$, Rotterdam (r) = $0.22h$.

Since:

$a + b + f + h + l + r = 1$

$0.20h + 0.24h + 0.18h + h + 0.07h + 0.22h = 1.91h = 1$

Therefore, $h =$ **0.52**

Iberian Peninsula

Let Antwerp be an unknown value a. From Table 7.4, the following relations can be observed: Felixstowe (f) = $1.19a$, Le Havre (l) = $0.46a$, Rotterdam (r) = $1.41a$.

Since:

$a + f + l + r = 1$

$a + 1.19a + 0.46a + 1.41a = 4.05a = 1$

Therefore, $a =$ **0.25**

It is now possible to calculate the New EMS (using equation [7.1]) and the results can be found in Section 7.1.2.

C3. EQUATIONS FOR CALCULATING POINT ELASTICITIES OF DEMAND

According to MNL, the probability of choosing Port A against Port B can be expressed as follows:

$$N_{(A)} = \frac{e^{\alpha+\beta[Z_{(A)}]}}{\{e^{\alpha+\beta[Z_{(A)}]} + e^{\beta[Z_{(B)}]}\}} \quad \textbf{[C1]}$$

Where $N_{(A)}$ and $Z_{(A)}$ represent the probability (i.e. Market Share) and utility (i.e. GCCI, see Chapter Five) of Port A respectively, α and β port represent specific dummy variable and scaling parameter respectively, whilst $Z_{(B)}$ represent the utility of Port B. In conventional economic theory, point elasticity of demand (η_p) can be expressed as:

$$\eta_p = \frac{\partial Q}{\partial P} * \frac{P}{Q} \quad \textbf{[C2]}$$

Where P and Q represent price and quantity demanded respectively. Thus, in accordance to equation [7.1], the own point elasticity of demand (η_{op}) can be expressed as:

$$\eta_{op} = \frac{\partial N_{(A)}}{\partial Z_{(A)}} * \frac{Z_{(A)}}{N_{(A)}} \quad \textbf{[C3]}$$

Note that Z is a utility expression and so monetary term should be involved. To address this, the generalized cost (C) should be inputted and thus equation [C3] becomes:

$$\eta_{op} = \frac{\partial N_{(A)}}{\partial Z_{(A)}} * \frac{\partial Z_{(A)}}{\partial C_{(A)}} * \frac{C_{(A)}}{N_{(A)}} \quad \textbf{[C4]}$$

According to Quotient Rule:

$$\frac{\partial N_{(A)}}{\partial Z_{(A)}} = \frac{\{e^{\alpha+\beta[Z_{(A)}]} + e^{\beta[Z_{(B)}]}\} * \{e^{\alpha+\beta[Z_{(A)}]}\} - \{e^{\alpha+\beta[Z_{(A)}]}\} * \{e^{\alpha+\beta[Z_{(A)}]}\}}{\{e^{\alpha+\beta[Z_{(A)}]} + e^{\beta[Z_{(B)}]}\}^2} \quad \textbf{[C5]}$$

Thus, $\frac{\partial N_{(A)}}{\partial Z_{(A)}} * \frac{1}{N_{(A)}}$ equals to:

$$= \frac{\{e^{\alpha+\beta[Z_{(A)}]} + e^{\beta[Z_{(B)}]}\} * \{e^{\alpha+\beta[Z_{(A)}]}\} - \{e^{\beta[Z_{(A)}]}\} * \{e^{\alpha+\beta[Z_{(A)}]}\}}{\{e^{\alpha+\beta[Z_{(A)}]} + e^{\beta[Z_{(B)}]}\}^2} * \frac{\{e^{\alpha+\beta[Z_{(A)}]} + e^{\beta[Z_{(B)}]}\}}{e^{\alpha+\beta[Z_{(A)}]}}$$

$$= \beta * [1 - N_{(A)}] \qquad \textbf{[C6]}$$

On the other hand, with reference to equation [5.2]:

$$\frac{\partial Z_{(A)}}{\partial C_{(A)}} * C_{(A)} = \frac{\partial[\frac{C_{(RTM)}}{C_{(A)}}]}{\partial C_{(A)}} * C_{(A)} = [C_{(A)}]^{(-2)} * C_{(RTM)} * C_{(A)} = [C_{(A)}]^{(-1)} * C_{(RTM)} \qquad \textbf{[C7]}$$

Where $C_{(RTM)}$ represents the generalized cost of the port of Rotterdam. By combining equations [C6] and [C7], η_{op} can be expressed as:

$$\eta_{op} = -\beta * [1 - N_{(A)}] * \frac{C_{(RTM)}}{C_{(A)}} \qquad \textbf{[C8]}$$

Note that a negative sign is added to equation [C8] because an increase in Z is actually a decrease in C. Using a similar method, the equation for calculating Port A's implications on the market shares of other ports (i.e. cross elasticity, or η_{cp}) can be expressed as:

$$\eta_{cp} = \{\beta * [N_{(A)}] * \frac{C_{(RTM)}}{C_{(A)}}\} \qquad \textbf{[C9]}$$

Where $N_{(A)}$, $C_{(RTM)}$ and $C_{(A)}$ represent the market share of Port A, generalized cost of Rotterdam and generalized cost of Port A respectively. Note that, due to IIA (see Section 7.2.2), η_{cp} values calculated from equation [C9] are identical for all ports.

C4. CONVERSION PROCESS FROM GCCI TO GENERALIZED COSTS

Since GCCI is the reference attribute of the LRM, this section illustrates the implications on generalized cost when the value of GCCI changes. From equation [5.2], GGCI of a particular port (say, Port A) $[Z_{(A)}]$ can be expressed as:

$$Z_{(A)} = \frac{1}{\left(\frac{C_{(A)}}{C_{(RTM)}}\right)} = \frac{C_{(RTM)}}{C_{(A)}} \qquad \textbf{[C10]}$$

$$\therefore C_{(A)} = \frac{C_{(RTM)}}{Z_{(A)}} \qquad \textbf{[C11]}$$

Where $C_{(A)}$ and $C_{(RTM)}$ represent the original generalized costs of Port A and Rotterdam respectively. If $Z_{(A)}$ increases by a certain percentage (say, x %), Port A's new generalized cost [$C_{(a)}$] can be expressed as:

$$C_{(a)} = \frac{C_{(RTM)}}{(1+x\%)*[Z_{(A)}]} \qquad \textbf{[C12]}$$

Thus, for example, if $Z_{(A)}$ increases by 1%, $C_{(a)}$ can be expressed as:

$$C_{(a)} = \frac{C_{(RTM)}}{(1.01)*[Z_{(A)}]} \qquad \textbf{[C13]}$$

So, with reference to Table 4.14, changes in generalized costs of the Core-Six Ports when Z is improved by 1% can be calculated and presented in Table C11, whilst the percentage changes in C are presented in Table C12. Here it is not difficult to find that the difference between 1% increase in Z is nearly equivalent to 1% decrease in C.

Table C11. New values of generalized cost when GCCI improves by one percent

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA
Antwerp	33.94	122.25	82.38
Bremerhaven	60.09	17.70	207.56
Felixstowe	150.51	224.97	210.77
Hamburg	66.28	8.03	193.52
Le Havre	224.65	379.57	219.46
Rotterdam	48.87	96.27	82.11

Note: All figures are expressed in Euros per TEU and corrected to two decimal places.

Table C12. Percentage changes in generalized cost values when GCCI improves by one percent

PORT	U.K.	SCANDINAVIA-BALTIC	IBERIAN PENINSULA
Antwerp	-0.99%	-0.99%	-0.99%
Bremerhaven	-0.99%	-0.99%	-0.99%
Felixstowe	-0.99%	-0.99%	-0.99%
Hamburg	-0.99%	-0.99%	-0.99%
Le Havre	-0.99%	-0.99%	-0.99%
Rotterdam	-0.99%	-0.99%	-0.99%

Note: All figures are corrected to two decimal places. A negative figure indicates that the generalized cost concerned has been reduced.